

ISSN 1814-9545 (PRINT)  
ISSN 2412-4354 (ONLINE)

# ВОПРОСЫ ОБРАЗОВАНИЯ

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**Educational Studies** Moscow

4

2018

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National Research University Higher School of Economics

**Voprosy obrazovaniya/Educational Studies Moscow  
No 4, 2018**

established in 2004, is an academic journal published quarterly by the Higher School of Economics (HSE)

**ISSN 1814-9545 (Print)**

**ISSN 2412-4354 (Online)**

**The mission of the journal** is to provide a medium for professional discussion on a wide range of educational issues. The journal publishes original research and perceptive essays from Russian and foreign experts on education, development and policy. "Educational Studies Moscow" strives for a multidisciplinary approach, covering traditional pedagogy as well as the sociology, economics and philosophy of education.

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All papers submitted for publication in the "Educational Studies Moscow" journal undergo peer review.

Distributed by subscription and direct order

Subscription Index:

"Rospechat" Agency—82950

"Pressa Rossii" Agency—15163

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# Table of contents

## No 4, 2018

### **SPECIAL ISSUE FOLLOWING THE INTERNATIONAL CONFERENCE “eLEARNING STAKEHOLDERS AND RESEARCHERS SUMMIT 2017” (eSTARS) JOINT PROJECT OF THE HIGHER SCHOOL OF ECONOMICS AND COURSERA**

Editorial Note . . . . . 8

#### **William Kuskin**

Mapping the New Education Ecosystem

*Introduction of the Guest Editor* . . . . . 9

### **INNOVATION AND DISRUPTION IN THE DIGITAL AGE**

#### **Sherman Young**

From Disruption to Innovation: Thoughts on the Future  
of MOOCs . . . . . 21

#### **Larry DeBrock**

The New Face-to-Face Education: Scalable Live-Engagement . . 44

#### **Quentin McAndrew**

Innovation Leashed: How a MOOC-Based Master’s Degree  
Brings Invention Home to the Institution . . . . . 60

### **STUDIES OF eLEARNING**

#### **Maria Janelli**

eLearning in Theory, Practice, and Research . . . . . 81

#### **Daria Kravchenko**

Classical Test Theory and Item Response Theory in  
Measuring Validity of Peer-Grading in MOOK . . . . . 99

#### **Deborah Keyek-Franssen**

Practices for Student Success: From Face-to-Face to  
At-Scale and Back. . . . . 116



<b>Tatiana Bystrova, Viola Larionova, Evgueny Sinitsyn, Alexander Tolmachev</b>	
Learning Analytics in MOOK as a Tool for Predicting Learner Performance . . . . .	139

#### LEADERSHIP AND CHANGE

<b>Stephen Ludwig</b>	
Higher Learning: Lessons from an Online Advocate . . . . .	167
<b>Rebecca Stein</b>	
Supporting Online Initiatives: From MOOCs to For-Credit Offerings . . . . .	188

#### EDUCATION STATISTICS AND SOCIOLOGY

<b>Daniel Alexandrov, Ksenia Tenisheva, Svetlana Savelyeva</b>	
Patterns of School Choice: Two Districts in St. Petersburg . . . .	199
<b>Inna Antipkina, Kristina Lyubitskaya, Anastasiya Nisskaya</b>	
Third-Grade Parent's Involvement in Schools . . . . .	230

#### PRACTICE

<b>Anita Poplavskaya, Ivan Gruzdev, Andrej Petlin</b>	
Defining the Problem of Choosing Extracurricular Activities for Children in Russia . . . . .	261
<b>Nadezhda Avdeenko, Larisa Denishcheva, Klara Krasnyanskaya, Aleksandra Mikhaylova, Marina Pinskaya</b>	
Creativity for Everyone: Integrating the 21st Century Skills in Russian Schools . . . . .	282

Table of Contents 2018 . . . . .	305
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# Editorial Note

In this issue of *Voprosy obrazovaniya / Educational Studies Moscow*, the reader is offered a themed selection of articles devoted to e-learning. Professional discussions about state-of-the-art technology and governance practices as well as integration of e-learning in higher education unfold as part of the *e-Learning Stakeholders and Researchers Summit (eSTARS)* co-hosted by the Higher School of Economics and Coursera, which will be held for the second time in early December 2018 in Moscow.

On this occasion, we have invited William Kuskin to be our guest editor. William is Professor, Vice Provost and Associate Vice Chancellor for Strategic Initiatives at the University of Colorado Boulder, US. His enthusiasm and creative approach have made it possible to initiate a dialogue among experts with diverse backgrounds and attitudes who share genuine interest in finding opportunities to make education accessible to everyone around the globe.

We are also grateful to our colleagues from the HSE e-Learning Office—Evgenia Kulik, Daria Kravchenko and Ksenia Kidimova—for their assistance on this issue of *Voprosy obrazovaniya / Educational Studies Moscow*.

In the articles collected, Russian and international researchers analyze their personal experiences of applying online courses in degree programs and try to predict the future of MOOCs and the newly-emerging MOOC era in education.

As ever, *Voprosy obrazovaniya / Educational Studies Moscow* is ready to publish a vast range of opinions about technology trends and predictions in offline and online learning.

Dear readers, we would really appreciate your opinions, too!

# Mapping the New Education Ecosystem

Introduction to the Special Issue by  
Professor William Kusklin

This is Major Tom to Ground Control  
I'm stepping through the door  
And I'm floating in a most peculiar way  
And the stars look very different today  
*David Bowie "Space Oddity"*

We teach in a time of disruption.<sup>1</sup> For higher education, this disruption feels omnipresent—in the global problem of educational access, in the popular migration from the broad curriculum of the liberal arts toward a narrow set of technical skills geared to employment, in the increasing inability of educated people to discern fact from fiction, to find a common language capable of bridging difference. The moment seems to imperil the core qualities of our charge as teachers: the importance of individual instruction in critical thinking, the necessity of sustained self-reflection for well-being, the benefits of disinterested imaginative exploration to well-being, and the validity, indeed the nobility, of our shared profession. Like all periods of genuine change, it is colored with the urgency of a crisis. Yet because the crisis appears pervasive, the urgency is defuse, and so the solution remains far from obvious—does it lie in retrenchment into the traditional university disciplines, in the abandonment of the comprehensive curriculum in favor of technical training, or in a new interdisciplinary curriculum. Nevertheless, the university system itself is premised on disruptive energy, on a dynamic of interrogation and revision that drives intellectual creation.<sup>2</sup> If we teach in a time of disruption, we must also recognize that disruption is one of our most powerful tools for the production of new

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<sup>1</sup> Famously and provocatively described by John L. Hennessy, President of Stanford, as a "Tsunami." See his keynote speech, "The Coming Tsunami in Educational Technology," delivered at the 2012 Computing Research Association, and summed up in the article by Jack Rosenberger, "John L. Hennessy on 'The Coming Tsunami in Educational Technology,'" *Communications of the ACM*, 23 July 2012, <http://cacm.acm.org/blogs/blog-cacm/153706-john-l-hennessy-on-the-coming-tsunami-in-education-al-technology/fulltext>.

<sup>2</sup> See, for example, Richard DeMillo, *Abelard to Apple: The Fate of American Colleges and Universities* (MIT Press, 2003).

knowledge. The university structure is designed to harness disruption for individual education and for global transformation.

This special issue of *Voprosy obrazovaniya / Educational Studies Moscow* investigates twenty-first century e-learning. The collection is inspired by the first annual eLearning Stakeholders and Researchers Summit, held in Moscow in October 2017. Sponsored by the National Research University Higher School of Economics and the global online learning platform, Coursera, the summit featured speakers from across Russia and the world, and from public and private sector institutions. Together, these speakers took up the transformations in educational policy and teaching practice necessary to accommodate the disruptive potential of e-learning at scale.

Scaled e-learning is a powerful marker of our moment. First launched in 2006, Massive Open Online Courses (MOOCs) exploded into the global consciousness in 2012 as a potential for change in the business practices of higher education.<sup>3</sup> In part, MOOCs contained a utopian promise: the best of higher education delivered openly across the internet.<sup>4</sup> In part, they also seemed a ruse—the infusion of Silicon Valley rhetoric into an institution defined by tradition, the depersonalization of the learning experience, and, above all, the massive enrollment numbers that did not lead to equally large completion rates.<sup>5</sup>

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<sup>3</sup> Named in 2008 by Dave Cormier and Bryan Alexander, Massive Open Online Courses rose to prominence in 2011 with three courses presented by Stanford University: Sebastian Thrun and Peter Norvig's "Introduction into AI," which boasted an enrollment of 160,000 students; Andrew Ng's "Machine Learning," which had an enrollment of over 100,000 students; and Jennifer Widom's "Introduction to Databases," which had an enrollment of 115,000.

<sup>4</sup> *The New York Times* named 2012 "The Year of the MOOC," (Laura Pappano, 2 November 2012, <http://www.nytimes.com/2012/11/04/education/edlife/massive-open-online-courses-are-multiplying-at-a-rapid-pace.html?pagewanted=all&r=1&>). A number of institutions quickly embraced MOOCs: San Jose State developed a MOOC undergraduate curriculum, and Georgia Institute of Technology, in partnership with AT&T, devised a low-cost MOOC MS in Computer Science. Both San Jose State and Georgia Institute of Technology worked with Udacity, a company spun off from the initial Stanford MOOC by Thrun. Since then, a number of universities have developed scaled programs. For a fuller bibliography, see the essays in section one.

<sup>5</sup> Early studies took some of the initial excitement away from MOOCs by tabulating their completion rates at about 4% and assessing that they are largely completed by an educated, male, western, student body seeking expanded credentialing. Thrun himself announced the San Jose venture "a lousy product." See Tamar Lewin, "After Setbacks, Online Courses Are Rethought," *New York Times*, 10 December 2013, <http://www.nytimes.com/2013/12/11/us/after-setbacks-online-courses-are-rethought.html>, which cites the report by Gayle Christensen, Andrew Steinmetz, Brandon Alcorn, Amy Bennett, Deirdre Woods, and Emanuel, Ezekiel, "The MOOC Phenomenon: Who Takes Massive Open Online Courses and Why?," 6 November 6, 2013, available at the Social Science Research Network, [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2350964](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2350964), and the paper, by Laura Perna, Alan

The tensions of the transformative power of technology, its alternation between utopic and dystopic promise, became real to me in fall 2013, when the University of Colorado Boulder piloted four MOOCs on the Coursera platform.<sup>6</sup> In this group, I taught a version of my bricks-and-mortar lecture, "Comics Books and Graphic Novels."<sup>7</sup> The course ran for two iterations. The first had approximately 37,000 students, the second about 32,000.

The course's homepage was designed by Tim Foss, an MFA from the University of Colorado Boulder's fine arts program (image one<sup>8</sup>). Foss drew it as a comic book cover in the style of Marvel Comics, circa. 1965, fitting for a comic-book MOOC. The cover depicted me, floating in outer space, tethered by an oxygen line to my spacecraft, reading a comic book, my radio antenna sending out a signal. I digitally mapped Foss's image so that the students could use it as an alternative to Coursera's navigation bar to access the course's various features. The image came to illustrate my experience teaching the course more accurately than I could have ever predicted. By week two, after months of recording lectures and writing assignments over the summer and early fall, I had become despondent, going on record in an interview as complaining, "this has been the most unpleasant teaching experience of my life."<sup>9</sup> What I had found was that I was as fixed as the course webpage, structured by the digital mode as the content-provider in a massive and impersonal digital environment. A colleague, Michael Breed, upon looking at Foss's drawing, reflected that I was Bowie's Major Tom alone in a one-way communication circuit—"Can you hear me, Major Tom? / Can you hear me, Major Tom? / Can you hear..." More dis-

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Ruby, Robert Boruch, Nicole Wang, Janie Scull, Chad Evans, Seher Ahmad, "The Life Cycle of a Million MOOC Users," MOOC Research Initiative Conference, 5 December 5, 2013 available at [http://www.gse.upenn.edu/pdf/ahead/perna\\_ruby\\_boruch\\_moocs\\_dec2013.pdf](http://www.gse.upenn.edu/pdf/ahead/perna_ruby_boruch_moocs_dec2013.pdf).

<sup>6</sup> The University of Colorado Boulder fielded two graduate courses in Engineering, a course in Power Electronics taught by Robert Erickson and a course in Linear and Integer Programming by Sriram Sankaranarayanan and Shalom D. Ruben. It also piloted an introductory Physics course, Physics I, taught by Michael Dubson. All four courses were on the original Coursera platform, since replaced. Only Prof. Erickson redesigned his course for the new platform.

<sup>7</sup> My MOOC was not the first to use comic books, an honor that belongs to Christina Blanch and her course "Gender Through Comic Books," created by Ball State in November 2012 and taught through the Canvas learning management system. See <https://www.canvas.net/courses/gender-through-comic-books>.

<sup>8</sup> Comics Books and Graphic Novels Homepage. Designed by William Kuskin; illustrated by Tim Foss. <https://sites.google.com/colorado.edu/kuskinimageone/home>

<sup>9</sup> Joel Warner (2013) CU's William Kuskin Takes Comics Seriously. *Westword*, 24–30 October. <https://www.westword.com/news/cus-william-kuskin-takes-comics-seriously-5122327>

connected than Tom, who at least had two-way communication with Ground Control for a while, I was the Wachowski's Brothers' Neo, living in a mediated reality, my body networked to the demands of a robotic structure, my brain feeding a giant machine system.

The very moment I realized Major Tom's isolation, I also saw his vision of the stars in the virtual spacescape before me. Cut off from the world, Tom steps through his spaceship door into a new world. His perspective is forever changed. Similarly, no sooner did I find myself cut off from my class, isolated by very web that constructed me as an authority on comics, teacher of tens of thousands, but alone, than I began to receive emails from around the globe, scores of emails, reporting how important the course was to its participants. The feedback constituted my students as individuals and gave me a way of interacting with them other than as content-provider. Cool Snake, the thirteen-year old in Portugal needed a little extra time for his essay because his parents had taken him to a movie the night before. That was certainly possible. Barbie wanted me to know that Brazil had a small but passionate comics community. Interesting to me, and far from my own ken. She sent me a picture of her cat watching my lecture. A computer programmer in Dublin had never received an "A" on an essay before in his life. Bravo! A CEO in Lyons felt a spiritual pathway was open to him in fiction. I recognize that in myself. At the very beginning of the course, one student set up an interactive map so students could note their location. By the end of the course, the map displayed a global mosaic of early adaptors, each pin-point a life networked together in a learning community (image two<sup>10</sup>). I could not know these learners the way I know my seminar students, could not recognize them crossing the lawn on the University of Colorado Boulder's Norlin Quadrangle, but I could know them through their representative statements, as writers from the beyond, emergent patterns constituted in their upward leap from raw stimuli to symbolic meaning. In answering them, I closed a feedback loop, turning them from digital messages into people I cared about, into my students.

In this quality—this paradoxically networked alienation, this contradictory connection through isolation—the MOOC sums up our digital age. That we cannot know intention is one of the tragic elements of the human condition. That we cannot know anyone, indeed, are even surprised by our own selves, speaks to the limitations of our perception, so powerfully bound as it is by temporality. We live in a world of partial truths created by our own perspective and thus limited to it. In this world, we are faced with the hopelessness of isolation, of sad days and lonely nights, overcome by the ceaseless progression of time, of min-

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<sup>10</sup> "Map Yourself", a volunteer exercise at self-identification showing the global distribution of "Comic Books and Graphic Novels" MOOC participants. Screen shot, 11.1.2013. <https://sites.google.com/colorado.edu/kuskinimage-two/home>

utes, of years that add up to a life. We are indeed like Major Tom, in his isolation. We are also networked. Recognizing this took me from experiencing the MOOC as alienating to realizing it as utterly transformative.

The nine essays that follow chart this transformative space, what Sherman Young identifies in the volume's first essay as a "new education ecosystem." Such an ecosystem seems uniquely suited to our historical moment. "The world needs more university-educated individuals, and governments don't have the resources, nor the available talent, to quickly scale brick-and-mortar universities to meet demand," writes Regent Steve Ludwig in the volume's last essay, continuing, "with the explosion of broadband and mobile data access, the solution also seems clear: scalable online education." As we survey this educational ecosystem, as we recognize the new hardware of teaching and deploy it toward the software of human needs, we face the weight of responsibility, for the application of technology, unlike education, is not in-and-of-itself an ethical imperative. Collectively, the volume suggests how we chart a course through this digital landscape— how we maintain a vibrant university culture that survives the flattening out created by the computer interface, how we formulate a responsible teaching practice that harnesses the power of the internet, and how we lead our institutions to some new form of educational success. In short, the volume continues the conversation begun at the eLearning Stakeholders and Researchers Summit by exploring how to utilize disruption in the service of global education.

I have organized the essays in three sections. The first, "Innovation and Disruption in the Digital Age," establishes the current landscape of scaled learning. The section begins with Young's essay, "From Disruption to Innovation: Thoughts on the Future of MOOCs." Recounting the utopian claims for MOOCs' disruptive energy, Young critiques the major MOOC platforms—Coursera, Udacity, edX, and FutureLearn—for offering only a disruption of business practices, not of educational strategies. The next two essays advance two different strategies for scaled online degree programs on the Coursera platform. Lawrence DeBrock's "The New Face-to-Face Education: Scalable Live-Engagement" narrates the genesis of Coursera's first for-credit degree, the iMBA launched by the Gies College of Business at the University of Illinois at Urbana-Champaign. Quentin McAndrew's "Innovation Leashed: How a MOOC-Based Master's Degree Brings Invention Home to the Institution" discusses the development of the University of Colorado Boulder's Master's Degree in Electrical Engineering, the MS-EE.

The initial claims around MOOCs were as naïve as they were broad. The three essays in section one offer new approaches for thinking about scaled learning within the university structure. For Young, MOOCs never developed into their initial disruptive potential, what he terms an "educational *superorganism* where individuals with different strengths come together to solve global problems and create innovative responses to the challenges we face." For DeBrock, scaled learn-

ing hybridizes the university classroom, making it more democratic and more global. For McAndrew, it affords an opportunity to rethink the structures of higher education that reaches from the classroom to the Registrar's and Bursar's offices. Though somewhat different in their approaches, each of the essays in section one accept that scaled-learning platforms have created a seismic shift in the online landscape. DeBrock and McAndrew, in particular, describe their scaled programs as interior to university practices. Their assessment repositions e-learning platforms such as Coursera and edX as complementary rather than oppositional to the traditions of higher education. Overall, by imagining scaled e-learning as organically connect to the university, Young, DeBrock, and McAndrew move beyond the stark binary juxtaposition of alienation and connection that I experienced teaching the first generation of MOOCs to describe a scaled educational community.

Section one describes what I would call the *post-MOOC turn in e-learning*, a turn from the utopian claims of open education to a more synthetic view of how universities can incorporate new educational technology. Section two, "Studies of e-Learning," presents four case studies of the e-learning classroom. Maria Janelli's essay, "E-learning in Theory, Practice, and Research," sets the terms for the section in her recognition that the literature on e-learning remains undeveloped and that scaled courses themselves, in her case a Coursera MOOC from the American Museum of Natural History in New York City, are educational research laboratories. Daria Kravchenko's essay, "Classical Test Theory and Item Response Theory in Measuring Validity of Peer-Grading in Massive Open Online Courses," explores the legitimacy of peer grading on MOOC platforms through two online courses, the National Research University Higher School of Economics' *Philosophy of Culture* and *Understanding Russians: contexts of Intercultural Communication*. Deborah Keyek-Franssen's "Practices for Student Success: From Face-to-Face to At-Scale and Back" brings three broad educational trends—longitudinal high-impact practices, high-impact learning design and teaching practices, and open-educational resources—to the testbed of the University of Colorado System MOOCs. Finally, Tatyana Bystrova, Viola Larionova, Eygeny Sinitsyn, and Alexander Tolmachev's essay, "Learning Analytics in Massive Open Online Courses as a Tool for Predicting Learner Performance" develops an evaluative algorithm to track student success in a number of Ural Federal University MOOCs on the National Open Education Platform.

Collectively, section two argues that MOOCs and scaled e-learning programs offer a powerful and recursive force for studies of teaching and learning. That is, e-learning, as it developed across the 1990s and 2000s, was almost entirely evaluated in comparison to the residential-campus seminar room and lecture hall. Regardless of the outcomes, by such a standard, e-learning could only approximate educational legitimacy, which was ultimately defined by the campus experience. In this tradition, MOOCs appear a minor sideline. The au-



thors of section two suggest a different approach: scaled e-learning is sufficiently different from the residential lecture hall to deserve sophisticated analytical tools for measuring student performance as well as a unified critical theory for explaining how learning occurs in the online environment. The essays, particularly Keyek-Franssen's, suggest the possibility of returning the lessons from the scaled classroom back to the campus. Yet there is also a dark shadow to these essays. Using both Classical Test Theory and Item Response Theory, Kravchenko's essay concludes that the peer judges she studied "tend to award higher scores than deserved." The work of perfecting the scaled environment has only begun, but it promises a transformation of how we understand student success. Born from the university into its own form, the scaled classroom can act as a laboratory for learning overall.

The final section, "Leadership and Change," suggests paths for institutional transformation. Rebecca Stein's essay, "Supporting Online Initiatives: from MOOCs to for-credit offerings," pulls together the previous two sections' themes by tracing the history of MOOCs from 2012 to the present day at the University of Pennsylvania. The last essay, "Higher Learning: Lessons from an Online Advocate," by Steve Ludwig, returns us to the social contract between the university and the public, to higher education's commitment to affordability, to access, and to quality.

Both Stein and Ludwig emphasize a set of tensions in online education and institutional practice, between the pace of university development and the rate of technological change, between the centralization and dispersion of authority, and between the pressures of a market economy based in prestige and the responsibility for educating the world. They also emphasize the roles of champions in online development, what Ludwig terms a "coalition the willing" to create change, and what Stein observes as a change in faculty attitudes: "Though there have been online classes at the Penn for over a decade, these were stand-alone courses mostly given over the summer months in our College of Liberal and Professional Studies that historically served nontraditional, older, students. Bringing MOOCs into Penn introduced faculty to the potential of a global reach and impact through online teaching." Ultimately, the section underscores that the leadership decisions we make now will have long-range implications for the fundamental mission of higher education—its commitment to access, to racial and cultural inclusivity, and to the individual dreams of self-improvement—across the twenty-first century.

What does the future look like? Major Tom can never fully report what he sees in the stars. We can, however, draw at least three conclusions from this volume's map of the new education ecosystem:

*We stand at the cusp of a new moment.* Perhaps every generation feels this way, but for higher education, the moment has a particular urgency. As Bystrova, Larionova, Sinitsyn, and Tolmachev remark, "the social need for studying the effectiveness of digital technology in edu-

cation has to do with the acute problem of organizing education in the information society with its high rates of technology turnover and life-long accumulation of statistics on this type of learning.” We must not allow our nostalgia and sentimentality for the university system we grew up in to sway us from our responsibility to shepherd affordable education in the digital age. Ludwig concludes, “what a university is, whom it serves, what it offers, how it operates, how it creates new knowledge, how its reward systems are structured, and how it delivers information are not permanently fixed. It never was.” Change is upon us. It is the responsibility of each reader of this journal to participate in navigating a way forward that sustains the principles of higher education for the coming generations.

*Scaled e-learning presents an opportunity to rethink residential teaching.* Many of the authors in this volume remark that the study of scaled online learning affords a new perspective on the traditional classroom. Stein writes, “innovation in the MOOC space helps faculty rethink face-to-face teaching by incorporating effective practices and supports innovations such as the flipped learning and enhanced use of peer and group projects.” Yet, we must also be cautious: almost all of the essays in section two note that the way forward is undertheorized and, as Darya Kravchenko’s essay particularly demonstrates, our current practices are not perfect. We must embrace the power of educational change, the excitement of disruption and the urgency of the moment and route the electronic currents of the internet back through the university sector, electrifying the classroom with ongoing research.

*The university remains a powerful institution for innovation.* The rhetoric surrounding the 2012 MOOC explosion suggested that the private sector would reform the university system from without. The past six years have demonstrated just the reverse: that the platforms for scaled learning such as Coursera, edX, Udacity, and FutureLearn, as well as Online Program Managers (OPMs) specializing in online program development, operate, at best, as partners with universities. Universities, in fact, have reformed how these companies do business. Reflecting on the process, McAndrew writes, “this lesson recalls us to a fundamental truth: while universities are conservators of academic tradition and systemic efficiency, they are also, most essentially, extraordinary engines of creation and innovative will. It is by tapping into this truth that we harness the potential for transformation.” Although educational change is upon us, and although the changes in online teaching may well change our classroom practices, the university itself remains a disruptive and visionary social institution.

It remains for me to thank the many people who made this international statement possible. Foremost, I thank the Rector of the National Research University Higher School of Economics and the Editor-in-Chief of this journal, Yaroslav Kuzminov, for graciously allowing me to step in as guest editor. Cathryn Richter of Coursera and Ksenia Kidimova of the Higher School of Economics initiated the effort and

gave it the energy necessary to get off the ground. I thank Richard Bradley, the English translator and copyeditor, as well as the anonymous Russian and American readers of the essays. Mr. Bradley and the readers improved everything they touched. Quentin McAndrew, Deborah Keyek-Franssen, David Thomas, and Richelle Munkhoff generously read my drafts of this introduction and gave it direction and coherence. Ultimately, my highest praise goes to Julia Belavina, the Executive Editor of *Voprosy obrazovaniya / Educational Studies Moscow*, who made this project a reality. She kept me on task even though five-thousand, four hundred, sixty-seven miles stood between us. She organized the many details, deadlines, and people necessary to complete the volume. I thank her for her patience and for her precision.

Lastly, I would like to thank the readers of this journal. No reader of *Voprosy obrazovaniya / Educational Studies Moscow* is ignorant of the tensions that crosscut twenty-first century global politics. I believe that it is not naive to say that e-learning presents the possibility for global connection. Case in point: the essays collected here come from writers in Yekaterinburg and Moscow, from Sydney, and from New York City, Philadelphia, Urbana-Champaign, Denver, and Boulder. They look to the future with both the skepticism and the confidence of the trained academic eye. Not all of the authors were at the original Moscow eLearning Summit, but all of them responded to its brave spirit of investigation. Working with them has taught me a great deal about the educational ecosystem in which we find ourselves. It is my sincere hope that this volume extends our ability to collaborate across national divisions.

*Professor William Kuskin,  
Vice Provost and Associate Vice  
Chancellor for Strategic Initiatives,  
University of Colorado Boulder*

# From Disruption to Innovation: Thoughts on the Future of MOOCs

**Sherman Young**

Received in  
July 2018

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**Abstract.** MOOCs have been heralded by some as disruptive of the higher education sector, but the reality is that they are examples of business rather than educational innovation. By enabling universities to focus on global scale and reach as they navigate the digital environment, current MOOCs mostly sustain existing learning practices rather than force pedagogical reconfiguration. Implementations to date have largely focussed on content delivery from superstar professors with little emphasis on the real needs of twenty-first century learners. We have reached a stage when all of our

educational approaches need to be better suited for a new information ecology that has demonstrably different characteristics from the past. Information scarcity has given way to ubiquity and learners need the appropriate skills to thrive in a digital life and career—creativity, critical thinking, collaboration and communication. Whilst real innovation to address these challenges is already happening in both fully online and blended offerings at some institutions, they are not so common in the MOOC space. This paper argues that MOOCs offer an opportunity to truly disrupt learning at scale and become exemplars for real educational innovation.

**Keywords:** digital age, disruption, innovation, MOOC, connectivism, network, Silicon Valley, curricular design, xMOOC, cMOOC.

**DOI:** 10.17323/1814-9545-2018-4-21-43

Since their emergence, Massive Open Online Courses have been hailed as disruptive. Just as the world wide web totally reshaped the newspaper industry, MOOCs were seen as the potential harbingers of creative destruction for the university sector; a digital tsunami that would lead to a reinvention of learning and teaching, but dramatic change has yet to happen, and the early hype seems to be merely fodder for critics of education innovation<sup>1</sup> [Harden, Hartsell 2014; Reeves, Hedberg 2014].

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<sup>1</sup> Christensen C.M., Michelle R. (2014) MOOCs' Disruption is Only Beginning // Boston Globe. May, 9. <https://www.bostonglobe.com/opinion/2014/05/09/moocs-disruption-only-beginning/S2VIsXpK6rzRx4DMrS4ADM/story.html>; Knowledge@Wharton (2012) MOOCs on the Move: How Coursera Is Disrupting the Traditional Classroom. <http://knowledge.wharton.upenn.edu/article/moocs-on-the-move-how-coursera-is-disrupting-the-traditional-class->

This paper argues disruption may still happen, but attention has been misplaced; focussing so far on the *business* of learning rather than the real opportunity that lies in disrupting learning itself. The motivation of early MOOC companies and their venture-capital investors has been in building an education marketplace to exploit digital efficiencies. Our understanding of the disruptive potential of MOOCs must be broadened to include pedagogy.

Digital technologies have done nothing less than introduce a new information ecology, with entirely new parameters. Scarcity is replaced by ubiquity, the control of information has been redistributed, machines are increasingly capable, and the way humans connect with those machines, information, and each other has been reconfigured dramatically. Unfortunately, for the most part we are still educating people for the past, teaching them how to act in a world of information that no longer exists. What we need is a new education ecosystem, one which de-emphasises "knowing things" and instead builds the connected, collaborative problem-solving skills that are needed in the twenty-first century. As digital first (and digital only) teaching tools, MOOCs could play a significant role in that new education ecosystem. University teaching has its roots in centuries old traditions and was constructed for an information age that no longer exists. It is ripe for digital innovation and disruption. Now is the time to act, before the business of digital education is built on the same old thinking.

### **A brief history of MOOC disruption**

The idea of disruption was popularised by Clayton Christensen in the mid-1990s with the term entering popular usage to "describe any situation in which an industry is shaken up and previously successful incumbents stumble"<sup>2</sup>. Christensen identifies two types of disruption—"low end" and "new market." Low-end disruption is the introduction of cheaper solutions to problems that are good enough for widespread adoption, despite being less fully featured than incumbent, more expensive, methods. New-market disruption refers to businesses that create new opportunities that compete against non-consumption.

In 2012, Coursera, Udacity and EdX spun out of US universities to become the first commercial MOOC platforms. At the time, online education was commonly derided as inferior to face-to-face approach-

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[room/](#); Lodge J. M. (2013) The Failure of Udacity: Lessons on Quality for Future MOOCs // The Conversation. November, 19. <https://theconversation.com/the-failure-of-udacity-lessons-on-quality-for-future-moocs-20416>; Head K. (2017) Disrupt This! MOOCs and the Promise of Technology. <https://computinged.wordpress.com/2017/10/06/disrupt-this-moocs-and-the-promises-of-technology-by-karen-head/>

<sup>2</sup> Christensen C.M., Michael E., McDonald R. (2015) What is Disruptive Innovation? // Harvard Business Review. December. <https://hbr.org/2015/12/what-is-disruptive-innovation>

es. MOOCs were potentially “good enough” to threaten traditional university offerings and provide low cost learning opportunities—classic low-end disruption. Udacity founder, Sebastian Thrun argued that MOOCs were the beginning of a world in which “in 50 years, there will only be 10 institutions in the world delivering higher education”<sup>3</sup>. MOOCs’ disruptive nature would trigger change that could reinvent the entire education sector. Describing the early days of Coursera, Thomas Friedman in the New York Times wrote simply “Welcome to the college education revolution”<sup>4</sup>, and David Brooks in the same newspaper wrote “What happened to the newspaper and magazine business is about to happen to higher education: a descrambling around the Web”<sup>5</sup>. There was, in the words of Stanford President John Hennessy “a tsunami coming”<sup>6</sup>. Such coverage certainly combined to give the impression that 2012 was “the year of the MOOC”<sup>7</sup>, and the focus was squarely on how the massive open online model would disrupt the business of universities.

Spooked by the hype, universities embraced partnerships with MOOC platform providers, first as defensive positions and then for reasons of new-market disruption. Whilst initially keen to stay in the game, they began to see the global reach and scalability of MOOCs as an opportunity to attract students who otherwise would not have considered their educational institution. Many universities also used MOOCs as a demonstration of their ability to innovate and established teams to develop their engagement across the various providers<sup>8</sup>.

The global reach of the MOOC platforms—Coursera has over 32 million learners from all around the world on its platform at the time of writing and is growing at a rate of 600,000 learners a month—meant that a university was able to leverage reach and develop reputation, as well as generate an alternative revenue stream. In reality, MOOCs largely fail as innovations as they essentially provide an online simulation of an existing on-campus experience. For example, massively popular MOOCs like Coursera’s “Learning to Learn” still rely on content-heavy lecture material delivered by charismatic professors. Student engagement is still dependent on the reputation of the rock-star

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<sup>3</sup> Leckart S. (2012) The Stanford Education Experiment Could Change Higher Learning Forever. [https://www.wired.com/2012/03/ff\\_aiclass/](https://www.wired.com/2012/03/ff_aiclass/)

<sup>4</sup> Friedman T. (2012) Come the Revolution // New York Times. May, 15.

<sup>5</sup> Brooks D. (2012) The Campus Tsunami // The New York Times. May, 3. <https://www.nytimes.com/2012/05/04/opinion/brooks-the-campus-tsunami.html>

<sup>6</sup> Auletta K. (2012) Get Rich U // New Yorker. April, 30.

<sup>7</sup> Pappano L. (2012) The Year of the MOOC // The New York Times. November, 2. <https://www.nytimes.com/2012/11/04/education/edlife/massive-open-online-courses-are-multiplying-at-a-rapid-pace.html>

<sup>8</sup> Dodd T. (2017) Massive Online Open Courses Are Back and They’re Threatening Universities // Australian Financial Review. April, 12. <https://www.afr.com/leadership/management/business-education/massive-online-open-courses-are-back-and-theyre-threatening-universities-20170406-gvfdsk>

academic and their ability to deliver “edutainment.” Even the MOOC-based, full-degree programs such as Coursera’s iMBA are duplicative rather than innovative: the process of admission, enrolment, progression, and engagement is largely designed to replicate the face-to-face learner experience. Students still work through a structured program based on synchronous learning and highly regulated credit hours within traditional disciplinary thinking. This is understandable, as the motivation for these programs is not learning innovation, but expanding reach, enabling an institution to connect with more students, for reasons of revenue, reputation and, sometimes, social responsibility.

“I normally teach 400 students,” Coursera founder Andrew Ng explained to Friedman, but last semester he taught 100,000 in an online course on machine learning. “To reach that many students before,” Ng said, “I would have had to teach my normal Stanford class for 250 years”<sup>9</sup>.

Business model aside, there is little truly new and innovative in MOOCs, which simply ape traditional teaching models.

**Disruption and  
the job to be  
done**

Students have many motivations for engaging with higher education so there are different ideas of what Christensen terms the “job to be done” by universities<sup>10</sup>. For many, learning is a means to an end, and much of the sector focuses on learning for the improvement of economic well-being. The increase in professional skills, be they in computer programming or business thinking, is certainly a driver for many learners. But many others are driven by other factors. Some want what many loosely call an education—what was historically understood as a preparation for engaged global citizenship and which has been the domain of liberal arts programs for some time. Others simply desire the social connections that educational institutions can provide by facilitating a community of like-minded individuals. Still others are driven by the status of attending or gaining a credential from an institution with a global brand.

Across these dimensions, there are many possibilities for disruption. But the easiest to understand revolves around the aforementioned business models and how universities might struggle with the challenge of low-end and relish the opportunity for new-market disruption.

For example, consider Coursera. Its mission is simple: “We envision a world where anyone, anywhere can transform their life by accessing the world’s best learning experience,” announces its webpage. From their mission statement, Coursera exists to provide a

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<sup>9</sup> Friedman T. (2012) Come the Revolution // New York Times. May, 15.

<sup>10</sup> Christensen C.M., Dillon K., Duncan D. S. (2016) Know Your Customers’ “Jobs to Be Done” // Harvard Business Review. September. <https://hbr.org/2016/09/know-your-customers-jobs-to-be-done>



function—better life and career outcomes through transformational learning. But the next sentence on the same webpage is as follows: “Every course on Coursera is taught by top instructors from the world’s best universities and educational institutions.” All of a sudden, the pitch shifts. Not only is the learning important, but Coursera leverages the emotional pull of the world’s leading universities to credential that learning. Tellingly, it is held to be self-evident that high-ranking universities will deliver the best transformational learning experience and outcomes. The model for Coursera has always been about partnering with a select group of highly ranked universities. The traditional virtue-signals remain in place, and the sole disruption is in enabling high-ranking universities to both protect and expand their market through greater reach on a scalable online platform<sup>11</sup>.

In that environment, low-end disruption of the higher education sector has yet to play out as Sebastian Thrun and others predicted. In a perfect example of culture being harder to change than technology, universities continue to dominate the profitable end of the market. Udacity itself has pivoted to focus on corporate partnerships<sup>12</sup>, and Thrun is no longer in charge<sup>13</sup>. In fact, most MOOC providers have refocused their efforts to profit from full-degree offerings in partnership with universities.

The recent introduction of degree offerings has enabled some to think beyond the templated approach of the initial MOOC platforms, if only because they provide a bigger opportunity for innovation. Unlike a single short MOOC, which can be very narrow in scope, a full degree is long enough, broad enough, and has sufficiently sophisticated learning outcomes to enable innovation. There is an opportunity in the degree space to shift the focus of MOOCs as disruptors away from the *business* of learning onto the learning itself. So far this has not happened. At present, innovation is in accessibility. For example, many of these new degrees allow students to enter the full degree program via completing MOOCs successfully, and those individual MOOCs are marketed as “stackable,” allowing degree completion via bite-sized chunks. Still, the degrees themselves differ little from existing models, and thus there is now little difference between MOOC companies and traditional online partner providers such as Pearson and Key Path. It may be that Coursera, EdX and FutureLearn are simply approaching that profit opportunity from a different starting point<sup>14</sup>.

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<sup>11</sup> <https://blog.coursera.org/about/>

<sup>12</sup> Mitra S. (2016) How Billion-Dollar Udacity Plans to Make Money // Inc.com. April, 12. <https://www.inc.com/linkedin/sramana-mitra/billion-dollar-unicorn-udacity-leans-industry-giants-sramana-mitra.html>

<sup>13</sup> Rao L. (2016) Sebastian Thrun Steps Down as Udacity’s CEO // Fortune. April, 22.

<sup>14</sup> ICEF (2018) Major MOOC Providers Shifting Focus to Fee-Paying Students. <http://monitor.icef.com/2018/01/major-mooc-providers-shifting-focus-fee-paying-students/>



There are other possibilities. For example, there is a distinction between xMOOCs and cMOOCs. xMOOCs were (and remain) the most common incarnation of the Massive Open Online Course as exemplified by Coursera and its ilk [Bates 2014; Siemens 2013]. cMOOCs have a very different philosophy, embracing a constructivist approach to learning. Whilst xMOOC implementation varies—just as in face-to-face offerings, instructors have a great deal of autonomy in their design and delivery—most are constrained by their platforms. As flagged, these generally include short video lectures from a “hero” professor, computer-graded quizzes, and peer-marked assessment tasks, shared discussion forums with some moderation from teaching assistants, a range of supporting material in the form of supplementary readings, multimedia resources and links, some form of certification on successful completion of the learning activities and a range of learning analytics providing instructors with opportunities to either intervene with struggling learners, or to modify their courses based on user engagement data.

In contrast to the mimicking of traditional passive learning that is the mainstay of these xMOOCs, the aforementioned cMOOCs revolve around autonomy of the learner, diversity of tools, participants, content and knowledge, real interactivity (co-operative learning, communications, emergent knowledge) and openness (access, activities and assessment). The idea of cMOOCs [Bates 2014] is built on George Siemens’ thinking around connectivism as a model of learning for the digital environment, exemplified by CCK08, “Connectivism and Connective Knowledge,” an online course offered through the University of Manitoba by Siemens and Stephen Downes in 2008. Downes recalls,

What made CCK08 a watershed moment was the realization that the use of distributed open resources would support—with ease—an attendance in the thousands. We weren’t expecting 2200 people in CCK08; George Siemens has quipped that we were expecting about 24 people, if we were lucky. After all, the course was devoted to a pretty obscure topic—the theory of Connectivism, a pedagogical theory articulated by George and myself. And the software and course design were the first to explicitly invoke the theory, and to focus on connections rather than content, which suggested the distributed and connected approach<sup>15</sup>.

Rather than being delivered on bespoke platforms, cMOOCs are built on a networked approach of learners and technologies. They emphasise social media tools in conjunction with open access learning management systems (such as Moodle). Importantly, they are par-

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<sup>15</sup> Downes S. (2012) The Rise of MOOCs. <http://halfanhour.blogspot.ca/2012/04/rise-of-moocs.html>

participant-driven rather than instructor-led and are built around a community of practice, encouraging and inviting participation based on common interest, and emphasising conversation and engagement. In Tony Bates' words:

cMOOCs therefore primarily use a networked approach to learning based on autonomous learners connecting with each other across open and connected social media and sharing knowledge through their own personal contributions. There is no pre-set curriculum and no formal teacher-student relationship, either for delivery of content or for learner support. Participants learn from the contributions of others, from the meta-level knowledge generated through the community, and from self-reflection on their own contributions [Bates 2014].

cMOOC and xMOOCs do completely different things and address entirely different audiences and learners. cMOOCs are best suited to self-directed students who are happy to engage with a loose network of fellow travellers to build emergent knowledge from their digital engagements. xMOOCs only allow engagement with a set of content, prescribed learning outcomes and a demonstration of that achievement with appropriate credentialing.

The music industry provides a parallel example. Responding to the realities of the digital age, and the easy movement of music files, that industry shifted from selling physical artefacts to selling digital artefacts to provide access to digital streams. Whilst there was much hand-wringing involved at the time, in hindsight the shift has occurred relatively quickly. After two decades of transition, the major industry stakeholders (the record labels) remain dominant, albeit with a shift in intermediaries from CD and record manufacturing plants to computer companies such as Apple, Google and Spotify. This parallels the xMOOC model: universities shifting from delivering physical experiences to online ones, remaining the dominant providers but with new intermediaries in the form of Coursera, Edx, FutureLearn, and others as their partners.

There is another side of the digital music revolution, however. As well as shifting the business of music production and distribution from long-play albums to streaming playlists, digital technologies also enable new possibilities for creativity and collaboration. Music itself has evolved to include remixes and mashups. For years, artists have enabled new creativity by releasing their raw tracks onto the internet for fans to remix and share<sup>16</sup>. Musicians from around the world have begun to work together on projects that, whilst not necessarily providing them with superstar status, have enabled them to fulfil creative aspi-

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<sup>16</sup> UPI (2005) Trent Reznor Lets Fans Remix Single. <https://www.upi.com/Trent-Reznor-lets-fans-remix-single/97151120411420/>

rations [Collins, Young 2014]. A recent example is the band Superorganism, whose members come from all around the world, met and collaborated on the internet, and released music online before meeting in person<sup>17</sup>. Whilst the popularity of Coursera and others demonstrate that there is value in the xMOOC model, true learning innovation comes from elsewhere. cMOOCs may be too challenging for some, but I would argue that disruption of learning is grounded in the cMOOC approach and that approach is better suited to the needs of twenty-first century learners.

Those needs raise challenges that universities struggle to meet. Not only are defined career paths increasingly rare but the work to be done is constantly changing. As Richard Riley suggests: "We are currently preparing students for jobs that don't yet exist, using technologies that haven't been invented, in order to solve problems we don't even know are problems yet" [Gunderson, Jones, Scanland 2004]. In this world, learning creativity, collaboration, communication, and critical thinking are important. The classroom cannot be simply about knowledge transfer, it has to enable learners to connect, to create things together and communicate to a diverse global population. We must envisage that classroom as a means to create the educational *superorganism* where individuals with different strengths come together to solve global problems and create innovative responses to the challenges we face. This is learning that reflects the rhizomatic characteristics of the digital world.

Gilles Deleuze and Félix Guattari's notion of the rhizome describes a system that, unlike hierarchical trees, is characterised by connections from any point to any other point—a network with a complexity of interconnected points [Deleuze, Guattari 1987]. Early internet theorists applied the notion of the rhizome to the networks of computing and communication that make up the internet and extrapolated cultural and political understandings based on that analysis<sup>18</sup> [Hess 2008]. As the internet has evolved into the digital ecosystem in which we all act, our interactions with information, with machines, and with each other much more closely resembles a rhizome or what Simon Phipps calls "a meshed society"<sup>19</sup>.

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<sup>17</sup> Miller N. (2018) Have Hit, Must Meet: How Internet Chums Superorganism Became the Next Big Thing // Sydney Morning Herald. May, 29. <https://www.smh.com.au/entertainment/have-hit-must-meet-how-internet-chums-superorganism-became-the-next-big-thing-20180529-h10ovw.html>

<sup>18</sup> Hammam R. (1996) Rhizome@Internet. <http://www.socio.demon.co.uk/rhizome.html>; Bluemink M. (2015) The Web as Rhizome in Deleuze and Guattari. <https://bluelabyrinths.com/2015/07/15/the-web-as-rhizome-in-deleuze-and-guattari/>; Flint J. (1997) Is the Internet a Rhizome? <http://www.jamesflint.net/is-the-internet-a-rhizome/>

<sup>19</sup> Phipps S. (2018) The Legislative Disconnect of the Meshed Society. <https://meshedinsights.com/2018/07/02/the-legislative-disconnect-of-the-meshed-society/>

cMOOCs represent an example of so-called rhizomatic education<sup>20</sup>. Just as the Super Organism of the music world was digitally enabled, cMOOCs represent an educational superorganism that has the potential to set the tone for how digital learning should occur.

### **MOOCs and the educational challenge**

Education is clearly different from recorded music. In many ways both the challenges and the opportunities are greater in an educational context. Just as Universities are grappling with shifting funding, government policies, and increased competition, they are also expected to deliver graduates equipped for a completely different world. Whilst xMOOCs may provoke changes to university business models, they do little to progress the learning that happens in those institutions, at a time when our educational approach needs dramatic changes.

It's no exaggeration to suggest that the twenty-first century world of work—continually reshaped by digital technologies ranging from computer automation to machine learning—requires graduates to have a range of new skills and capabilities. Cognizant of the ever-present threat of a *Terminator*-style world where the robots are able to do existing jobs more effectively and more efficiently than humans, we need an education system that prepares its students with attributes relevant to the workplace into which they will graduate. To do that, we need an education system that is not only digitally enabled, but understands the digital information ecosystem in which we exist. Being digital must be a primary principle of learning, something that is currently not true.

The literature resonates with suggestions for the skills required in the new workplaces [McGaw 2013; Lamb 2017]. One example is the Four Cs (creativity, collaboration, critical thinking, and communication), which are oft-cited replacements for the traditional Three Rs. In the United States, The National Education Association argues that:

America's system of education was built for an economy and a society that no longer exists. In the manufacturing and agrarian economies that existed 50 years ago, it was enough to master the "Three Rs" (reading, writing, and arithmetic). In the modern "flat world," the "Three Rs" simply aren't enough. If today's students want to compete in this global society, however, they must also be proficient communicators, creators, critical thinkers, and collaborators (the "Four Cs") [National Education Association 2017].

In Australia, the Foundation for Young Australians analysed 4.2 million unique job advertisements and identified a growth in demand for what they term "enterprise skills"—presentation skills, problem solv-

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<sup>20</sup> Gillies D. Rhizomatic Learning // A Brief Critical Dictionary of Education. [www.dictionarofeducation.co.uk](http://www.dictionarofeducation.co.uk)

ing, creativity, critical thinking—which align with the Four Cs. Additionally, they identified digital literacy and language skills as being in extremely high demand. This suggests that there is also the need to be able to engage as a global citizen and that the context for all of these skills is the digital information ecosystem<sup>21</sup>.

Importantly, because we live in a world in which we do almost everything digitally, from shopping to banking to reading and thinking, equipping our students with those relevant skills cannot happen using traditional pedagogies. There is little value in training students for a world without google or smartphones when the skills they need to survive and thrive require that they understand and can critically engage with those tools. K-12 schooling is visibly grappling with these challenges. For example, the NSW Education Department in Australia has commissioned a major piece of work exploring requirements for an AI world and there are many experiments to bring authenticity to the learning experience for school age learners [Loble, Greenaune, Hayes 2017].

Whilst many universities are embracing the digital reality, the traditional approach for learning and teaching retains a stranglehold. Much university teaching remains stubbornly focussed on the fifth C—content—which is arguably no longer as important as it once was. Certainly neither the NEA or the FYA research suggests that content recall is critical. Arguably, in this age of information ubiquity, “remembering” and “understanding” are increasingly less relevant than Bloom’s higher order skills of analysis and synthesis<sup>22</sup>, but university teaching has been designed around an information ecology based on the characteristics of print and have not evolved to properly understand the characteristics of the digital age. Rather than teaching delivery and activities which emphasise scarcity, authority, and isolation, our teaching needs to provide active engagement with multiple sources of content across many disciplines and ensure a range of appropriate literacies (see Figure 1).

A new information ecology means that we have student cohorts who expect to have a digital experience akin to other domains of their lives. As social media, online commerce, and an increasing reliance on internet enabled activities suggests, we need to integrate digital experiences and expectations into our educational practices. Ultimately, this requires a rethinking of pedagogy away from content delivery and knowledge testing and towards higher-level engagement, active problem solving, and linking content with enterprise-skills development.

On campus, these expectations are being slowly met through a range of changes. Students as partners in their learning is a common

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<sup>21</sup> AlphaBeta (2017) The New Basics: Big Data Reveals the Skills Young People Need for the New Work Order. [fya.org.au](http://fya.org.au)

<sup>22</sup> Armstrong P. Bloom’s Taxonomy. <https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/>

**Fig 1. Teaching then and now**

Then (analog)	Teaching then	Now (digital)	Teaching Now
Scarce content	Content delivery, lectures	Ubiquitous content	Active Facilitation of Problem Solving
Authoritative	Remembering, Understanding, exams based	Contested	Application, Analysis, Evaluation and Creation
Isolated	Discipline specific, discouraged groupwork	Contested	Trans-disciplinary, collaborative
Text-based	Academic literacy	Multimedia	Digital, Visual, Cultural literacies

refrain [Healey, Flint, Harrington 2014] and much face-to-face teaching has shifted from the traditional passive lecture model to a more engaging active learning approach. Models for this include the flipped classroom, where video material (either produced or sourced) replaces lecture time and face-to-face engagement is based around facilitated activities often in small groups in bespoke spaces designed to encourage collaboration. This is often built as so-called problem-based learning, where the activities are focussed on solving specific problems—often set by external partners to provide authentic workplace examples. Project-based approaches differ perhaps only in scale and all sit within a practice-based curriculum emphasizing relevant workplace skills. Another approach gaining widespread adoption is experiential learning. Again, there is overlap with some of the other pedagogies described, but the emphasis is not on what some might have called book- or theoretical-learning so much as on learning from engaging in authentic activities. This might happen in a workplace, where it is called “work integrated learning,” or in other offsite environments.

The other dimension of students-as-partners is to enable students to learn from each other and to empower them to co-create both their curriculum and the learning activities. The former might occur through formal peer-assisted learning programs where students who have already completed a subject may assist those who haven’t or simply as a matter of designing activities where students are encouraged to contribute their diverse skills collaboratively. Co-creation might include empowering students to choose the areas of learning, create assessment tasks and rubrics, co-mark and curate resources. Of course, in universities, much can and does happen digitally in blended approaches. Flipped classrooms, collaborative workspaces such as google docs, curatorial tools and digital portfolios all provide not only platforms for activities but opportunities to develop the essential digital literacies. Indeed, teachers have used online technologies to address the challenges raised for quite some time [Hoppe, Ogata, Soller 2007; Raymond et al. 2016; Hakkinen, Hämäläinen 2012], and

it is easy to forget the immense progress in online pedagogical development outside of MOOCs.

The opportunity in the MOOC space is much bigger. cMOOCs suggest a model for learning that takes those fairly basic ideas and expands them to fully engage with the possibilities of the digital ecology, where the possibilities for collaboration, connection, and communication are vastly expanded. Fully online learning experiences designed specifically for a new educational ecosystem are the disruptors we need to ensure students are fully prepared for our brave new world. We have only just begun to explore the potential, and if we are serious, MOOCs can provide a real platform for progress.

### **Thoughts on the future of learning**

Most existing MOOC initiatives address the business of learning rather than the learning itself. Despite their digital origins, and their implicit place as part of the new information ecology, they largely exist as extensions of analogue habits. So far, they represent a missed opportunity for truly exciting learning opportunities. Other than early cMOOCs, there has been little thinking about how the new technologies might allow new pedagogies to thrive. Real innovation—and disruption—might occur when those digital technologies are employed to address the learning challenges identified above. Given the digital information ecology, we should utilise the new tools to ensure that learners are properly equipped for the world we have described.

It is beyond the scope of this short paper to comprehensively interrogate the possibilities and properly explore the experiments that might be enabled through creative thinking. But it is worth canvassing some thoughts on what those new pedagogies might be and how they might exist in our current MOOC provision. Broadly, there are three areas to consider, all technically possible, but perhaps culturally challenging: rethinking student engagement, connecting with external partners, and delivering relevant learning outcomes for an interdisciplinary world.

As previously suggested, many universities now espouse the mantra of students as partners or students as co-creators of their learning. The meaning varies—from ensuring that students are involved in academic governance activities or curriculum design, through formal peer-assisted learning programs, through learning activities built on active learning paradigms that emphasize the student's role in owning their learning. On most campuses, these activities happen through a blend of on-line and face-to-face engagement. This approach to pedagogy is embraced and designed by teachers who are happy to rethink their roles and become facilitators of learning rather than professors of knowledge.

At the moment, such rethinking is uncommon in the mainstream MOOC space. Even when platforms discuss their full degree offerings and expand into human-centric so-called "high touch" activities, they



continue to place the teacher (rather than the student) in the centre of the learning. The cMOOC approach—a loose network of advanced learners taking a constructivist approach—appears at first glance to demand too much of students who are more used to an educational approach where the content and learning are delivered on a platform. But a greater focus on social learning and empowering students should be possible through appropriate learning design. Structured group work, facilitated by the learning activities and enabled on platforms which encourage both strong and loose ties between learners and teachers, would go some of the way towards such a model. Whilst no such ideal platform currently exists, FutureLearn does take a more social learning approach, and platforms as diverse as D2L and UCroo in the non-MOOC space are attempting to address the need to better connect students with each other and their formal and informal learning. An ideal platform would enable self-identified groupings, emergent (and defined) peer learning approaches and generally encourage students to engage with their learning beyond absorbing and regurgitating content.

Embedded active learning approaches are also key. For example, rather than provide video lectures, it would be useful to ask students to identify and locate existing content relevant to the subject matter and to discuss and rate it in a structured manner. Similarly, they could be asked to co-create the required assessment tasks and extend existing peer-review approaches into full self-assessment through an agreed upon, co-created, rubric. Problem-based learning approaches are naturally aligned to this idea, and designing for scale on appropriate platforms would enable distinctive global perspectives to be brought into play, enabling a range of learning outcomes including inter-cultural communications competencies that are increasingly in demand in modern trans-national employment situations. Many learners, particularly so-called digital natives, would already be familiar with identifying, curating and sharing content on social media platforms, and it would be an interesting challenge to re-imagine a platform for those activities in a more structured educational context.

The next obvious step for active, problem-based approaches to learning is to involve corporate and community partners in the design and delivery of curriculum. Universities already do this in a number of ways. Not only are corporate partners increasingly involved in curriculum design, but they participate through work integrated learning partnerships in incubators through hackathons and business innovation sessions. For example, my university has a comprehensive, work-integrated learning program that requires all of its undergraduate students to have an academically-relevant experiential learning opportunity with an external partner—a project which sees 8,000 students involved with over 2,000 partners every year. More elaborate examples include Swinburne University's Engineering Practice Academy, where the entire curriculum is designed around a project-based engi-



neering consultancy, solving real problems set by partner clients, with learning objectives met along the way. Such a reconfiguration of learning approaches is no doubt challenging online and at scale, but just as crowdsourcing online has resulted in innovative solutions (think Kickstarter or even YouTube), a sustained effort to construct such learning could result in real innovation. Again, online opportunities for co-creating would appear plentiful: it's easy to imagine collaborative networks emerging from linked-in connections for example. At the very least, MOOCs can (and do) offer the ability for learners to engage with a curriculum co-designed by industry and universities, presenting a mix of theoretical and applied that enables both desirable short term (a job) and long term outcomes (an education).

Which leads to the final area for disruption: the breaking down of disciplinary silos. The reality of twenty-first century work and life is the need for individuals to increasingly blur once-distinctive boundaries. Whilst it's entirely possible to forge a career within a single traditional discipline, doing so limits both individual and broader social opportunities. Creative outputs are more likely with diverse inputs and, conversely, the lack of diversity will often result in suboptimal outcomes. For example, Facebook's issues with privacy are no surprise to anyone who has studied ethics, and one wonders how Silicon Valley startups might approach their mission with greater input from those schooled in the traditional humanities. John Naughton goes as far as to say that the problem with our tech companies is that their leadership—technically adept and well-informed as they are—are only "half educated" without philosophy, history, anthropology and literature<sup>23</sup>.

Most current MOOCs re-emphasise the divide. The most popular courses focus on particular skills and are designed to fulfil quite instrumental needs; indeed, Coursera even calls clusters of courses "Specialisations" in the hope of attracting paying learners with a clear focus. The opportunity exists to embed broader thinking into offerings. Whilst programmers might balk at a curriculum which overtly embeds ethics, creative approaches might allow this to occur naturally. For example, case studies, assignments and assessments could easily incorporate broader educational opportunities and the design of the courses themselves could encourage diversity in all of its forms—thinking, culture, discipline, and so forth.

Finally, the instant connectivity of the online space makes linking diverse offerings very straightforward. Whilst it is possible to take an interdisciplinary approach within a single MOOC—Macquarie's Big History is an example, involving academics from nearly every discipline that the university offers—an alternative might be to curate a range of courses and offer them in an interdisciplinary specialisa-

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<sup>23</sup> Naughton J. (2017) How a Half-Educated Tech Elite Delivered Us into Chaos // The Guardian. November, 19. <https://www.theguardian.com/commentisfree/2017/nov/19/how-tech-leaders-delivered-us-into-evil-john-naughton>

tion, even across institutions. Finding ways to accredit (and generate revenue from) a cross-institutional, interdisciplinary, and global qualification would be a challenge worth taking up. Not only can these connections bridge the disciplines, but they can enable global collaborations. Diverse approaches from around the world could be connected to provide a truly international educational experience. An example might be to develop linkages using the United Nations Sustainable Development Goals, providing recognition for learners who have engaged with the SDGs and opportunities for teachers to contextualise their material with contemporary issues.

**Conclusion** The reality of the new information ecology demands a rethinking of our approach to higher education. The higher-order skills required by citizens and workers cannot be provided by a reliance on traditional teaching models that emphasise content transmission. Massive Open Online Courses have thus far focussed on business models that provide partner universities with a vehicle for both low-end and new-market disruption; however, MOOCs have the potential to be a vehicle for true disruption by enabling new approaches to learning and teaching that are designed to provide the educational opportunities needed by students around the world. Rather than merely disrupting the business of learning, we should leverage their presence to properly disrupt learning. They should be the harbinger for a new educational ecosystem. Not pursuing the opportunity for real disruption condemns us (and our children) to an increasingly irrelevant educational experience.

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# The New Face-to-Face Education

## Scalable Live-Engagement

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Received in  
July 2018

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**Abstract.** The iMBA, which is delivered 100% online, was launched by Gies College of Business at the University of Illinois at Urbana-Champaign in 2016. By fall of 2018, the program will enroll more than 1,700 students from 70 countries. With its US\$22,000 tuition, about 1/3 the price of programs of similar caliber, the iMBA is reaching under-served populations, including those unable to pay premium prices or make time for in-person residency as well as late-career learners who are disinclined to attend a conventional program. One of the iMBA's major breakthroughs is its scalability, and that scalability has been accomplished in ways that enhance the quality of education. An iMBA course has two main components—an open MOOC, which delivers core concepts equivalent to what might be covered in a conventional in-person lecture, plus a live global classroom led by a professor and supported by a team of course assistants. As the MOOC delivers the fundamentals of a topic, the live-engagement class focuses on a richer exploration of the material. In the live-engagement classes, hundreds of students can participate simultaneously—yet receive significant individu-

al attention and personalization by interacting with professors and course assistants in real time through chat technology. Students also interact with each other, which often results in side topics being explored, thus producing a richer environment for knowledge discovery than would be possible in a traditional lecture hall in which side conversations are discouraged. Course assistants answer basic questions, and elevate particularly important insights or questions to the professor at the head of the full class, also in real time. Another distinctive feature of the iMBA is that it is delivered in “stackable” components: A MOOC plus live-engagement element stacks into a for-credit course. A series of for-credit courses stack plus a capstone project stacks into a “Specialization.” In turn, a series of Specializations stack into the full MBA degree. In this way, students have various on-ramps to the full degree. The iMBA has to a significant degree cured the cost disease in higher education. Faculty create content for multiple uses—for the full MBA as well as for certificate programs, for example—producing multiple revenue streams. Plus classes can be large owing to the novel teaching-team structure, enabling one senior faculty member to potentially teach thousands.

**Keywords:** MBA, MOOC, curricular design, disruption, innovation, scalability, stackability, cost disease, access, University of Illinois at Urbana-Champaign, Gies College of Business.

**DOI:** 10.17323/1814-9545-2018-4-44-59

The iMBA from the University of Illinois at Urbana-Champaign's Gies College of Business was launched in 2016. It is delivered 100 per-cent online and by fall 2018 will enroll over 1,700 students from more than 70 countries. Yet it is an intimate, personalized, in-depth learning, and developmental experience with content taught by senior faculty as well as highly-placed practitioners and is delivered at a price point which, at US\$22,000, is about one-third that of programs from institutions of similar caliber.

The program was developed in partnership with the private-sector online education provider, Coursera, while also drawing on the University of Illinois' long experience with e-learning. Content comes mainly from existing Gies College of Business MBA-level classes, though courses are grouped in ways that don't always follow traditional academic-department silos, which we will discuss later in this essay. In some cases, we pull material and faculty from beyond the business school—from other schools and colleges at the University of Illinois, as well as from practitioner-partners, such as a senior executive at Google.

The iMBA has been called a disruptive innovation. We have found a way to serve an under-served market globally. The market includes people unable to pay premium prices and unable to make time for in-person residency, yet talented enough to succeed in a premium educational environment. It also includes those who are at later stages in their careers, disinclined to return to school but eager to learn. In the process of inventing a better way to serve these and other markets, we've created something that's as powerful in terms of educational impact and potential to transform lives as the traditional version of face-to-face education.

### **The anatomy of an iMBA course**

Before discussing the strategy and impact of various aspects of this program, it is instructive to outline the nature of the iMBA program. The following section will provide a framework of the program by considering the elements of a typical iMBA course.

Each course is composed of three key parts: the MOOC videos accessible on the Coursera open platform, assessments on Coursera and on assignments distributed through a secure server at the University of Illinois, and weekly live sessions with faculty and students.

Each iMBA course lasts for eight weeks. Each week is a module that, consistent with the brick-and-mortar versions of these courses, builds upon previous modules.

Videos    On-demand videos contain the core material of the course—all the essential elements to give them mastery of the content. The videos mainly follow a lecture format but may also include vignettes in which faculty, for example, go with cameras to locations other than the studio.

**Assessments** In addition, there are assessment assignments for each module, available on a secure server at Illinois. Some are timed in the sense that students have X hours to complete them and submit their answers after they first download the assignment. Some assignments have no time limit. All assignments associated with a given module must be submitted by 11:59 p. m. on the last day of the module. These assignments can be machine gradable or require grading by the teaching team associated with a particular iMBA course.

**Live sessions** The live sessions elaborate on the videos and are one of the places students can bring their questions and comments. The live sessions also tend to include advanced material and thought-provoking insights from both the professor and students.

A typical live session starts with a brief reminder of the material covered in the previous module and ends with a brief discussion of the content of next week's module. The majority of the live session, however, is devoted to the content of the current module.

The live session studio includes the professor, a senior course assistant, and the studio engineer. Students submit questions via a chat feature in the ZOOM platform. These questions could be about material currently being discussed in the live session, or about some other material relevant to the current module. In addition to the senior course assistant (SCA) working on camera with the professor, there are additional members of our live-engagement team: two or three more course assistants (CAs) sit in a satellite location and monitor the questions submitted by students. These CAs can and do answer the majority of questions submitted; however, they forward the questions they cannot immediately answer to the SCA. The SCA can answer the question directly or move the question to a video board that the professor can see. The professor will then decide to answer the question or defer it to post-session answering, depending on the time available.

**Office hours** There are also individual live-session opportunities. Faculty members hold online office hours, during which time any student can receive personal attention. Those sessions give students an opportunity to ask questions and discuss content with the professor.

**The mission** Our core mission, and our passion, is to democratize high-quality higher education. We are out to remove obstacles in the way of talented people getting an MBA and getting ahead in life. In fact, we have expanded our definition of an MBA student. We are finding talent from around the world—in jobs and in places such that they would not otherwise come to an MBA program and are huge contributors to the learning process. This includes people who find the current MBA offerings inconvenient, or students who traditionally did not look at MBA as a career option, and even people not looking for MBA for career

advancement. By virtue of attracting this “knowledge for knowledge’s sake” segment, we’re expanding the market. And in doing so, we’re enhancing the learning experiences. It is a virtuous cycle.

The diversity our students represent enriches everyone’s learning—all the more because it’s “real-time diversity” in that students are coming to us live from their daily lives and bringing insights from that day’s work.

Even online programs, if they are truly high-quality, carry high price tags and require a residency. Not ours; we found a way to keep prices down and the educational experience as rich or richer than traditional face-to-face. Our target market doesn’t require all the accoutrements of a traditional residential education. They do, though, expect not just convenience but also quality and high impact—a combination that is rare.

Democratizing education is in our blood: We are one of America’s top public universities. Public universities were founded to expand access to high-quality education, to provide access to opportunity. At the same time, the best public universities easily rival or surpass the best private universities. (The University of Illinois at Urbana-Champaign, for example, is rated by *The Times* of London as one of the world’s 30 most powerful university brands.) We carried that mission of access and quality over to the creation of the iMBA.

**The new face-to-face: Intensely personal yet highly scalable**

As we’ve seen, the new face-to-face in the iMBA centers on two major elements—the live-engagement classes taught by a team of instructors and the individual live sessions for those who want them.

So what do the live-engagement classes look and feel like? They are global and large, yet deliver a rich and personalized experience that in some ways bests traditional face-to-face. Bigness turns out to be, in the online ecosystem we’ve created, an educational advantage. It is one aspect of how we cure the cost disease in higher education. But it’s also a major aspect of what makes the iMBA great. The degree and quality of connectedness in these classes is truly exciting.

There is connectedness on two levels—student/teacher and student/student.

First let’s look at student/teacher connectedness. In the iMBA, live classes are centered on the senior faculty member, but we are not the only ones teaching. We are part of a teaching team working together in real time. The team makes each class hum on multiple levels simultaneously. Senior faculty address the highest-level content. The faculty member’s teammates—associate instructors and course assistants—work with students on a fuller range of questions and take comments through technology-facilitated side discussions during the class. There is far more engagement going on than you’d find in a typical brick-and-mortar lecture hall, where students are less inclined to raise their hands and have far less opportunity to do so.



With this system, a single senior faculty member can teach hundreds of students at a time but deliver an experience that's textured, personal, and continuously interactive.

With respect to student/student connectedness, learners are not only connected with instructors but also with each other, as they swap insights and observations on the side. Unlike a traditional classroom, such chatter is not only possible; it's encouraged. Side conversations have a tendency to produce novel thinking. It's where students can try out their ideas on each other. And great insights get floated up to the entire class. This is one way in which bigness is a virtue: The quantity and variety of side conversations is exceptional.

In a traditional classroom, it's critical that I stay on plan—and every question and answer needs to move the discussion in a linear and largely preordained fashion. There is a particular lesson to be imparted in any given class session, and that has to be the primary objective. Tangents, even valuable tangents, can only be allowed to go so far lest the main lesson be lost. But in our live-engagement global classroom many things can happen at once. There's room for varied and deep deviations from the norm because the main lesson can go on even as new ideas are being discussed, and as basic questions are being answered away from the main event.

When I taught large introductory economics classes in a lecture hall, nobody raised a hand and there was minimal discussion or true interaction, but in this online global classroom, there is constant interaction.

There's yet another layer of live engagement, a critical one that prepares students to apply what they learn. All students take part in capstone projects at the end of each three-class sequence in our program. The sequences, which we call Specializations, are career-curated in that material is organized according to how it will be brought to bear in the real world, not necessarily according to traditional university departmental structures. So the material is ready to operationalize, and the students are given projects which demand a multi-dimensional approach. Students work in teams on real issues inside real organizations, which play virtual host—all online.

**Stackable  
courses &  
credentials**

Which brings us to another way in which the iMBA is disruptive: It is delivered in a novel “stackable” format. This format creates educational benefits even as it produces multiple revenue streams from a single product, which helps us keep tuition affordable.

There is stackability at several levels. Here's what that means.

At the course level, teaching takes place in two segments. The first segment is the foundational content of the course. It is delivered via a non-credit MOOC. It includes video lectures, machine-graded quizzes, and group projects with that extraordinary mix of fellow students.



Anyone can take that portion, and indeed thousands (in some cases hundreds of thousands) of people do.

The second segment of each course is the advanced-content, live-engagement class, open to those who pay tuition. The two parts "stack" into a complete for-credit course.

A collection of these two-part courses then "stack" into a Specialization—the sequence of career-curated courses that produce mastery in a major area of business mentioned in the previous section. For example, Strategic Leadership and Management is a Specialization. The capstone project tops off each Specialization.

In total there are seven Specializations, five of which are needed to stack into a full MBA degree. Students can stop at the Specialization level and earn a certificate for a fee—or they can go on to earn the full MBA.

Most of our students apply to the iMBA and enter the program with the intention of going on to complete the full degree (and currently our completion rate stands at about 97 percent).

Not all learners take classes with that intention. Many start out with the intention of earning a certificate in a particular Specialization, and then stopping. Others just want to try out a single course. In so doing, students often find once they've completed a first level of stackability they're eager—and ready—to go on to the next level. This creates on-ramps and entry points to the iMBA, which effectively creates new markets: People who never intended to get an MBA end up doing just that.

Another reason for stackability is that students may be hesitant to have an upfront commitment of two to three years. In this program, they can do one certificate at a time.

The certificate-only learner makes up a significant portion of our students. A certificate in, say, digital marketing is all they need for their purposes. So this course flexibility works incredibly well for both us and them. The students receive the certificate they need, and we deepen our revenue stream (in addition to the MBA) without the cost of creating new content. This, too, is part of how we cure the cost disease.

### **Harnessing the power of the MOOC**

There are learning and developmental advantages to MBA students that come from having an open MOOC as part of every class. Most MBA programs are completely closed systems: You study with people who are more or less like you, because that's who gets into an MBA program. In the MOOC, however, you are exposed to a wider variety of people—people who think differently, who might be customers, colleagues, sources of innovation. We see value in the creative collisions this produces and believe it's another educational advantage to the disruptive iMBA approach (and another advantage of bigness).

For faculty, it means we get to use our live sessions to really elaborate, explain, and explore. It's fun to do the videos for the MOOC. And it's also fun to be done with that, and to be able to have deeper conversations with students about the material in the live sessions. Students have an opportunity to digest concepts through the on-demand foundational content in the MOOC.

When they come to live sessions, that's where they connect the concepts to real-world business issues using case studies, and where we get into those rich multilayered discussions.

By contrast, in the brick-and-mortar world, the contact in the classroom is core content delivery, the equivalent of what the iMBA does in the MOOC. In a residential MBA, it is a 50-minute footrace to get all the concepts introduced in the short timeframe. In the iMBA, students absorb that core content at their own pace. They can watch and re-watch the MOOC videos as much as they want. That frees us up to do more in the live-engagement class.

### **Shifting fundamentals**

Along the way, the iMBA alters what it means to be a faculty member, and not just in the sense that we now deliver our lessons on video and in large, global live-engagement classrooms. In the iMBA the faculty member has two roles. We are content creators, producing videos and quizzes that will be used across multiple product lines. And we are members of a real-time teaching team, working with others to produce a deep and personalized learning experience for students in our live-engagement global classrooms. That's a departure from what most faculty are used to—being a solo operator in front of a lecture hall.

Another fundamental role change is in the area of admissions. Our stackable approach creates new ways to discover great business talent and get them into a top MBA program. Many outstanding future business leaders are screened out by traditional admissions procedures. Maybe they had a mediocre undergraduate GPA or their GMAT-taking skills are not strong. But with stackability, we have a way to enable students to test and prove themselves on actual content before they are admitted to the full iMBA program. If a student is enrolled in one of our certificate programs and does well, it improves his or her chances of getting into the iMBA. Over time, this could mean thousands of people with high potential being discovered, earning MBAs, and boosting both their personal careers and their contributions to the world as a result.

The iMBA is truly a disruptive innovation in business education, delivering an online experience in a way that brings cost down while ratcheting up the program's quality, richness, depth, convenience, and features to serve a global audience.

Programs like the iMBA are often referred to as distance learning. I believe that is a misnomer. In the online live sessions, the students are right in front of you—someone sitting at a kitchen table in Kabul,

on a couch in Moscow, at an office desk in New York. They appear to me as individuals, not an audience. And they are connected to me or a member of my teaching team the instant they want to be.

### **The genesis of the iMBA program**

When we began our work, we were looking for ways to serve working professionals. Like most universities, until relatively recently we were confined to who we could serve within commuting distance—or else open up satellite campuses. In recent years, the advances in technology offered a chance for Illinois to take our programs to the professionals rather than make the professionals come to Champaign.

When we turned our attention to online, we initially were planning to offer executive-style certificate programs, not a full MBA. But as the Gies team pushed deeper into the construction of a number of online certificate offerings, the idea of growing this to the level of an actual online MBA program began to take shape. College leadership devoted significant time to the feasibility of such an undertaking.

We decided that it would indeed be a good move for us to create an online MBA. We formed task forces and committees, met with top faculty and administrators from the university, and began the long process of creating the program and obtaining the necessary approval to launch it. We held town halls to get the valued input of our faculty, which we used to further shape the program. Then we began the approval process, first meeting with the Education Policy Committee (EPC). Gaining the approval of this committee was a long and painstaking process, because the committee recognized the iMBA as something very new; it was not like approving a program that the university had created before. When we gained approval of the EPC, our final step for approval was the university's Academic Senate. We gained approval from the senate in spring of 2015, and were cleared to launch a program that we believed was going to change the way we do business education.

Timing was fortuitous. The College, founded in 1915, was preparing for its coming centennial. We felt this was a perfect way to celebrate the occasion, and it was also an ideal fit for the University of Illinois, which is a land grant school, meaning that it has a mission to offer affordable education. Consistent with this mission, the College worked with the campus to push for a very low price point for such a degree. This democratization of top quality education, along with the ability to deliver this education around the world, was a key driver in the College's development and introduction of the iMBA.

The best partnerships happen when both parties benefit from the relationship. The partnership of Coursera and Illinois is a great example of this win-win collaboration. The Gies College of Business has world-class faculty and a reputation for excellent teaching. However, we are also located in a small town, and the world has to come to us for education.

Coursera brought Illinois to the world. They took us to the homes and offices of learners in the US and in Afghanistan, China, Kenya, Russia, and more from around the world. It is hard to overstate this great advantage. With millions of learners on their platform, Coursera was able to help Illinois reach a much wider market. On top of that, Coursera brought an unbelievable amount of data to our relationship. And, with the data gathered from this large number of learners, Coursera helped us focus our early attention on the content with the highest interest.

**Faculty experience  
with changing  
pedagogy**

Every major business school has more than a handful of scholars researching and writing about the effect of disruptive innovation. Disruptive innovation is just what it says: an innovation that disrupts an industry. Throughout the 1990s, Blockbuster Video grew to be the dominant firm in the video rental market. By 2004, it employed over 80,000 people and had more than 9,000 stores worldwide. By 2010, it had filed for bankruptcy. How did this happen? A startup named Netflix grew to dominance in the market. The irony is that Blockbuster rejected an opportunity to buy Netflix for just US\$50 million in 2000.

Disruptive innovation happens in every industry, and higher education is certainly not immune to its impact. Faculty at America's great universities are no different. They have been teaching, usually with great success, with one delivery method for years. But the technological revolution brought about by the rise of the internet has made things different. Faculty were being asked to change their old ways of delivering their courses and join the online education world. Ex-post it is clear that Blockbuster should have adjusted. But ex-ante, it is difficult for the market leader in a particular business to abandon what got them to that position and adopt a fledgling innovation.

This same challenging dilemma has been playing out in faculty meetings across academia as the pressure by some to adopt the new technology of content delivery is met with (sometimes fierce) resistance by those who wish to continue with methods that have proven successful for years. Fortunately, the faculty in Gies College of Business agreed with the plan to introduce the iMBA. And, since the launch of the iMBA in 2016, faculty in other colleges at the University of Illinois have also moved forward with several new online degree initiatives.

Even though faculty agreed to push forward, most were like me: quite unsure how to convert comfortable lecture notes into successful videos. This uncertainty translated to reluctance to dive into the process, even if these same faculty agreed with the decision to offer such an online degree.

We were fortunate in two ways. First, we had an exceptional faculty task force that was guiding us through the process. Second, we have an exceptional faculty. Faculty at leading universities make their mark by producing important research and gaining worldwide visibili-

ty. But they also walk into classrooms year after year and teach eager students. Nearly every one of those faculty members clearly want to be successful in this teacher-student relationship. They took four to seven years earning a PhD in a discipline, and they have spent many years becoming a world-class expert in some small segment of that discipline. No faculty member wants her students to think this area of expertise is a waste of time. Rather, they strive to convince their students that this material is not just interesting; it is important. They spend hours outside of the classroom constructing better lectures, better examples, better exercises, etc.

In the case of the iMBA and Gies College of Business, the first few faculty members to agree to teach in the iMBA program were some of the most successful teachers in our College. They were winners of College and university-wide teaching awards. They had demonstrated great success in the classroom using the traditional delivery methods, but were willing to put those methods aside and convert their successful methods into the new delivery paradigm.

This was a key moment for the program. Those faculty who were reluctant to jump in could see that these first-mover faculty, who had built wildly successful courses already, were willing to abandon that methodology for the new delivery platform. Clearly, these academics did that because they could see the advantages of using this new technology to better help their students learn. As a result, more and more faculty agreed to teach in the iMBA.

As the online course production proceeded, it was clear that this task was going to be more time-consuming than most faculty members had anticipated. After all, we were moving the content of an entire MBA course into video in sessions in a small studio in the basement of our building. Of course, while a face-to-face conventional course may involve many hours of classroom contact, much of that time is filled with questions and discussions. While this meant the total hours of video was not overwhelming, the process was sufficiently different as to cause delays.

**Quality issues** The first issue was the camera itself. Most faculty are not prepared to "teach" by talking to a camera lens in a small room with just a video engineer as the "live" audience. But, after just a few sessions, faculty became much more comfortable with this procedure. (It was not uncommon for professors to reshoot their first lecture video after completing the course, because they were uncomfortably "wooden" in their first appearance.)

The second issue was cleaning up the video lectures for the Coursera posting. This task was also quite time-consuming, but mostly invisible to the faculty members. Each of the faculty members who joined the program had already demonstrated they had a high-quality brick-and-mortar course that was well received by the residential

MBA students. What remained was the task of converting that course into a professional video format.

Last but not least was the time spent in editing and reshooting parts of the video lectures where faculty forgot some material or realized they misspoke about a concept.

The College decided to accept nothing less than professional studio quality output from our video production efforts. That meant investing many scarce resources into expensive top-drawer studios, cameras, video boards, etc. It also meant we needed to rapidly grow our video production staff.

Most of these decisions were handled by the eLearning office in the College. We also enlisted the help of the university's Center for Innovation in Teaching and Learning (CITL). CITL had already produced many courses for Coursera, working with various colleges and departments across campus to create online courses. The production of the iMBA became a collaboration among the College professors, the eLearning unit, CITL, and Coursera—each bringing their own strengths, perspectives, and experiences to the table, each contributing mightily in the process, each adding value that only they could add.

The final challenge to faculty is becoming part of a real-time teaching team in a dizzyingly robust global classroom, rather than an independent operator standing in front of a mostly quiet lecture hall. But most faculty find quickly that this kind of teaching, though it requires you to be more agile, is immensely rewarding. We spend time on content that generally goes beyond the standard syllabus, and we get to teach live the most sophisticated material—leaving the lower-order content to the videos, which are largely one and done. We also get to see students come alive in ways they seldom do in a live-lecture situation, and we get to see new lines of inquiry being hatched before our eyes. It all takes some getting used to—there's a lot going on. But with the right kind of technical and teaching support, it ends up being an exhilarating and nourishing experience.

### **The future of online education**

Online education is ubiquitous in the higher education landscape. It is not going away. In fact, it will only grow in prominence. That growth is the result of several factors: the advancing technology; our grasp on how to better use that technology to our advantage; and the changing needs of students. Higher education is adapting to those changing needs, and in the process, it is revolutionizing higher education. The greater impact will be on the nontraditional college students, yet even traditional students will be impacted.

Online education will also benefit well-respected universities, because the accessibility means more people can earn degrees from those universities. Online courses and programs only extend such a university's global reach, and they expand access to underserved populations. The universities that can provide access to quality edu-

cation at reasonable costs to the greatest number of people are going to be the winners.

Higher education is a massive institution, and sometimes change in large institutions is hard to detect. Our mission to educate has not and will not change, but how we go about achieving that mission is undergoing constant adaptation. Online education is one of our change agents, and it will be an increasingly important agent.

**A final word** Make no mistake, the creation of our iMBA was a painstaking process that involved many significant challenges and the combined efforts of (seemingly) a cast of thousands. But it has been a game-changer for us. It has been everything we have dreamed of, and more. It has proven to be the innovative disrupter we believed it could be.

When I speak with colleagues at other universities, they have lots of questions about the iMBA. They express a willingness to try such a venture at their school. But, for many, the decision to make such a change in pedagogy is overwhelming. My recommendation is to put skepticism aside and push forward. There is no question that the job will be difficult.

There is also no question that, if the results are like ours, it will be worth it. You will scale what you are teaching in ways that could never be accomplished before. And you will change lives—all over the world—for the better.

After all, isn't that what education is all about?



# Innovation Leashed:

## How a MOOC-Based Master's Degree Brings Invention Home to the Institution

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Received in  
July 2018

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**Abstract.** This paper tells the story of the first MOOC-based Electrical Engineering graduate degree in the world. In so doing, it provides an object lesson about the narrative of disruption that has grown up around MOOC providers and the speed at which self-limiting systems emerge in even the newest ventures. This in turn reveals a paradox brewing at the heart of the MOOC enterprise: it is the supposedly staid institution of the university—whose entrenched systems tend to recoil from innovation back to the status quo—that actually wields the critical mass to effect change. This observation recalls us to a fundamental truth: while universities are conservators of academic tradition and systemic efficiency, they are also, most essentially, extraordinary engines of creation and innovative will. It is by tapping into that truth that we harness the potential for transformation. Ul-

timately, this paper offers a message of hope and a pathway to change at a moment when the institution of higher education is under threat. The experience of the MOOC Electrical Engineering degree suggests three primary lessons about our ability to answer that challenge: First, if we mean to achieve broad change, we must commit to the hard work of creating that change from within. Second, a bottom-up effort led by a small team with top-down support generates momentum to overcome entrenched systems that inherently resist difference. Third, and most importantly, the impetus for innovation has always resided with the university. In recognizing the systems that work to collapse innovation into convention, this paper acknowledges the difficulties that beset any groundbreaking venture; it also argues for universities' pride of place as engines of transformation that can lead the way to the future.

**Key Words:** MOOC, curricular design, University of Colorado Boulder, Coursera, disruption, innovation, MOOC-based Electrical Engineering graduate degree.

**DOI:** 10.17323/1814-9545-2018-4-60-80

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This is the story of the first MOOC-based Electrical Engineering master's degree in the world. The mission to develop the University of Colorado Boulder's MS-EE, as I term it here, is a tale of creative endurance and institutional will. We join that tale *in medias res*, as Horace might say. The degree is still under development and not quite launched, but nonetheless offers a case study in how a bureaucratic entity overcame the inertia of long-established systems to cultivate

educational invention. The MS-EE also offers an object lesson in the narrative of disruption that has grown up around MOOC providers [Billsberry 2013]. That cautionary tale finds roots in the irony of how quickly self-limiting structures emerge in even the newest businesses, and how those structures act immediately to disrupt disruption. There's a paradox brewing at the heart of the MOOC enterprise: it is the supposedly staid institution of the university—whose entrenched systems tend to recoil from innovation back to the status quo—that actually wields the critical mass to effect change. This lesson recalls us to a fundamental truth: while universities are conservators of academic tradition and systemic efficiency, they are also, most essentially, extraordinary engines of creation and innovative will. It is by tapping into this truth that we harness the potential for transformation.

Granted, this paper's title, "Innovation Leashed," might imply that the MS-EE's inventive leap succumbed to systemic inertia, and that I'm embarking on a less-than-triumphant tale. Not so. Rather, this paper offers a message of hope and a pathway to change at a moment when the institution of higher education is under threat [Barber, Donnelly, Rizvi 2013]. Escalating costs, shrinking state funding, the pressing need to serve more diverse students, and the necessity in a rapidly changing world for professionals to engage in life-long learning for workplace survival, challenge colleges and universities everywhere in the United States. The design of the MS-EE pioneers answers to those challenges; however, even as we pushed the structure of the degree to its limit, we understood that we needed the scaffolding of the University and the larger institution of higher education to support and endorse our radical undertaking.<sup>1</sup> Thus, I use the phrase "Innovation Leashed" not because we compromised our vision, but because our success is entirely based on tethering the degree to the systems that, by their very nature, stood arrayed against radical change at the beginning of our journey. This brings me to three principles that I hope the story of the MS-EE will impart:

*First, if innovation is to be transformative, it can't be sidelined.* As CU Boulder embarked on the MS-EE, we resisted compartmentalizing inventiveness away from the central functioning of our campus. While it might be temptingly expedient to house non-normative programs in places like departments of Continuing or Professional Education, that decision marginalizes invention and insulates the university proper from disruption. We chose instead to operate from within our core as the best way to effect broad-based change. This approach is fraught, as it risks defeat from necessarily conservative systems that are built to protect and perpetuate the institution, not change it, re-

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<sup>1</sup> Tickle L. (2014) Will a Degree Made Up of MOOCs Ever Be Worth the Paper It's Written On? // The Guardian. June, 23. <https://www.theguardian.com/higher-education-network/blog/2014/jun/12/moocs-viable-alternative-traditional-degree>

ardless of the inventive drive of the human actors involved. In order to be successful, we had to understand, and pay tribute to, the validity of those systems and commit to the hard work of building change from within.

*Second, internal change can happen when a small group shepherds a bottom-up initiative that has top-down support.* The MS-EE is a faculty-driven endeavor that originated from the Electrical, Computer, and Energy Engineering (EE) department faculty with the full support of the College of Engineering and Applied Science Dean, our Graduate School Dean, and a Graduate School Executive Advisory Committee comprised of faculty representatives from every college and school at CU Boulder. This gave the project momentum and credibility as a bottom-up, academically driven mission. Our Regents, Chancellor, Provost, and CFO simultaneously endorsed the degree from the top. Their backing gave permission to our administrative teams to innovate alongside us. A small team from the Office of Strategic Initiatives partnered with EE faculty to spearhead degree development and channel that momentum across campus and within our state and federal regulatory bodies.

*Third, the impetus for innovation has rebounded from MOOC providers to the university.* In Laura Pappano's 2012 *New York Times* article, "The Year of the MOOC," massive platforms engendered notoriety and much anxiety for their disruptive potential; universities felt threatened, outdated, and staid by comparison.<sup>2</sup> Now, as MOOC providers move rapidly to offer for-credit programs, a new truth materializes: in just a few short years, MOOC platforms have already grown their own inertial systems that resist innovation. It is up to the university to disrupt them.

The lessons of the MS-EE suggest that MOOC providers have matured from their original emergence as the *enfants terribles* of higher education, poised to destroy and reinvent the field, to a more mature adolescence couched in the comfortable harbors of educational tradition.<sup>3</sup> Before I go further, let me emphasize that, as a leader of the MOOC effort on the CU Boulder campus and a MOOC instructor on Coursera, I am a fan of both.<sup>4</sup> There's little question that MOOCs usefully challenge our assumptions about teaching and instructional design and that those lessons trickle out from the platform to benefit campus-based teaching and online endeavors in general [O'Connor

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<sup>2</sup> Pappano L. (2012) The Year of the MOOC // *New York Times*. November, 2. <https://www.nytimes.com/2012/11/04/education/edlife/massive-open-online-courses-are-multiplying-at-a-rapid-pace.html>

<sup>3</sup> The discussion of disruption that's grown up around MOOCs is deeply inflected by [Christensen 2011].

<sup>4</sup> McAndrew Q. (2016) *Business Writing. Effective Communication Specialization*. Mountain View: Coursera. <https://www.coursera.org/learn/writing-for-business>

2014]. There's also no question that CU Boulder arrived at the revolutionary MS-EE because Coursera and their competitors disrupted our thinking and showed us a revolutionary means of educational delivery. We invent on MOOC platforms because they showed us the way.

This discussion's goal is not to critique MOOC providers, our University collaborators, or our Coursera partners, who eagerly joined with us to execute the vision of the MS-EE. Rather, this conversation investigates, by the MS-EE example, the implacable structural and systemic forces that threaten any risk-taking venture, no matter the human enthusiasm for it. If we are to succeed in reforming higher education, we must understand, for better or worse, what we're up against. CU Boulder first encountered these structures in the internal development of our new degree; we found them again, already emergent, in our MOOC partners. In recognizing the systems that work to collapse innovation into convention, this paper argues for universities' pride of place as engines of transformation, so that we may feed that energy back to our MOOC providers and lead the way with them to the future.

**Old school vs.  
new school**

The state-run, non-profit University of Colorado Boulder is a beautiful place to work or pursue an education.<sup>5</sup> Founded in 1876, the same year as the state, our flagship campus sits nestled at the feet of the Rocky Mountains. Those foothills provide a postcard-like backdrop for grassy quads bordered by century-old sandstone buildings capped with red tile roofs. Strolling the grounds on a beautiful, blue-sky day—of which Colorado has many—one senses deeply the Georgic rhythms that undergird campus-based higher education in the United States. Over the last 150 years, our university, like almost all others, has organically grown a set of systems—enrollment, billing, advising, and the like—and standard products—undergraduate and graduate degrees, certificates, and courses—that serve the 33,000 students and 6,500 employees on our campus.

Coursera, founded only six years ago, couldn't be more different. Based in the start-up cauldron of Silicon Valley, now with approximately 300 employees, Coursera's office-park headquarters boast a hip, open office plan with hoteling space, stand-up team meetings, work-from-home Wednesdays, catered meals, and a staff of dedicated Courserians bent on changing the world (and, one presumes, bent on taking the company public and enjoying a liberal sprinkling of financial gain from that event).<sup>6</sup>

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<sup>5</sup> Morton C., Vogel L. (2017) The 25 Most Beautiful College Campuses in America // Condé Nast Traveler. August, 28. <https://www.cntraveler.com/galleries/2016-01-29/the-20-most-beautiful-college-campuses-in-america>

<sup>6</sup> Young J.R. (2017) New CEO at Coursera Comes from Financial Tech, Not

We all know the story. This brash, for-profit upstart and its competitors Udacity and edX seemed to arise out of nowhere to challenge the august institution of higher education with astonishingly massive enrollments, completely automated environments, and an implicit threat to the campus-based university itself. edX and Coursera continue their mission, while Udacity has famously (sort of) exited the MOOC space and called its own products into question.<sup>7</sup> The hype and skeptical push-back that MOOCs still generate demonstrates the depth of their challenge to our closely held practice of higher education [Marshall, 2013]. Initially, those platforms only delivered non-credit courses, which made them easy to discount as unserious, or not truly academic, if one were looking to discredit them. Our Provost chose the opposite tack. A year after Coursera was founded, he challenged four of his most creative faculty to give this controversial, fascinating space a try.

### **The grand experiment**

One of those early CU Boulder MOOC adopters was a full professor of the Electrical, Computing, and Energy Engineering (EE) department and its former Chair, Robert Erickson. Professor Erickson holds thirteen patents, has won almost ten million dollars (U.S.) in research grants, has founded two companies, and is the author of over one hundred articles and the seminal textbook, *Fundamentals of Power Electronics* [Erickson, 1997]. He is a fellow of the Institute of Electrical and Electronics Engineers (IEEE) and he's received both CU Boulder's prestigious "Inventor of the Year" award and the Holland Teaching Excellence Award. His academic credentials are both impressive and impeccable. Professor Erickson is also a teaching rebel: he has been offering his courses with distance technologies and thinking about ways to renovate traditional university practices for decades. He was a perfect choice to test-drive Coursera.

Professor Erickson translated his graduate-level Power Electronics course onto the new platform, then redesigned it a few years later as a specialization with two departmental colleagues, Charles V. Schelke Endowed Professor Dragan Maksimovic and Assistant Professor Khurram Afridi.<sup>8</sup> In the process, they refused to dilute the rigor of the

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Higher Ed // EdSurge. June, 13. <https://www.edsurge.com/news/2017-06-13-new-ceo-at-coursera-comes-from-financial-tech-not-higher-ed>

<sup>7</sup> Cafkin M. (2013) Udacity's Sebastian Thrun, Godfather of Free Online Education, Changes Course // Fast Company. November, 14. <https://www.fast-company.com/3021473/udacity-sebastian-thrun-uphill-climb>; Young J. R. (2017) Udacity Official Declares MOOCs 'Dead' (Though the Company Still Offers Them) // EdSurge. October, 13. <https://www.edsurge.com/news/2017-10-12-udacity-official-declares-moocs-dead-though-the-company-still-offers-them>

<sup>8</sup> Afridi Kh., Erickson R., Maksimovic D. (2016) Power Electronics. Mountain View: Coursera. <https://www.coursera.org/specializations/power-electronics>

student experience. Although it's not offered for credit, Power Electronics is a true graduate class, with challenging content, homework, and assessments. The specialization's first course, "Introduction to Power Electronics," launched in January 2016. To date, over 100,000 learners have visited; the course hosts 30,000 active participants from over 185 countries, with 2,500 completions. India is the second largest home to the specialization's students behind the United States, which itself only comprises 23% of the total learner population. Professors Erickson, Afridi, and Maksimovic reach engineers almost everywhere on the planet, who absorb their rigorous curriculum in an automated environment and exit the experience with hard-core skills.

As MOOCs began to move into the for-credit space, an idea was born from the Power Electronics test case. A small group of champions, including Professor Erickson, two other EE faculty, and members of the Office of Strategic Initiatives, began to envision a full graduate degree. We were determined to use the lessons of MOOCs and the scalability and functionality of the platform to offer a student-oriented, completely redesigned, affordable degree. In our meetings, Professor Erickson consistently asked "Why?" to challenge our assumptions about teaching and university functions. From the initial, Coursera-inspired, "Why do we believe in-person lectures are inherently better than intimate video lessons?" we branched out to question everything. "Why?" became our mantra.

Why, for instance, do we have a sixteen-week semester? There's no relationship to the length of the term and the length of the time that it takes to teach a particular subject. We stretch or condense our topics into an arbitrary shell. Why is our content offered in three-credit units? Wouldn't it be better to modularize the entire curriculum into discrete learning outcomes, so that students can truly tailor their learning to their needs? Why do we think only in terms of degrees? We already know from our graduate certificates that many engineers already have master's degrees or don't need a full thirty-credit degree to refresh their training.

And, finally, most radical of all: Why do we have admissions? Historically, campuses have reviewed applications because of limited capacity and the need to create a sense of selectivity. We also owe it to our applicants to judge their ability to succeed before they make the large financial and personal commitments to come to campus. But, what if the capacity of a degree was essentially limitless? And what if tuition were greatly reduced and students didn't have to come to campus at all? Why would we have an application?

"Why?" inspired the faculty to design a truly innovative degree built on student needs and curricular outcomes, not on the systemic requirements of the university.<sup>9</sup> The MS-EE is:

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<sup>9</sup> Gershon E. (2018) Digital Frontier: CU Boulder pioneers a MOOC-based

- *Rigorous*: The curriculum derives from our accredited on-campus graduate program.
- *Scalable*: The degree will accommodate thousands of students at once.
- *Accessible*: The 30-credit degree costs US\$20,000, or about a third of our regular EE graduate degree for non-resident students.
- *Modular*: Course work is broken down into discrete subject areas and assigned fractional credit hours as suits the content.
- *Stackable*: Students may stack courses any way they like to build a degree.
- *Elective*: MS-EE faculty plan to offer 100 credits worth of curriculum under the umbrella of a 30-credit degree to give students ultimate choice in their educational journey.
- *Microcredentialled*: We assume only a small fraction of our students will actually want the full degree. Depending on their needs, learners can earn credits in a specific topic area, like Bluetooth, or a graduate certificate in a subject like Embedded Systems, or the full degree.
- *Asynchronous*: Students may take courses any time, from anywhere, at their own pace.
- *Community-based*: The degree experience includes structures of support and community and faculty interaction to foster student success.
- *Automated*: To create a truly scalable degree, the EE faculty created assessments that were rigorous but that could also be machine graded.
- *Open*: Performance-based admissions opens the program to any qualified student. To earn the degree, learners complete a designated “gateway course” with an A or B and continue until they’ve completed thirty credit hours with at least a B average. There’s no application, no entrance exam, no recommendations to collect or transcript to submit. There’s just a form to record student information for registration and billing.

In addition, the department will build two features into the degree experience: the program will be *responsive* to student needs and *research-driven*. As we break new ground in automation, we will monitor student progress and iterate our support structures to ensure student success. We will also validate or adjust the program design with educational research propelled by MS-EE data.

Of all the features of the MS-EE, performance-based admissions generated the most internal deliberations. Concern centered on two points. First, performance-based admissions seemed to imply that,

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graduate degree in Electrical Engineering // The Coloradan. June, 1. <https://www.colorado.edu/coloradan/2018/06/01/digital-frontier>



without an application, we were somehow awarding the degree to anyone, regardless of their qualifications. This of course is not true in any sense. Learners enter a graduate-level Electrical Engineering program. It's *hard*. They have to earn thirty credits and a B average throughout to obtain the degree. Second, without an application, it's possible for someone without an undergraduate degree to earn the master's degree. This prospect required us to rethink assumptions so ingrained that we didn't even know we had them. Our mantra provided the counter argument: Why is an undergraduate degree prerequisite to a graduate degree? If a student successfully completes graduate-level, rigorous, electrical engineering content, why does their undergraduate status matter at all?

**Innovation  
leashed**

The simple, three-letter question "Why?" led us to the outer reaches of program design, but we couldn't just innovate in a vacuum. Whatever the logic behind our design decisions, we had to commit to communicating broadly and building consensus in the institution of higher education around difference. We also had to forge a path through our established processes to support and approve the degree. This was an enormous undertaking. It meant re-engineering a pipeline built to replicate, not challenge, long-validated norms that legitimately protect our operational efficiency, the student experience, and the authority of the degree.

Each point of the MS-EE's variance caused necessary friction in that protective pipeline. The process of program development and review was long and complex, and involved managing difference by addressing concerns, soliciting input, and securing consensus at all levels of the University and the state and federal institutions of higher education. We were able to succeed because everyone the degree touched at CU Boulder answered its challenges with a commitment to innovation and change.

One of the imperatives of the MS-EE is its relative affordability; the degree will cost students about a third of our regular out-of-state tuition. This worthy goal cannot be sustained on good will alone; we must pay pragmatic attention to how the University will afford a two-thirds reduction in revenue if the degree is to survive. Thus, we need to scale enrollments while simultaneously reducing the burden, not just on our faculty with automated grading, but on our administrative teams with automated operational functionality.<sup>10</sup> We worked with our Registrar, Bursar, enrollment management team, and especially our information technology team to create new back-office functionality that could join our incumbent IT systems with the MOOC platform to automatical-

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<sup>10</sup> Newton D. (2018) Why College Tuition is Actually Higher for Online Programs // Forbes. June, 25. <https://www.forbes.com/sites/dereknewton/2018/06/25/why-college-tuition-is-actually-higher-for-online-programs/#1dd848fff11a>

ly enroll students, collect their payments, track their progress, and issue transcripts, certificates, and degrees. Our information technology team especially leads the charge to create one of the most operationally automated degree experiences on a MOOC platform in the world.

The chunked, modular curricular design, focused on specific learning outcomes instead of the sixteen-week, three-credit course, meant that we needed to redesign how we offer and count credit. Our Registrar answered by innovating our systems so that we can offer fractional credit for the first time in our one-hundred, forty-two-year history. Our Bursar reconsidered how we charge tuition, and the Enrollment Management team created a way for us to accommodate asynchronous, on-demand education within a tracking system that traditionally requires tethering our students to a specific term. In every case, the faculty origin of the degree gave the program credibility, while the unwavering support of our executives brought our teams to the table empowered to innovate. One of this project's most gratifying outcomes is the close partnership that emerged between the academic, technology, and administrative personnel of the University, who have come together in an audacious mission of sweeping change.

To balance the radical design of the MS-EE, we deliberately navigated a path of responsible approvals at the local, state, and federal level. On the face of it, our bureaucratic compliance might appear as the antithesis of innovation, and we faced potential failure or delay at every juncture; however, our commitment to accountability built an infrastructure of support around the MS-EE's differences that achieved the credentialing of the ground-breaking degree and the full realization of its revolutionary vision.

Our chain of approvals began critically with broad-based faculty support, not just in engineering, but from across the University. The project originated with the EE department, who voted with large majority to develop the program. This marked a vital, first step in our entire process that was key to the acceptance of the degree at every subsequent turn. Faculty remain deeply involved in the degree, which has become central to the identity of the department. About thirty EE faculty members are engaged in creating content for the MS-EE, and a faculty oversight committee develops policy and practices for the degree; they will continue their work after the program launches. Once the EE faculty voted, the Engineering College Dean approved the degree and passed it to the Executive Advisory Committee (EAC) of the Graduate School and its Dean for comment and vote.

The Graduate School Dean and her EAC, comprised of faculty members from every school and college at the University, provided important input into the degree and also voted to support it. The asynchronous, stackable nature of the MS-EE, which allows students ultimate flexibility in their experience, also required consideration of our Graduate School rules. The Dean partnered with the EAC to enable the MS-EE, and future degrees like it, to operate within the administra-

tive oversight of the Graduate School and maintain educational quality and programmatic consistency.

Finally, our University of Colorado Board of Regents, which govern the four campuses that make up our larger state-wide system, and whose members are long proponents of innovative, affordable online education, endorsed the MS-EE and its groundbreaking tuition.<sup>11</sup> The Colorado Department of Higher Education likewise approved the degree as central to the mission of our university. Thanks to collaborative problem solving at every level, we achieved endorsement of the degree by our leaders; likewise, the operational structures required for the MS-EE to succeed were falling into place.

Even as our internal approvals accumulated, we realized that we needed to account for state and federal laws that might impact the degree. We partnered closely with our legal counsel to chart a responsible path. With their input, we decided to offer the MS-EE as an auxiliary program. While this designation is transparent to our students, it's critical to the program's eventual assessment. CU Boulder must report degree completions and time to degree across our regular University programs as a measure of our institutional effectiveness. Yet, the MS-EE is an entirely different kind of offering. It's conceived for a professional audience whose members may already have a master's degree or may only need a few credits or a graduate certificate to refresh their education. Degree completers will probably be the smallest portion of our learners and may thus be an inadequate measure of the program's real value. We needed the freedom to measure success differently. The auxiliary designation establishes a responsible means for doing so and empowers the full realization of the MS-EE experiment.

Finally, we took the accreditation of the MS-EE especially seriously. We wanted to insure that the program, as path-breaking as it is, also operates fully within the guidelines of the U. S. Department of Education. Under our regional accrediting body, the Higher Learning Commission (HLC), CU Boulder is authorized to offer distance degrees broadly and in Electrical Engineering at the master's degree level specifically.<sup>12</sup> We already deliver graduate electrical engineering courses and degrees via a synchronous distance model on campus, whereby students join live classes from afar. HLC guidelines use the term "distance" to include asynchronous online degrees.<sup>13</sup> At first analysis, our

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<sup>11</sup> University of Colorado Board of Regents (2018) "Agenda Item Details." University Affairs Committee Meeting. January, 17. <https://www.boarddocs.com/co/cu/Board.nsf/Public>; University of Colorado Board of Regents (2018) Minutes of the Regular Board Meeting. February, 8. <https://www.boarddocs.com/co/cu/Board.nsf/Public>

<sup>12</sup> Higher Learning Commission (2010) Organizational Profile, University of Colorado at Boulder. August, 18. <https://www.colorado.edu/accreditation/downloads/HLCUCBNotice.pdf>

<sup>13</sup> Higher Learning Commission. Distance Education // Glossary of HLC Terminology. <https://www.hlcommission.org/General/glossary.html#InstChange>

distance accreditation seemed to cover the MS-EE and offer an expeditious solution that required no further action on our part.

In keeping with our philosophy of careful regulatory compliance, we examined the accreditation regulations closely. Per the HLC definition, a distance program hinges upon “regular and substantive interaction between the student and instructor.” We believed that the support the faculty was building into the MS-EE would meet this standard; however, a lack of specific guidelines about what “regular and substantive” actually means gave us pause. This definitional grey area, coupled with the entirety of innovations in the MS-EE, led us to a decision to proactively reach out to the HLC to accredit the degree. We also decided to re-examine the programmatic categories available to us for accreditation, and to choose the option that would provide the most conservative authorization available.

Under federal standards, seemingly old-fashioned, much maligned “correspondence” education does not require “regular and substantive interaction between the student and the instructor.” Instead of only relying on CU Boulder’s existing authorization to offer distance degrees, we sent a formal proposal detailing the MS-EE to the HLC in which we also chose to categorize it as a correspondence program. This allowed us to avoid any definitional doubt about our practices, while we also remained committed to student success. The MS-EE subsequently achieved unanimous accreditation approval from both the HLC Change Committee and the full HLC board.<sup>14</sup>

The term “correspondence” does not sit easily with any of our team members. To innovate, we had to refurbish our notions about the term, and redefine it not as a moniker of outmoded educational delivery, but as a solution that enabled our invention when every other accreditation category would have potentially curtailed it. The MS-EE will provide robust student support, but the correspondence designation provides room for us to conduct our experiment responsibly.

Throughout the approval process, we achieved success by continually balancing our groundbreaking degree with the opposite extreme of accountability. This approach allowed us to build a coalition around difference and to establish the MS-EE, not as an outlier to our academic mission, but as a revolution housed directly in its midst.<sup>15</sup> That revolution was and still is powered by the innovative will of individuals

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<sup>14</sup> Higher Learning Commission Change Panel to Dr. Philip DiStefano, Chancellor, University of Colorado Boulder, “Panel Letter and Recommendation.” (April 2, 2018); Gellman-Danley B., President, Higher Learning Commission letter to Dr. Philip DiStefano, Chancellor, University of Colorado Boulder (May 4, 2018).

<sup>15</sup> CU Boulder to offer first MOOC-delivered electrical engineering master’s degree CU Boulder Today (February 8, 2018). <https://www.colorado.edu/to-day/2018/02/08/cu-boulder-offer-first-mooc-delivered-electrical-engineering-masters-degree>

from every part of the University who are committed to the transformative mission heralded by the MS-EE.

**The innovation  
paradox**

Two years ago, the idea for the first MOOC-based Electrical Engineering degree in the world was born at the University of Colorado Boulder. Achieving that vision requires enormous effort from every part of our institution; that effort is still underway today. Our University teams have come together to take risk, to challenge the comfort of known systems, and to urge ourselves to a new frontier. We fully embraced the invitation from Coursera and its competitors to test our assumptions and push their platforms to the limit to deliver truly scaled, global, affordable, education.<sup>16</sup>

But something funny happened on the way to 2018 from the heady days of the 2012 Year of the MOOC. Coursera, a Silicon Valley-funded start-up, evolved towards profitability. edX, a Harvard- and MIT-funded non-profit, terms their goal "sustainability."<sup>17</sup> Whatever the label, the outcome is the same: MOOC providers began to restrict variability on their platforms in favor of risk management and systemic efficiency. As the University moved from standardization to innovation, it was as if our MOOC partners passed us going in exactly the opposite direction.

I don't mean to criticize either Coursera or edX in this analysis. Their survival depends on their financial viability—and we want them to survive so that we can continue to create great student experiences on their remarkable platforms. Rather, this discussion seeks to recognize, nonjudgmentally, how quickly even the newest, hippest, most disruptive venture develops systems that hinder innovation. Just as we at the University find ourselves restricted by our infrastructure, so to do our partners find themselves compelled to conformity.

As MOOC providers matured, they developed product lines with clearly defined features, protocols, and policies. This makes business sense. Discrete products create a standard experience for learners and a standard brand and quality identity around which the marketing dollar can be maximized. Whether you call them specializations or x-series, MicroMasters or MasterTracks, those product definitions and the systems that support them can quickly ossify into narrow possibilities. The result is that the opportunity for additional innovation withers; if a concept doesn't fit into a pre-determined product track, then the platform technology, business plan, and marketing strategy can't support it.

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<sup>16</sup> Friedman Th. (2012) Come the Revolution // The New York Times. May, 15. <https://www.nytimes.com/2012/05/16/opinion/friedman-come-the-revolution.html>

<sup>17</sup> McKenzie L. (2018) Free MOOCs Face the Music // Inside Higher Ed. June, 14. <https://www.insidehighered.com/news/2018/06/14/edx-introduces-support-fee-free-online-courses>

Thus, much to our surprise, it was the groundbreaking nature of the MS-EE, its assertive staking out of difference, and all the features that made it so revolutionary and exciting, that raised concerns for MOOC providers about the degree. We didn't fit the formula. The move of MOOC platforms into the high-investment, for-credit degree space only exacerbates the drive to reduce risk as the cost of failure goes up.<sup>18</sup> This is evidenced by the launch of MBAs on MOOC platforms—a logical choice, but one that is largely imitative, not inventive: MBAs are already the most popular online degree; some might even argue that they saturate the market.<sup>19</sup> Furthermore, current MOOC degrees are built on a model whereby students move into smaller-sized cohort spaces whose features replicate many of the (costly) practices of on-campus or traditional online programs.<sup>20</sup> These moves reproduce long-validated educational practices that enable student success. The problem is that, whatever our good intentions, if we simply duplicate what already works, we'll never innovate the larger structures and practices of higher education that call out for change. The MS-EE is built on a radically different vision of what a MOOC-based degree might be. Ironically, we were so proud that we'd activated the entire system of higher education behind our new vision that it never occurred to us that our innovation partners would find themselves stymied by their move to standardization.

So, where's the MS-EE stand now? The tale hasn't reached its conclusion, and it hopefully won't for many years to come. After all, finding a platform is only the very beginning of the degree's experimental quest. At the time of this writing, we're optimistic that we'll be moving forward with Coursera. The process of making that happen mirrored our own internal creation of the MS-EE. We committed to listening to and working with Coursera to find a solution. Then, just as a small team at CU Boulder spearheaded our internal effort, a small team of champions inside Coursera committed to the degree's vision and took on the work of building internal alliances and tethering the MS-EE to their systems. Coursera's executive team and CEO heard their team's creative solutions and decided—much as our Provost did five years ago when we joined Coursera—to take a risk. Today, we are undertaking the process of contract negotiation.

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<sup>18</sup> Shah Dh. (2018) The Second Wave of MOOC Hype is Here, and It's Online Degrees // EdSurge. May, 21. <https://www.edsurge.com/news/2018-05-21-the-second-wave-of-mooc-hype-is-here-and-it-s-online-degrees>

<sup>19</sup> Fullington R. MBA Popularity in the U.S. (July 2, 2018) via Economic Modeling Specialists International (EMSI).

<sup>20</sup> Lederman D. (2018) Look Who's Championing the Degree // Inside Higher Ed. March. <https://www.insidehighered.com/digital-learning/article/2018/03/06/coursera-purveyor-moocs-bets-big-university-degrees>



**Conclusion** The story of the University of Colorado Boulder's MS-EE is unfinished, yet already offers powerful lessons about the potential for institutional transformation. First, if we mean to achieve broad change, we must commit to the hard work of creating that change from within. Second, a bottom-up effort led by a small team with top-down support generates momentum to overcome entrenched systems that inherently resist difference. Third, and most importantly, the impetus for innovation has always resided with the university.

Coursera and edX are young businesses. Their condition requires conservatism as they attempt to bridge the gap between start-up financing and autonomous viability. In comparison, the University of Colorado Boulder is exceedingly viable; we've been around, doing what we do, for a century and a half. We may be underfunded, chronically under-resourced, and under threat, but we also operate with a US\$1.8 billion-dollar budget.<sup>21</sup> While that money is almost wholly encumbered, it is fed by diverse revenue streams: tuition, state funding, research grants, returns on tech transfer, and the like. If we fail with the MS-EE, it won't pose an immediate financial crisis for our institution. What *will* pose a crisis for the University and the institution of higher education is if we fail to innovate at all [Jewett 2017]. Universities must move boldly into the future; Coursera and edX have done us the great favor of both showing us a way to that future and inviting us to participate in it.

From the very moment of our foundation, universities like ours have driven transformation—of societies, of technologies, of education, of thought and knowledge. Change is our essential DNA and has been for centuries. The University of Colorado Boulder is a Research 1 institution that proudly anchors one of the most innovative business corridors in the United States.<sup>22</sup> Technology developed by our faculty has launched over 140 new start-ups, our researchers have filed for 1,276 patents in the last eight years, and 548 inventions have been submitted to CU Boulder's Tech Transfer office in the last five. We are the proud home of a community of scientists, scholars, and educators that includes five Nobel Laureates, eight MacArthur Genius Grant winners, four National Medal of Science awardees, and over eleven cutting-edge interdisciplinary research institutes that are deeply embedded in the fabric of the University. The truth of this paper is that the individual institution remains and always has been the necessary hub of invention within higher education. The MS-EE powerfully demonstrates that the drive to invent doesn't just belong to the professorate;

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<sup>21</sup> Niedringhaus C. (2018) University of Colorado Approves \$4.5 Billion Total Budget for Next Fiscal Year // Daily Camera. June, 22. [http://www.dailycamera.com/cu-news/ci\\_31963149/university-colorado-approves-budget](http://www.dailycamera.com/cu-news/ci_31963149/university-colorado-approves-budget)

<sup>22</sup> Dill K. (2015) The 10 Most Innovative Tech Hubs in the U.S. // Forbes. February, 12. <https://www.forbes.com/sites/kathryndill/2015/02/12/the-10-most-innovative-tech-hubs-in-the-u-s/#6e1717575d7d>



it infuses our entire staff—who work, after all, at a university because they are passionate about education and serving our students. Coursera and their competitors can partner with us and push us towards transformation, but it is we who have the both the real power and the real responsibility to undertake our own radical reinvention.

We're all here because we believe that education can change the world. Let's get on with it.

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# E-Learning in Theory, Practice, and Research

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Received in  
July 2018

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**Abstract.** This article presents three intersecting aspects of e-learning: theory, practice, and research. It begins with a review of the major theoretical frameworks to date—behaviorism, cognitivism, constructivism, digital media theory, and active learning theory—to demonstrate the ways in which e-learning is both similar and dissimilar to traditional modes of learning. The article then turns to a practical case study of e-learning, a Massive Open Online Course (MOOC) created

by the American Museum of Natural History and hosted on the Coursera platform. The case study demonstrates both how learning theory affords a template to guide MOOC creation, and how MOOC platforms can be a laboratory for e-learning instructional design. The article concludes with an example of e-learning research, demonstrating the importance of synergy among theory, practice, and research.

**Keywords:** learning management systems (LMS), MOOCs, e-learning, learning design, student success, behaviorism, cognitivism, constructivism, digital media theory, active learning theory, scholarship on teaching and learning, assessment, feedback.

**DOI:** 10.17323/1814-9545-2018-4-81-98

The term e-learning is a source of controversy and debate among scholars and practitioners alike [Andrews 2011]. Depending on whom you ask, e-learning is a buzzword, fad, teaching strategy, or a pedagogy unto itself. In the following paper, I address three aspects of e-learning. The first section situates e-learning within theoretical frameworks. The second describes e-learning in practice—specifically an e-learning initiative at the American Museum of Natural History (AMNH) in New York City. In the final section, I present a research study that will contribute to the e-learning body of knowledge. My purpose is to assert the importance of research-based practices for those who design, develop, and implement e-learning resources.

## **E-learning: Theory**

At its most basic level, e-learning is the use of technology for teaching and learning [Mayes, Freitas 2005]. A more refined definition is that e-learning is the use of any electronic media in the service of all aspects of teaching and learning, both online and offline [Andrews, 2011;

Koohang et al. 2009]. Pange and Pange [2011] posit that e-learning is even more specific, that it builds knowledge and increases the quality of learning by transmitting content and instruction via the internet.

Effective e-learning is structured to provide resources and support for students. There are many, many types of e-learning applications. These include blogs, wikis, online discussion boards, online games and simulations, online courses offered within learning management systems (LMSs), massive open online courses (MOOCs), tablet apps, and a host of others. Despite the countless free and commercial e-learning resources available, many are not grounded in formal and empirical understandings of best practices regarding how students are taught, how content is delivered, and how the technology interface is designed [Pange. Pange 2011]. Similarly, e-learning applications, and online learning in particular, often are not grounded in educational theory [Mayer 2015]. We must change this. E-learning design and development should be grounded in theoretical frameworks and empirical findings so that good instructional design principles can be applied to teaching and learning [Mayer 2015; Mayes, Freitas 2005] and, equally importantly, so that scholars and researchers have a common vocabulary and understanding from which to conduct research on the effectiveness of e-learning applications, resources, and interventions.

To date, there is no unified theory of e-learning. Many scholars agree that existing theories of learning can be combined, modified, and/or directly applied to e-learning [Pange, Pange 2011]. Of these existing theories, cognitivism and constructivism are most frequently applied to e-learning development and instruction. Behaviorism, digital media theory, and active learning theory are also applied, though less often. Some scholars, however, contend that e-learning requires a new learning theory. Let us explore these possibilities, starting with cognitivism.

Cognitivists posit that learning is an internal process involving thought, memory, reflection, motivation, and metacognition [Mödritscher 2006. Information is received through different senses, processed by working memory, which is limited, and then transferred to long-term memory, which is unlimited [Burke 2013; Mödritscher 2006; Van Merriënboer, Ayres 2005]. Long-term memory organizes complex material into schemas that reduce the load on and extend the capacity of working memory. Working memory can be affected intrinsically (by the nature of the content) and extraneously (by how the content is presented) [van Merriënboer, Ayres 2005]. Cognitive overload occurs when too much material is presented such that it cannot be processed by working memory and transferred to long-term memory. A problem with educational technology/e-learning is that much of it increases rather than decreases the likelihood of cognitive overload [Burke 2013]. This issue is addressed when cognitivism is the theoretical foundation on which e-learning applications are developed.

Several scholars have developed cognitivist approaches to educational technology. Among these is Richard Mayer. Dubbed “the father of the science of e-learning” [Mayer 2015], Mayer has put forth a cognitive theory of multimedia learning, the goals of which are to reduce extraneous cognitive processing; manage essential cognitive processing (processing required to comprehend the material); and support generative processing (deep processing needed to organize and integrate the material). Through decades of empirical research and hundreds of experiments, Mayer has identified twelve principles for reducing the cognitive load of multimedia material by organizing and presenting information to students in a way that optimizes their ability to process the material in their working and long-term memory [Ibid.].

Like Mayer, Mödritscher [2006] and van Merriënboer and Ayres [2005] are also proponents of a cognitivist approach to e-learning. Van Merriënboer and Ayres [2005] note that many online learning tasks are complex and include interacting elements that must be processed by working memory. Even if one were to address the issue of cognitive load in the content, the interactive nature of the task itself may present a cognitive load so demanding that it poses a barrier to learning.

Van Merriënboer and Ayres [2005] and Mödritscher [2006] offer suggestions similar to Mayers—principles in order to reduce the cognitive load of interactive e-learning tasks. Together, their guidelines create a blueprint for those who wish to use cognitivism as a theoretical framework to inform the design, development, and assessment of e-learning applications.

In addition to cognitive load theory, constructivism—the act of constructing new knowledge based on experience [Koochang et al. 2009]—is also applied to e-learning. In fact, constructivism is the theory used most often for e-learning [Pange, Pange 2011]. Constructivism in e-learning is present when students engage in active and/or interactive processes that promote collaboration. Additionally, students who engage in constructivist e-learning tasks have a degree of control over the learning process, usually in the form of instructor-guided discovery, or on-screen guided discovery, that culminates in student decision-making. Instructors who incorporate constructivism in their teaching include examples in their e-learning activities and provide opportunities for students to reflect on their work [Mödritscher 2006].

In 2009, Koochang et al. put forth a constructivist approach to e-learning that has three core components: *activities* that include collaboration and cooperation, the adoption of multiple perspectives, real world examples, self-reflection, scaffolding, self-assessment, and multiple representations of ideas; *assessments* that include instructor assessments, group assessments, and self-assessments; and instructor *roles* that include coaching, mentoring, acknowledging student work and effort, providing feedback, and assessing student learning. The authors subsequently expanded this model by identify-

ing nine constructivist elements of e-learning such as interdisciplinary learning, self-reflection, the use of real-world examples, and scaffolding to facilitate the Zone of Proximal Development [Koohang et al. 2009].

Constructivism in e-learning is not dissimilar from constructivism in traditional learning. Both provide students with opportunities to actively construct their own knowledge through experience, present information from a variety of perspectives, incorporate the facilitation of an expert or guide, and provide time and opportunities for students to develop metacognitive skills [Mödritscher 2006]. However, constructivism in both traditional and e-learning is not without limitations. It takes a lot of time and effort to create context-based content, and it takes even more time and effort to create content that aligns with individual learners—interests and experiences. Constructivism necessarily limits the degree to which a teacher can focus learners—attention in a particular direction, and in the absence of extrinsic motivators, students can lose interest in the activity. Finally, it is not always easy or possible to adequately evaluate student learning in constructivist situations. It is possible, however, for e-learning systems to automate some aspects of student assessment, removing the burden from the instructor.

There are three additional theories of learning that are applied to e-learning, though with less frequency than cognitive load theory and constructivism. The first is behaviorism. Behaviorism situates learning within the contexts of external or environmental stimuli. Knowledge is acquired through experiences and interactions with and within the world around us [Schunk 2012].

Behaviorists recommend that instructional designers take a structured approach to the development of e-learning materials. For example, all material should be broken down into smaller pieces or segmented tasks to make complex information and activities easier to understand. Another way to incorporate behaviorism into e-learning design is to give learners more control of the learning process by allowing them to choose the next steps in their learning sequence (watch a video or read text, etc.) [Mödritscher 2006]. With a behaviorist framework, material should be organized in a sequence that becomes more difficult over time. As students master the initial content, more difficult material becomes available to them. Lastly, teachers or e-tutors should guide students by describing and/or modeling the task in discrete parts. This allows the learner to copy the guide's behavior [Mödritscher 2006].

The remaining two theories that can be applied to e-learning are mentioned briefly in the literature. A digital media theory approach to e-learning focuses on the variety of media formats available for teaching and learning. This focus is evocative of Marshall McLuhan's "the medium is the message" [McLuhan 2003: 23] in that the emphasis is on hardware (computers, hand-held devices, recording devices, etc.),

not software or content. Additionally, digital media theory examines the important issues of access and accessibility [Andrews 2011] which are not critical to either cognitivism or constructivism.

Finally, activity theory and active learning theory can also be applied to e-learning [Mayes, Freitas 2005; Pange, Pange 2011]. Active learning is any instructional strategy that engages learners in educational processes. This increased student activity can lead to better understanding of the content [Pange, Pange 2011]. Gamification, for example, is one popular way to increase student motivation that incorporates active learning theory and could be delivered via e-learning.

Despite the successful application of existing learning theories to e-learning, the question remains: does e-learning require a theory of its own [Andrews 2011]? Pange and Pange [2011] and Siemens [2005] contend that the problem with existing learning theories is that they were developed before education was infiltrated by electronics, the internet, software, computers, and electronic media. These critical components of e-learning, which have become ubiquitous in many schools and classrooms, have thus been excluded from traditional theories of learning. Furthermore, e-learning—the term itself—suggests that it is distinct from traditional learning and thus could benefit from its own theory. Lastly, to keep up with changes in technology development, e-learning is necessarily dynamic and ever-evolving. Existing learning theories do not adequately capture this dynamism [Andrews 2011].

Andrews [2011] has suggested that a new theoretical approach to e-learning is needed because e-learning differs from traditional face-to-face learning. He notes that e-learning happens in communities that are significantly different from traditional learning communities. For example, e-communities gather and communicate via social network sites, virtual learning environments, learning management systems (LMSs), email groups/lists, chat rooms, video chat interfaces, and more. Unlike traditional communities, these communities function regardless of individuals' locations, and they can be much larger than traditional learning communities. When motivated e-learners are isolated, they tend to make extra efforts to communicate with others and establish themselves as members of the learning community.

Like e-learning communities, e-learning practices are also different than traditional learning practices. E-learning allows students to participate in special interest e-groups, subscribe to e-journals, conduct research quickly within databases and digital archives, communicate via email with classmates and instructors, create blogs, participate in online discussions, and much more [Andrews, 2011]. The breadth of these activities is simply unavailable in traditional teaching and learning.

Yet another way in which e-learning is distinct from traditional learning is through student agency. Andrews [2011] posits that the digitization of text gives students greater agency, as digital text can

easily be changed or manipulated into other works. Related to the digitization of text is that e-learning creates a less hierarchical social structure of education. In traditional education, conversation between scholars happens in print. The exchange of information, ideas, and discoveries is a formal and slow process in which most learners cannot contribute. E-learning levels this playing field. When texts are digitized, they become more accessible to learners, more easily critiqued, and more easily integrated into e-learning projects, processes, and activities. In this way, knowledge continually changes and develops as a result of the social practice of deconstructing and reconstructing digital texts. This evolution of knowledge is not possible in traditional, hierarchical teaching and learning practices [Andrews, 2011].

These features of e-learning that distinguish it from traditional learning suggest that e-learning requires a new theory (Ibid.). Siemens agrees, but for a different reason. He states that existing learning theories fail to consider external learning that is “stored and manipulated by technology” [Siemens 2005: 5] and learning within the context of organizations. Therefore, a theory of learning appropriate for the digitally saturated world in which we live must explicitly acknowledge connections—among people, institutions, and technology. He articulates a theory called connectivism to fill this void in the literature: “Connectivism is the integration of principles explored by chaos, network, and complexity and self-organization theories. . . . Learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a database), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing (Ibid.: 7).” Connectivism shifts learning from an internal to an external activity, and from what one knows in the present to what one is able to learn in the future.

The perspectives of Andrews [2011] and Siemens [2005] highlight the discord that exists among scholars about theories of e-learning. Though scholarly consensus is elusive, one thing is certain: more research is necessary. The existing body of e-learning research is saturated with studies about strategies, social contexts, and instructional design. Most of these studies are either descriptive or ethnographic [Andrews 2011]. Very few theoretical papers exist [Andrews 2011; U. S. Department of Education, Office of Planning, Evaluation, and Policy Development 2009]. Unless this changes, researchers and practitioners alike will continue to be tempted by the seduction and shine of new technologies instead of focusing on understanding and communicating how learning and cognition are most affected by educational technology [Burke 2013]. When it comes to e-learning, we must shift from good intentions to learning theories, learning outcomes, and empirical evidence [Mayer 2015]. The following case study is an examination of one institution’s effort to contribute to this shift.



**E-learning:  
Practice** Founded in 1869, the American Museum of Natural History in New York City is among the world's most renowned scientific, educational, and cultural institutions. The Museum's mission is to discover, interpret, and share information through research, exhibitions, and education. With more than 33 million objects in its collections, this is both an exciting and challenging undertaking that is facilitated by the use of digital experiences. Indeed, AMNH has a decades-long track record of creating award-winning educational media and resources. From its OLogy science website for children to its *Seminars on Science* graduate courses for educators, AMNH has long been an e-learning innovator. When MOOC platforms emerged, it was natural for AMNH to create educational opportunities in that space as well.

With more than 150 institutional partners, more than 2600 courses, and more than 31 million learners from around the world<sup>1</sup>, Coursera is one of the leading MOOC providers<sup>2</sup>. Coursera grew out of its founders' belief that the best courses from the best teachers at the best schools should be available to anyone anywhere in the world [TED, 2012].

In 2013, the American Museum of Natural History partnered with Coursera on its inaugural Teacher Professional Development program. Through the Coursera platform, AMNH offers several online science courses designed with science teachers in mind. Each of the first three MOOCs created by AMNH has a science content component for a general audience and a science teaching component for science educators. These courses (about genetics, evolution, and the Earth) were—and continue to be—utilized by tens of thousands of people, with educators from around the world translating AMNH essays and videos into their native languages to be used in their own classrooms.

Though the Coursera Teacher Professional Development program has ended, the AMNH partnership with Coursera continues. To date, AMNH has designed and developed six science MOOCs. AMNH relies upon a collaborative team of instructional designers, learning science experts, scientists, writers, videographers, and graphic designers to create pedagogically sound and visually compelling online courses. During the past five years of MOOC production, this team has learned valuable lessons about creating online courses for the large and diverse audience of MOOCs. The following is a blueprint of the Museum's existing MOOC production process that may be useful to instructional designers who are just getting started with MOOCs.

- *Course outline.* Every MOOC produced by AMNH starts with an articulation of learning goals and a course outline. The outline lists

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<sup>1</sup> Maggioncalda J. (2018) Keynote Address. Coursera Conference, Tempe, AZ.

<sup>2</sup> As the Museum's MOOC partner, Coursera is the focus of this paper. Other MOOC providers not represented here offer similar educational and research opportunities.

all of the course content: syllabi, modules, essays, videos, quizzes, and related resources. Included in the outline is a note about whether the asset already exists or needs to be produced.

- *Asset aggregation.* AMNH MOOCs combine previously created content with brand new material. After a course outline is finalized, the production team determines which assets exist and which need to be added to the department's production schedule. Existing resources are gathered, and new essays are written.
- *Video production.* Video production is among the most labor-intensive and expensive parts of MOOC production. To create flexible content, the production team creates evergreen graphics and excludes dated words from scripts.
- *Assessment creation.* Multiple-choice quizzes are used in all of the AMNH MOOCs. Creating high-quality assessment questions is difficult and time-consuming. The team strives to ensure that all content addressed in quizzes is easily accessible in the course material, and that the lures we use in the answer options are not too confusing. The goal is not for the quizzes to be a source of misinformation; rather, the goal is for each question to be an opportunity for learners to check their understanding. Once a quiz is published, we analyze the results periodically, revising and updating any quiz question with an average first-attempt correct response score of less than 70%. This access to real-time data and editing is one of the benefits of online education broadly, and the Coursera platform specifically.
- *Course production and quality assurance testing.* Every course is built and tested several weeks prior to the start date. Coursera staff also review the course to ensure that all links and grading formulas work properly. Once a course is live, learners have the ability to flag content that is incorrect. These oversights can be fixed and published immediately. In this way, part of the quality assurance process is crowd-sourced.
- *Course communication.* Each course has a series of custom emails that is scheduled to be sent to learners at the start of each week. These emails recap the previous week's content and remind learners about assessment deadlines and survey requests. They can motivate students to continue the course.
- *Research and evaluation.* In addition to the demographic data collected by Coursera, AMNH conducts a pre-course and post-course survey for each MOOC. Through these voluntary surveys, we learn about the age, sex, location, prior education, occupation, and learning objectives of the people who enroll in our courses. For example, we have learned that the majority of people who engage with AMNH MOOCs do not start the course with the intention of completing it. They come for the educational resources, not a certificate.

The production team is constantly iterating on this instructional design process; each MOOC is an opportunity to learn from the last one that we created and to inform the Museum's other online educational media production processes. Additionally, the MOOC portfolio and Coursera partnership create opportunities to measure and learn more about teaching and learning best practices, thus contributing empirical research to the body of educational technology knowledge.

**E-learning:  
Research**

One benefit of MOOCs is their potential for rigorous educational research. In addition to my role as the senior manager of online teacher education programs at AMNH, I am also a Ph.D. fellow studying educational psychology at the City University of New York (CUNY). I have the good fortune of using the expertise I have gained at the Museum to inform the research I am conducting as a graduate student. My dissertation is an experiment using A/B/C/D design in which I use randomized testing in an AMNH MOOC to determine the effectiveness of tests and feedback for adult learners.


Though it is often associated exclusively with assessment, testing serves other purposes as well. For example, "testing has often been shown to be more effective than further study in encouraging retention of tested information" [Richland, Kornell, Kao 2009: 243]. Additionally, research indicates that testing-as-instruction can be just as effective as testing-as-assessment [Beckman 2008; Bjork, Storm, deWinstanley 2010; Kornell, Hays, Bjork 2009; Richland et al., 2009]. Educational psychology studies have found that pre-tests before instruction can help students' brains learn and encode important concepts that are then presented in detail in future lessons [Dunlosky et al. 2013]. Research also shows that the effectiveness of tests-as-instruction can be dependent on the feedback students receive after taking a test [Richland, Kornell, Kao 2009]. Most of the studies about pre-testing and feedback focus on K-12 or undergraduate populations in traditional face-to-face classrooms. Few, if any, studies include adult online learners as participants.

Building on these findings, my dissertation study is an experiment designed to identify the effects of pre-tests and feedback on learning outcomes in a five-week online science course for adults. A secondary component of this study is a pre-course self-efficacy survey which will be used to identify links between student self-efficacy, learning outcomes (post-test scores), and persistence (course completion).

The experiment is being conducted in one of AMNH's Coursera courses. The course has five modules. A pre-test is administered at the start of each module, and a post-test is administered at the end of each module. Pre-test and post-test scores will be compared to understand which treatment, if any, has a greater effect on learning outcomes.

**Figure 1. Each of the four course samples and the course material that is included for each**

	Self- efficacy survey	Pre-test no feedback	Pre-test basic feedback	Pre-test detailed feedback	Post- test
Control group	<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>
Sample one	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>
Sample two	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
Sample three	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>



The pre-test questions, post-test questions, and feedback were written by Dr. Debra Tillinger, an AMNH online educator. The pre- and post-test questions are not identical, but they address the same course themes. While Dr. Tillinger wrote the questions and feedback, I prepared the new course shells for the four samples.

The implementation is simple. When a student enrolls in the course, she is randomly assigned to one of the groups<sup>3</sup>.

**Pre-test no feedback:** Students randomly assigned to this version of the course receive a quiz score, but they don't know which questions they answer correctly/incorrectly.

**Pre-test basic feedback:** Students randomly assigned to this version of the course receive information about which pre-test questions they answer correctly/incorrectly, as well as their quiz score.

**Pre-test detailed feedback:** Students randomly assigned to this version of the course receive information about which pre-test questions they answer correctly/incorrectly, their quiz score, and detailed feedback for each pre-test question.

**Control group:** Students randomly assigned to this version of the course take the post-tests but no pre-tests.

This study is designed to address the following questions: Does taking a pre-test at the start of an online learning module prime adult students to learn key concepts? Does question-level feedback moderate the effect of the pre-test in an online learning module for adults? Does hiding the pre-test results moderate the effect of the pre-test in an online learning module for adults?

<sup>3</sup> Random assignment is not easy to do in educational research, and it is a feature of the Coursera platform that makes MOOC research a compelling option for learning science scholars.

Figure 2. Screenshot of Postico, the SQL program used to query data from the exported course.csv files. The SQL query for this project was developed with the assistance of Dr. Neil Sarnak, who holds a Ph.D. in computer science from New York University.

The screenshot displays the Postico SQL client interface. The top toolbar includes icons for file operations, database connections, and execution. The left sidebar shows a tree view of the database schema, including tables like 'assessment\_actions', 'assessment\_questions', 'assessment\_responses', 'course\_branch\_items', and 'pg\_catalog'. The main area contains a SQL query window with a complex JOIN query. The query selects columns from 'assessment\_actions', 'assessment\_questions', 'assessment\_responses', 'course\_branch\_items', and 'course\_branch\_item\_assessments', filtering by a date range and a specific module name. Below the query window, the results are displayed in a table with 7 columns: 'amh.user\_id', 'authoring\_course\_branch\_name', 'course\_branch\_item\_name', 'assessment\_question\_prompt', 'assessment\_response\_score', and 'assessment\_action\_ts'. The table shows 1353 rows of data. The bottom status bar indicates 'Result 1', '1353 rows', and '238 ms'.

```
SELECT
  assessment_actions.amh_user_id,
  course_branches.authoring_course_branch_name,
  course_branch_items.course_branch_item_name,
  assessment_questions.assessment_question_prompt,
  assessment_responses.assessment_response_score,
  assessment_actions.assessment_action_ts
FROM
  assessment_responses,
  assessment_actions,
  course_branch_items,
  course_branch_item_assessments,
  course_branches
WHERE
  assessment_responses.assessment_action_id = assessment_actions.assessment_action_id
  AND assessment_questions.assessment_question_id = assessment_responses.assessment_question_id
  AND course_branch_item_assessments.assessment_id = assessment_actions.assessment_id
  AND (course_branch_item_assessments.course_item_id = course_branch_items.course_item_id
  AND course_branch_item_assessments.course_branch_id = course_branch_items.course_branch_id)
  AND course_branches.course_branch_id = course_branch_items.course_branch_id
  AND assessment_action_ts > '2018-01-08 00:00:00.0'
  AND course_branch_items.course_branch_item_name = 'Module One: What have you learned?'
```

amh.user_id	authoring_course_branch_name	course_branch_item_name	assessment_question_prompt	assessment_response_score	assessment_action_ts
cf2f6fa07924d6d0b81c8424b281f83a19ebb1c6	control group	Module One: What have you learned?	For research purposes are you 18 years of age or older?	1	2018-01-23 14:22:1
cf2f6fa07924d6d0b81c8424b281f83a19ebb1c6	control group	Module One: What have you learned?	What is the main reason that year-round the tropics are warmer than polar regions?	0	2018-01-23 14:22:1
cf2f6fa07924d6d0b81c8424b281f83a19ebb1c6	control group	Module One: What have you learned?	Which of these is NOT a greenhouse gas?	0	2018-01-23 14:22:1
cf2f6fa07924d6d0b81c8424b281f83a19ebb1c6	control group	Module One: What have you learned?	Which of these statements describe a location's climate?	0	2018-01-23 14:22:1
cf2f6fa07924d6d0b81c8424b281f83a19ebb1c6	control group	Module One: What have you learned?	Think about the definition of a scientific statement. Which of these is not a scientific statement?	1	2018-01-23 14:22:1
cf2f6fa07924d6d0b81c8424b281f83a19ebb1c6	control group	Module One: What have you learned?	The Keeling Curve shows that:	1	2018-01-23 14:22:1
cf2f6fa07924d6d0b81c8424b281f83a19ebb1c6	control group	Module One: What have you learned?	A scientific statement is one that:	0	2018-01-23 14:22:1
cf2f6fa07924d6d0b81c8424b281f83a19ebb1c6	control group	Module One: What have you learned?	How do greenhouse gas molecules in the atmosphere warm the surface of Earth?	1	2018-01-23 14:22:1
cf2f6fa07924d6d0b81c8424b281f83a19ebb1c6	control group	Module One: What have you learned?	Which statement about longwave and shortwave radiation is correct?	0	2018-01-23 14:22:1
cf2f6fa07924d6d0b81c8424b281f83a19ebb1c6	control group	Module One: What have you learned?	When a system is in energetic equilibrium it is:	1	2018-01-23 14:22:1

In addition to an exploration of testing and assessment, this study provides the opportunity to learn about students through non-cognitive factors as well. One non-cognitive factor that will be explored is self-efficacy. Upon enrolling in the course, students will be asked to complete a pre-course survey. Survey questions were designed to address students' confidence in their ability to complete online courses; their confidence in their understanding of the course content; and their perceptions of and receptivity to feedback. Survey responses will be correlated with quiz scores and course completions to understand the relationship between these non-cognitive factors and learning outcomes.

Participants include adult learners from all over the world who enroll in the MOOC. Data collection for this study began on January 8, 2018 and will conclude on December 24, 2018. The dataset will include quiz submissions and pre-course surveys from twelve offerings (one course offering every four weeks).

At the end of a course offering, I submit a request to Coursera for a student data export. This anonymized data is stored in 74 different tables on Coursera's servers and is exported from the platform in.csv files. I import the relevant tables into a SQL program in which custom queries are used to combine the exported data from the original ta-

bles into a single spreadsheet (See Figure 2). The dataset is then imported into SPSS for analysis.

This research, which is possible in part because of the unique affordances of Coursera's MOOC platform, contributes to the educational technology and e-learning landscape in several ways. First, it expands upon existing assessment and feedback research that focuses on traditional classrooms and instead focuses exclusively on online learning. Second, unlike many educational studies that focus on young learners, it examines a broad adult population, including all learners 18 years-of-age and older. Third, it is a global study, with participants from the United States, India, China, Russia, Germany, Pakistan, Canada, and many additional countries. The results of this experiment, which will be published in the spring of 2019, will help online education practitioners understand the effectiveness of both pre-tests and feedback.

This research study is just one example of how MOOCs and Coursera can be used to create quantitative research designs with random assignment that can inform the way practitioners create and conduct e-learning experiences. The results of this study will inform future MOOC work undertaken at AMNH and hopefully also at other institutions that produce online courses.

**Summary** When it is done well, e-learning has many benefits. Unfortunately, theory, practice, and research don't often intersect, resulting in e-learning applications that can actually decrease learning outcomes. One way in which the theory/practice/research intersection can successfully occur is on a platform like Coursera. MOOCs can be created using one or more learning theories as the pedagogical foundation. These courses can be delivered to countless learners easily and quickly, and the real-time data and experimentation features available to course administrators can facilitate the development and execution of quantitative research designs. A single platform—a single course!—can be used to contribute empirical findings to the growing body of knowledge in the e-learning domain. It is my hope—and the hope of my colleagues at AMNH and CUNY—that the MOOC research study described herein can contribute meaningfully to that shared body of knowledge.

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# Classical Test Theory and Item Response Theory in Measuring Validity of Peer-Grading in Massive Open Online Courses

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Received in  
July 2018

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**Abstract.** The article presents the results of research on validity of peer-review assignments in massive open online courses within the framework of classical test theory (CTT) and item response theory (IRT). CTT-based analysis yielded data on convergent validity of the

peer-review assignment, the low level of its criterion validity, and rater disagreement. IRT-based analysis revealed rater bias and established that experts largely tend to be lenient and overrate their peers. The findings are used to discuss the advantages and disadvantages of the psychometric theories in question and the opportunities for combining the two. **Keywords:** massive open online courses, peer grading, classical test theory, item response theory, peer-review assignments.

**DOI:** 10.17323/1814-9545-2018-4-99-115

Massive open online courses (MOOCs) as a form of distance learning have been growing more and more popular among students as well as universities. In 2016, 6,850 courses from over 700 universities were available worldwide. Coursera was the largest MOOC platform in 2016 with over 23 million registered users [Shah 2016]. In 2017, over 800 universities were offering more than 9,400 MOOCs, and Coursera crossed the milestone of 30 million users and 2,700 courses [Shah 2017].

MOOCs provide open access to learning materials online, thus being able to enroll an unlimited number of students. An online course consists of video lectures, readings, hands-on activities, quizzes, and discussion forums. MOOCs are usually developed by universities and offered through providers, or platforms, such as Coursera, EdX, XuetangX, FutureLearn, Udacity, National Open Education Platform, Stepik, or Universarium. Coursera and EdX are the two largest provid-

The author thanks her academic supervisor Dmitry Abbakumov for assistance with this article.  
*Translated from Russian by I. Zhuchkova.*

ers of MOOCs with around 30 and 14 million registered users, respectively [Shah 2017].

When colleges started accepting MOOCs for credit on equal terms with conventional offline courses, stricter requirements began to be applied to validity and reliability of assessment tools. MOOCs most often use automated and peer grading to test knowledge and skills. Peer assessment implies that at least three students provide feedback on an answer constructed by a peer. Submissions to be evaluated are selected randomly.

Peer grading allows using open-ended assignments (e. g. essays and design projects) and has a high educational potential, as students improve their analytical skills by reviewing and commenting on their fellows' works. However, there is substantial bias in peer ratings, which are largely subjective, so their validity and credibility are questionable.

Peer assessment validity research findings are dubious. A number of works revealed a strong positive correlation between peer grades, instructor grades and tests [Kaplan, Bornet 2014; Dancey, Reidy 2017]. Other researchers found validity of peer ratings to be low due to raters' unawareness of the principles of objective assessment [Admiraal, Huisman, van de Ven 2014], their lack of expertise in the subject [Falchikov, Goldfinch 2000] and the fact that objective assessment criteria are not provided for every course [Falchikov, Goldfinch 2000].

This article explores classical test theory and item response theory as two approaches toward research on validity of peer grading in MOOCs, illustrates using two online courses how these approaches can be applied, discusses their advantages and disadvantages as well as the opportunities for combining the two.

## **1. Research on validity of Peer-review assignments**

Psychometrics offers two approaches to studying validity of assessment tools: classical test theory and item response theory<sup>1</sup>. The two approaches do not exclude each other, so it is proposed to combine them.

### **1.1. Classical test theory**

A valid test, according to Anne Anastasi, measures reliably the quality that it was designed to measure. In this article, validity of peer ratings is taken as accuracy of the scores that students award to one another. In terms of classical test theory, researchers usually measure construct and criterion validity as well as classical reliability [Anastasi, Urbina 2007].

Construct validity is one of the fundamental theoretical types of validity reflecting the degree to which the stated property is repre-

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<sup>1</sup> The National Council on Measurement in Education: *A Professional Organization for Individuals Involved in Assessment, Evaluation, Testing*. Philadelphia, PA. <http://www.ncme.org/home>

sented in test results [Shmelev 2013]. This study measures convergent validity, which is understood as positive correlation between results obtained using different tools measuring the same construct. For instance, several tests are available that measure intrinsic motivation. In order to establish convergent validity, it makes sense to collect data from every test and compare the results. If results of different tests show a strong correlation, one can talk about their convergent validity.

In this study, convergent validity is measured by computing Pearson's correlation coefficients between average peer grade and test scores as well as between every individual peer's rating and test scores (since the course contains both peer-review assignments and automatically graded quizzes).

Linear correlation formula:

$$(1) \quad r_{xy} = \frac{\Sigma(X - \bar{X})(Y - \bar{Y})}{\sqrt{\Sigma(X - \bar{X})^2 \Sigma(Y - \bar{Y})^2}},$$

where  $X, Y$  are observations, i. e. sample units,  $\bar{X}, \bar{Y}$  are sample means.

Criterion validity is understood as positive correlation between outcome and an empirical criterion. Possible criteria may include, for example, final grades in the subject in which students' knowledge and skills are tested. This study uses final course grade as a criterion. To measure criterion validity, Pearson's correlation coefficients were computed (see equation (1)) between every individual peer's rating and final course grade as well as between average peer grade and final course grade.

Reliability is normally calculated as the correlation coefficient between peer and professor grades, implying that the professor is able to provide an accurate and objective assessment of students' works. In this study, classical reliability is taken as the degree of rater agreement based on a comparison of scores awarded by the raters. If all the three peers award the highest score, one can talk about rater agreement, unlike when different scores are awarded.

Rater agreement was measured using Kendall's coefficient of concordance ( $W$ ):

$$(2) \quad W = \frac{12S}{n^2(m^3 - m)},$$

where  $S$  is the sum of squared deviations in all the ranks given to every object from the mean;  $n$  is the number of judges; and  $m$  is the number of objects.

## 1.2. Item response theory

Validity of peer ratings and the very grading procedure have been discredited a number of times [Charney 1984; Gere 1980; Huot 1990]. Even if judges specialize in the area assessed and are able to provide equipollent evaluations, interpretation of the assessment scale leaves questions: it cannot be a linear scale, and two points in one assignment cannot be equipollent to two points in another. This and other

characteristics of the CTT assessment scale make ensuring validity and reliability of peer-review assignments challenging. Item response theory (IRT) offers a metric scale with no lower limit, and the sum of all assignment difficulties is zero. This approach allows measuring assessment validity more accurately and identify bias in peer ratings.

Research in expert ratings mainly focuses on their reliability. John M. Linacre [Linacre 1989] states that true-score theory is key how variance in expert ratings and undesired judge-dependent "error" variance become a measurement challenge, so these variances should be reduced as much as possible. Another approach to expert ratings is applied in a multifaceted model designed by Linacre, who took the Rasch model as a basis. In this model, variance in expert ratings is seen as an inevitable part of the rating process; moreover, it is regarded not as a barrier but as conducive to measurement as it provides variability sufficient to estimate the probability of judge severity, item difficulty and examinee ability on a linear scale.

Adherents of the Rasch model argue for the importance of giving judges the understanding of the rating scale that they will be using to assess students [Lunz, Wright, Linacre 1990]. In fact, the use of the Rasch model eliminates the need to ensure rater agreement, since examinee ability ratings do not depend on severity of individual judges.

Within an IRT framework, the scores awarded to students in peer grading are approached as a function of three variables—examinee ability, item difficulty and judge severity or lenience [Lunz, Wright, Linacre 1990]—and students' test scores are regarded as a function of two variables, examinee ability and item difficulty.

A multifaceted Rasch model was used [Lunz, Wright, Linacre 1990]:

$$(3) \log \left( \frac{P_{nijk}}{P_{nijk} - 1} \right) = B_n - D_i - C_j - F_{jk},$$

where  $P_{ni}$  is the chance of examinee completing item  $i$  successfully; examinee  $n$  has ability  $B_n$  and item difficulty  $D_i$ ; and  $C_j$  is severity of judge  $j$ , who awards rating  $k$  to examinee  $n$  for item  $i$ .

The low validity of this model manifests itself in the high level of unexpected ratings and values differing from statistical criteria. Unexpected ratings occur when judges give ratings that differ from the ones that are expected, i. e. predicted by the model.

**2. Applying  
classical test  
theory and item  
response theory to  
validity research  
using online  
courses**  
**2.1. Classical test  
theory**

Data from 1,308 learners (total registered users) in the course *Philosophy of Culture*<sup>2</sup> was analyzed. Sixty-six percent of the students were female and 34 percent were male. The age varied between 15 and 50

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<sup>2</sup> National Research University Higher School of Economics. *Philosophy of Culture*. <https://www.coursera.org/learn/filosofiya-kulturny>

years ( $M=30$  years). Forty-six percent of the enrollment had an undergraduate degree (Bachelor's/Specialist's). The majority (67 percent) had been born and lived in Russia.

The focus was on students who completed the course successfully, took part in peer assessments and were rated by at least three judges. The resulting sample was thus comprised of 188 people.

Data on peer grades, test scores and final course grades in Coursera's *Philosophy of Culture* was obtained from the final report on a student survey run by the Centre for Institutional Research, Higher School of Economics.

*Philosophy of Culture* includes five multiple-choice quizzes and two peer-review assignments. CTT was used to analyze one peer-review assignment with assessment criteria. Students were asked to write a short essay on a particular topic. Analysis involved only data from the students whose essays were rated by at least three judges. Performance was assessed using four criteria, on a scale from 0 to 3 points for each criterion. Thus, the highest total score that could be awarded by a judge was 12.

The peer-review task was the following: "Please choose a specific moment or event in history (it may be the one analyzed by the lecturer) and find typical examples of "nature vs. culture", "nature vs. spirit" and "culture vs. spirit" dualisms. If desired, you can map them into an Euler diagram". Students were given model diagrams to perform the task. One of the criteria is described below.

Criterion 1. What elements can be found in the diagram? The elements the presence of which is assessed: name of the diagram, two examples of categories, and the dualism between them.

3 points: name of the diagram, two examples of categories, the dualism between them;

2 points: three out of four elements;

1 point: two out of four elements;

0 points: only one element.

The assignment provided examples to make assessment easier, which could also be referred to when performing the task.

Final grade was calculated as follows:

*Final grade* = average score for tests and peer-review assignments (performed during 7 weeks)  $\times 0.5$  + final exam score  $\times 0.4$  + active participation in the discussion forum  $\times 0.1$

Coefficients of contribution were assigned to each type of activity by the course developer. In this particular course, peer-review assignments account for 50 percent of the final grade, so it is vital to ensure that there is no bias in peer ratings.

Ratings based on the four criteria were used to estimate the score awarded by each of the raters (the median). Next, every student was awarded a score from each of the three judges. Those scores were used to calculate the coefficient of concordance. The overall score for the peer-review assignment, which contributed to the final grade, was calculated as the arithmetic mean of the three judges' ratings. Those overall scores were used to measure correlations.

**2.2. Item  
response theory**

The sample included 1,483 student works (868 in *Philosophy of Culture* and 615 in the English-taught course *Understanding Russians: Contexts of Intercultural Communication*<sup>3</sup>). All in all, 4,449 peer grades were obtained, as every work was rated by three judges.

The peer-review assignment in *Understanding Russians: Contexts of Intercultural Communication* also consisted in writing an essay. Students were free to choose between two topics. The essay instructions explained how to structure an essay, mentioned the keywords to use, and provided length requirements.

Judges were instructed to rate essays based on six criteria. One of the criteria implied awarding the highest score in case the essay provided an answer on how to bridge cultural gaps in cross-cultural communication, specified cultural barriers and discussed them from the perspective of cultural dimensions. Other requirements included length of 500–1000 words, novelty, and references to external sources or course resources. Depending on whether the essay featured all the required content elements, it was awarded the relevant score.

Every student has an ID, for which every action on the platform is recorded. IDs of examinees and raters were used for analysis. The data was exported to the FACETS control file, which captured student's ID, IDs of the three judges, and the scores based on six criteria. In other words, the file contained comprehensive information on the students and the grades that they received from the judges.

This analysis provided information on rater bias, i. e. extreme severity or lenience in peer ratings.

**3. Peer grading  
validity measure-  
ment results**

**3.1. Classical test  
theory**

Table 1 presents the results of convergent validity evaluation.

Correlations among tests 2, 3, 4, 5, 6 and the peer-review assignment are weak and insignificant. Multiple-choice tests and peer-review assignments differ in their content. The coefficients thus do not have to be significant, since the tasks measure knowledge in different subdomains of philosophy of culture. However, the correlation coefficient of 0.57 between test 1 and the peer-review assignment is significant, so it can be concluded that peer grading is characterized by con-

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<sup>3</sup> National Research University Higher School of Economics. *Understanding Russians: Contexts of Intercultural Communications*. <https://www.coursera.org/learn/intercultural-communication-russians>

**Table 1. Correlations Between Peer-Review Assignments and Multiple-Choice Tests in MOOCs**

	Peer-review assignment
Test 1	0.57**
Test 2	0.04
Test 3	0.26
Test 4	0.18
Test 5	0.02
Test 6	0.01

\*  $p \leq 0.05$ . \*\*  $p \leq 0.01$

vergent validity as the first peer-review assignment and test 1 measure knowledge about the same constructs.

The correlation coefficient between the final grade and the peer-review assignment is 0.73 ( $p \leq 0.01$ ), i. e. significantly high. It demonstrates that peer assessment contributes a lot to the final grade and has a high predictive value. One can also talk in this case about criterion validity of peer reviews in *Philosophy of Culture*, final grade serving as the evaluation criterion.

Reliability of peer grading is determined by the coefficient of concordance, which is 0.53 ( $p=0.000$ ). This level of rater agreement is considered to be medium, which means that judges may differ in their opinions when it comes to criteria-based ratings. Rater disagreement may result from the lack of understanding of the assessment criteria or such criteria being inadequately defined. Kendall's coefficient of concordance is a simple and comprehensible statistic to assess agreement among raters, that is why this study only analyzes one example of a peer-review assignment.

Analysis of the ratings awarded for each criterion revealed that the raters tended to give extremely high or low grades, avoiding the middle categories of the rating scale. Research literature also describes the effects of rater severity or lenience, the findings being obtained within an IRT framework [Falchikov 1986; Orpen 1982; Ueno, Okamoto to 2016; Lunz, Wright, Linacre 1990].

The most important CTT-yielded findings in research on validity of peer assessment in the specified course are as follows:

1. The assignment has a medium level of convergent validity.
2. The contribution of the peer-review assignment to the final grade



must be considered significant. The level of criterion validity is just below average.

3. The level of criterion reliability is medium, i. e. experts may disagree in their criteria-based ratings. Insufficient reliability can be explained by inaccurate wording. The four criteria proposed for assessment allowed for subjective interpretation, hence considerable disagreement among raters. Criteria should be made simpler and more accurate. Grading instructions also should be more detailed, enabling students to evaluate performance of their peers more adequately.

When using these findings, it is important to consider the study's gross limitations. First, it only analyzed peer grading in terms of a single peer-review assignment in a humanities online course. There was no chance of comparing peer reviews in this task with those in other MOOCs (whether in humanities or in science). Another essential limitation consists in the sample size of under 1,000. Such limitations can be mitigated by reproducing the study in other different MOOCs (in humanities and science) that use peer grading.

Data analysis in terms of CTT also has some limitations. In particular, it provides no possibility of assessing measurement error and rater severity. These limitations were overcome by framing the analysis into item response theory.

### 3.2. Item response theory

Results of evaluating peer grading validity in *Philosophy of Culture* in terms of IRT are presented in Figure 1 as graphic measures of examinees, raters and assignment (with criteria). The left-hand side of the map displays a logit scale (log probability), which is the same for all the three facets (examinees, raters, criteria). The map is scaled using asterisks, one for every four examinees/raters.

All the facets are ranked top down: examinees from the best to the worst performers, criteria from the highest to the lowest comprehensibility, and raters from the most lenient to the most severe ones.

The far right column contains the most probable indicators for each level of examinee ability. Differences in the figure are presented as a difference between the facet elements.

In this particular case, data is ranged between  $-8$  and  $+10$  logits. As can be seen from the rater column, 28 raters are extremely lenient, i. e. their ratings are higher than those of other judges for all the criteria. It follows from the relative position of raters and students in the map that raters tend to award higher scores than deserved: most of them nestle between  $0$  and  $+4$  logits, while examinees are ranged between  $-2$  and  $+2$  logits, which means that the raters were not severe in assessing students' abilities. The distribution of examinee ability is skewed negatively, i. e. most of the students have an average level of ability which is lower than the ratings awarded by their peers. The distribution of rater severity is skewed positively, i. e. raters tend to be le-

Figure 1. **Data Map for Assessing Validity of Peer Grading in the Course *Philosophy of Culture***

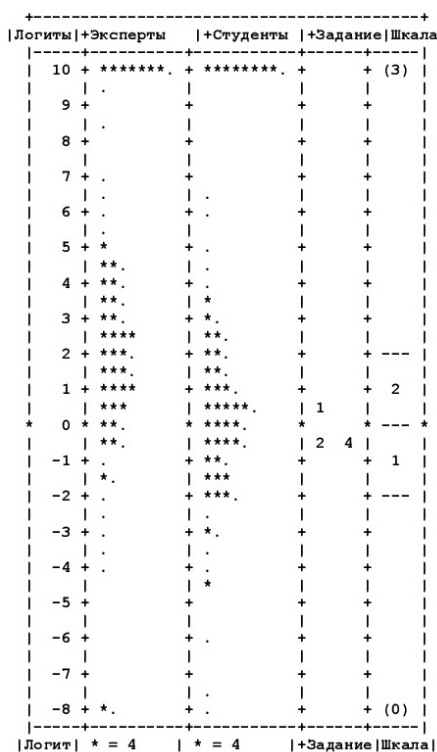
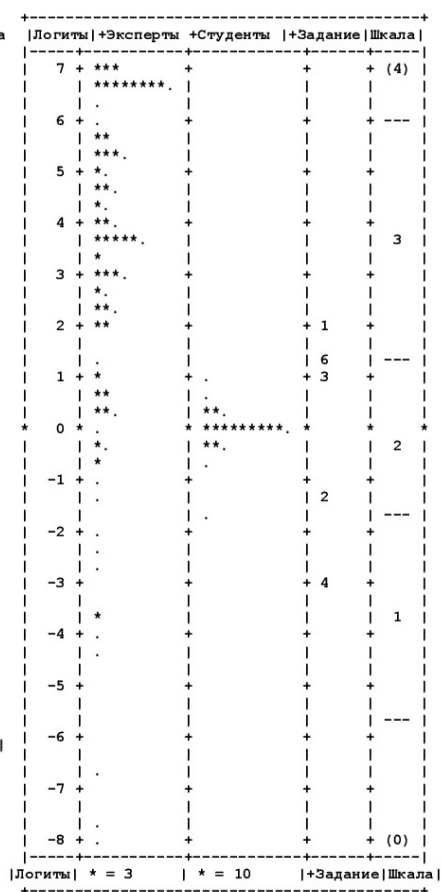


Figure 2. **Data Map for Assessing Validity of Peer Grading in *Understanding Russians: Contexts of Intercultural Communication***



nient. Such disagreement between the ratings and the levels of examinee ability indicates low validity of peer grading in this assignment.

Therefore, it was found that judges tend to rate their peers higher than deserved and the levels of examinee ability are lower than rated.

Another course was analyzed to demonstrate the opportunities of the multifaceted Rasch model in detecting rater bias.

Figure 2 presents the results of evaluating validity of peer grading in an assignment from the course *Understanding Russians: Contexts of Intercultural Communication*. The map is scaled using asterisks, one for every three examinees and every ten raters.

Data is dispersed here between  $-8$  and  $+7$  logits. The rater column shows that nine of the raters were the least severe.

Most raters are ranked between 0 and +6 logits and examinees between -1 and +1 logits. Obviously, the raters were not severe in this assignment either. It follows from the relative position of raters and students in the map that judges tend to award higher scores than deserved. Such disagreement between the ratings and the levels of examinee ability indicates low validity of peer grading in this assignment and thus confirms the findings obtained for the assignment in the first MOOC.

Therefore, analysis of data on the second assignment also shows that raters tend to rate their peers higher than deserved. The grades that they award do not correspond to the levels of examinee ability.

The most important IRT-yielded findings in research on validity of peer assessment are as follows:

1. In both MOOCs, ratings do not correspond to the levels of examinee ability, i. e. judges are largely lenient and tend to give higher ratings than deserved.
2. In both MOOCs, unexpected ratings are observed. Unexpected ratings occur when raters award scores that differ greatly from the ones predicted by the model. Despite the overall tendency toward leniency, there are experts who give lower ratings than deserved. When students with high levels of ability are underrated, it brings inequality into the conditions of task performance and course completion as such. We believe that such ratings should be discarded and factored out when computing the average assignment score and the final grade to maximize assessment objectivity. Analysis in terms of IRT also has a number of limitations:
  - It is impossible to determine whether experts overrate or under-rate their peers on purpose or just award random scores;
  - The model does not make allowance for student gender, age, motivation, or time spent on a task;
  - Analysis involved only two peer-review assignments in humanities courses.
3. For these limitations to be mitigated, further research is needed that would involve rater surveys and apply other models with more parameters (gender, age, country, etc.).

#### **4. Discussion and conclusion**

Validity and reliability of peer grading in two humanities MOOC assignments was measured using two approaches, classical test theory and item response theory. Table 4 shows the advantages and disadvantages of both.

The analysis results obtained with both CTT and IRT are comparable. Still, each of the two theories has its advantages and disadvantages.

The obvious advantage of CTT is that analysis and interpretation are easier than in IRT. This method is easy to use as a quick diagnos-

**Table 4. Measuring Validity and Reliability of Peer Grading in CTT and IRT**

	CTT (Classical Test Theory)	IRT (Item Response Theory)
1	The level of reliability was assessed as medium due to analysis limitations. Level of reliability may be considered low	Individual assignment reliability was assessed separately from examinee and rater reliability. The level of reliability is high
2	The level of criterion reliability is medium. The lowest values are obtained for criteria 1 and 3. When these two are discarded from analysis, no significant increase in reliability is observed	Criterion analysis shows that scores 1 and 0 are awarded the least often. Task performance should be assessed more severely using the existing criteria. The latter probably need to be improved
3	The level of convergent validity is medium. Peer ratings contribute significantly to the final grade. The level of criterion validity is just below average	The data fits well into the model. However, there is no reason to consider the level of validity to be high, as a number of unexpected ratings and values differing from statistical criteria are revealed
4	Analysis allowed to measure rater agreement and accuracy	Analysis allowed to measure item difficulty, examinee ability and rater severity
5	The need to improve the assessment criteria was revealed	Rater bias was revealed, namely the sample's general tendency to overrate
6	Analysis is quite simple to run	Both analysis and interpretation are more complex than in CTT
7	Measurement error was not assessed	Measurement error was assessed for examinee ability and rater severity

tic method for testing peer-review assignments. However, one should keep in mind that rater agreement depends on the competencies of a specific rater sample and the focus of analysis is limited to measuring rater agreement, providing no possibility of calculating measurement error or assessing rater severity objectively. These limitations are overcome by applying item response theory. This method is more complex but it enables the researcher to spot bias, i.e. over- or under-rating, in peer grading.

CTT-based quick diagnostics is an integral part of data analysis. It allows detecting the major weak points and outlining a vector for a more in-depth research using IRT. For this reason, applying a hybrid approach appears to be optimal to fine-tune and improve peer-review assignments.

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# Practices for Student Success: From Face-to-Face to At-Scale and Back

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Received in  
July 2018

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**Abstract.** U.S. higher education is experiencing a time of shifting landscapes, of new technologies, and of unfamiliar competitors. These and other factors, including decreasing public support for colleges and universities, mean that student success is increasingly paramount as a strategic goal for postsecondary institutions. While institutional-level activities such as increased funding for and emphasis on student advising and predictive analytics are crucial, they are insufficient for postsecondary institutions to realize broad and consistent student success. Instead, institutions can look to practices at the curriculum and course level to further student success. This article examines those learning design and teaching practices that constitute the overlap between a) higher educa-

tion research and trends and b) the lessons learned from at-scale learning experiments. Postsecondary research has shown the effectiveness of practices supported by longitudinal data (high-impact practices), represent a confluence of effective learning design and teaching practices (high-impact teaching practices), and focus attention on lowering the costs of education, thereby making access to postsecondary education at least somewhat more equitable (open-educational resources). An analysis of at-scale learning experiments at the University of Colorado allows the layering of relevant and timely examples of specific MOOC design practices on top of the higher-education research and trends framework, illustrating the ways these two strands of student-success practices mutually reinforce one another. **Keywords:** student success, learning design, MOOC, high-impact practices, high-impact teaching practices, open-education resources, scholarship on teaching and learning, University of Colorado.

**DOI:** 10.17323/1814-9545-2018-4-116-138

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Higher education is in a turbulent time, one of shifting landscapes, of new technologies, and of unfamiliar competitors. It is also a time in which student success is increasingly paramount as a strategic goal for postsecondary institutions large and small. Over the past few years, attention to student success at the institutional-level may have translated into modest gains in persistence, learning outcomes, and degree completion in the United States [National Student Clearinghouse Research Center 2017]. While institutional-level activities such as increased funding for and emphasis on student advising and predictive analytics are crucial, they are insufficient for postsecondary

institutions to realize broad and consistent student success. Universities and colleges should concomitantly, intentionally, and systematically expand exploration and support for course-design techniques and pedagogies shown to promote student success. We likely know enough already about these practices to have a positive impact on student success, but I argue that the practices have not yet gained sufficient traction on our campuses. Because they are mutually reinforcing, I contend that investigating two strands of research about learning design and teaching activities can provide a stronger foundation and motivation for faculty and administrators wishing to implement widely the course-level practices that lead to student success.

This article examines learning-design and teaching practices that constitute a conceptual overlap between a) higher-education research and b) the lessons learned from at-scale learning experiments. I begin by providing context about the United States postsecondary environment and then move to review three higher-education trends: high-impact practices (HIPs), high-impact teaching practices (HITPs), and open-educational resources (OER). I have chosen these three trends because they are supported by longitudinal data (HIPs), represent a confluence of effective learning design and teaching practices (HITPs), and focus attention on lowering the costs of education, thereby making access to postsecondary education at least somewhat more equitable (OER). I then analyze at-scale learning experiments to layer relevant and timely examples of effective practices on top of the higher-education research and trends framework, illustrating the convergence of these two strands of student success practices. Finally, I offer a call to action to encourage the broader recognition and adoption of these mutually reinforcing practices across our institutions, mutually reinforcing because at-scale learning benefits from the design and activities it borrows from traditional (face-to-face or online) design and teaching practices and in turn reinforces and validates those practices with at-scale data.

### **1. The United States context**

U.S. postsecondary education has rarely seen such relentless change and tumult as in the past decade. U.S. universities and colleges are subject to declining public support for higher education, with deep splits along urban-rural, gender, and political party lines, even as data continue to show the long-term career and economic benefits of degree completion.<sup>1</sup> State-supported institutions in individual states such as Colorado have seen an erosion of financial support from public funds. Additionally, an expected, long-term decline in high school graduates has already begun, leading to the potential for a precarious

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<sup>1</sup> Peterson J., Rudgers L. (2018) Saddle Up: 7 Trends Coming in 2018. *Inside Higher Ed*, January, 2. <https://www.insidehighered.com/views/2018/01/02/predictions-higher-education-coming-year-opinion>



decrease in enrollments in some areas of the country, for some institutional types, exacerbating the fact that a majority of funding for post-secondary institutions comes from student tuition and fees [Grawe 2017]. Student demographics continue to shift to include more students from historically underserved groups—racial minorities, low-income, and first-generation university students—which puts added pressure on universities and colleges to change to meet those students' needs and evolve campus environments to support both diversity and inclusivity. Simultaneously, institutions are under increasing workforce demands for postsecondary and post-baccalaureate learning opportunities and credentials, especially for working adults. In short, "it's tough out there."<sup>2</sup>

Within this context, growing numbers of U.S. institutions are adopting strategic goals for student success. Those goals include increasing degree-completion rates, making certain that learning outcomes are met and that students have educational pathways to future employment, and ensuring that learners from historically underserved groups realize both access to postsecondary education and successful completion of degrees. In this article, I refer to these goals collectively as student-success.

I argue that employing mutually reinforcing learning design and teaching practices from different learning modalities can improve institutional ability to meet those goals.

## **2. Student success research and practices**

The United States has a rich body of student success scholarship that stretches back decades and continues to grow in both volume and impact. Scholarship on effective teaching practices, both general and discipline-specific, is also well-established and influential. Most universities and colleges have faculty development or teaching and learning centers that expose faculty to effective teaching practices and course design. Three distinct groups of research-based practices for face-to-face or "traditional" online teaching overlap with at-scale findings: high-impact practices, high-impact teaching practices, and the use of open educational resources.

### **2.1. High-impact practices**

Although most instructors contend that they generally employ practices that lead to student persistence, learning, and completion, they have largely anecdotal, and rarely longitudinal data to describe their individual classroom successes. Rigorous research over the past decade, however, has identified a set of specific, well-defined practices that lead to student success when implemented deliberately. These 10 research-based high-impact practices (HIPs) improve student suc-

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<sup>2</sup> Peterson J., Rudgers L. (2018) Saddle Up: 7 Trends Coming in 2018. *Inside Higher Ed*, January, 2. <https://www.insidehighered.com/views/2018/01/02/predictions-higher-education-coming-year-opinion>

cess especially for those students from historically underrepresented groups.<sup>3</sup> Researcher George D. Kuh first described HIPs after analyzing data from the National Survey of Student Engagement (NSSE) in 2008.<sup>4</sup> In 2013, he and Ken O'Donnell noted that these practices, when implemented well, share key elements, such as high-performance expectations, investment of student time and effort over an extended period of time, and frequent, timely, and constructive feedback [Kuh, O'Donnell 2013].

Although continued research on HIPs show that they benefit all students, and especially historically underrepresented students, institutions can and should make improvements in how they are implemented. Jillian Kinzie and George Kuh recently reiterated the need to go beyond just making high-impact practices available to students.<sup>5</sup> Rather, they argue, for students individually and collectively to benefit from them, institutions must ensure that HIPs are implemented broadly, equitably, and with fidelity to the characteristics that made their initial instances high-impact in the first place.

Hundreds of universities across the country are working together to integrate HIPs more widely at the campus level, to ensure equitable, high-quality opportunities for all students, and to build an extensive community of faculty, staff, and administrators committed to the expansion of HIPs nationally. HIPs constitute one of the three interventions in the Taking Student Success to Scale (TS3) initiative of the National Association of System Heads (NASH), whose member institutions—public higher education systems like the University of Colorado System—collectively enroll 75% of the undergraduates in the United States.<sup>6</sup>

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<sup>3</sup> The Association of American Colleges & Universities provides information about high-impact practices and their benefits to students, and calls for campuses to be more systematic in their integration of HIPs into learning environments. <https://www.aacu.org/leap/hips> and [https://www.aacu.org/sites/default/files/files/LEAP/HIP\\_tables.pdf](https://www.aacu.org/sites/default/files/files/LEAP/HIP_tables.pdf).

<sup>4</sup> The National Survey of Student Engagement (NSSE) annually surveys first-year and senior year students' at hundreds of four-year colleges and universities about their participation in programs and activities. See <http://nsse.indiana.edu/html/about.cfm> for more details about the survey and how institutions use its results. See: [Kuh 2008].

<sup>5</sup> <https://www.insidehighered.com/views/2018/05/01/kuh-and-kinzie-respond-essay-questioning-high-impact-practices-opinion>

<sup>6</sup> See the Nash Website, "Taking Student Success to Scale (TS3)," which reports it is "a degree completion initiative led by a collaborative of higher education systems and campuses. Encompassing over 75 percent of the U.S. undergraduate student body in four-year institutions of great diversity, our member systems and campuses have the scale, influence, and desire to impact college completion in unprecedented ways. Based on the collective wisdom of our member system heads and chief academic officers, as well as research, three interventions have been identified as a starting point for

Many of the high-impact practices evidence themselves at the campus or programmatic level: first-year seminars and experiences, common intellectual experiences, learning communities, coordinated writing intensive courses, collaborative assignments and projects, and internships. I describe here those that overlap with at-scale learning design and teaching practices; examples of how they manifest in at-scale learning at the University of Colorado are provided in a later section.<sup>7</sup>

1. Undergraduate Research—opportunities for students to actively engage in research with faculty, and the concomitant changes to especially undergraduate courses to better support student understanding of concepts they will encounter in research projects.
2. Diversity/Global Perspectives—courses and programs that help students explore cultures and worldviews different from their own and that may include experiential learning in local communities or study abroad opportunities.
3. Service Learning, Community-Based Learning—experiential opportunities with community partners in which students apply learning in real-world settings by serving local communities.
4. Capstone Projects and Courses—culminating projects that require students to integrate and apply learning in a final research paper or public presentation.

Longitudinal research shows unquestionably that these practices lead to student success. Students who engage in one or more high-impact practices have been shown to persist longer in degree programs, have higher GPAs and higher 6-year completion rates than students who do not. Responding to research findings, postsecondary institutions are taking steps to ensure that high-quality HIPs are widely available, deliberately and systemically implemented, and that historically under-represented groups are encouraged to participate in them.

## 2.2. Discrete teaching practices

HIPs focus primarily on providing learning experiences integrated at the curricular or institutional level. I now turn to discrete teaching practices at the level of course design and in-classroom pedagogies for either face-to-face, hybrid, or fully online courses. A growing strand of postsecondary scholarship, the scholarship on teaching and learning (SOTL), the continued importance of campus teaching and learning centers, and the emergence of the instructional design and learning experience design professions focus needed attention

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this holistic and collective approach. These interventions are: Guided Pathways Using Predictive Analytics, Redesigning the Math Pathway, and High Impact Practices for All Students.” <http://ts3.nashonline.org/>

<sup>7</sup> Definitions are provided by the Association of American Colleges & Universities on their HIPs resource page: <https://www.aacu.org/leap/hips>.

on these course level practices, especially on those that have been shown to lead to and deepen significant learning.<sup>8</sup> SOTL research focuses dually on discipline expertise and effective pedagogy, while instructional and learning experience design combine learning science with user experience design and educational technology tools.

Because the research base is so broad, I highlight one author, L. Dee Fink, whose easily accessible guidelines for course design and corollary high-impact teaching practices are reflective of the SOTL and other pedagogical research of the past decades. In *Creating Significant Learning Experiences: An Integrated Approach to Designing College Courses* and *A Self-Directed Guide to Designing Courses for Significant Learning*, Fink recommends a learner-centered course design process with four main steps [Fink 2013; 2005]:

1. Articulating the situational context of the course for learner and instructor;
2. Defining the learning outcomes by describing how students will be different after completing the course;
3. Developing "educative" assessments that are learning experiences in and of themselves and that provide quick, frequent feedback; and
4. Designing active, experiential learning experiences.

There is a convergence even within the postsecondary scholarship on student success: Fink used HIPs research as motivation to translate his design principles into a list of high-impact *teaching* practices (HITPs). He contends that, over time, HITPs can radically transform postsecondary teaching for the better, moving attention from the institutional level to course and classroom level, and shifting focus from teaching to learning [Fink 2016]. Unlike HIPs, which often require coordinated, campus-level effort, HITPs are especially beneficial because instructors can quickly integrate them into day-to-day learning activities. Building on his principles of course design, Fink's HITPs include incorporating activities that encourage a "growth mindset" on the part of students (as opposed to a "fixed mindset"), providing structured team-based learning opportunities, and engaging students in both service learning and reflection.<sup>9</sup>

### 2.3. Open educational resources to increase learning and degree completion

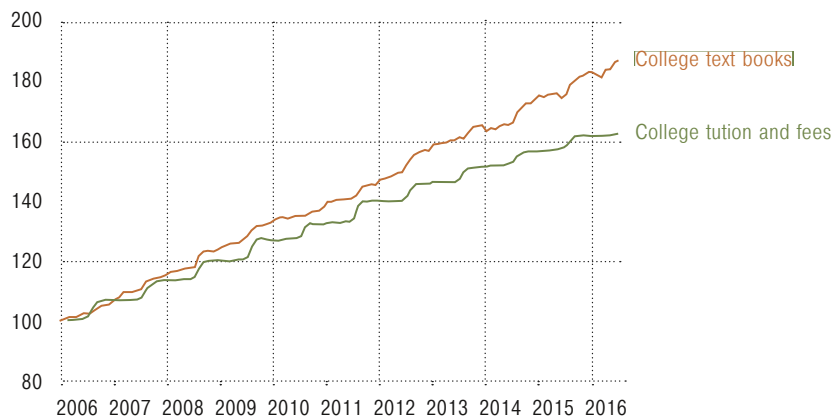
Combining HIPs at the campus and programmatic level with high-impact teaching practices at the course and classroom level can provide a double dose student success practices. The increase in adoption of open-education resources (OER) represents another trend in U.S.

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<sup>8</sup> For an overview of SOTL, including methodologies and references, see: <https://www.stlhe.ca/sotl/what-is-sotl/>

<sup>9</sup> See <https://www.mindsetnetworks.com/Science/> for the science behind mindsets, as well as practices and case studies.

Figure 1: **Percentage increase in U.S. textbook cost since 2006.**



postsecondary education practice that may also lead to student success, as well as to equitable student access to learning materials. The William and Flora Hewlett Foundation has defined open educational resources as “teaching, learning and research materials in any medium—digital or otherwise—that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions.”<sup>10</sup>

Although the OER movement includes many practices, including sharing and co-creation of pedagogies and learning objects, postsecondary and mainstream media most frequently cover the use of OER as textbook replacements. When faculty switch from expensive textbooks to open, sharable versions, especially in large undergraduate courses, the cumulative savings for students is high and plays at least a small a role in lowering the cost of education.

Many faculty in the U.S., and especially at two-year community colleges, are turning to open digital textbooks provided by organizations such as the Open Textbook Network or OpenStax.<sup>11</sup> Although the cost of textbooks represents only a fraction of the total cost of attendance for U.S. students, textbook costs rose dramatically between 2006 and 2016 (see Figure 1), nearly doubling in price in this period, rising even more steeply than increases in

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<sup>10</sup> <https://www.hewlett.org/strategy/open-educational-resources/>

<sup>11</sup> Both Open Textbook Network <https://open.umn.edu/opentextbooks/> and OpenStax <https://openstax.org/subjects> offer free, peer-reviewed textbooks and work with both individual faculty and whole institutions interested in adopting open textbooks. A group from the California State University System created MERLOT (<https://www.merlot.org/merlot/index.htm>) as a curated repository for open online learning and support materials.

tuition.<sup>12</sup> Additionally, two recent studies show that between 66% and 85% of students delay purchasing a textbook or forego purchasing one altogether. One study found that fully 91% of students who did not purchase a textbook cited cost as the reason and that half of those asserted that their learning and grades suffered as a result.<sup>13</sup>

Increased adoption of OER can counter the disadvantages of high textbook prices and the propensity of students not to purchase them. In addition to providing financial benefit to students, OER allows all students to have access to learning materials on the first day of classes. OER adoption as textbook replacement, therefore, has the potential to ensure equitable learning opportunities for all students. Nascent research on OER adoption indicates that students in courses with OER enroll in more credit hours and enjoy similar or even improved learning outcomes than in courses that do not use OER, thereby providing the potential to lower time-to-degree and raising completion rates [Hilton 2016].<sup>14</sup> Because of these benefits, states throughout the country like Colorado are investing heavily in OER initiatives, in part by providing grant funding to faculty, promoting the use of OER through faculty and staff professional development opportunities, and evaluating the impact of OER adoption.<sup>15</sup>

### **3. Converging student success practices**

In short, HIPs, high-impact teaching practices, and OER together point to a set of common practices that can lead to student success and that overlap with at-scale learning design principles, including:

1. Employing learner-centric design that focuses scrupulously on learner outcomes;
2. Designing educative learning assessments that are frequent, provide quick feedback, and offer a capstone or reflective experience;
3. Providing significant experiential learning that includes research, service or community assignments, and interaction with and between students from different backgrounds or countries; and
4. Incorporating open resources, including textbooks, learning materials, or even courses, to ensure equitable access to learning opportunities.

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<sup>12</sup> <https://www.bls.gov/opub/ted/2016/college-tuition-and-fees-increase-63-percent-since-january-2006.htm>

<sup>13</sup> <https://campustechnology.com/articles/2016/08/24/report-students-shun-new-textbooks-to-reduce-education-expenses.aspx> and <https://www.insidehighered.com/quicktakes/2017/09/20/study-high-textbook-prices-lead-poor-grades>

<sup>14</sup> See also the study of Virginia State University's School of Business concluded that higher grades were correlated with courses that used OER: [Feldstein et al.].

<sup>15</sup> <https://medium.com/@CoHigherEd/the-brave-free-world-of-open-educational-resources-16446868791b>

#### **4. At-scale learning design**

While the research base for student success is relatively well-established, scholarship on at-scale learning is necessarily in its infancy. Much of that research analyzes learner demographics, participation, and completion of courses. In general, critics of at-scale learning correctly note that completion rates are very low for open, at-scale learning, as low as 4% in one study, although completion rates rise when learners pay for enhanced learning opportunities and certificates [Chuang, Ho 2016]. Demographic research indicates that major platforms such as EdX and Coursera might not be as egalitarian as initially hoped: they tend to reach learners who already have postsecondary degrees and are working professionals from developed countries. One study, however, showed tangible career and economic benefits to learners who completed at-scale courses, noting that learners with lower levels of socioeconomic status and education in developing countries were “significantly *more* likely to report tangible career benefits.”<sup>16</sup>

Because research on at-scale learning is relatively new, there exists little that evaluates the impact of design principles that might lead to student success (again: persistence, learning, and completions) both at-scale and, if transferred to them, for more traditional modalities such as face-to-face, hybrid, or “traditional” online. For that reason, sources different than traditional research studies reveal the lessons learned about at-scale learning detailed below: direct experience guiding faculty to design effective massive open online courses (MOOCs) and specializations; effective practices developed by Coursera through data analysis of existing courses and formalized in design workshops, documentation, and practices; and learner feedback to University of Colorado faculty and staff responsible for the continued success and improvement of courses.

#### **5. The University of Colorado context**

The University of Colorado System (CU) comprises four separate universities: the University of Colorado Boulder, the University of Colorado Anschutz Medical Campus, the University of Colorado Colorado Springs (UCCS), and the University of Colorado Denver. The CU System is a public university that is provided some financial support by the state of Colorado and is funded largely through tuition and fees.

The University of Colorado has been a Coursera partner since 2013 and has launched nearly 100 MOOCs and 18 specializations (a series of four-to-six short, roughly one-month courses) with over two million enrollments combined.<sup>17</sup> Coursera’s evolving business model means that this content is more accurately described as at-scale learning op-

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<sup>16</sup> Zhenghao C. et al. (2015) Who’s Benefitting From MOOCs, and Why. Harvard Business Review, September, 22. <https://hbr.org/2015/09/whos-benefitting-from-moocs-and-why>

<sup>17</sup> See <https://www.cu.edu/mooc> for current data on CU’s Coursera content.



portunities: only videos and discussion forums remain open, while assessments are reserved for learners who pay a fee for a course or specialization certificate.

Faculty from all four campuses may opt to teach at-scale on the Coursera platform for a variety of reasons. Some experiment with new pedagogical models or engage in SOTL research. Others are evangelists for their disciplines. Still others see the potential to recruit students into their traditional programs or to contribute to workforce development needs. Whatever the motivation for commencing, most CU instructors report changing their practices in their face-to-face or on-line teaching once they have undergone the intense experience of designing for at-scale learning.

## **6. Lessons learned from at-scale design**

As the Coursera point-of-content for three of the CU campuses, I have had the opportunity to support faculty in their course and specialization design, write and evaluate proposals for at-scale courses and specializations, participate in several Coursera design workshops, speak formally and informally with faculty about their experiences, and review beta testing and course data with an eye toward continuous improvement. My observations of course development across many fields, combined with opportunities to reflect on those observations in the context of teaching and learning trends in postsecondary education, suggest a set of four at-scale design and teaching practices. These practices are especially in evidence in those courses that attract the greatest number of enrollments, completions, and payments and/or the highest ratings—or most passionate learners.

## **7. Unwavering attention on the learner and learning outcomes**

Instructors developing content for the Coursera platform begin by considering the learner—who they are, how they might discover and enroll in a course, and what their life experiences might be. For many faculty, teaching on the Coursera platform is their first exposure to significant numbers of non-U.S. learners and, for some, their first time designing learning experiences for working professionals, both of which require a new orientation toward structure and presentation of content. Early in the design process, faculty are encouraged to create a few personas about hypothetical learners and detail potential background stories, behaviors, life situations, attitudes, goals, and skills. Foregrounding these personas through design, launch, and continuous improvement helps instructors maintain a learner-centric approach.

Throughout the design process, faculty consider how a student changes during and because of the course—in skills, beliefs, knowledge—and how assessments can provide evidence of that learning. Because learners on the Coursera platform are largely working professionals, faculty creating many of CU's courses and specializations design for a learner seeking tangible benefits from a course: a new job,

a promotion, a transition to a new field, skills to improve work performance. They consider how course completion may align with professional credentials, such as continuing medication education credits.

Fink emphasizes the importance of articulating the situational context of learners, especially with regard to content and encouraging in students a growth mindset [Fink 2005]. Providing context, continuity within and between courses, and coaching are critical practices for student success.

These practices in face-to-face classrooms are often implicit or intuitive: faculty sense when a student might not understand and might instinctively let students know when a difficult section of the course is approaching. Effective instructors provide context for their students and coach them through the course, often without even having to think about doing so. These practices are more difficult to integrate into at-scale learning because the implicit must be made explicit. Context, continuity, and coaching must be woven into videos and assignments. All faculty designing at-scale courses are encouraged to frequently ground learning in the larger context of the learners' professional goals or the discipline itself, and to provide explicitly continuity from one module to the next. Most videos begin with a few sentences about what learners will be able to do at the end of the module and end with a few words about the next video. The latter practice in particular seems to increase persistence from one video to the next. To provide context to his learners, Professor Tim Chamillard (UCCS) gives a graphic representation of the flow of the courses in his "C# Programming for Unity Game Development" specialization, allowing the students to see in graphical form (a sine wave) when the workload will be heavier and lighter. He also encourages them in his videos, explicitly acknowledging difficult concepts or weeks, while reassuring learners that they will succeed and have an easier following week.

**8. Educative assessments that provide frequent, quick feedback**

The Coursera platform offers a significant benefit to faculty and learners: automatically- and peer-graded assessments in a mastery learning environment. These two features allow the large enrollments in courses without an overwhelming amount of work or monitoring by faculty. Automatic grading allows frequent formative and summative assessments—from weekly quizzes, to final texts, even to a one-question, in-video knowledge check—without the burden of faculty grading. When both correct and incorrect responses are annotated, even a multiple choice quiz becomes a learning experience in and of itself, especially when taken more than once. Similarly, peer-graded assessments with detailed rubrics promote reflection on learning and offer an opportunity to receive rich feedback about writing or other projects.

Several University of Colorado faculty design intentionally educative assessments and programming projects for their learners. In particular, Dr. Jay Lemery (Anschutz Medical Campus) incorporates

a case study as the final assessment for his "Global Health Responders" course. Learners write memos as a global health responder assisting in a refugee crisis planning. Similarly, Greg Williams (UCCS) uses a case study project at the end of his "Detecting and Mitigating Cyber Threats and Attacks" course to propose detection and mitigation strategies that could have been used by a company that suffered a data breach. The final assessment of his "Proactive Computer Security" course allows students to test their cyber security detection and mitigation skills in a safe computing environment.

## **9. Experiential learning**

While at-scale courses feature rich videos and frequent, automatically-graded assessments, they run the risk of being little more than television programs with quizzes. To counter this risk, many at-scale courses incorporate learning opportunities that align with the HIPs listed above. University of Colorado faculty have incorporated research opportunities, global learning, community-based learning, and capstone projects in their Coursera courses.

*Research Opportunities* Roger Martinez (UCCS) has created a "Deciphering Secrets" series that empowers learners to conduct primary research as co-creators of new knowledge. After providing learners the opportunity to explore the historical, religious, and social contexts of walled cities in medieval Spain, Professor Martinez teaches paleography, the deciphering of medieval manuscripts, and then offers the opportunity for students to transcribe and translate newly digitized manuscripts from the archives of these walled cities. Professor Martinez estimates that the learners the initial offering of his first at-scale course completed in 6 weeks the work it would have taken a researcher 10 years to finish. The opportunity to work with primary documents and to contribute to the larger body of knowledge has proved to be an engaging experience for learners that encourages both persistence and passion.

*Diversity/Global Learning* All learners on the Coursera platform are necessarily exposed to worldviews different from their own: learners come from all around the globe, and bring with them diverse political, religious, cultural, and economic experiences and views. The challenge for faculty is to be aware of any implicit ethnocentric frames inherent in their classes and to be prepared to address any cultural misunderstandings. Setting expectations for behaviors in the discussion forums is critical, as is the willingness for faculty to intervene in the case of altercations. Many CU faculty teaching on the Coursera platform recruit "Community TAs" from around the globe to assist with monitoring discussions, with an eye toward recognizing and addressing cultural misunderstandings.

*Service Learning/Community-Based Learning* While traditional service learning in the HIPs literature has a component of giving back to a student's community through deliberate, structured service, community-based learning also can be part of at-scale courses. In an upcoming palliative care specialization created by a team on the Anschutz Medical Campus, learners apply what they have learned in their own communities. Using a "Nature of Suffering Evaluation Form," learners interview a person with a chronic or fatal illness, practicing the very skills they will need as professionals in the palliative care field. Reflecting on their experiences in applying new knowledge in real-world settings both promotes deep learning and prepares them for professional work.

*Capstone Projects* In the HIPs literature, capstone projects are a culminating experience at the end of a full degree. At-scale learning is modularized, so capstone projects on the Coursera platform are featured at the end of specializations, which take a period of time roughly equivalent to a single semester to complete. The "Data Warehousing for Business Intelligence" specialization created by Professors Mike Mannino and Jahan Karmini (Denver) provides a culminating experience that allows learners to integrate and apply what they learned in the specialization. Using a case study approach and building on the prior courses, learners design and build a data warehouse, integrate data, and write analytical queries as the basis for data visualization and dashboard design.

#### **10. Open educational resources at-scale**

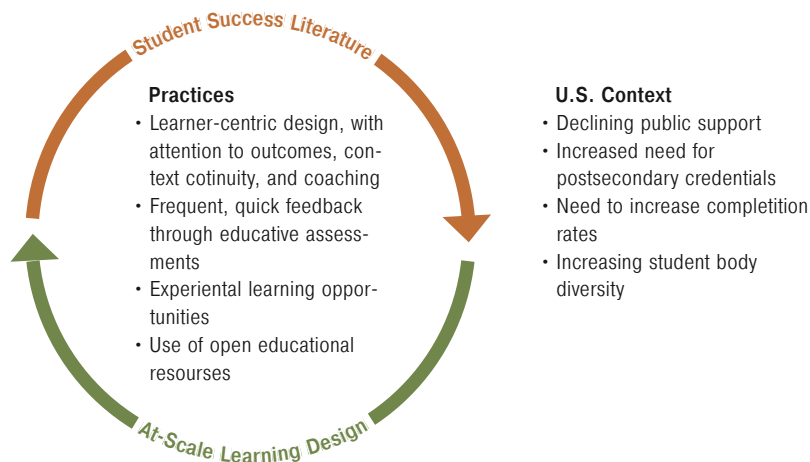
While Coursera and other MOOC providers' courses could be considered free educational resources, in 2012 and for a few years after, they stopped being truly open. That is, although the access was free, there were and are restrictions on use, adaptation and redistribution by others. Additionally, since some of the most important aspects of the courses—assessments, feedback, and credentials—are behind a paywall, at-scale courses on the Coursera platform have moved even further away from being open.

Although a Coursera paywall exists, learners are not considered regular university students. Faculty are therefore discouraged from claiming fair use exemptions for any copyrighted materials they wish to post in their at-scale courses. This provides motivation for faculty to turn to open educational resources instead and many learn about OER options for the first time through working with librarians to choose materials for their at-scale courses.

#### **11. Convergent, mutually reinforcing practices for student success**

Lessons learned through at-scale course design and research-based teaching overlap conceptually with practices gleaned from student success and SOTL scholarship. In fact, a strong research base com-

Figure 2: **Convergent Practices for Student Success.**



bined with analysis of learner behavior on the platform constitute the foundation for many of Coursera's recommendations for at-scale learning design:

1. Learner-centric design, with attention to outcomes, context, continuity, and coaching;
2. Frequent, quick feedback through educative assessments;
3. Experiential learning opportunities; and
4. Use of open educational resources.

Figure 2 encapsulates the idea of converging, mutually reinforcing sources for student success practices. The U. S. postsecondary context provides the urgency for ensuring that these practices are adopted broadly.

**12. A modest call to action: from conceptual overlap to mutually reinforcing**

One of the least touted benefits of at-scale learning is the ability to know immediately and at full volume when a part of a course is unsuccessful. Discussion forum posts critical of course content, though representing a very small percentage of learner voices, nonetheless motivate faculty to make changes in the course. Negative comments from even a very small percentage of a very large number of learners still represent more complaints than a faculty member might have received in an entire professional career.

More importantly, data analysis on the Coursera platform can help pinpoint when learners drop a course, help understand which modules might have mismatched assessments and content, which videos or assignments result in greater engagement. CU faculty teaching on

Coursera have been eager to make adjustments to their courses in response to learner feedback and data analysis. Even more importantly still, most have reported changing their face-to-face and “traditional” online practices to better align them with known effective practices.

For all of our insights into student success, we still do not know exactly how individual people learn. We make very good guesses based on research from any number of disciplines, including biology, neuroscience, and education. We use longitudinal data about practices to make solid recommendations about which seem to have the best chance of leading to improved learning outcomes and degree completion, and which seem to be especially beneficial for historically underrepresented groups. With the expansion of at-scale learning, we have an unprecedented opportunity to use truly big data to test those learning practices for effectiveness at-scale. Although there is clear support for at-scale learning design practices in the student success and SOTL literature and vice versa, the relationship between the two could be strengthened to the benefit of institutional student success goals. Deliberately incorporating HIPs, high-impact teaching practices, and OER into at-scale learning and then testing their effectiveness for persistence and completion, even at the micro-level of a learning module, would provide data that can lead to increased financial, administrative, and even faculty support for continuous improvement of course design in all modalities and thereby to increased student success.

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# Learning Analytics in Massive Open Online Courses as a Tool for Predicting Learner Performance

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Received in  
September 2018

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**Abstract.** Learning analytics in MOOCs can be used to predict learner performance, which is critical as higher education is moving towards adaptive learning. Interdisciplinary methods used in the article allow for interpreting empirical qualitative data on performance in specific types of course assignments to predict learner performance and improve the quality of MOOCs. Learning analytics results make it possible to take the most from the data regarding the ways learners engage with information and their level of skills at entry. The article presents the results of applying the proposed learning analytics algorithm to analyze learner performance in specific MOOCs developed by Ural Federal University and offered through the National Open Education Platform.

**Keywords:** massive open online courses, learning analytics, empirical evidence, online learning, assessment tools, checkpoint assignments, academic performance monitoring.

**DOI:** 10.17323/1814-9545-2018-4-139-166

This study was supported by financial assistance provided under the Resolution of the Government of the Russian Federation No. 211, Contract No. 02. A03.21.0006. Translated from Russian by I. Zhuchkova.

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Due to the emergence of massive open online courses (MOOCs) that have swept the global education market [Semenova, Vilkova, Shcheglova 2018], online learning technologies have become widespread not only in informal education but in higher education and continuing professional development as well over the past decade [Eu-

ropean Association of Distance Teaching Universities 2018; Netology Group 2017]. Use of MOOCs in education programs [Roshchina, Roshchin, Rudakov 2018] has allowed universities and vocational schools to expand their educational choice options and create conditions for virtual mobility among students [Sancho, de Vries 2013], enhancing access to education and reducing college costs [Larionova, Tretyakov 2016]. In resorting to MOOCs, universities face the problem of selecting high-quality courses as well as the need to measure the effectiveness of online learning. The strategies for selecting online courses and the methods of assessing their effectiveness must be analyzed comprehensively in order to come up with well-defined decision-making criteria. Learning analytics in MOOCs is one of the key tools to improve education quality [O'Farrell 2017]. Not only does learning analytics data allow for monitoring learner performance and analyzing learner engagement but it also provides objective information on the effectiveness of online learning methods and techniques applied.

MOOC platforms offer diverse online courses [Hollands, Tirthali 2014]. The quality of MOOCs as a selection criterion is determined by how effective they are in achieving educational goals. In accordance with the experts' definition [Zagvyazinsky, Zakirova 2008; Samokhin et al. 2018], education effectiveness is understood as "the extent to which education outcomes are consistent to established goals", not just as an equivalent of economic efficiency defined as the ratio of actual education outcomes to the resources invested [Vishnyakova 1999]. The reliability of online learning effectiveness measurements depends on the adequacy of assessment tools and their consistence with the course performance requirements. Unlike with the conventional learning system, where the teacher provides a subjective face-to-face assessment of the student's knowledge and skills, MOOCs which imply exclusively distant interactions normally suggest that education outcomes are assessed using automated tests or peer reviews. Assessment objectivity requires fulfillment of the following conditions, which constitute the underlying principles of classical test theory and item response theory (IRT) [Crocker, Algina 2010].

- MOOC objectives must be formulated based on specific learning outcomes [Nekhaev 2016];
- Learning outcomes must be measurable;
- Assessment tools must be valid, reliable and sensitive to different levels of learner progress;
- Assessment results must be trustworthy and representative [Shmelev 2013].

The existing psychometric methods allow for assessing the quality of tests using the mathematical models and analytical procedures which are applied to analyze answers to specific test items [Mayorov 2002; Zvonnikov, Chelyshkova 2012]. The information theory-based algo-

rithm of assessing the informational value and quality of MOOC assessment tools proposed in this article expands the range of psychometric instruments and can be used to complement the conventional measures of test validity.

The social need for studying the effectiveness of digital technology in education has to do with the acute problem of organizing education in the information society with its high rates of technology turnover and lifelong accumulation of statistics on this type of learning. Reasons for low lifelong learning development rates may include, in particular, defects in the existing online courses and low motivation of students, who mostly belong to the so-called Generation Z, characterized by dependence on technology, impatience, drive for participation [Freitas, Morgan, Gibson 2015] and the habit of using the Internet to find information [Gryaznova, Mukovozov 2016; Guo, Kim, Rubin 2014; Tyler-Smith 2006]. Conventional teaching techniques prove to be low-effective for this cohort, so the need to modernize the learning process comes to the fore.

Apart from being socially relevant, research on the effectiveness of using online technology in education also has a pedagogical aspect. The content in online learning is still based on conservative mass education programs, and no allowance is made for the new educational paradigm [Jansen, Schuwer 2015; Kop, Fournier, Mak 2011]. Advocates of the traditional approach treat MOOC content as a series of video lectures and standard reading modules, although it has been about twenty years since education began to be understood not only as access to information but as the acquisition of specific practical skills as well [Lundvall, Borrás 1997; Nonaka, Takeuchi 2011]. As a result, MOOC statistics usually demonstrate a radical decrease in learning engagement and a gap between what learners expect and what MOOC providers have to offer [Brown, Lally 2017; Castano Muñoz et al. 2016]. A comparative study of the effectiveness of different online technologies will provide an opportunity to reduce that gap.

Effectiveness of online learning is crucial for a modern learner, too. In the information age, people want their learning trajectories to be AI-personalized to suit their personal needs and abilities. MOOCs provide ample opportunity for customized education and lifelong learning [Deev, Glotova, Krevskiy 2015], in particular because they are adaptable to students' individual needs and characteristics.

The technological implications of this study are predetermined by the format of exclusively distance learning courses, which implies documentation of learning outcomes as a "learner footprint" in the digital learning environment. This allows for monitoring individual learning trajectories, identifying cause-effect relationships between learner engagement and learning outcomes, exploring possible reasons for failure, and predicting ultimate progress based on average student performance. In addition, learning analytics is one of the few objective indicators of MOOC quality and is actively used to improve it.

The central hypothesis of this study is that learning analytics can be used to obtain objective information on the effectiveness of online learning and predict the academic performance of different types of learners. The study aims at developing learning analytics algorithms in order to evaluate the quality of MOOC assessment tools, analyze patterns of learner performance, and predict the probability of success/failure using the statistics on MOOCs provided by Ural Federal University and available through the National Open Education Platform. Achieving this goal involves the following objectives: (i) analyze the quality of MOOC assessment tools based on empirical evidence; (ii) estimate and compare functions of learner performance distribution for all midterm and final tests; (iii) clusterize learners by their performance and analyze their progress in dynamics; (iv) construct a probability model of changes in performance among different types of learners throughout the course. The study also seeks to identify factors that have negative effects on student performance in MOOCs. Research findings will help develop recommendations for course developers, in order to enhance teaching methods in online learning and improve the quality of assessment tools, as well as for MOOC tutors and engineers.

## **1. Theoretical aspects of online learning effectiveness**

### **1.1. Characteristics of learning with MOOCs**

A massive open online course is understood here as an openly accessible, structured, theoretically substantiated, goal-oriented set of educational materials, assessment tools and other distance learning resources. An online course determines the teaching methods, progress checkpoints and tools for assessing learners' knowledge and skills. Student-teacher and student-student communication is provided using digital learning environment services. The well-elaborated pedagogical design of an online course ensures achievement of the learning outcomes, provided that entrants possess the required knowledge and skills and sufficient motivation for learning.

A MOOC can be taken by anyone regardless of age, location, educational background and financial opportunities. Most MOOCs are asynchronous, i. e. knowledge is transferred from teacher to student with a time lag. This allows MOOC learners to customize their learning schedules with due regard to their individual preferences and abilities and choose their own pace in accessing course materials and doing assignments. Self-paced courses are not bound to specific dates and are offered in the "on-demand" format, which means they can be accessed at any time which is convenient for the learner. To ensure a consistent pace and improve self-regulation among students, most courses set deadlines for application, webinars and tests, including final exams.

To obtain a certificate of completion, a MOOC learner must complete name verification and take an online proctored final exam. Certificates are issued to learners who meet the course passing threshold

(specified in course overview) and pass the final exam. Final exams with online proctoring are usually taken for a fee. University students may earn credits for MOOCs in their major or minor by submitting a certificate of MOOC completion. Credit transfer procedures are regulated locally by educational institutions.

### **1.2. Factors of online learning effectiveness**

In contrast to digital teaching and learning packages as a series of syllabus-related teaching materials and assessment tools, important features of MOOCs include organization of the learning process and consistent monitoring of learner performance. In this regard, every MOOC is a set of unique teaching techniques. Their effectiveness is measured not so much by content quality as by teaching methods applied in the digital learning environment and by the quality of assessment tools allowing adequate measurement of learner progress.

Predictors of effective online learning include:

- Methodologically substantiated presentation of digital content in consistence with the learning cycle [Kolb 1985];
- Use of interactive learning technology;
- Monitoring of learning outcomes and detection of bugs and errors throughout the course;
- Organization of learners' interaction;
- Learner support and motivation strategies;
- Use of active online teaching methods;
- Collection and statistical analysis of learner feedback;
- Prompt changes and updates, when necessary [Jasnani 2013].

MOOC design is thus a complex pedagogical challenge that requires a high level of professional expertise, teaching experience, methodological and information technology skills. The key to designing an effective online course is the use of interactive technology based on active teaching strategies in the online format [Lisitsyna, Lyamin 2014].

As we can see, the use of a digital learning environment services allows for regulating the learning process distantly and running online courses without direct teacher-student interaction. Course maintenance is thus restricted to keeping the content up to date throughout and after the course as well as providing student counseling services. As maintenance is ensured with regard to original course content and teaching methods, it does not require the direct participation of the course designer just as it rarely requires in-depth knowledge of the subject matter from counselors. Therefore, the teacher's main function consists in creating an online course, while the learning process may be controlled by tutors who provide methodological and organizational support to students, advise them on the choice of MOOCs and credit transfer opportunities, and help them build personalized learning trajectories, creating the conditions for successful performance in midterm and final checkpoint assignments.

**1.3. Use of learning analytics to support learners**

As compared to traditional education, where teachers get feedback from students only in face-to-face interactions, online learning leaves a digital footprint, with all learner accomplishments and activities during the course being recorded in the digital learning environment. Analysis of such data—learning analytics—allows for monitoring learning consistency, student progress and assignment performance.

Learning analytics is based on analyzing big data on learning behaviors in MOOCs [Usha Keshavamurthy, Guruprasad 2014]. It can provide a lot of information on the causes of learner success and failure and allows for predicting future learning behaviors. Findings are used to fine-tune learning contexts, support students and adapt them to new environments [O'Farrell 2017]. The core objectives of learning analytics are as follows:

- Measure, collect and present data on user behavior;
- Analyze student performance throughout the course;
- Analyze behavioral patterns using big data;
- Establish cause-effect relationships between performance indicators and learning activities;
- Detect errors and methodological issues in MOOCs;
- Develop recommendations for course content revision;
- Predict student success or failure.

Learning analytics includes diverse methods, from descriptive statistics to data mining. Additional sources of information, along with streaming data on user behavior fetched from MOOC platforms, may include administrative databases of educational institutions, surveys of learners and instructors, pre-test results, etc.

The global leaders in learning analytics include the National Forum for the Enhancement of Teaching and Learning in Higher Education, the National Research Center for Distance Education and Technological Advancements at the University of Wisconsin-Milwaukee and Ed-Plus at Arizona State University.

Research at Arizona State University is currently focused on finding efficient adaptive learning tools using big data on MOOC learner behaviors. By identifying behavioral patterns at the early stages of learning and classifying students based on their learning activities, researchers examine the factors that have a positive impact on student performance and use them to predict course completion (e. g. [Sharkey, Ansari 2014]).

**2. Research methods**

The algorithms described below are applied, among other things, to analyze the informational value and quality of MOOC assignments, which must differentiate between learners by level of performance as well as ensure and reflect their consistent progress. Another equally important objective consists in predicting checkpoint performance among students at different stages of their progress which is meas-

ured by average student performance. Such a prediction will allow for adapting learners with different performance levels to course requirements by additional counseling, personalized assignments, etc.

From the standpoint of the first objective, assignments that are either passed or failed by the great majority of learners should be recognized as equally ineffective, as they provide instructors with no information on course progress or the performance of individual students.

Informational value of assignments in terms of how well they are able to differentiate learners by their performance is assessed using standard information theory methods. If the distribution of checkpoint test grades (measured in scores) is labelled as  $(x)$ , the fact that an individual learner has obtained a specific score will be loaded with the following number of information bits [Korn, Korn1973]:

$$(1) \quad I = - \int_0^{100} \varphi(x) \cdot \log_2(\varphi(x)) \cdot dx, \text{ bit}$$

In practical calculations, the range of scores is divided into ten-point discrete intervals, and the integral is transformed into a sum of integral elements for such intervals. For convenience, this value will be compared to the maximum amount of information to which uniform distribution  $\varphi_1(x) = 1/n$  corresponds, where  $n$  is the number of intervals:

$$I_{\max} = \log_2(n) = 3.22$$

In this case, the informational value of a checkpoint assignment will be described by measure

$$(2) \quad inf = 100 \frac{I}{I_{\max}}$$

rounded to the nearest whole number.

Statistical characteristics of individual learner performance in a series of checkpoint assignments must be analyzed to determine course progress and predict course completion. Our previous study [Larionova et al. 2018] examined changes throughout the course in the statistical distributions of scores among categories of learners identified based on their average performance in earlier periods (A students, B students, etc.).

To solve the problem of reflecting learner progress with the use of assessment tools, we will introduce three learner categories based on learner progress:

- Non-performers, who failed the assignment, i. e. scored under 40 ("Failure");
- Average performers, whose scores are ranged between 40 and 60 ("Pass"); and
- Constant performers, who scored 60 or higher ("Success").



There can be more categories, but three is enough to fully describe the level of learner progress and ensure that results are illustrative.

While taking a course and the checkpoint assignments within it, MOOC learners migrate from one category to another. If such transitions are traced for every student, the probability of cross-category transition for each checkpoint can be estimated. Accuracy of estimates depends on the number of learners in the sample: the larger the sample, the more accurate the probability of transition. Such estimates will allow for making inferences on how checkpoints reflect learner progress as well as predicting performance in checkpoint assignments among learners of different categories. Predictions like that require the accumulation of information on transition probabilities and the processing of large volumes of data on performance in the checkpoint assignments.

Let us label as  $|i\rangle$  and  $|j\rangle$  learner status before and after a checkpoint, respectively (status being understood as belonging to category  $i$  before the assignment and  $j$  after it;  $i, j = 1, 2, 3$ ). Suppose each cross-category transition corresponds to operator  $T_{ij}$ , which is defined as follows:

$$(3) \quad T_{ij} \cdot |i\rangle = |j\rangle$$

Operator  $T_{ij}$  is the operator of transition  $i \rightarrow j$ , transition probability being determined by the matrix

$$(4) \quad \hat{P} = \begin{pmatrix} P_{11} & P_{12} & P_{13} \\ P_{21} & P_{22} & P_{23} \\ P_{31} & P_{32} & P_{33} \end{pmatrix}$$

Matrix  $\hat{P}$  is asymmetric, its entries satisfying the condition:

$$(5) \quad \sum_{j=1}^3 P_{ij} = 1$$

The number of learners in every category, at probabilities (4), can be estimated using the model proposed by Astratova et al. (2017), which allows for determining the probability that categories 1, 2, 3 will contain  $X_1, X_2, X_3$  members, respectively, at the moment of time  $t - P(X_1, X_2, X_3 | t)$ . The equation for  $P(X_1, X_2, X_3 | t)$  is written as follows:

$$(6) \quad \frac{\partial P(X_1, X_2, X_3 | t)}{\partial t} = P(X_1, X_2, X_3 | t) \cdot \{(1-z) \cdot \sum_{j=1}^3 P_{ii} - \sum_{j=1}^3 X_j\} + \\ + z \cdot \sum_{i=1}^3 (X_i + 1) \cdot P(\dots, X_{i+1}, \dots | t) + (1-z) \cdot \sum_{j=1, i \neq j}^3 P_{ij} \cdot (X_i + 1) \times \\ \times P(\dots, X_{i+1}, \dots | t)$$

In this equation,  $z$  is the probability of learner withdrawal per unit of time. Hereinafter,  $z$  will be considered equal to zero (for this purpose,

students who withdrew should be excluded from analysis at the preliminary stage).

Equation (6) can be solved in a general fashion, but for most types of problems, analysis of means and covariances will suffice:

$$(7) \quad \bar{X}_i = \langle X_i \rangle = \int_0^{100} X_i \cdot P(X_1, X_2, X_3 | t) \cdot dX_i,$$

$$\sigma_{ij} = \overline{(X_i - \langle X_i \rangle) \cdot (X_j - \langle X_j \rangle)} = \int_0^{100} X_i \cdot X_j \cdot P(X_1, X_2, X_3 | t) \cdot dX_i \cdot dX_j - \langle X_i \rangle \cdot \langle X_j \rangle.$$

It can be shown that the following conditions are satisfied:

$$(8) \quad \bar{X}_i \sim N,$$

$$\sigma_{ij} \sim \sqrt{N}$$

$N$  is the total number of learners in a MOOC. Therefore, where  $N \rightarrow \infty$ , variation coefficients tend to be zero:

$$C_V(ij) \sim \frac{1}{\sqrt{N}} \rightarrow 0,$$

which illustrates the law of large numbers. This way, if the number of learners  $N$  is high enough, their distribution among categories is hardly a coincidence and the size of category approaches  $\langle X_i \rangle$ , where:

$$\langle X_1 \rangle + \langle X_2 \rangle + \langle X_3 \rangle = N$$

The equation for  $X_i$  is written as follows:

$$(9) \quad \frac{\partial X_i}{\partial t} = \sum_{k=1}^3 [\tilde{P}_{ki} \cdot X_k - \tilde{P}_{ik} \cdot X_i],$$

where

$$(10) \quad \tilde{P}_{kl} = 0 \text{ for } k = l$$

$$\tilde{P}_{kl} = P_{kl} \text{ defined (4) for } k \neq l$$

Transition matrix (4) can be linked to a problem of random walks on a directed graph whose vertices correspond to categories  $i = 1, 2, 3$  and where the probabilities of cross-vertex transition are determined by (4) [Leskovec, Rajaraman, Ullman 2016].

Transition probabilities (4) determine unambiguously the influence of checkpoints on the distribution of learners among performance categories and may be indirect indicators of assignment quality. However, using matrix (4) directly is inconvenient, first of all because of the abundance of parameters (9 transition probabilities) and their intricate, however unambiguous, relationship with the comprehensible conventional characteristics of academic performance. For this reason, the role of an illustrative parameter will be assigned

to vector  $\vec{\alpha}_x = \{X_1, X_2, X_3\}$ , which determines the steady-state distribution of learners among performance categories  $j = 1, 2, 3$ . This vector can be treated as a steady-state solution of equation (9), corresponding to continuous case ( $\frac{\partial X_j}{\partial t} = 0$ ), or as a limiting distribution that results after multiple transitions of the form  $\vec{\alpha}_x(n) = \hat{P} \cdot \vec{\alpha}_x(n-1)$  on a graph relative to matrix (4) [Astratova et al. 2017], provided that  $n \rightarrow \infty$ . This limiting case corresponds to a hypothetical situation where the checkpoint assignment is taken a number of times by categories of learners with statistically equivalent characteristics of academic performance. It is easy to show that  $\vec{\alpha}_x(n \rightarrow \infty) = \hat{P} \cdot \vec{\alpha}_x$  satisfies the equation [Ibid.]:

$$(11) \quad \vec{\alpha}_x = \hat{P} \cdot \vec{\alpha}_x$$

Hence,  $\vec{\alpha}_x$  is an eigenvector of  $\hat{P}$  (4) with eigenvalue 1. Using (5), (10), it can be shown that  $\vec{\alpha}_x$  in (11) corresponds to steady-state solution (9) for  $\frac{\partial X_j}{\partial t} = 0$ .

A formula analogous to (11) can also be used with known matrix  $\hat{P}$  (4) to predict checkpoint performance. Suppose that  $\vec{\alpha}_x(0)$  is a vector describing the distribution of learners among performance categories before the checkpoint and  $\vec{\alpha}_x(1)$  after the checkpoint; then, in compliance with the theory of Markov processes [Maksimov 2001], these two vectors are related by the following formula:

$$(12) \quad \vec{\alpha}_x(1) = \hat{P} \cdot \vec{\alpha}_x(0)$$

where  $\hat{P}$  is a matrix of the form (4) corresponding to the checkpoint analyzed.

### 3. Application and discussion

A case study illustrating how the algorithm described above can be applied involves analysis of data on the online course *Engineering Mechanics* offered by Ural Federal University and available through the National Open Education Platform<sup>1</sup>. The course includes the following assessment tools (checkpoint assignments):

- theory tests (T);
- home assignments (HA);
- project assignments (PA);
- the final test (FT).

In the source database, each checkpoint assignment was assessed on a 100-point scale, and each of them was assigned weight coefficient

<sup>1</sup> <https://openedu.ru/course/urfu/ENGM/>

$k_p, p = 1, \dots, 4$ . Weight coefficients  $0 \leq k_p \leq 1$  and scores  $0 \leq B_i(C) \leq 100$  obtained by learners in each checkpoint, where  $C = T, HA, PA, FT$ , were used to calculate the following indicators:

- Average student current performance
- $$(13) \quad Avg = k_1 \frac{1}{16} \sum_{j=1}^{16} B(T)_j + k_2 \frac{1}{18} \sum_{j=1}^{18} B(HA)_j + k_3 \frac{1}{5} \sum_{j=1}^5 B(PA)_j.$$
- Final course grade
- $$(14) \quad Grade = Avg + k_4 B(FT).$$
- In accordance with course design, coefficients  $k_p$  took on values:  $k_1 = 0.16; k_2 = 0.34; k_3 = 0.1; k_4 = 0.4$ . Therefore, maximum Avg value is 60. To facilitate comparison of results in different checkpoints to this value for every learner with identifier  $i$ , the maximum Avg value was translated to a 100-point scale using the formula

$$(15) \quad Avg_i(100) = 100 \cdot \frac{Avg_i}{\max\{Avg_i | i = 1, \dots, N\}}.$$

where  $N$  is the total number of learners in the MOOC.

Each checkpoint can be assigned the following characteristics:

- Average checkpoint grade;
- Task solvability coefficient:  $k_i = \frac{c_i}{N}$ ,  
 where  $c_i$  is the number of learners who solved the task and  $N$  is the total number of learners in the MOOC;
- Checkpoint assignment grade probability density function (a more complex characteristic).

The latter can be used to assess the informational value of checkpoint (2).

Let us analyze Test 1 as an example. The grade distribution function is displayed in Figure 1. Normal distribution is shown in the same figure for comparison. Even when no special criteria are used, it can be seen that deviations in actual distribution of scores for Test 1 from normal distribution are significant and cannot be explained by random processes. The load of information contained in the fact “learner was awarded a specific number of scores for Test 1”, calculated using formula (1), is  $I=1.47$  bits.

Formula (2) is used to calculate the informational value of all “test”-type checkpoints. The results are presented in Figure 2.

In particular, Figure 2 makes it clear that Tests 2, 14 and 15 have the highest informational value, which means that they are effective in differentiating learners by the level of progress. Meanwhile, Tests 3, 6 and 16 are the least informative: they are probably too easy, as the great majority of learners perform them successfully. Table 1 compares the highest and lowest informational values of the tests with other checkpoint characteristics.

Figure 1. **Probability Distribution Function for Grades Obtained for Test 1  $\varphi_1(x)$ .**

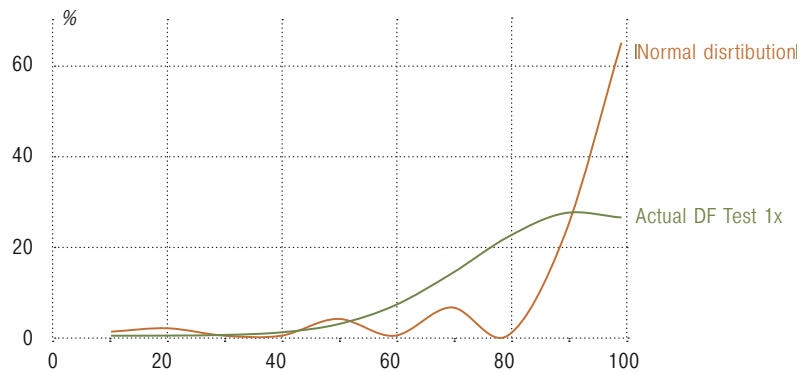


Figure 2. **Informational Value of Tests Calculated Using Formula (2).**

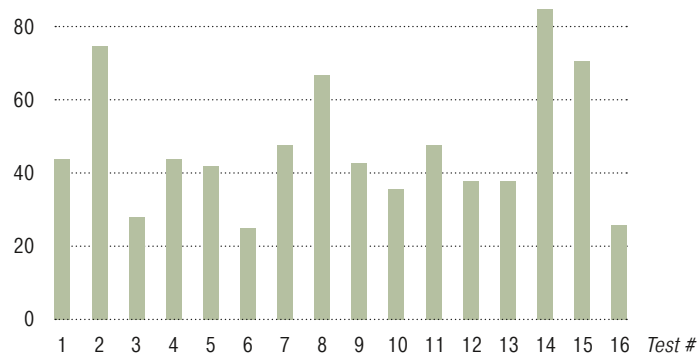


Table 1. **Characteristics of the Most and the Least Informative Tests**

Test #	Informative Value <i>inf</i> (2)	Average Grade	Solvability Coefficient
Test 6	25	96.3	0.993
Test 16	26	95.8	0.985
Test 2	75	80.2	0.898
Test 14	85	68.5	0.797
Test 15	71	72.4	0.869
Relative difference between the highest value and the lowest one (Max – Min)/Min, %	240	40.5	24.6

Figure 3. **Grade Probability Density for Average Student Current Performance, Final Test and Grade.**

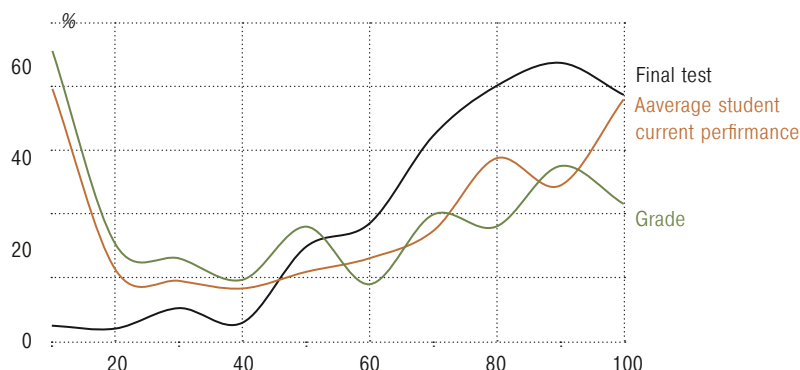


Table 2. **Informational Value of Checkpoints**

#	Checkpoint	$Inf$ , formula (2)
1	Average student performance ( <i>Avg</i> )	93
2	Final test	84
3	Grade	94

The difference in informational value between the most and the least informative tests, calculated using formula (2), is essentially higher than the relevant differences in such characteristics as average grade and solvability coefficient. Therefore, informational value is the most convenient tool for comparing checkpoint assignments and their quality.

Of all the types of checkpoints, the following is of the most interest:

- Average student current performance (*Avg*);
- the Final test (FT);
- Grade, i. e. integral estimate of course completion which includes *Avg* and FT.

Grade probability densities for these types of checkpoints are shown in Figure 3.

All the three checkpoints in Figure 3 have a rather broad range of grades, i. e. each of them is a good differentiator of learners. Data on the informational value  $inf$  of relevant checkpoints, calculated using formula (2), is given in Table 2.

As we can see, such integral checkpoints as *Avg* and Grade, which reflect learner progress throughout the course, have a high informa-

**Table 3. Steady-State Distribution of Learners among Performance Categories and its Informational Value (i) for Different Checkpoints**

Proportion of Category in the Sample	Test	HA	PA	FT
$x_1$ (non-performers)	0.336	0.436	0.658	0.296
$x_2$ (average performers)	0.002	0.087	0	0.129
$x_3$ (constant performers)	0.662	0.477	0.342	0.575
<i>inf</i> (informational value)	59	84	58	86

tional value, which is not always true for individual checkpoint assignments (see Table 1). The informational value of the final test is somewhat lower but still pretty high.

Next, a series of checkpoints corresponding to different types of assignments (T, HA, PA, FT) are analyzed instead of individual checkpoints. The state after the first checkpoint in a set is taken as the input state here. It thus becomes possible to analyze all the sets of checkpoints independently; besides, it solves the problem of no entrance testing in most MOOCs (information on entrants' skills is usually unavailable). The results are shown in Table 3. Analysis results can be presented even more concisely if factor *inf* (2) is used. In this case, it reflects the informational value of post-checkpoint learner distribution.

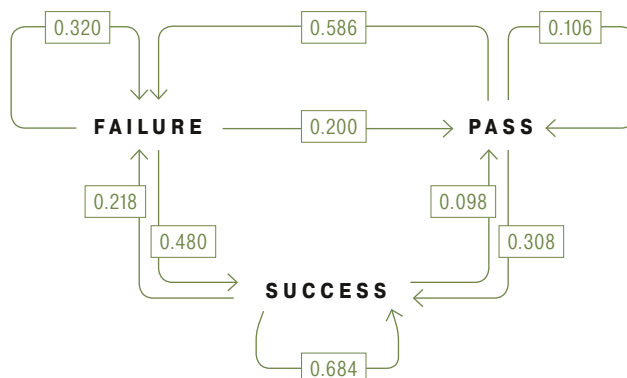
Assessment tools of the types "test" and "project assignment" in fact split learners into constant performers and non-performers, the intermediate category of average performers being virtually indistinguishable. This data indicates, in particular, the low informational value of the respective types of checkpoints, which is illustrated by the last row in Table 2. Indeed, learners either fail or obtain high grades in these checkpoint assignments. Perhaps, the assignments are too easy or results are assessed as pass/fail, which is especially typical of project assignments. Of course, there can be other reasons for the stratification observed. Anyway, the analysis performed obviously provides course designers with useful information to measure the quality of assessment tools.

Data on average student performance (*Avg*) can be used when taking the final test as input state  $|i\rangle$ . In this case, transitions among performance categories as a result of the final test will be calculated:  $Avg(i) \rightarrow FT(j)$  (*i* and *j* are performance categories here). The resulting pairs  $\{ij\}$  for post-FT transitions among performance categories yield the following matrix:

$$(16) \quad \hat{P} = \begin{pmatrix} 0.320 & 0.586 & 0.218 \\ 0.200 & 0.106 & 0.098 \\ 0.480 & 0.308 & 0.684 \end{pmatrix}$$



Figure 4. **Oriented Graph for Transitions among Performance Categories Generated by the “Final Test” Checkpoint. Numbers correspond to transition probabilities (16).**



Transition probabilities can be presented as a directed graph, as shown in Figure 4.

As can be seen from Figure 4, transitions from “Success” to “Success” and from “Pass” to “Failure” are the most probable ones. The probability of transition from “Failure” to “Success” is also surprisingly high. However, researchers at Arizona State University have also observed this personality type in students, referring to them as “kangaroos” ([Johnson 2018]).

Let’s suppose that learners are distributed uniformly among performance categories just before the final test:

$$x_1 = x_2 = x_3 = \frac{1}{3},$$

According to estimated transition probabilities (16), the predicted distribution of learners after the final test in compliance with (12) will be the following:  $x_1 = 0.375$ ;  $x_2 = 0.135$ ;  $x_3 = 0.491$ . If the predicted distribution is unacceptable for instructors (e. g. an increase of the non-performer category as compared to the current state is predicted in the case analyzed), they can take some provisional measures to support students and increase overall performance.

Let us now compare efficiency of this learning analytics algorithm for different online courses. Since every analyzed MOOC has its own structure of checkpoints, it makes sense to compare transitions  $Avg(i) \rightarrow FT(j)$  ( $i, j$  are categories “Failure”, “Pass”, “Success”), as data on average student performance and the final test is available in any course. The findings are presented in Table 4.

The predicted proportion of constant performers in Descriptive Geometry and Technical Drawing is the lowest, while that of the “Failure” category is, vice versa, the highest among the courses analyz-

**Table 4. Predicted Steady-State Distribution of Learners among Performance Categories for Transitions Avg → FT in Different MOOCs.**

	$x_1$ (Failure)	$x_2$ (Pass)	$x_3$ (Success)	$inf$ (informational value)
Engineering Mechanics	0.296	0.129	0.575	86
Construction Materials Engineering	0.197	0.105	0.698	73
Descriptive Geometry and Technical Drawing	0.48	0.149	0.371	91

**Table 5. Probabilities of Transition among Performance Categories Avg → FT in the Descriptive Geometry and Technical Drawing MOOC.**

Descriptive Geometry and Technical Drawing	Failure	Pass	Success
Failure	0.40	0.98	0.38
Pass	0.25	0.00	0.08
Success	0.35	0.02	0.54

ed. The final test will be the most informative assessment tool in this course.

Probabilities of transition  $Avg(i) \rightarrow FT(j)$  among performance categories in Descriptive Geometry and Technical Drawing are given in Table 5<sup>2</sup>.

The probability of transition from "Pass" to any other category is extremely low, while that of transition from "Failure" to "Success" (the "kangaroo" personality type) is rather high (0.35). The "Success" category tends towards stratification at the FT checkpoint: students classified under this category based on their average performance either pass into the "Failure" category (with a probability of 0.38) or, more likely (0.54), retain their positions among constant performers.

The "kangaroo" personality type manifests itself more in Construction Materials Engineering (probability of relevant transitions being equal to 0.47), whereas the probability of transition from "Success" to "Failure" after the final test is low here (0.15). Most students in the "Success" category remain high performers with a probability of 0.83. The probability of transition from "Success" to "Pass" is the lowest for this course (Table 6).

<sup>2</sup> The matrix presents probabilities of transition from categories corresponding to columns to those corresponding to rows (the sum of elements in each column thus being 1).

**Table 6. Probabilities of Transition among Performance Categories  
 Avg → FT in the Construction Materials Engineering MOOC**

Construction Materials Engineering	Failure	Pass	Success
Failure	0.13	0.64	0.15
Pass	0.40	0.07	0.03
Success	0.47	0.29	0.83

The Engineering Mechanics MOOC was analyzed earlier in this article (see Figure 4). It differs significantly from the other two MOOCs in transition probabilities  $Avg(i) \rightarrow FT(j)$  and provides the most adequate distribution of final course grades, which indicates sufficient reliability of the assessment system in this online course, a high level of instructor support, and theoretically substantiated course content that contributes to learner progress.

#### 4. Conclusion

Online learning is a new educational paradigm generated by recent sociocultural processes, communicational ones in the first place. It implies better feedback for learners, which shapes personalized learning trajectories and ultimately promotes lifelong learning. Education has moved from monologue to dialogue, making the student an active participant in learning. The method of predicting MOOC performance proposed in this article will allow for providing learners with better feedback and more personalized learning trajectories; it could become an integral part of online learning over time.

The results of learning analytics research show that:

- Analysis of the informational value of assessment tools based on the method described herein may provide course developers with useful information on the quality of checkpoint assignments in addition to traditional psychometric analysis;

- Monitoring of learners' checkpoint performance trajectories and the probabilities of learner transition among performance categories estimated based on the monitoring data can be used to assess post-checkpoint redistribution of learners, which provides additional information to assess the quality of assessment tools;

- Knowing the probabilities of learner transition among performance categories, instructors can predict the final distribution and take necessary measures to enhance their teaching efforts.

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# Higher Learning: Lessons from an Online Advocate

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Received in  
July 2018

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**Abstract.** On November 16, 2017, the University of Colorado Board of Regents voted unanimously to allocate US\$20 million for a number of online program initiatives including the development of an online-only master's degree and an online-only bachelor's degree with a total fixed-cost—including tuition, books, and fees—of US\$15,000 each. The price for the online-only bachelor's degree will be roughly 75-percent cheaper than a traditional on-campus degree. This article examines lessons learned from the success and failures of an online advocate at the senior leadership level of an institution—the board of directors—that helped make the development of these new degrees possible. From these lessons, the paper argues that United States higher education culture is holding back the rapid expansion of online programs, preventing many universities from fulfilling their social contract with

the public and serving more students in the mission of access. The article explores how the dominant mental framework in higher education—the prestige economy—unconsciously drives decisions by many faculty and administrative leaders, and it argues that reputation unto itself does not necessarily equate to a higher quality academic experience for students. As a recourse to the academic prestige economy, the article maps one individual board member's experience, tracing the importance of vision, leadership, and determination in creating coalition of the willing committed to institutional change. The article ends with a series of thought questions intended as conversational prompt for institutions, regardless of size or mission, to examine their own academic cultural bias and institutional barriers that prevent embracing online programs or change in general.

**Keywords:** MOOCs, cost, access, innovation, disruption, leadership, cultural change, curricular design, University of Colorado.

**DOI:** 10.17323/1814-9545-2018-4-167-187

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The problem is clear.

The world needs more university-educated individuals, and governments don't have the resources, nor the available talent, to quickly scale brick-and-mortar universities to meet demand. With the explosion of broadband and mobile data access, the solution also seems clear: scalable online education.

One major obstacle: higher education culture.

While I argue for the rapid expansion for online programs, I view these programs as supplementing traditional universities, not replac-



ing them. We don't need to throw out tradition or traditional universities; they will always have their place. Rather, we need to acknowledge and address how our current structures and biases are holding back the development of online programs that can quickly and effectively serve more students. And, we need to be honest about the individual and societal costs of that failure.

I've come to this conclusion after serving nearly twelve years as a member of the University of Colorado Board of Regents (Colorado, USA). We, as a board, oversee four campuses—one R1 research university with five Nobel Prize winners that is part of the prestigious American Association of Universities; one R1 research medical campus that is among a handful of academic medical centers in the United States that combine teaching, research, and clinical care; one urban research university; and one regional research university. They share a combined annual operating budget of US\$4.5 billion and nearly 65,000 students.

As a Regent I have served as vice-chair of the Board, and chair of the academic affairs, strategic planning, budget and finance, and laws and policies committees. During my tenure the University entered into the Massive Online Open Course market, with more than two million unique enrollments in the coursework to date and has significantly expanded online degree offerings. I have personally championed efforts to create a three-year, cross-institution, online-only bachelor's degree; the development of a US\$15,000 online-only master's degree, and a US\$15,000 online-only bachelor's degree. Those prices include tuition, books, and fees.

As a higher education policy maker, as someone committed that our universities fulfill their mission to serve the communities to which we owe our founding and ongoing existence, and as a former non-traditional student that had a life-transforming experience because of affordable public higher education, I see online education as a necessary and critical component of our delivery model. Done properly, online education provides access to those who have the mental capacity and rigor to succeed, but do not have access to a campus due to geographic, family, work, and/or other limitations.

After initial investments, which can be significant, online education can begin to lower the costs of undergraduate and graduate education through scale. Like large undergraduate lecture classes that are revenue positive (profitable), scaling classes to a few thousand paying students can generate enough revenue that will cover costs, generate revenue, and allow universities to charge less. That, in turn, makes a university education affordable to more people.

There is no question that universities and academic societies have benefited their host countries and all of humankind through teaching and the advancement of knowledge through research. Decades of success and general high regard, combined with little oversight, have left too many universities and faculty self-satisfied, however. Com-

fortable with their positions and accompanying rewards, institutions and faculty have become more insular. This comes at the cost of better serving those that ultimately make academic institutions viable—taxpayers.

The self-focused university culture is enabled and rewarded by business, government, university trustees, accrediting bodies, philanthropies, donors, professional organizations, scholarly societies, media rankings, and alumni that fail to challenge the status quo. Without strong pressure from these groups, and the general public, there is no urgency for universities to change.

This is not some conspiracy, nor is it ill intent; rather we are limited by current policy structures and mental frameworks of how we understand, reward, and govern higher education. The challenge is not whom we are serving today, which we do reasonably well, rather whom we are leaving behind, which is many. This is where online education brings us hope.

My experience, success and failures, with the University of Colorado system provides insight as to how policy makers can influence the expansion of online education. While no two institutions or situations are identical, extensive literature has shown similarities in higher education culture in universities, large and small, public and private, throughout the world.

These insights, provided below, can provide useful prompts to further dialogue on how to identify and work through institutional and cultural barriers regarding development and implementation of significant online programs. This includes the necessity of understanding the mental framework of higher education; that academic reputation does not necessarily equate to a quality academic experience; how reward systems are built to maintain the status quo; the importance of leadership; the limits of board power; and the necessity of forming coalitions of the willing.

## Mental Framework

“Prestige in higher education is like profit is to corporations.”  
Jeffery J. Selingo,  
*College (Un) Bound*

Academic reputation has been conflated with overall academic quality and/or academic experience. These are separate issues. An improving reputation does not automatically equate to a better student experience. Nor does an increasing reputation mean that an institution is actually fulfilling its mission in the way that is generally understood through the existing social contract between universities and the public/government that funds them.<sup>1</sup> Yet, reputation remains the curren-

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<sup>1</sup> In my analysis, the social contract between the people and universities looks like this: *We, the people and government, will support your university with money and tax-free status and, in turn, you will dedicate yourselves to educating individuals, at a reasonable price, across a range of disciplines that, ultimately, will benefit society. And, for some institutions, we will encourage you to conduct research that will further advance society. Do that, and we*

### What Can You Do?

For those committed to vastly expanding access to higher education through online education there are a number of actions that can be taken. Here are some suggestions:

#### Presidents/Chancellors

- Clearly explain how online programs will help students and fulfill your public mission. This will be key in winning over reluctant faculty and garnering donor support.
- Set firm expectations about online program goals; be clear that failure is not an option.
- Bring all stakeholders together to ensure collaboration.
- Provide proper funding and time.
- Provide other necessary financial incentive programs that encourage faculty and staff to embrace online efforts.
- Develop dedicated areas of online excellence and expertise; ensure they are connected throughout the university.
- Create campus awards for online efforts.
- Include online performance measures for Provost, Deans, admissions officers, etc.
- Ensure you have the right technology and other academic support structures and staff in place.
- If your campus leaders won't innovate, replace them.

#### Trustees/Regents

- For fastest results within a university system, direct the president/chancellor to develop an online-on-

cy of higher education and that poses major challenges for quickly developing significant online educational programs.

Prestigious universities don't want, or need, the unwashed masses. Meaning, there is no interest in students that are not practically guaranteed to succeed in the classroom. They want, as do many universities, the "best and brightest" students, those straight out of high school with stellar academic records. The faculty wants to teach the "best" students [DeMillo 2011]. Media rankings reward exclusivity. Alumni and lawmakers love increased prestige. Donors reward "success." These universities have more students applying than they can ever serve, so outside of some public shaming and liberal guilt, there isn't a lot of incentive to change.

While educating a miniscule fraction of the global population of higher education students, these prestigious universities set the standard to which many higher educational institutions aspire. They have become the mental model of what a university "should" be [Selingo 2013]. While there is only one Harvard, universities spend a disproportionate amount of time working to bolster research, often at the expense of less attention on undergraduate education, in an attempt to climb the academic reputation ladder [Christensen, Eyring 2011]. Reputation, the lifeblood of higher education, has become its poison.

Decisions about who is hired, what degrees are offered, what institutions call themselves, what costs are incurred, which students are admitted—or kept out—are influenced by how those decisions will impact reputation. The thinking goes, if reputation is improving than the university must be doing the right things.

While higher education means well, when a university's resources, attention, hiring practices, reward systems, and brainpower are aligned behind the goal to increase reputation, other areas suffer through a lack of attention and investment. As numerous reports have pointed out there are common issues across all of higher education including undergraduate retention rates, six-year graduation rates, access, affordability, diversity, transferability, and in-class instruction. Short-changing these areas as a sacrifice for other goals is a violation of the social contract. It's no wonder higher education continues to lose public support.

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*will generally continue to give you money and leave you to your own devices.*

ly campus or unit that has its own set of rules and reward systems.

- Include online performance measures for President/Chancellor/Campus Leadership.
- Ensure proper funding for online programs.
- Ensure proper metrics to measure online performance: recruitment, retention, graduation rates, non-duplicated students, etc.
- Ensure proper technology infrastructure is in place.
- Understand demographics and trends for online learners as these are changing rapidly.
- Ensure online programs are aligned with your mission and community/country needs.
- Ensure proper policies are in place.
- If you choose to use outside pressure:
  - Universities react most quickly to:
    - Threats by lawmakers to take away autonomy or funds.
    - Bad media coverage.
  - The also respond, but less quickly, to:
    - Threats from the Board of Directors
    - Upset major donors
    - Large numbers of angry students/alumni
- If your leaders won't innovate, replace them.

#### Policy

- Align tenure and promotion rules so they reward and do not punish faculty that teach online.
- Provide greater flexibility to gain tenure through teaching and teaching online.
- Create better permanent career paths for online instructors (non-tenure faculty).

The *2018 Survey of [U.S.] College and University Presidents: A Study by Inside Higher Ed and Gallup* found 80 percent of respondents asked about race relations on their own campus, “describe them as ‘excellent’ or ‘good,’ compared with 20 percent who say the same about race relations on U.S. campuses generally.”<sup>2</sup> When these results were shared on March 12, 2018 at the American Council on Education conference in Washington, D.C.—the audience laughed. The higher education leaders in attendance immediately recognized the obvious bias of the survey respondents, “We are doing well, while others are not.” How likely would similar responses be when university presidents are asked about balancing growing reputation with other goals?

The higher education cultural bias towards reputation came into full view when I first joined the CU Board of Regents. At the time, I proposed CU should create a version of what had been operating in the University of California system for decades—a guaranteed admission program for community college transfer students.<sup>3</sup>

Two of our general campus chancellors had no interest in such a program. They didn’t need the students, it hurt their rankings, and it might cost them some tuition money. The chancellors were more interested in prestige and an easy budget model over the mission to create more access for students. There was no obvious reward to changing the status quo.

There are limits to what an individual board member can accomplish on one’s own, as any board member only has one vote. A typical higher education board member wields three generally accepted types of power: the ability to ask questions and gather facts; the ability to request and secure meetings with key leaders; and the ability to influence and/or persuade key stakeholders and other board members.

In this effort to secure a guaranteed admission program I asked questions, gathered facts, and was initially unsuccessful in persuading leaders that the program was the right way to move forward. Not happy with that result I decided to break the unwritten “rule” to keep university business in-

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<sup>2</sup> [https://www.insidehighered.com/system/files/media/2018\\_Presidents\\_Survey\\_Final.pdf](https://www.insidehighered.com/system/files/media/2018_Presidents_Survey_Final.pdf)

<sup>3</sup> In the United States, community colleges, also called junior colleges, are institutions that grant two-year associate degrees. Community colleges students are, generally speaking, from lower socio-economic backgrounds and underserved student populations. These colleges have a dual mission: prepare students to transfer to four-year universities and/or vocational training.

- Make clear articulation agreements about transfer credits for online courses with area feeder colleges.

#### Faculty/Staff

- Build your own coalition of the willing.
- Tenured faculty—use your position to advocate for change.
- Understand the context you are operating in and speak to people's valid concerns.
- Where possible, collaborate across departments.
- Seek grant funding for on-line programs.
- Advocate for online programs with department chairs, deans, and provosts.
- Encourage faculty and staff governance groups to advocate for online programs and university policies and investments that support online education.

#### Higher Education Professional Organizations and Academic Societies

- Acknowledge how you are complicit in preventing rapid adoption of online education and the impact that is having.
- Develop workgroups around best practices in higher education, ensuring rigor.
- Create prestigious societies, awards, and other recognition programs for online programs, teaching, and faculty.

#### Philanthropy/Donors

- Take responsibility for your part in perpetuating the current system.
- Develop dedicated grants for the creation of online programs.

house and brought external pressure, a fourth form of power, to force change. I developed an advocacy video calling on state lawmakers to pass a law requiring guaranteed admission programs for community college transfer students at all of Colorado's four-year public universities, including those outside the CU system. I lobbied elected officials, higher education regulators, and local media to embrace the idea.

Between the time the University initially turned down a guaranteed admission program and my lobbying effort, the Regents had hired a new University of Colorado President, Bruce Benson. Benson was more sympathetic to the plight of transfer students and, after sharing with whom I was speaking and the goal of those conversations, he agreed to take a fresh look at the issue. While that review took place, I suspended my external lobbying efforts to provide him an opportunity to see what the University could come up with. Because he put his leadership behind the measure, the University changed course and now has one of the best guaranteed admission programs for community college transfer students in the country.<sup>4</sup> And, none of the feared ill effects ever came to be.

While the lobbying effort had worked, it came at a cost. My relationships with other board members and university leadership had been strained. They felt I had gone around them—which I had—and they didn't appreciate it. If I was to avoid being marginalized, a fate inflicted on previous board members and a common practice in group dynamics, I needed to maintain strong relationships with both my board colleagues and university leaders. That meant, when it came time to advocate for online education, I had to play by the rules.

It had become painfully clear, as others had learned long before me, that higher education culture and the many re-

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<sup>4</sup> See <https://www.denverpost.com/2010/11/16/cu-guarantees-admission-to-community-college-students-with-30-hours-and-2-7-gpa/> and <https://www.denverpost.com/2010/11/18/two-years-of-college-good-four-years-even-better/> The requirements for guaranteed admission to the liberal arts program of University of Colorado's Boulder, Colorado Springs, or Denver campus are:  
– High school diploma or GED 30 semester hours of transferable Colorado community college coursework, with a GPA of 2.7 or higher A cumulative GPA of 2.7 or higher for all college coursework—including credits from attendance at other institutions—with consistent or improving grades Completion of Minimum Academic Preparation Standards (MAPS): <http://tiny.cc/CUMAPS>  
Completion of an admissions application and submission of all required documents by published deadlines.



- Create scholarships for online-only students.
- Develop an "X" prize for driving the cost of a degree down by using online delivery.
- Develop prestigious awards for online education innovation.
- Endow online education chairs.
- Fund projects that advance online teaching excellence, ensure rigor, and spread best practices.

#### Lawmakers

- Take responsibility for your part in perpetuating the current system.
- Gain a better understanding of online capabilities and what is currently being done in your country.
- If you feel universities are not doing enough, threaten to regulate.
- Don't allow the haze of nostalgia to impact your decisions.
- Hold institutions to account for graduation rates and accessibility.
- Prevent mission creep from universities that would encourage exclusivity over access.

#### Business Leaders

- Change the way you look at hiring and find ways to become more accepting of online credentials.
- Provide internships for online students.
- Partner with universities for online programs that are needed for your workforce.
- Encourage executives to serve on university advisory boards and advocate for online options.

ward systems in place for faculty and administration are too entrenched to expect a quick embrace and implementation of any significant changes [Bok 2006]. As reputation is the currency of higher education, institutions and individuals do not see how rapidly expanding online education helps them win the reputation game.

That's why in 2013, I argued the easiest and fastest way to create and expand online programs at CU would be to develop an entirely new, online-only campus dedicated to different goals, models, and reward systems that were completely focused on online education. It would be the fifth campus in the university system that would have relationships with, but would be separate from, the other institutions. The idea was not that radical; other institutions had already taken a similar approach.

For the reasons stated above, this proposal was by the rules. That meant asking the president and campuses to explore the idea, determine its strengths and weaknesses, calculate costs, and make a recommendation back to the board. Some external pressure did come, as the largest newspaper in the region endorsed the idea.<sup>5</sup>

Campus leaders hated the proposal and killed it.

In a move typical of large bureaucratic institutions with various and competing interests, an initial recommendation by an internal group of experts was set aside and never presented to the board. Why? There were three main reasons: 1) concerns about losing revenue at some unknown point in the future when they got around to significant online offerings; 2) they didn't want start-up costs diverted to a new campus when that money could go to them; and, 3) they wanted to maintain control and continue to operate with the current reward systems. In short, they didn't see any upside for this new venture for themselves and they didn't want a new direction imposed upon them. They did, however, present the board with a plan to move online efforts forward. It was uninspired, slow, and protective of the academic culture status quo, but it was a plan where none had previously existed.

Being a board member means trusting the leadership team you have in place. If that trust fades, or your leaders don't meet goals and expectations, it's time to get new leaders. For this effort, we had to wait and see the results.

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<sup>5</sup> <https://www.denverpost.com/2013/12/05/cu-online-plan-is-groundbreaking/>

Over the next couple of years, the CU Board of Regents saw new online programs from our campuses progressing at the typical academic pace, lacking true direction, with no urgency, and limited innovation.

While the campus response was beyond frustrating, we shouldn't have been surprised. When leaders are reasonably successful under the current rules and rewards there is an immense avoidance to change and risk. Senior leaders worked their way up the academic ladder, they know the culture, they know the rules, they know how to work them to their and their institution's advantage. It appears more logical to double down on the current course than to venture into unknown areas. Why mess with what worked in the past? The challenge of getting organizations to embrace innovation and change is not unique to higher education [Christensen 1997].

Universities that were quick to embrace and deliver a high number of quality online programs had strong leaders that demanded, funded, and built a culture of expectation and support around it.<sup>6</sup> These exceptions highlight what is possible and, in contrast, how moribund traditional academic culture can be.

Taking lessons from the failure of developing an online-only campus, the Regents proposed a solution that embraced parts of higher education culture, rather than trying to fight it, while encouraging a reluctant university community to become more innovative. We put together a grant program calling for faculty proposals to develop a three-year online-only degree that includes the following requirements<sup>7</sup>:

- Degree must be offered completely online
- Provide for three-year completion option
- Classes offered had to originate from at least two of CU's three general campuses.

In addition to developing a three-year, online-only degree, the goals of the program were: get the campuses and faculty to think and develop new ways for program delivery; force cooperation among campuses; align classes for faster degree completion by motivated students which, in turn, would save them money; and lower university costs by sharing resources across campuses.

The grant from central administration funds provided money for degree development costs and stipends to the faculty and staff on the winning proposal team.

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<sup>6</sup> Two of the earliest adopters of significant online program offerings in the United States, the University of Arizona and Southern New Hampshire University, followed this model.

<sup>7</sup> [https://www.cu.edu/sites/default/files/online-degree-grant\\_guidelines2016.pdf](https://www.cu.edu/sites/default/files/online-degree-grant_guidelines2016.pdf)



The campus leadership agreed to this approach for two main reasons: campuses maintained control, and brought revenue back to the campuses. Faculty liked the grant proposal approach, as it was part of the existing academic culture.

This three-year program is launching in the fall of 2018. It is a modest success, at best, as projected enrollment is low, there is limited enthusiasm for the program because it is not wholly owned by one campus, and the forced inter-campus cooperation met with a great deal of resistance.

Like the previous efforts, this experience provided new insights into how to move future online programs forward. In hindsight, using the development of the three-year program to force cooperation among competitive entities, without strong leadership demanding it and holding people accountable, was overly optimistic if not outright naive. Getting a creative online program set up and launched within the current academic culture is difficult enough without tying it up in other institutional baggage.

### **Coalition of the Willing**

"Culture eats strategy for breakfast."

*Peter Drucker, Ph.D.*

While higher education culture needs to change, there are many traditions worthy of cherishing and protecting—one of which is the ethos of broadly disseminating new findings. Demonstrated most often by faculty in publications, this willingness to share new knowledge has become part of academic DNA. Best business practices around recruitment, admissions, facilities management, cyber security, big data, and dozens of other areas are shared freely among universities. This desire to share is especially true for advocates of online education, as most universities are facing the same issues regardless of location.

In addition to learning from experts within the CU system and looking to the latest literature, we sought to learn directly from other university systems.

Under the leadership of Deborah Keyek-Franssen, CU Vice President for Digital Education and Engagement, we met with three separate university system offices dealing with online education over two years. These visits were with the University of Texas, with 14 campuses, a US\$17.9 billion operating budget (2016), and 221,000 students; the University of Nebraska, with four campuses, a US\$2.35 billion operating budget (2014), and 52,000 students; and the State University of New York, with 64 campuses (two-year and four-year), a US\$13.3 billion operating budget (2017), and 1.3 million students.

The teams we met with were comprised of accomplished individuals who provided great insight and wisdom. Our team had three broad goals for each meeting: learn each university system's overall approach to online education, gain a greater understanding of their challenges and how they are addressing them, and have a free-flowing exchange of ideas.

Each university has its own approaches, goals, leadership involvement and/or direction, campus commitments, and funding models based on their specific circumstances. A consistent theme did arise across the visits: the necessity to build coalitions of the willing. Coalitions were comprised of those faculty and staff who wanted to break new ground in developing online learning programs and expertise. Once these initial efforts were successful, others would begin to see the value and possibility of online—albeit slowly—and begin to join in. The seeds of culture change were planted.

Something these trips provided that was not immediately understood at the time, was an increase in my credibility around online education with campus leadership and my own board. Working within proper structures, communicating clearly about the visits, doing other homework, and remaining a committed advocate for online education laid the groundwork for the next phase of our system-wide efforts at CU.

By 2016, it became clear in private conversations that nearly all of the CU Regents were disappointed with how the university was performing with online education. Because our campuses were functioning well in many traditional areas, underperforming in online wasn't reason enough to get new leaders. What to do?

Through our general disappointment, the Board of Regents had become the ultimate coalition of the willing. While individual board members have limited power (discussed above), the board acting as whole has the ultimate power to enact change—albeit on paper. With any large, complex organization trying to force change, unless the proper support structures are in place, even the clearest board directives can get derailed.

Based on past efforts and developed expertise, my colleagues allowed me to take the lead on drafting a proposal. We took all the lessons learned from our previous successes and failures and brought forth a dramatic proposal that would be our "moon shot" for CU. On November 16, 2017 the Regents unanimously passed a number of online directives for the CU system. Excerpts of that proposal include:<sup>8</sup>

- **RESOLVED:** In order to more fully meet the needs of current and future students; increase access and affordability especially for first generation college students, working adults, and rural residents; and ensure that Colorado has the trained workforce it needs; the CU Board of Regents directs the administration to meet the goals listed below so that CU can embark on a new era for online learning

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<sup>8</sup> The full resolution: <http://www.boarddocs.com/co/cu/Board.nsf/got-o?open&id=AT3PJP63BCA0>

- By Fall 2022, develop and launch two online-only degrees with a total fixed cost to students of US\$15,000, including books and fees, one for bachelor's level and one for master's level. These proof-of-concept online degrees would use techniques such as asynchronous delivery, multiple start-times per semester, efficient scaling, and open educational resources.
- Noting that the proposed alternate technologies and pedagogies will require changes to basic infrastructure such as admissions, financial aid, registration systems and bursar operations, and will also require support for the faculty, such as instructional design professionals and studio facilities, the university shall invest at least US\$20 million to reach these goals over the next 4 years. Additionally, the university shall develop revenue models that will support the ongoing needs of the online efforts across the campuses after this investment.

The hope is that a bachelor's degree for US\$15,000 will prove to be a game-changer for higher education.<sup>9</sup> That aim is to prove that through scale and online educational resources, the price of higher education can be brought under control. It is also intended demonstrate to governments and governing bodies that proper incentives and investments in online education can help meet a society's higher education needs.

A four-year bachelor's degree at US\$3,750 per year brings back the possibility of a student working her way through college without becoming thousands of dollars in debt. That makes a college education possible for those that feel left behind due to price.

The US\$15,000 master's degree is also intended to be a game changer, similar to above, with the additional bonus of allowing professionals an affordable option to further their education and careers at a reasonable cost.

As a board we did our job: set clear goals and deadlines, and provided the money to accomplish them. Because there were still concerns from our individual campuses about future revenue, investments, and control—similar to those concerns about the 2013 online-only campus proposal—the questions remained which campus would be required to do what.<sup>10</sup>

Learning from past experience, rather than fight our current culture, we decided to work within it. The campuses volunteered to take accountability for specific goals that they felt best fit their mission and had a high likelihood of success. At the same time, all campuses

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<sup>9</sup> That figure is only available to the State of Colorado residents, whose tax dollars directly support the University of Colorado.

<sup>10</sup> Typically, a board of directors should have nothing to do with deciding who should accomplish a task. In this case it was important for the board to provide that guidance due to circumstances unique to CU.

would receive investments to improve the necessary technology infrastructure to help both online and in-person students.

Time to celebrate, right? Not yet. Significant institutional resistance needs to be managed to ensure the university doesn't revert back to the status quo. Even with a unanimous board, clear goals, and proper funding, these measures can fail. Calling back to Peter Drucker, higher education culture can still eat strategy for breakfast. As a board, we have the opportunity to set direction, but it remains to be seen at what level these initiatives will actually be implemented.

What remains true is that each success and failure provides further insight on how online education advocates might approach institutional change and begin to influence the current academic culture. Granted, these case studies are for a specific university system with a specific set of financial, political, and financial circumstances. The stories of success and failure are offered as a conversational prompt, not a "how-to" manual. They are intended to help bring forward the hard questions about how institutional and academic cultural barriers might be preventing the development of significant online programs at any given institution.

## **Conclusion**

The University of Colorado was founded in 1876, the same year Colorado became the 38th state of the United States of America. The country itself was only 100 years old. The two most significant technologies of the day were the steam engine and the telegraph. Railways were still transforming the wide-open and empty American West. Students and faculty arrived to CU's one building, in the middle of an empty field, via a horse and buggy.

From those humble beginnings what we have become would be unrecognizable to CU's first class. Like most universities around the world, what we now teach and research did not exist when the institution was founded.

As online advocates look at transforming higher education to embrace online delivery, we need to remember that higher education has always changed and adapted to new knowledge, disciplines and technology. At one-point microscopes, telescopes, x-rays, typewriters, and computers were new. The same for disciplines like microbiology, computer science, quantum physics, aerospace, bioengineering, film studies, sociology, economics, etc. While our traditions have guided us, they did not prevent us from adapting and growing into what we are today.

Those who continue to claim online programs have no place in a university don't understand the history of higher education. What a university is, whom it serves, what it offers, how it operates, how it creates new knowledge, how its reward systems are structured, and how it delivers information are not permanently fixed. It never was.

People made decisions to get universities where they are today, that means we have the power to make different decisions to create something new.

With current technology, universities have the ability to transform millions of lives across the globe through online programs. Geography and status no longer have to be density. We can empower people born into the “wrong” place or come from the “wrong” family to chart their own course. Through online scale, we can help countries with exploding populations ensure access to quality higher education. In developing countries, or impoverished regions, online programs can help workers become more economically competitive which, in turn, raises a community’s standard of living and improves the overall quality of life.

To deny individuals access to life-changing education because universities are committed to the reputation game has become indefensible.

That is why our task is to deal with the headaches and the resistance of well-meaning and respected colleagues; call on lawmakers, business, philanthropies, donors, and academic societies to think beyond the status quo and support developing the necessary infrastructure that embraces online programming; and take the risks that come with challenging an entrenched culture—because it matters.

Advise boards and advocate for online options.

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# Supporting Online Initiatives: From MOOCs to For-Credit Offerings

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Received in  
July 2018

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**Abstract.** When the Massive Open Online Course (MOOC) revolution erupted in 2012 there was a vision of bringing the world of first-class research and exceptional teaching to the broadest possible audience. The University of Pennsylvania embraced MOOCs with the spirit of innovation and experimentation and is currently building on this initial foray to advance our leadership role into the online space by creating new for-credit courses

and degrees. This paper describes the administrative infrastructure that was put in place to support open online learning in its early days and explains how changing goals are bringing about reassessment of the administrative role of the online unit. This case study could inform other institutions as they explore using MOOCs towards a for-credit program by suggesting a method of incorporating a transformative technology into a traditional research and residential based teaching institution.

**Keywords:** MOOC, The University of Pennsylvania, for-credit courses, degree programs, Online Learning Initiative.

**DOI:** 10.17323/1814-9545-2018-4-188-198

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In 2011 at the launch of the first MOOCs by Stanford's Daphne Koller and Andrew Ng, it was understood that the endpoint of this transformation was yet unknown. The University of Pennsylvania (Penn) was nonetheless eager to push the limits of what could be done through this medium and was one of the first sets of universities to partner with Coursera in spring 2012. Penn also became an equity investor in the company. In fall 2012 Edward Rock, then a faculty member in the Law School, was appointed Senior Adviser to the President and Provost and Director of Open Course Initiatives. Rock was responsible for the implementation of Penn's partnership with Coursera, which was then seen as exclusively providing open-access non-credit courses. He led the development of an administrative structure to support this initiative, heading the newly formed Open Learning Initiative under the Office of the Provost. This was an unusual format for the university that has a diffuse financial structure: innovation at the department or school level is normally encouraged through a school-based financing model, with the university as whole setting priorities through a broad

I would like to thank William Kuskin and Deborah Keyek-Franssen, as well as the anonymous referees, for helpful comments.

strategic plan. Interestingly, this initiative was not placed in the existing technology focused units: neither under general computer or information systems nor under the library, the unit that is responsible for the learning management systems.

One of the first steps for OLI was the creation of policies for faculty compensation and the iteration of the existing intellectual property policies and their applicability to the online environment. A structure was put in place not only for the production of MOOCs, but maybe more importantly, for approving and financing them. A call for proposals was made in the University's Almanac, its internal journal of record, explaining that faculty would get a small stipend for development of a MOOC and have the potential for earning small royalties if the courses were financially sustainable. Costs would be shared between the faculty member's school and the Provost's office. The small royalty reflected the understanding that the intellectual contribution of the faculty is a resource valued by the university and that the faculty own the content of the course and license it to the university, whereby the university owns the expression of the course (e. g. the videos).

A Faculty Advisory Committee was formed to review these proposals, MOOC-related policies, and to discuss potential impact of this innovation on the university at-large. The faculty advisory committee was an astute mechanism of including faculty in the process. By design, it included members who had an interest and openness to the new medium, thereby allowing for these path breakers to influence the more tentative.

From the start there was an understanding that individual faculty members would need help in adjusting their teaching methodology to this new environment, and Penn's Center for Teaching and Learning offered workshops to introduce MOOCs to faculty and consulted with those who wanted to try this new medium.

Over time there have been adjustments to this centralized approach, with schools now having the option of taking on a bigger burden of the financing and production of MOOCs and being able to do so with greater autonomy. A number of our schools, including The Wharton School and Penn Engineering now have robust online units of their own. At this time, Penn's online initiatives encompass all 12 Penn schools, with MOOC enrollments nearing seven million around the world.

Penn's culture embraces a focus on research and intellectual activity as well as an understanding of the need to develop practical skills and applied knowledge. It is with this openness to the needs of learners that Penn offers a variety of MOOCs from courses such as Single Variable Calculus and Greek and Roman Mythology to courses that build particular skills such as How to Apply to College and English for Media Literacy. In addition, Penn offers non-credit certificates, such as the Business Foundations Specialization through the Wharton School on the Coursera platform, and a MicroMasters® in Robotics



from Penn Engineering on the edX platform. This practical side of the institution also ensures that the experimentation with MOOCs pushes the frontier of teaching and learning in a financially sustainable way.

Innovation in the MOOC space helps faculty rethink face-to-face teaching by incorporating effective practices and supports innovations such as the flipped learning and enhanced use of peer and group projects. It has also been an opportunity to introduce faculty to the potential of transforming students' lives from afar through online teaching. This, in turn, created an openness for new exploration in the online space that resulted in the development of fully-online degree programs. Though there have been online classes at the Penn for over a decade, these were stand-alone courses mostly given over the summer months in our College of Liberal and Professional Studies that historically served nontraditional, older, students. Bringing MOOCs into Penn introduced faculty to the potential of a global reach and impact through online teaching. It is not a coincidence that one of the first Penn professors to teach a MOOC, Penn's Vice Provost for Global Initiatives, Ezekiel Emanuel, also sparked the development of the first asynchronous online degree at Penn, the Master of Health Care Innovation which resides in the Department of Medical Ethics & Health Policy at the Perelman School of Medicine. Other successful MOOCs from Penn Engineering led to the development of their Robotics MicroMasters® hosted on edX and to the Master of Computer and Information Technology, the first fully online Ivy League degree to be hosted on Coursera, announced in July 2018.

As the provisions in the MOOC space changed so did the name of the office that supports them, now called the Online Learning Initiative, suggesting support of *all* types of online programs, not only open ones.

The move from open learning to using these new technologies in for-credit courses was an opportunity for Penn to rethink its priorities and strategies for the online space. This was the task put forward to Peter Decherney, the current Faculty Director of the Online Learning Initiative, and Rebecca Stein, the new Executive Director, in fall 2017, beginning with thinking through the opportunities and challenges of this transition. The first opportunity seems almost too obvious to state: in the online space Penn can reach more students, not only in terms of numbers but in terms of a broader student base. Many online students are either unable to travel to Philadelphia for Penn's residential programs or to take time off in their lives to participate in a full-time, year-round program. Bringing programs online allows Penn to fulfill its mission of inclusiveness. A second opportunity arises from the openness of online platforms and programs to explore and innovate through the creation of stackable forms of degrees. This comes naturally from a world where "massive" and "open" are core concepts. There is an understanding that students want a low-stakes environment to find their areas of strength and establish an appropriate level of interest before

making a long-term and significant financial commitment to a full degree. The creation of smaller credentials such as certificates and MicroMasters® is an opportunity to meet students where they are intellectually as well as geographically. A third opportunity is building lifelong relationships with students. Institutionalized education is no longer something that ends with an undergraduate degree. Throughout their lives, individuals in the workplace need to learn new skills and re-skill to keep up with an ever-changing environment. As an institution that is always on the frontier of knowledge-creation, Penn should be ready to share new information with our graduates. Taking learning online makes this a viable mechanism.

Of course there are also concerns and challenges surrounding the use of MOOCs as part of degree programs. Without the barrier of distance, the online world is flat. Any one online program competes with all of the programs offered by other institutions. For example, some of the largest online programs in the United States were either nonexistent in the residential market (e. g. University of Phoenix, Western Governors University) or had only a regional appeal before they took their offerings online (e. g., Southern New Hampshire University). The fear is that this competition will be centered on the program's price, at the expense of other attributes such as quality of instruction or potential impact on career. To combat this threat, Penn needed to create programs that leverage the unique strengths of the institution and create a product that is differentiated. The university then sought to create unique offerings with clear branding and messaging that stands out among search engine results. At the University of Pennsylvania, this implies creating programs that leverage our outstanding research-oriented faculty, our multidisciplinary approach, and our global orientation. Other institutions have their own distinguishing features; to be successful, they must focus on what makes them different and, therefore, special.

As Penn explored the opportunities and challenges of online learning, it also reviewed the institutional structure necessary to support exceptional online education. What is the optimal the organizational relationship between individual programs and the rest of the institution's academic offerings? In many universities, online programs are corralled into a separate unit within the institution and framed as part of executive education or an extension branch. In a few cases, online programs are the main driving force of the institution as a whole so that the whole strategy of the university is focused on what is happening in the online environment. Both approaches would be inappropriate for Penn. Placing these programs into a separate unit would create a "second class" degree, working against the premise that one of Penn's core strengths is our faculty. Above all, our faculty must be inherently linked with online offerings. To do so, online degrees must be integrated within the departments and units where faculty are involved with research and teaching residential students. Similarly, online edu-

cation could not determine the strategy of the overall institution, since Penn is committed to residential education and has research as part of its core mission. This implies that the online programs should have the same governance structure as any other program and, as with residential programs, sit within the specific faculties that teach them. Nonetheless, there is an understanding that online teaching requires unique investments in infrastructure. Faculty must develop new skills and capabilities in terms of course design. Without the support of the university center, individual schools and faculties would not succeed.

It is within this tension that the Online Learning Initiative is taking shape and defining our role. OLI is putting in place a system that allows new degrees and programs to flourish by balancing central support and academic independence. OLI is part of the Office of the Provost, supporting online programs across the twelve schools in for-credit degree programs and courses as well as free open courses, professional certificates, and other non-credit initiatives. OLI is headed by a Faculty Director and a staff Executive Director, who both report to the Vice Provost for Education. A series of committees connect the central office to the wider community: the Faculty Advisory Committee is still in place to include the faculty perspective; an Online Programs Working Group is comprised of key administrative members whose input is vital in starting new programs and integrating into the existing information and compliance frameworks; a new Online Directors Group brings the key staff member responsible for producing and supporting online units from each of the twelve schools together and, finally, an Instructional Design Working Group gathers staff members from across the university who work with faculty to bring learner-focused pedagogy online using educational technology.

OLI has three central roles. The first role is in the creation, implementation, and management of Penn's virtual campus, the technological infrastructure needed for online programing. This includes consideration of third-party platforms (e. g., Coursera for degree programs) and the prospect of building an internal platform to be our virtual campus. Second, OLI builds communication across the twelve independent schools to share best practices, fulfill compliance and accreditation requirements, and coordinate shared investments. OLI's third role is to build capacity for new programs through the creation of a toolkit that supports new programs from the initial stage of market analysis and budget proposals, through faculty training and instructional design, to marketing know-how and program evaluation. Samples and resources for each step of the process of creating a program or a degree are centrally located within a timeline that links them together. With guidance from OLI, the goal is that a program manager at any of the schools can utilize specific tools at each step of the way.

I would like to share three observations from my first year as the Executive Director of this central office that supports online learning. First is a pleasant recognition that the spirit of sharing information and

knowledge is inherently part of research institutions. This spirit transfers to mutual support and sharing of best practices among the administrators across and between universities. Despite the fact that universities could see one another as competitors in the online educational marketplace, the common mission of supporting students' educational needs and furthering knowledge takes over, allowing institutions to collaborate and share best practices in ways that could not be recognized or understood in any other industry. Coursera and edX supported this collaboration from the start by running annual conferences that allow for sharing of best practices and for networking. When Penn evaluated policies for awarding academic credit to matriculating students who completed a MicroMasters®, it was easy to call administrators at other institutions that accept these credentials and find the appropriate terminology and processes. Georgia Tech is an exemplar of cross-institutional support by creating an annual conference dedicated to educating other institutions on how to create successful at scale degrees based on a MOOC framework. A number of institutions (Georgia Tech, U of Illinois, Western Governors and University of Washington) ran a series of sessions on this subject at a recent Summit for Online Leadership and Administration + Roundtable session hosted by the University Professional and Continuing Education Association (UPCEA SOLA+R). This meeting included practical takeaways such as a template for a business plan for a MOOC based program. Both online and physical meetups and visits across school are common and invaluable. My recommendation, therefore, is that administrators not be shy of asking for help and resources from their peer institutions. Not only is Penn/OLI open to sharing, but this is an integral process of self-reflection and review of our practices.

The second is the challenge of managing the distinct paces at which higher education and technology work. I sometimes think of our office as a car that has one set of wheels spinning at the quick pace of Silicon Valley and another set of wheels that move at the leisurely pace of a 250 year-old institution. As the metaphor suggests, sometimes OLI feels like a car spinning around in circles. Coursera's practice of frequently changing revenue models—first limiting the meaning of “open,” then adding subscriptions to specializations and, for a while, creating platform-wide subscriptions—has run into existing commitments that some of our courses remain free and escalated tension with internal branding. OLI created an Online Directors group comprised of staff program directors across Penn's schools and programs in part to assist with communication about the most recent platform experiments. The group allows schools and programs to have a clear line of communication to the external platforms through OLI. Over time, patience and communication can continue to bridge these two extremes.

Similar to the point above, a third reflection is on the complexity of supporting disparate programs through a central office. OLI needs

to be a source of information and assistance that allows programs to move at a quick pace while retaining a focus on the institution's overall brand and mission. An example is the process of adapting student services structure to support online students. Creating an internal set of recommendations entailed input and consultation with more than 20 offices and units across campus (including programmatic units, finance, computer and student information systems, career services, institutional research, learning support, library, and crisis intervention). Moving from a set of recommendations to an action plan is one of the major objectives for our unit for the next year.

There is no doubt that new technologies will continue to transform higher education and that higher education institutions around the globe are just at the start of this process. With that in mind, the range of questions future conferences should address is overwhelming. Topics include understanding the nature of competition between schools and across programs in the online environment; evaluation of various teaching methodologies and practices; and the assessment of the impact of online programs to the financial security of higher education. To explore these topics further, OLI encourage future discussion and research on the following three areas:

How do universities build the lifelong relationships with the students supported by online programs? What is the role of third-party platforms with this long run relationship in mind?

How can institutions measure success in online programs? Besides learning outcomes and financial sustainability, what other considerations should be front and center?

What is the role of a research-focused university in an educational marketplace focused on reskilling the workforce?

As our online programs grow, the role of the central office that supports them will change. Once the infrastructure is in place, the policies are set and there are established units across all twelve schools producing and creating online degrees, Penn may find less need for OLI's type of central support. I look forward to that time and to re-writing our vision for the next cycle of technological breakthrough that is sure to arrive.

# Patterns of School Choice: Two Districts in St. Petersburg

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Received in  
January 2018

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**Abstract.** Parental choice of primary school is analyzed using the example of local education systems in two districts of Saint Petersburg. The empirical basis of the research is provided by the results of a parent survey conducted in 34 schools (1,055 respondents). The following data is sorted and compared successively: whether parents make education-

al choices at all, whether they consider alternative options, what school characteristics they believe to be important, what sources of information they use, and what actions they take. The study explores how characteristics of choice are related to parental education and socioeconomic status as well as to the probability of selecting a school of a specific status.

Insight is provided not only into how the desire of parents to analyze all possible school options and sources of information correlates with their educational and socioeconomic backgrounds in general but also how parental choice is affected by neighborhood structural characteristics (school diversity, proportion of higher-status schools). Districts with broader structural opportunities and larger middle classes feature a variety of choice strategies, which is not observed in districts with limited structural opportunities even if they are socioeconomically heterogeneous.

**Keywords:** school differentiation, parental choice of primary school, neighborhood context, structural opportunities.

**DOI:** 10.17323/1814-9545-2018-4-199-229

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The article is focused on the patterns of parental choice of primary school in different structural contexts within a megalopolis. Original empirical evidence from two districts is used to show that parents with similar educational backgrounds pursue different educational choice strategies depending on local structural contexts.

Research on the reproduction of social inequality through education conducted in Germany, Great Britain and France shows that polarization of educational institutions results from choice differences

*Translated from  
Russian by  
I. Zhuchkova.*

across social classes [Broccolichi, van Zanten 2000; Ball 1993; Ball et al. 2002; Kristen 2003]. Even being entitled to exercise the freedom of choice, parents tend to make educational decisions that match their social class or socioeconomic status. More advantaged parents send their children to more effective schools to boost their chances for success. As a result, social advantage is reproduced through education: it is not only the level of education selected by students and their families but also the quality of educational institutions, starting from the first grade or even preschool, that is critical.

The role of school in social inequality reproduction became particularly visible in the 1980s, when a number of countries began to reform their education systems and integrate market mechanisms. Institutional changes affected school choice, which became free for parents. With all the diversity of national educational contexts, the major consequences of introducing free school choice were the same for most countries. Instead of improving education quality, as had been expected, competition resulted in school differentiation. Market rules benefit schools that are already better off and make it worse for those attended by working-class children [Lauder, Hughes 1999; Reay, Ball 1997].

In a situation like that, school choice becomes the “middle-class strategy” [Ball 1993]. Access to educational services is unequal in favor of the middle class. What is more, middle-class parents regulate the education market according to their needs and goals [Ball, Bowe, Gewirtz 1996; Ball, 2003]. However, such opportunities are fraught with risk and may require heavier investments than ever before, as market conditions decrease the probability of replicating the social status of parents. Although the middle class controls the education market, the market as such is so open and disorganized that it disturbs the order and long-term planning which middle-class parents want so badly [Ball et al. 2002].

Vague choice criteria are an important feature of modern education markets. Which kindergarten or school is better? There are no evaluation tools that could be applied universally, so middle-class parents spend a lot of time choosing the “right” school. Not infrequently, they pay attention to student performance or ethnic composition [Hastings, Kane, Staiger 2005; Saporito, Lareau 1999], but they do not have a clear idea of what exactly should be selected and what criteria should be considered. Uncertainty is giving rise to a new type of moral panic around schooling and school choice [Ball et al. 2002], which is especially typical of large cities with their saturated education markets, fierce competition and high levels of school diversity and accessibility.

Middle-class parents living in large cities think in such a strategic way as to preventively move to better neighborhoods with the same socioeconomic status as theirs, which is called *moving to opportunity* [Leventhal, Brooks-Gunn 2003]. In this case, parents are not involved



in the school choice process as they made this choice in advance by choosing where to live [Gabay-Egozi 2015]. Some researchers, understanding how such concentration of the middle class in neighborhoods contributed to inequality reproduction, suggest breaking the link between the school market and the housing market [Benson, Bridge, Wilson 2015].

Working-class parents are involved in school choice much less actively than middle-class families. In a number of cases it happens due to the lack of information and cultural and social resources in the family to make optimal decisions. Disadvantaged (migrant or low-income) families often refuse to make a choice, being convinced that all public schools are the same and simply sending their children to the nearest one [Broccolichi, van Zanten 2000; Kristen 2003]. However, even if they do choose an institution, they tend to be guided by the criteria that are of little interest to middle-class parents, attaching most importance to school proximity and road safety [Warrington 2005]. As a result, working-class children turn out to be disadvantaged even though their parents enjoy the freedom of school choice [Ball 1993; Reay, Ball 1997].

It is not only parents' socioeconomic status but also their race and religious beliefs that affect school choice. The most important thing, however, is that socioeconomic inequality at the level of neighborhoods results in choice being determined by local contexts, namely the ethnic and sociodemographic composition of individual neighborhoods and differences in the organization of local education systems. Population density plays an important role in shaping local education markets: as the population decreases, more places become available at schools, while as neighborhoods get more populated, schools become overcrowded, hence less accessible. The distribution of students among schools depends on the availability and ratio of schools of different statuses and their location. Based on these characteristics, researchers identify types of competitive environments in local education markets [Lubienski, Gulosino, Weitzel 2009; Taylor 2001].

Until very recently, the physical and social contexts of school choice had hardly been addressed by researchers [Lubienski, Gulosino, Weitzel 2009]. However, modern studies are increasingly built around analyzing local educational markets or even micromarkets and microsystems. At this level of analysis, it is easier to understand context-conditioned processes, including the differentiation of schools across neighborhoods [Taylor 2001].

Russian research findings also reveal class differences in school choice strategies. Better-educated and wealthier parents attach more importance to teacher competence than school proximity [Sobkin, Ivanova, Skobeltsina 2011; Roshchina 2013]. Low-educated parents tend to follow the "package investment strategy", delegating concerns about their children's academic achievement to the education system, while highly educated parents make "targeted investments"

at every stage of education, deciding what classes or activities will contribute the most to their children's future success<sup>1</sup>. However, there have been no comparative studies that would explore the choice of school by Russian parents with due regard for their structural opportunities.

### **The Changing Rules of School Choice**

The problem of school choice is very acute nowadays. Parents who consciously build their children's educational strategies are ready to spend nights camping in queues to get their children enrolled in the school of choice. Such situations can be observed from time to time in various cities.

Address-based school enrollment frustrates highly educated parents who want quality education for their children:

"What country of opportunities are you talking about??? I don't understand why not allow everyone to choose the schools they want? Very few parents struggle for strong schools today, very few! So why not allow overloaded schools to run admission tests??? Let them enroll students who are capable and willing to learn! Not everyone can afford a gymnasium or a lyceum! And failure in such tests does not mean infringement of anyone's rights! Decisions should be made by schools only! And if we have to queue overnight, we'll do it right by the school building because it's closer and easier to understand what's going on in there."<sup>2</sup>

The relevance and social significance of the problem of school choice today are comparable to those of introducing the Unified State Exam (USE) several years ago. However, while the USE integration involved a universal set of rules and procedures applicable to the whole country, the rules on admission to schools still vary year after year in some regions.

The 1990s brought complete freedom of choice to education, enabling parents to choose from a variety of learning formats and schools of different statuses offering different sets of educational services [Cherednichenko 1999]. That was when education markets began to emerge. Meanwhile, schools were inheriting their statuses, as well as reputations, from the Soviet era, using them as the main signals to translate to the market.

The education market grew and evolved for two decades, followed by critical national policy decisions on the rules of school choice designed to improve the opportunities for children from low-resource

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<sup>1</sup> [http://ria.ru/ratings\\_analytics/20120514/647531719.html](http://ria.ru/ratings_analytics/20120514/647531719.html)

<sup>2</sup> <http://www.shkola-spb.ru/>

families. The Federal Law No. 273 On Education in the Russian Federation of December 29, 2012 introduced the notion of “school zone”.

The law allowed every federal subject to interpret the term in their own way. Whole administrative districts were declared school zones in St. Petersburg in 2013<sup>3</sup>, so every family had the right to choose any school within their administrative district in 2014. However, this practice only lasted for one year. As early as 2014, some schools had already begun to be officially linked to specific addresses, the residents of which were the only ones entitled to attend those schools. An experiment carried out in St. Petersburg revealed the heart of the problem of school choice: while some parents advocate for free school choice, all of them want to have the right to attend the school nearest to their home.

Linking specific schools to restricted neighborhoods aims at reducing the segregation of schools: the larger the territory within which parents are allowed to make free choice, the higher the inequality among educational institutions, which inevitably results in reduced educational chances for lower-class groups. However, when free choice is limited by school zones, it harms parents who want their children to attend higher-status schools but have none near their home. The decision of the government of St. Petersburg to link schools to residential districts is an attempt to come to a compromise and balance the interests of all market participants.

The issue is especially acute in megalopolises that have more advanced and differentiated education systems, i. e. more educational institutions, higher school density and status diversity.

## **Data Collection and Sampling**

In order to analyze the process of parental school choice, two surveys of primary school students' parents were conducted, one in the schools of Vasileostrovsky District in 2013 and the other in the schools of the left-bank part of Nevsky District in 2015. Schools were sampled randomly. The resulting sample included 581 parents in 21 schools (of the total of 30) in Vasileostrovsky District and 474 parents in 13 schools (of the total of 19) in the left-bank part of Nevsky District. The surveys were carried out by students and researchers of the National Research University Higher School of Economics, who did short interviews with parents outside the school, recording their answers in questionnaires<sup>4</sup>.

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<sup>3</sup> St. Petersburg Law No. 461–83 On Education in Saint Petersburg of July 17, 2013.

<sup>4</sup> Data was collected and analyzed within the framework of the projects supported by the HSE Program for Basic Research in 2013–2015. The analytical part of the study was also supported by the Russian Humanities Research Foundation (Project No. 16–03–00802 “Differentiation of Schools and Educational Choice: Schools and Parents”, 2016–2018).

The questionnaire tool offered both open- and closed-ended questions on various aspects of school choice: how many options were considered, how much time it took to make a decision, how exactly the choice was made, how different schools were compared, what the choice criteria were, which sources of information were used, etc. Next, parents were asked whether they considered changing school before the middle grades as well as about their plans concerning middle and high school education and their college ambitions. A separate module of questions was devoted to sociodemographic characteristics, namely parental education and parental socio-occupational status (SOS)<sup>5</sup>.

### **Characteristics of the District Cases**

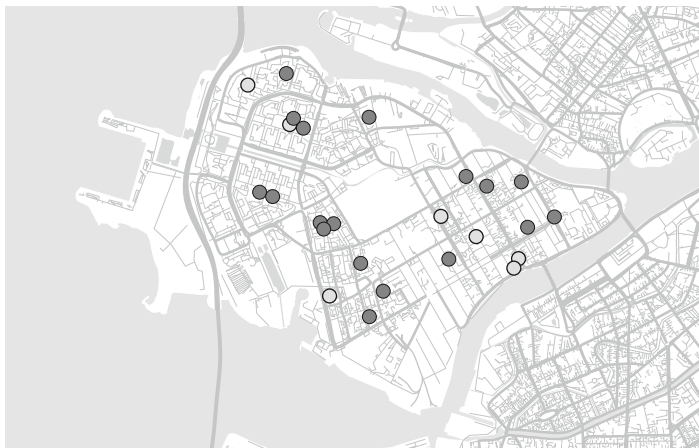
Differentiation in local education markets in general and in school choice in particular is largely affected by the historical, socioeconomic, geographic and residential contexts of specific neighborhoods.

The two districts selected for analysis represent contrasting cases in terms of their socioeconomic contexts, spatial accessibility and location of schools in them. Vasileostrovsky District (VD), which occupies the territory of Vasilyevsky Island (it also includes two smaller islands) is characterized by the high population density and spatial accessibility of virtually all schools. The island has an area of only 10.9 km<sup>2</sup>, stretching up to 4.2 km north to south and up to 6.6 km west to east. The district has good transportation and is part of the city's historic center. For instance, the eastern part of the island is home to such sightseeing attractions as the Spit of Vasilyevsky Island, the Kunstkamera Museum, The Twelve Collegia edifice headquartering St. Petersburg State University, and others. At the same time, the district is isolated from the rest of the city, being connected to the mainland by bridges, which are raised nightly to allow the passage of sea vessels along the Neva River. These characteristics make VD a unique locality. Some of its spatial characteristics are displayed on the map, which also shows the location of all the schools in the district (Fig. 1).

Nevsky District (ND) differs significantly from VD in the historical, geographic and demographic contexts. Despite being rather stretched out (20 km from north to south, 8 km from west to east) and having an impressive area of 61.79 km<sup>2</sup>, it is sparsely populated. Residential housing occupies only 1.6 percent of the territory. The district is split in two by the Neva River, over which transportation is rather difficult: only three bridges connect the two parts of ND, turning them into isolated "ecosystems" (Fig. 2).

<sup>5</sup> ISEI-08 (International Socio-Economic Index of Occupational Status) was used as an indicator of socio-occupational status. The index is based on the detailed international classification of occupations ISCO-08 and shows the social prestige of various occupations and the relevant levels of education required.

Fig. 1. **Vasileostrovsky District Schools Plotted on the Map**  
(dark circles indicate schools covered by the surveys).



The left-bank part of Nevsky District involved in the study is very stretched along the Neva River with residential neighborhoods alternating with industrial parks, which creates structural limitations for school choice. The district is bordered by the river on one side and by the Nevsky Overpass (Sortirovochny Bridge) on the other. Only two main roads run along the Neva River connecting the district with the city center (Alexander Nevsky Square) and Kolpinsky District, and they are congested most of the time. Transport accessibility of the district and transportation within it thus cannot be considered satisfactory.

There are similarities as well as differences between the geographical contexts of the two districts. Both VD and the left-bank part of ND are fairly isolated from other districts by topographical barriers, which hamper student mobility between schools of neighboring districts. VD, however, is more compact, and nearly all families have more than one school available within walking distance. The left-bank part of ND is very stretched and divided into sectors, which may affect student mobility within the district.

The socioeconomic contexts of the districts are inextricably associated with the processes of their historical and real estate development. VD was among the first districts in the city to be involved in real estate development. It has a lot of housing which was built before the first third of the 20th century and which is now dilapidated or used as communal apartments. At the same time, the district has quarters developed in the 1960s-1970s as well as luxury infill apartment buildings. Such a diversity of residential housing renders the district attractive to all social classes.

Nevsky District was developed during the Soviet period and constructed by the proletariat for the proletariat. It still has housing with-

Fig. 2. **Nevsky District Schools Plotted on the Map**  
(dark circles indicate schools covered by the surveys).



out shower facilities—it was suggested that residents would go to public saunas. Although the population changed over years, in fact the composition stayed the same, consisting mainly of the working class. Numerous industrial zones virtually turn the residential quarters into isolated “pockets” with a small number of schools in each. As a result, parents have to choose from those few institutions near their homes.

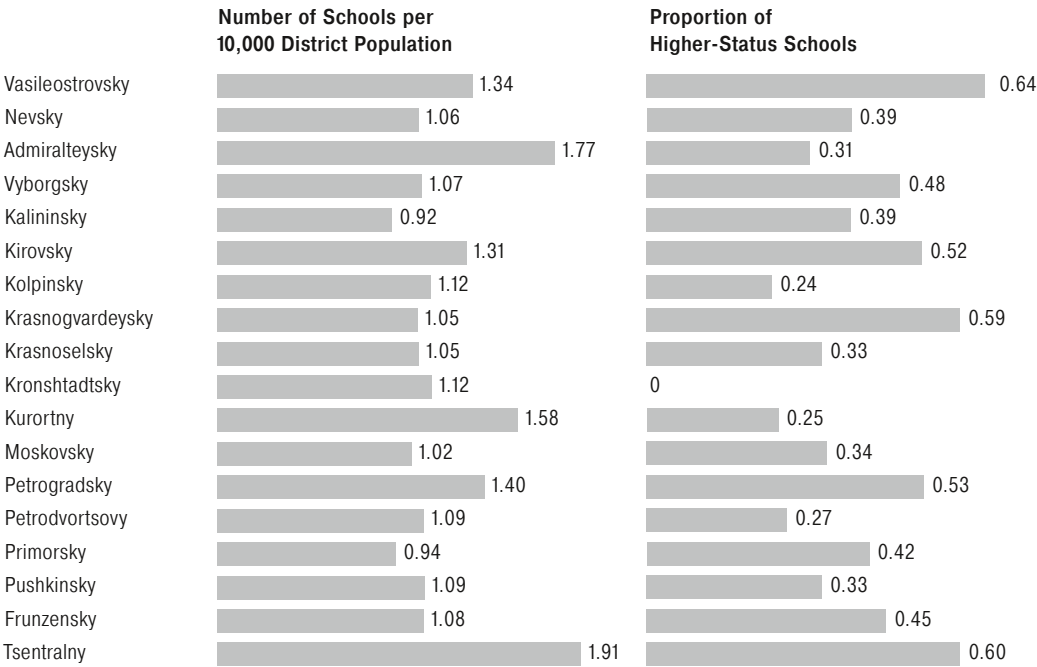
Differences in the cost of housing (purchase and rent) help to see the gap in the socio-occupational standings of residents between the two districts: the average price per square meter is 103,027 rubles in VD, as compared to 77,094 rubles in ND; average monthly rent for a one-bedroom apartment is 35,574 rubles in VD, as compared to 25,028 rubles in ND<sup>6</sup>.

The contextual differences described above influence the structure of local education markets, the VD market being more differentiated and the ND market being more homogeneous, as shown below.

<sup>6</sup> Estimated using the 2017 statistics from the Byulleten Nedvizhimosti (Real Estate Bulletin) website.



Figure 3. **The Number of Schools (Adjusted for Population) and the Proportion of Higher-Status Schools in the City Districts.**



### Characteristics of the Local Education Markets

Most city districts have approximately one school per 10,000 of the population, the highest school per capita rates being observed in Tsentralny and Admiralteysky Districts. VD has a 30 percent higher rate than ND, and it also features the highest proportion of higher-status schools (lyceums, gymnasiums, specialized schools) in the city—64 percent (Fig. 3<sup>7</sup>), as compared to only 39 percent in ND, which is close to the average city rate.

VD and ND differ in accessibility of educational institutions, their characteristics and, as a consequence, the aspects of school choice. Assumedly, choices in ND may be limited due to the specific spatial organization of the district, while VD parents will be more concerned about school choice—not because of the high limitations but because they have choice opportunities.

The contexts described and the differences in local education markets between the two districts frame the basic conditions of parental school choice. The important factors affecting it include population density, the number of educational institutions in the district, and

<sup>7</sup> The data was provided to the Laboratory of Sociology in Education and Science by St. Petersburg Center for Assessing the Quality of Education and Information Technology.



**Table 1. Socio-occupational status and College Education of VD and ND Parents: Mean Values with Confidence Intervals.\***

	VD	ND
Average maternal SOS	51.3 ( $\pm 15.7$ )	49.9 ( $\pm 13.4$ )
Average paternal SOS	51.4 ( $\pm 14.2$ )	50.4 ( $\pm 13.6$ )
Percentage of college-educated mothers**	63.8 (60.3–67.8)	59.1 (54.2–63.7)

\* The international index ISEI-08 used to assess socio-occupational status takes values from 10 to 90, the lowest values corresponding to unprestigious, low-paying unskilled labor jobs (e. g. cleaning lady), and the highest ones to prestigious, high-paying occupations that require a college degree (e. g. surgeon or lawyer). In this sample, SOS values range from 10 to 79.

\*\* Confidence intervals for college education were calculated by bootstrapping.

their characteristics. School choice contexts differ greatly at the level of city districts, which coincide with “school zones”.

### **School Choice in St. Petersburg**

There are no established social classes in Russia today that would use their advantages or lose within the education market. Rather, we are talking about socio-occupational status and different educational backgrounds. At least, these parameters can be measured and included into the analysis model.

Despite the differences in socioeconomic development between the city districts described above, the data collected indicates that parental socio-occupational status and educational background of parents do not differ statistically significantly between VD and ND (Table 1).

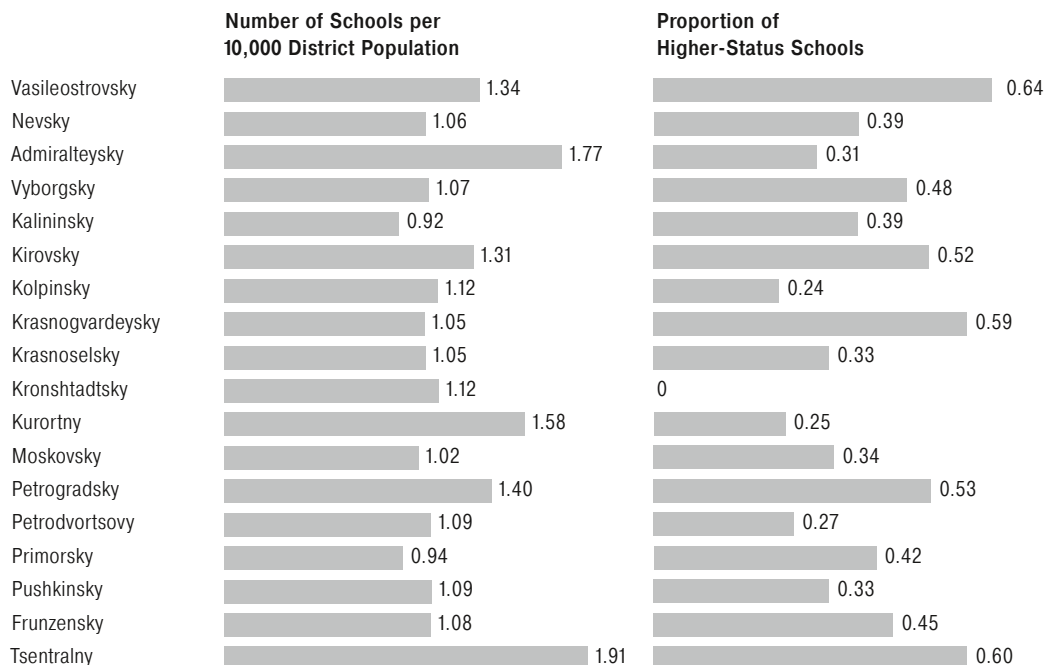
However, the districts differ considerably in their socioeconomic composition, as evidenced by the paternal and maternal SOS density functions (Fig. 4, 5).

ND has a population of heterogeneous composition. Both pictures show two peaks, particularly prominent in the paternal SOS density function graph (Fig. 5). The first one indicates highly-qualified managers and professional engineers, and the second one denotes specialists, i. e. vocational teachers, junior managers in the construction and welfare sectors. The proportion of the lower middle class is very small, which results in a gap in the middle of the distribution.

Vasileostrovsky District has a high-SOS stratum of both fathers and mothers—specialists such as engineers, geophysicists, physicians, dentists, judges, etc.—which is barely distinguishable in ND.

The majority of parents in both districts—67.3 percent in VD and 71.9 percent in ND—are firmly convinced that their children will obtain a college degree in the future. In VD, 10.2 percent of parents intend to move their children to another school later, as compared to 2.4 per-

**Figure 3. The Number of Schools (Adjusted for Population) and the Proportion of Higher-Status Schools in the City Districts.**



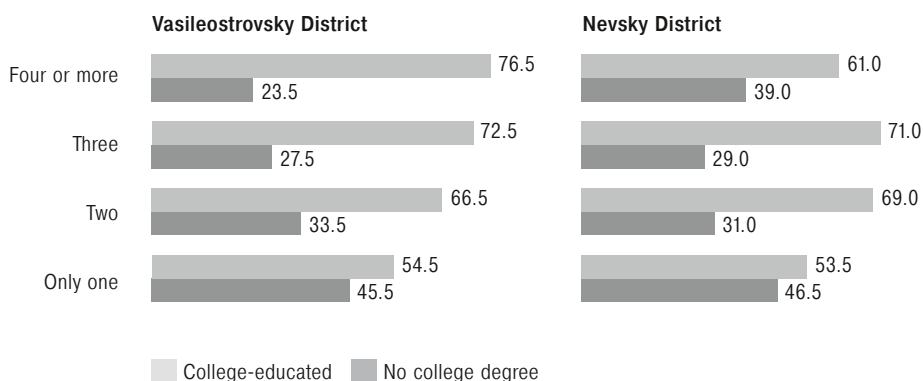
cent in ND. College aspirations and school changing intentions are positively related with mother's higher education.

Only 42 percent of VD families did not consider other school options apart from the school attended by their children. The proportion is considerably higher in ND (59%). In most cases, parents chose from two schools only (29% in both districts).

The response "Only one" (no other school options were considered) cannot be interpreted unambiguously. As seen from the interviews<sup>8</sup>, different motivations and family backgrounds may be behind it. Parents could have chosen that specific school because they or their friends had attended it, so they consider it trustworthy enough and do not have to engage in the complicated process of school selection. Alternatively, such a response may indicate that other nearby schools were so bad that they were not even considered as options. From this point on, families that did not make a choice are treated as a homogeneous group in being compared to those who made a choice, but it

<sup>8</sup> After completing the formalized questionnaires, some of the parents (N=40) gave extended interviews on school choice. In particular, they were asked to specify how they interpreted certain items of the formalized questionnaire.

Figure 6. **The Distribution of Parents' Responses to How Many School Options They Considered.**



should be kept in mind that this category includes rather diverse families with different educational decisions.

Figure 6 shows the distribution of responses on the number of school options considered in VD and ND, adjusted for mother's education. In both districts, parents without college degrees were more likely to consider only one school option, while college-educated parents chose from two or more institutions.

Children of 42 percent of ND families attend schools other than the nearest one. This question was not asked in VD, but it can be safely assumed that the proportion of such families is higher, since the journey to school takes on average 1.5 minutes longer in VD than in ND.

### **School Characteristics Perceived as Important by Parents**

Parents consider a number of factors when choosing a school, balancing their choice criteria with their family's needs and opportunities. The respondents were asked about the school characteristics that had mattered the most to them. In VD, parents were supposed to rate all of the characteristics proposed, while ND parents were asked to select and rank only three. Seven response options were proposed: "school status (gymnasium, lyceum, specialized school)", "availability of extracurricular activities", "high USE performance", "ethnic composition", "cultural background of classmates", "neat and well-equipped facilities" and "security guards and student safety"; they could also select "other" and provide an answer of their own. The first survey in VD offered two more options, "proximity to home" and "good teachers and administrators", which were later excluded as they were selected by nearly all parents and thus did not allow for discriminating among different categories. The resulting response distribution is shown in Figure 7. Response differences between the districts are reflected in Table 2.

Figure 7. **The Distribution of Responses to Which School Characteristics Were Considered When Making a Choice.**

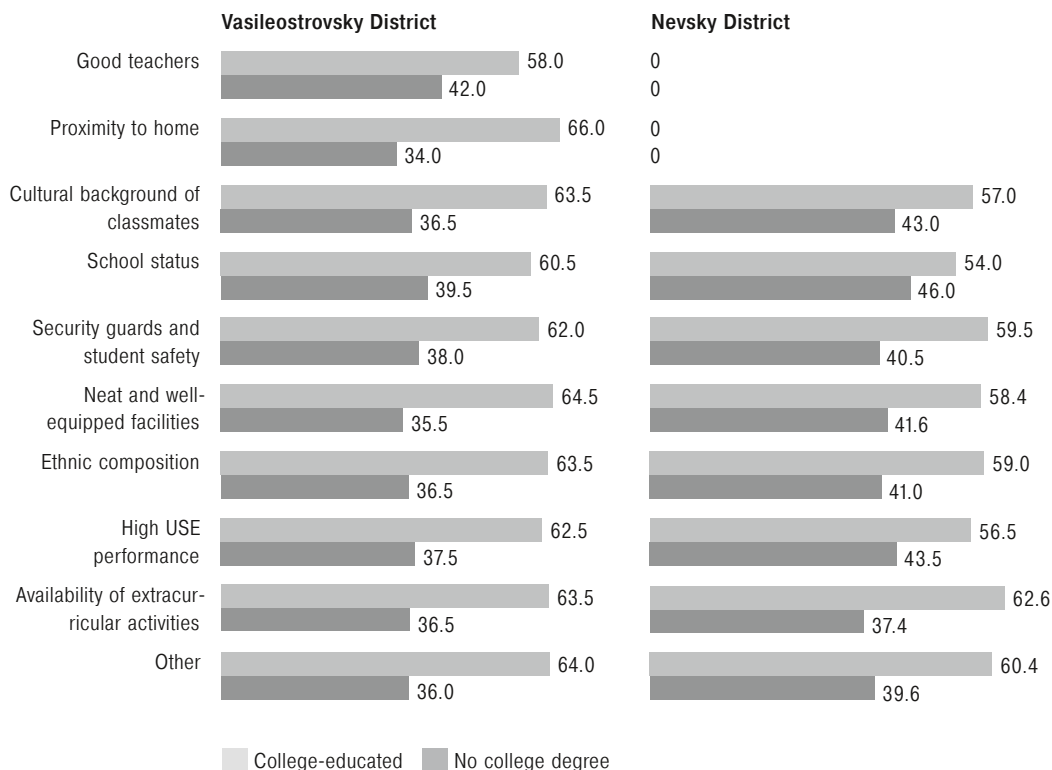


Table 2. **Differences in School Characteristics Perceived as Important by Parents (%).**

	Total	ND	VD
School status	35.3	36.7	33.3
<b>Extracurricular activities</b>	25.4	<b>19.8</b>	<b>32.7</b>
<b>USE performance</b>	20.3	<b>12.7</b>	<b>30.2</b>
<b>Ethnic composition</b>	10	<b>5.3</b>	<b>16.2</b>
Cultural background	17.6	15.8	20
<b>Facilities</b>	28.9	<b>25.2</b>	<b>33.5</b>
<b>Safety</b>	21.2	<b>13.8</b>	<b>30.8</b>

School status, neat and well-equipped facilities and availability of extracurricular activities were found to be the most significant criteria of parental school choice. Cultural background of classmates is also considered as quite important. Ethnic composition is a much greater concern for parents in ND than in VD. Items on school proximity and the quality of teachers and administrators were only offered in the VD survey, and the overwhelming majority of parents marked these characteristics as important. Below, we zero in on each of the school characteristics as well as the categories of parents who attach the most importance to them.

*School status* (gymnasium, lyceum, specialized school). School status orientation is strongly related to parental education—this criterion was selected more often by college-educated mothers in both districts. For fathers, however, this relationship is only observed in VD. School status plays an important role for parents who chose the school other than the nearest one to their home. VD parents who paid attention to school status consider their choice to be final and have no intention of moving their children to another institution.

Some parents obviously understood “school status” in a way that was different from what was implied by the questionnaire. Despite the bracketed explanation that formal status (gymnasium, lyceum, specialized school) was meant, they assessed the informal status of schools, i. e. their prestige and popularity in the local community. That is why a good proportion of parents who marked school status as an important criterion had actually sent their children to regular schools.

*High USE performance.* In both districts, this school characteristic was selected as important by parents who considered two or more school options. It is considered equally significant by mothers of all educational backgrounds. In VD, this parameter was selected more often by college-educated fathers than by fathers with no college degree. School effectiveness is valued more by those VD parents who have college aspirations for their children.

*Availability of extracurricular activities.* This characteristic is equally important to parents who chose from two or more school options as well as those who did not consider any alternatives. The gap between parents who attach importance to this criterion and those who do not is only observed in ND, where extracurricular activities are valued more by high-school-educated mothers and fathers, while college-educated mothers are not likely to consider this parameter significant. In VD, attaching importance to extracurricular activities is related to parents’ college aspirations: those who find extracurricular participation important are more likely to expect their children to obtain a college education (less likely to opt for “Unlikely”). Only parents whose children attended regular schools had been interested in extracurriculars, while those who sent their kids to gymnasiums and lyceums had barely taken this factor into account.

*Ethnic composition.* This criterion is equally important to mothers of all educational backgrounds. VD fathers' attitudes vary across educational levels, ethnic composition being more likely to be considered an important school characteristic in families where fathers had vocational education. In VD, this factor also plays a greater role for parents who consider the possibility of changing school. This finding is based on the responses of parents from a number of schools, and there are no signs that their children attended schools with high proportions of ethnic minority students.

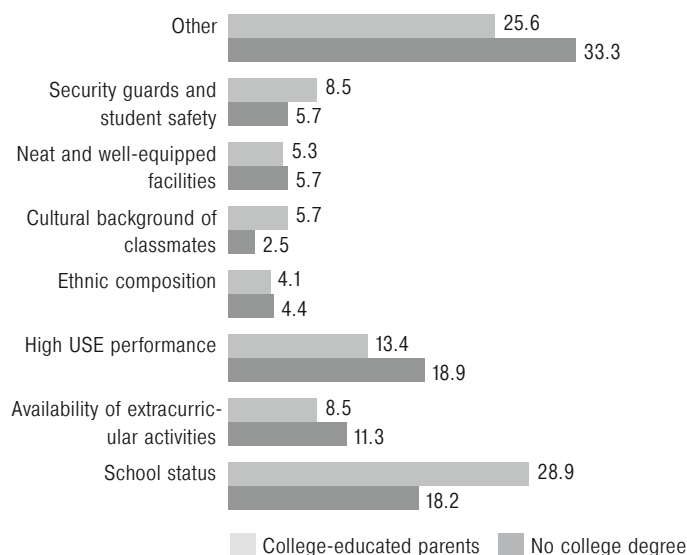
*Cultural background of classmates.* This school characteristic is valuable most of all for better-educated parents with fairly high ambitions. In VD, it was selected by college-educated fathers and parents who had considered two or more school options before making a choice. In ND, cultural background of classmates is significant for college-educated parents (significance level=0.10). ND parents who attach importance to the level of classmates' cultural development expect their children to obtain higher education.

*Neat and well-equipped facilities, security guards and student safety.* The survey results do not allow for identifying the specific categories of parents considering or not considering these two characteristics. In ND, neat and well-equipped facilities play a more significant role for parents who have no intentions of changing school. In VD, the proportion of parents with college aspirations was higher among those who valued school facilities than among those who attached no importance to the factor. In VD, student safety is more important to parents who chose from a few school options than to those who only considered one.

The items on "school proximity" and "good teachers and administrators" were only proposed during the first survey conducted in VD. School-home distance is an important factor for parents who did not consider alternative options. Interestingly enough, college aspirations are found more often in parents attaching importance to school location. Good teachers and administrators represent a characteristic that is more likely to be considered by parents who intend to provide their children with a college education; it is rarely taken into account by parents with high school and vocational education. In addition, it is valued by parents who were involved in the school-choice process and disregarded by those who were not.

Parents in ND were asked to rank three school characteristics that they had considered when making school choice by their importance. School status was the first choice of most respondents (24.7%), followed by high USE performance (15.6%). Other factors were much less likely to be selected as the first choice. The second most important factor was availability of extracurricular activities for most parents, followed by neat and well-equipped facilities, security guards and student safety, and high USE performance. As for the third most impor-

Figure 8. **Differences in Choosing the Top Priority School Characteristic (First Choice) between College- and Lower-Educated Parents (%).**



tant school characteristic, the most popular answers were school facilities, followed by student safety and extracurricular activities.

College-educated mothers are significantly more likely to rank school status as their top priority criterion, their second choice being high USE performance, while non-college-educated parents value availability of extracurricular activities and student safety the most. No difference in the frequency of selecting specific school characteristics as the third choice was found among parents with different educational backgrounds (Fig. 8).

Some patterns can be traced in choice combinations, too. Parents who valued school status the most were very likely to rank high USE performance or availability of extracurricular activities as the second most important factor. Those who attached the most importance to extracurriculars were also concerned about the cultural background of classmates or ethnic composition. Ethnic composition was also the next thing considered by parents whose primary choice criterion was school effectiveness. Cultural background of classmates is related to other characteristics of school effectiveness and composition, while neither neat and well-equipped facilities nor security guards and student safety are related to any other aspect of school effectiveness.

Parents were allowed to specify important school choice criteria of their own. All in all, 134 “other” responses were provided, Figure 9 showing the distribution of the most popular ones. The most common response was school proximity to home or (in some rare cases)



to a parent's workplace. Parents concerned about school proximity were significantly more likely to choose the school nearest to their homes. The second most common response was teachers. This category includes requesting a particular teacher, mentions of teaching quality, teaching staff competence and "teachers' behavior towards students". This is a pretty powerful factor, as parents who searched for good teachers were significantly less likely to choose the school nearest their home.

Some parents reported having chosen a specific school because it was attended by their older children. First of all, such parents are familiar and apparently satisfied with the school personnel and environment. Second, enrollment priority is given to students whose siblings already attend the school even if the family lives in another school zone. Some parents chose the school that they themselves had attended or that was attended by their friends' children. In this case, the school feels familiar to parents, and they tend to perceive their choice as more informed, even though it may have been over a decade since their graduation. It is probably for the same reason that some parents choose the school where someone whom they know works, hoping for some guarantee of a comfortable learning environment for their children.

Some parents reported having chosen a specific school because a particular subject was taught at a good level there, or because its students demonstrated a high level of knowledge, or because it offered unique learning programs. Foreign languages (English, Chinese) and mathematics were mentioned most often among the particular subjects that parents wanted to be taught at a good level. Parents who specified such school characteristics had made informed choices, caring about specific criteria, collecting information on various schools' offers and searching for the most suitable option. The quality of knowledge, learning programs or teaching of a particular subject was mentioned as a school characteristic significantly more often by college-educated parents. Those who paid attention to such characteristics were significantly less likely to choose the school nearest their home.

Parents described some other characteristics as well, such as teacher tolerance, school discipline ("no smoking in the school building or toilets"; "order, discipline"; "everything is negotiable"; "a Stalinism-hardened principal"). Yet, such responses are unique and thus not shown in Figure 9.

School proximity and requests for a specific teacher, not school, were reported most often among "other" reasons. Parents also mentioned friends' recommendations, education program and knowledge quality, and class composition. However, such responses were rather unpopular.

Figure 9. **The Distribution of Responses on the Important Characteristics Specified in the “Other” Category (Proportion of parents who selected the “Other” option).**

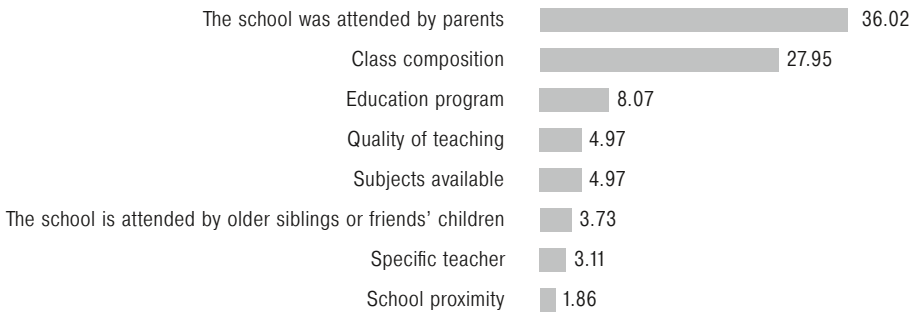
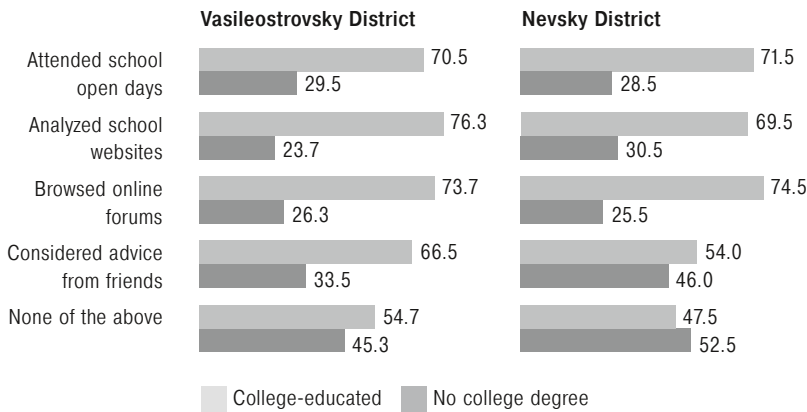


Figure 10. **The Distribution of Responses to “What Activities Did You Involve in before Making Your Choice?”**



**Sources of Information**

The respondents were asked a series of questions about what they had done before deciding on the school for their children. It was found out that 36.9 percent of ND parents and 33.3 percent of VD parents had taken no action to choose the school.

Overall, college-educated parents actively use different sources of information about schools. They are more likely to consider advice of other parents, analyze online forums and school websites and attend school open days than lower-educated parents (Fig. 10).

In VD, parents who only considered one school option did not collect any information on the institution—they did not consider advice from their friends and family, or analyze online forums and school websites, or attend school open days—as compared to those who

considered two or more school options. No such difference was revealed in ND.

Parents with college aspirations for their children tend to search for information more actively, striving to make informed choices by considering advice from their friends and family and analyzing on-line forums.

In VD, 57.5 percent of the parents who considered two or more school options sent their children to higher-status schools, as compared to 55.3 percent of the parents who made no choice (the difference is insignificant). Meanwhile, the corresponding percentages in ND are 28.6 and 18.9 percent, indicating a significant gap. Therefore, school status is considered an important factor by parents making their school choices.

In ND, higher-status schools were the nearest options for 46.3 percent of the parents who did not consider any alternatives and 30.2 percent of the parents who compared different schools, while regular schools were the nearest ones for 67.5 and 59.3 percent, respectively.

Both districts feature significant differences between mothers who did not make a choice but sent their children to higher-status schools and those who were engaged in the choice-making process, on the one hand, and mothers who did not make a choice and sent their children to regular schools, on the other, the latter category being characterized by a comparatively low socio-occupational status.

In both districts, parents who considered two or more options and chose higher-status schools were guided by formal school effectiveness characteristics, namely USE performance and status. In addition, VD parents also took the cultural background of classmates into consideration. Virtually the same criteria (school status in both districts and USE performance in VD) were important to parents who sent their children to higher-status schools without considering alternative options. However, they also took some action before making their final decision: VD parents analyzed online forums and ND parents considered advice from friends and family. Parents who chose regular schools from two or more options attached the most importance to neat and well-equipped facilities (this difference is observed in VD). Meanwhile, those who sent their children to regular schools without considering alternative options valued ethnic composition most of all, neglecting good teachers and school proximity (in VD).

## **Results and Discussion**

Logistic regression analysis allows for comparing the influence of parental SOS and education on school selection patterns. Two models were constructed, one for each of the two districts, the question as to whether parents considered alternative options (choice) being used as a dependent variable (Table 3).

It is not only the mother's education but also her socio-occupational status that making a school choice is related to in both districts.

Table 3. **Logistic Regression Results, Dependent Variable: Making a School Choice.**

	ND			VD		
	Odds Ratio	CI	p	Odds Ratio	CI	p
Intercept	0.37	0.16–0.86	0.022	0.87	0.45–1.69	0.687
Maternal SOS	1.00	0.99–1.02	0.612	1.00	0.99–1.01	0.917
<b>Mother's education</b>	<b>1.96</b>	<b>1.18–3.29</b>	<b>0.010</b>	<b>1.93</b>	<b>1.21–3.10</b>	<b>0.006</b>
N	358			428		
AIC	483.712			576.426		

Table 4. **Logistic Regression Results, Dependent Variable: School Status.**

	ND			VD		
	Odds Ratio	CI	p	Odds Ratio	CI	p
Intercept	0.23	0.09–0.59	0.003	0.30	0.15–0.59	<0.001
Maternal SOS	1.00	0.98–1.02	0.673	<b>1.02</b>	<b>1.01–1.04</b>	<b>0.003</b>
<b>Mother's education</b>	<b>2.54</b>	<b>1.39–4.79</b>	<b>0.003</b>	<b>1.96</b>	<b>1.22–3.15</b>	<b>0.005</b>
N	358			428		
AIC	405.459			554.616		

College-educated mothers are more likely to consider two or more options before making a decision.

Two more models for each district were constructed with the status of the selected school (regular or lyceum/gymnasium/specialized) being used as a dependent variable (Table 4).

School status is also related to mother's education in both districts: having a college-educated mother boosts the child's chances of attending a higher-status school. VD findings indicate the important role of maternal SOS as well, which is positively related to the probability of selecting a higher-status school (Fig. 11).

The graphs also show that SOS has more weight than mother's education in VD. The probability of choosing a higher-status school is 16.4 percent higher among college-educated mothers. Every additional score on the SOS scale increases this probability by 5 percent on average, which results in a 31% gap between the highest- and lowest-SOS parents.

Obviously, the differences described above are explained by different structural opportunities of the two districts. Vasileostrovsky District compares favorably with Nevsky District by school diversity and

Figure 11. **Predicted Probability of Selecting a Higher-Status School.**

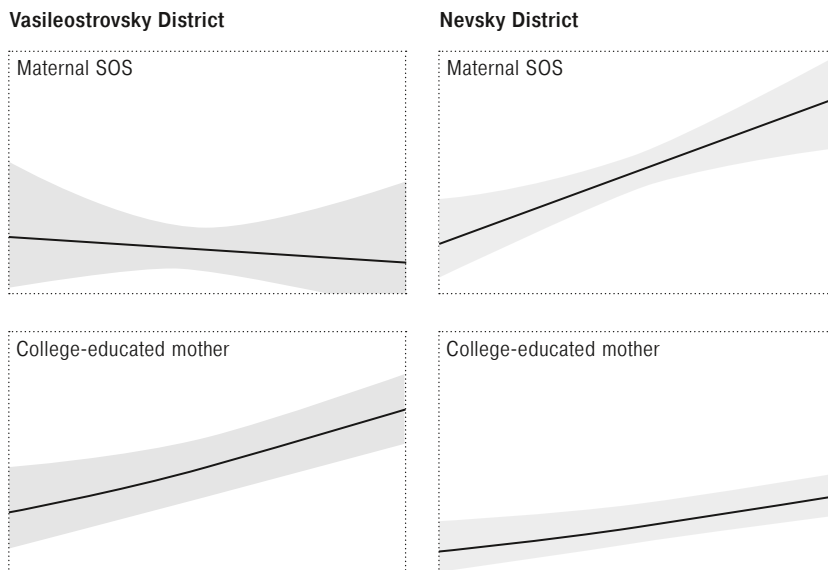
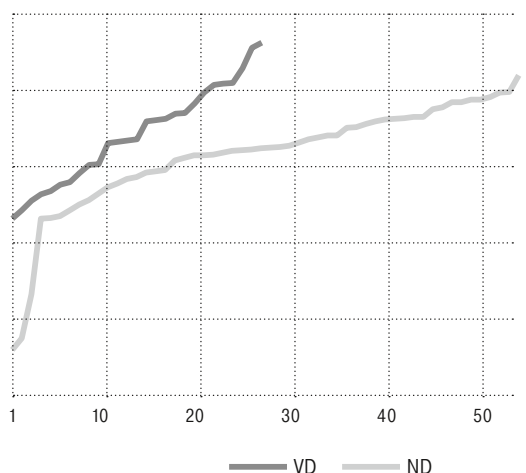
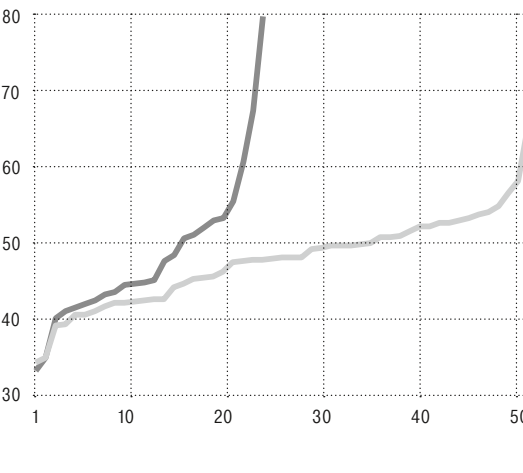


Table 5. **Number of Schools of Different Statuses in VD and ND.**

School Status	VD	Percentage	ND	Percentage
Regular school	9	34.60%	31	57.40%
Gymnasium	3	11.50%	4	7.40%
Gymnasium with enhanced education in foreign languages	1	3.80%	1	1.90%
Gymnasium with enhanced education in physics and mathematics	1	3.80%	1	1.90%
Lyceum	0	0.00%	3	5.60%
Artistic lyceum	1	3.80%		0.00%
School with enhanced education in foreign languages	7	26.80%	10	18.70%
School with enhanced education in mathematics	1	3.80%	1	1.90%
School with enhanced education in chemistry	1	3.80%		0.00%
School with enhanced education in the humanities	1	3.80%		0.00%
Educational center	1	3.80%	1	1.90%
Resource center		0.00%	1	1.90%
Center for culture and education		0.00%	1	1.90%

Figure 12. **USE Performance of VD and ND Schools in Russian.**Figure 13. **USE Performance of VD and ND Schools in Mathematics.**

the proportion of higher-status schools (Table 5). Besides, it is home to two of the six prestigious selective admission schools.

School choice strategies are differentiated little in ND despite the residents being split into two social groups (see Fig. 4 and 5), whereas differentiation is obvious in VD with its extended structural opportunities. It would seem that two peaks in SOS distribution should divide schools into two groups, families of higher SOS creating demand for more prestigious schools, but nothing like this happens in ND. The driving force behind school choice thus seems to be structural opportunities combined with the presence of high-SOS residents. The availability of selective admission schools and the presence of upper-class families in VD create conditions for the so-called conspicuous consumption. As a result, social groups of the same SOS tend to choose prestigious schools in VD and regular ones in ND.

Involvement in school choice is more typical of college-educated parents in both districts. College-educated mothers are more likely to consider two or more school options and to be willing to change school before the middle grades (they are still few, however). They use various sources of information (friends, online resources, school visits) and regard school status as an attractive characteristic of the highest priority, being ready to sacrifice school proximity for a higher school status. USE performance is the second most important factor of school attractiveness for college-educated parents. Attaching importance to school effectiveness is part of long-term educational strategies, as such parents are convinced that their children will obtain college education in the future. Parental education is therefore the fundamental factor determining parents' choice behavior.

School choice strategies have specific characteristics in both dis-

tricts. VD parents are more likely to get involved in the choice-making process, consider more school options, choose more remote schools and use various sources of information. VD also has a higher proportion of parents intending to change school before the middle grades and a higher student mobility rate. ND parents tend to consider other parents' advice and go to school open days more often than VD parents, but the use of specific sources of information is not related to parental education in ND. A specific characteristic of ND is that availability of extracurricular activities is valued by non-college-educated parents.

The school choice strategy pattern shared by a number of countries, which was first illustrated by Steven J. Ball through the example of Great Britain [Ball 1993], is found in this study as well: involvement in school choice is much higher among parents from better educational and socioeconomic backgrounds. In addition, it transpires that the structural opportunities of specific neighborhoods affect the degree of choice stratification. In VD, which represents all social classes and has more high-SOS residents, the middle class can identify itself in the process of social comparison [Festinger 1954] and detach itself using academic choice strategies. This becomes possible due to an extended structure of opportunities, which affects not only school choice as such but also adjustment of choice strategies. In situations of limited supply, the strategy of selecting prestigious schools becomes irrelevant for the middle class, so no further stratification is observed. However, as soon as the menu of prestigious schools is extended, the choice strategy described by Ball becomes important not only to the upper middle class but to other layers of the middle class, too. Choice strategies are always determined by comparison horizon, both at the level of schools and at that of SOS categories of parents pursuing a specific strategy. This is the underlying logic behind conspicuous consumption, and the findings of this study are very much in line with it.

Researchers identify the following important effects of school choice: parents who engaged actively in the choice-making process tend to be more satisfied with the school selected [Bosetti 2004], their children being more academically successful and more school-oriented [Shumow, Vandell, Kang 1996]. In a broad sense, school choice strategies depend on family characteristics and contribute to the differentiation of schools and social inequality in general. School choice plays a particularly important role in stratified systems. High social significance of differences in school choice behavior across social classes dictates the need to consider those differences when developing education policies and school choice regulations [Whitty 2001]. In the context of present-day education policies and educational strategy research, it appears vital to switch from nationwide and regional-level samples to a more in-depth and localized analysis. Academic choice strategies in Russia, while being similar to those in Europe, are still contingent on local structural contexts.



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# Third-Grade Parent Involvement in Schools

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Received in  
March 2018

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**Abstract.** The significance of the problem of parental involvement in children's education has to do with the proven positive effects of parental involvement in schools on children's wellbeing. However, no universal comprehensive idea of family involvement types and strategies has been developed so far, and the jury is still out on the efficiency of various family-school interactions in use today. This study is designed to shed light on the forms of parental involvement, which may differ depending on family, student and school characteristics. The study seeks to operationalize the concept of parental

involvement, describe parental involvement based on the findings of a large-scale survey, evaluate the dependence of parental involvement on family, student and school characteristics, suggest models to predict the level of parental involvement in the third grade, and develop recommendations for schools. Parents of 1,447 students from Krasnoyarsk and Kazan secondary schools involved in the iP-IPS project were surveyed twice, first at baseline and then at the beginning of the third grade. The survey contained questions on family demographic characteristics, parents' at-home and at-school academic involvement, and parental satisfaction with school communication. It was established that parental perception of school communication climate is a much more important predictor of third-grade parental involvement in schools than family sociodemographic characteristics or the level of children's development assessed at baseline. On the whole, the results obtained do not confirm the benefit of using universal strategies to encourage parental involvement.

**Keywords:** elementary school, parental involvement, school communication climate, parental satisfaction with family-school communication.

**DOI:** 10.17323/1814-9545-2018-4-230-260

This study uses the results of the project Predicting the Effectiveness of Primary Schooling sponsored by grant No. 16-18-10401 from the Russian Science Foundation within the program Basic Scientific Research and Exploratory Scientific Research Conducted by International Research Teams. Translated from Russian by I. Zhuchkova.

## 1. Problem Statement

The positive role of parental involvement in education has been proved in a number of meta-analytical studies across the globe [Wilder 2014, Freund et al. 2018]. However, the existing mechanisms and effects of parental involvement in Russian schools have been described poor-

ly so far [Antipkina 2017]. It has been established that teachers' attitudes toward parental involvement in school life as well as parental behavior are affected by perceived and unperceived beliefs of teachers and parents, legal standards, and everyday reality that can either create barriers to or promote parental involvement.

If a school has been sticking to teaching practices that date back to the era where social education was a priority, teachers may tend to assign a secondary role to the family in children's education and parents may tend to disengage from schooling. The family was long seen as a less-than-reliable partner of school, if not a hindrance: "There are good and bad families. We can neither go bail for parenting practices or say that families are free to rear their children as they wish. Parenting practices should be structured." [Makarenko 1990, p. 416]

Parental involvement in education is not only legislatively encouraged today but it is also formalized as a family's right and responsibility. Pursuant to the Federal Law *On Education*, "parents (legal guardians) of minors have the right of first refusal to educate and bring up their children" (Art. 44, par. 1)<sup>1</sup>, while the role of educational institutions is restricted to "helping parents (legal guardians) of minors rear their children, protect and improve their physical and mental health, develop their individual potential and address developmental delays when necessary" (Art. 44, par. 2). "Parents (legal guardians) are entitled to be involved in school governance to the extent and under the conditions stipulated in the educational institution's statute" (Art. 44, par. 3.7). "Parents (legal guardians) of minors have the right to familiarize themselves with the content of school education, the teaching practices and educational technology used at school, and the results of assessing their children's academic achievement" (Art. 44, par. 3.4), which makes them a party to the educational relationship (Art. 2).

The transition from the universal "expert" model of family-school interactions to a great variety of models (expert model, sponsorship model, consumer model, partnership model, etc.) [Mertsalova, Goshin 2015] has produced a number of problems in family-school relationships. For example, teachers complain about difficulties in scheduling family-school partnership activities. They also report that parents are unwilling to communicate with class teachers, psychologists and school counselors on a regular basis or to learn and improve their own pedagogical competence [Alieva, Zagladina 2012, p. 76].

The proposed study of parental motivations will provide an insight into the specific features of parental involvement in Russia and reduce the shortage of quantitative studies in this domain.

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<sup>1</sup> Federal Law of the Russian Federation No. 273-FZ *On Education* of December 29, 2012 <https://fzakon.ru/laws/federalnyy-zakon-ot-29.12.2012-n-273-fz/statya-1/>

**2. International  
Research in  
Parental  
Involvement**

Recent educational research findings encourage teachers to engage parents in school life. Parent involvement in education has positive effects on student achievement and motivation, promotes teacher involvement, reduces school violence, and improves the school's reputation in the professional community and in the neighborhood [Fan, Chen 2001; Hill, Tyson 2009]. In urban schools with heterogeneous socioeconomic backgrounds, parental support has a positive impact on attendance, students' attitude towards school, their self-confidence and motivation [Jeynes 2005; 2007].

Parental involvement in schools is a multidimensional construct, which embraces direct involvement in learning, volunteering for events, participation in parent-teacher conferences, discussion of schooling and parenting issues with teachers, and adjustment of families' educational expectations with those of the school [Epstein, Sanders 2002; McWayne et al. 2004].

Attempts have been made to differentiate between parents' at-home and at-school academic involvement [Eccles, Harold 1996; Sui-Chu, Willms 1996]. At-home involvement is assessed based on learning-oriented parent-child interactions, and at-school involvement is measured by parents' ability to initiate and maintain contact with school personnel [Shumow, Miller 2001]. There is empirical evidence that at-home parental involvement, e. g. in homework or preparation for tests and exams, is critical for children's academic achievement [Desforges, Abouchaar 2003; Emerson et al. 2012; Hattie 2009; Izzo et al. 1999; Sheldon, Epstein 2005]. Researchers hold that teachers tend to underestimate the role of parents' at-home academic involvement, as they often believe that parents do not care about their children's education unless they participate in school life directly [Auerbach 2007]. However, even being inconspicuous for teachers, parental involvement in discussing school life and educational trajectories with their children has a dramatic impact on academic performance [McNeal 1999].

The importance of different types of parental involvement for school students' academic and social achievement makes it vital to examine the motivations of parents' at-home and at-school academic involvement as well as the predictors of the level and type of such involvement [Niia et al. 2015; Grolnick et al. 1997; Hoover-Dempsey, Sandler 1995; 1997; 2005; Freund et al. 2018].

The effects of socioeconomic status as a predictor of the quality and level of parental involvement in education have been confirmed in a number of studies. For instance, lower-educated parents have been found to engage less in their children's education both at home and at school [Dauber, Epstein 1993] as they do not feel that their support will be productive enough [Lee, Bowen 2006]. Parents' busy schedules and/or low educational backgrounds may become barriers to meaningful parent involvement. Families may lack time and money to render assistance and psychological support to their children, en-

courage their self-help skills, organize and enrich their home learning environment. Family composition can also be a predictor of parental involvement. Parents who have fewer children demonstrate higher levels of at-home involvement in education, yet family size does not appear to have any influence on parents' at-school academic involvement [Dauber, Epstein 1993].

Employment and income are two more predictors of parental involvement. Mothers who work outside the home are less likely to be involved in school life, but their level of at-home academic involvement is the same as among mothers who do not work outside the home [Dauber, Epstein 1993; Eccles, Harold 1996]. Parents engage differently in the school life of sons and daughters, meaning that girls are usually nurtured more and face restrictions more often, while boys are more likely to receive harsh discipline [Eccles, Harold 1996]. Higher-income parents often build and maintain personal relationships with school teachers, which makes it easier to exchange information and allows parents to make informed decisions concerning their children's academic needs and progress [Cucchiara, Horvat 2009; McGrath, Kuriloff 1999; Weininger, Lareau 2003]. Lower-income parents normally focus their efforts on helping their children at home as they believe that school is responsible for education and family for providing emotional support and preparing children for adult life [Auerbach 2007; Ingram, Wolfe, Lieberman 2007; Ji, Koblinsky 2009; Lareau 1987]. Parental involvement in schools can also be influenced by certain community traditions. In the United States, for example, a lot of Latino immigrant parents hold that their role in children's education consists in fulfilling their basic parental responsibilities and providing general support to their children [Carrasquillo, London 1993; Delgado-Gaitan 1992; 1996] but they should not intervene in education if they want to avoid the risk of losing the respect of teachers [Garcia Coll et al. 2002; Holloway et al. 1995].

A separate domain is represented by psychological research in parental involvement in school life. Such studies evaluate, in particular, how parents' involvement can be affected by their personal characteristics, such as perceived competence [Hoover-Dempsey, Sandler 1995, 1997; Hoover-Dempsey, Whitaker, Ice 2010; Walker et al. 2005], or analyze the importance of school communication climate and teacher-student relationship as factors of parental motivation for involvement in children's education [Kerr, Stattin, Ozdemir 2012].

### **3. Russian Research on Parental Involvement**

Russian studies largely analyze the role of parents in education in the psychological and sociological frameworks. It is not the effects of parental involvement that they focus on but the conditions (at home and at school) that promote their interest in their children's education, the preferred types of parent-school interaction [Nisskaya, Savina 2018], and the factors affecting school choice [Nisskaya 2016]. Important

information about parenting practices can be obtained from international comparative assessments of education quality (PIRLS, PISA, TIMSS), which involve parent surveys [Zakharov, Kapuza 2017].

In addition to research papers, there is a body of methodological literature for teachers in Russia, who are advised to educate parents, enlighten them pedagogically and even “pedagogize” their minds. This term is not restricted to educating parents and involving them in school life; it also implies making parents interested in their own pedagogical competence, enriching them with knowledge in psychology, pedagogy and hygiene, involving them in schooling, school life and school problems as well as in discussing family conflicts and searching for ways out of them together [Kruzhilina 2009].

Pedagogical enlightenment and translation of purposes, forms and methods of educating children and stimulating their development are recommended as the most effective ways of working with parents. Another important set of policies to integrate the efforts of school and family has to do with promoting openness in education and enabling parents to express their expectations, monitor the quality of education and engage in the teaching process. Family-school relationships depend a lot on the joint activities of teachers, students and parents both at school and outside of it, such as events, performances, socially important projects, etc. Pedagogical literature also stresses the importance of personalized strategies in working with dysfunctional families and families where children have learning disabilities or behavior problems [Asrieva, Kovalenko 2012]. Analysis of methodological literature for school teachers allows for assuming that the recommendations available are based on an implicit belief that parental involvement in education is affected by the level of parents’ awareness, pedagogical literacy and willingness to share the school’s mission. Additional factors of parental involvement include school openness and community cohesion.

The nature of measures that schools undertake to engage parents in cooperation suggests that involvement of parents is based on the principles of uniform hierarchical translation of knowledge and behavior models from teachers. Such strategies are not sensitive enough to individual family and parent characteristics; they provide no opportunity to unlock and develop the potential of parental involvement in learning.

#### **4. Aims and Objectives**

The study in question gleans the lack of information on the types of parental participation (involvement) in learning, which may vary depending on family characteristics (socioeconomic status, parents’ busyness, interests and education), child characteristics, and the degree of school openness.

The theoretically significant aim of this study consists in assessing the prognostic value of factors affecting parental involvement, while



the practically significant one is in developing recommendations on personalizing teacher-parent communication to avoid excessive pressure on vulnerable (deficient) family resources and activate family's strengths.

Achievement of these aims involves the following objectives: (i) propose a model for operationalizing the notion of "parental involvement" and specific measurement scales; (ii) describe parental involvement based on the results of a large-scale survey; (iii) assess the relationship between parental involvement and family, student and school characteristics; (iv) propose models to predict levels of parental involvement half way through elementary school; and (v) adjust and improve the existing guidelines on family-school communication based on the models constructed.

## **5. Research Hypotheses**

1. College-educated parents from higher-income families are involved more in their children's education as they have more financial and cultural resources to do so.
2. At the beginning of school education, parents of children with better cognitive and non-cognitive abilities have lower levels of at-home academic involvement (as children need less assistance from parents) and higher levels of at-school academic involvement (as higher levels of child development make it more comfortable to discuss learning progress with the teacher) as compared to parents of children with lower abilities.
3. Parents of two or more children engage less in learning both at home and at school than one-child parents.

## **6. Parent Sampling**

The sample consists of parents of students attending schools in Krasnoyarsk and Kazan, 115 males and 1132 females. The respondents' children took part in the 2014 iPIPS survey which tested school readiness of first-graders and their progress across the first grade [Ivanova, Nisskaya 2015]. The iPIPS instrument is designed to measure reading and mathematical literacy, phonological awareness and the vocabulary of children at the beginning and at the end of the first grade. The survey represents a game that uses adaptive assessment algorithms. The parents filled out questionnaires twice, first at the beginning of the first grade (fall 2014) and then at the beginning of the third grade (fall 2016). Because the questionnaires were completed by parents of only 45 percent of the children who had originally made a representative sample, the resulting data cannot be considered representative.

## **7. iPIPS**

The questionnaires, filled out by parents when their children were first- and third-graders, were designed to collect contextual information on the children's development. They contained demographic questions

about family (parental education and occupation, family income, educational resources, kindergarten attendance, preschool education experience, attendance of local classes, groups and activities) as well as questions that formed parenting scales. The parents' responses to questions of all the scales were processed within the framework of Item Response Theory (IRT) procedure using the Rasch Rating Scale Model and Winsteps software [Linacre 2017]. All the scales constructed and described below are unidimensional, and their items show a good match with the model. Using IRT to process questionnaire responses offers the advantage of interpreting results in the logit metric, which expands the scope of using statistical analysis methods.

### **7.1. First-Grade Parenting Scales**

First-grade parents were asked how often they had engaged in various educational games with their preschool children, the number of such questions totaling 17. Annette Lareau showed that formal and informal parenting practices can be related differently to academic achievement at school [Lareau 2011]. Considering Lareau's theory, scales of formal and informal parenting practices were identified, formal practices being understood as activities specifically designed to educate and prepare a child for school.

The formal parenting practices scale included the following questions: "How often did you or other members of your family engage in the following activities with your child: (i) alphabet games, (ii) word games, (iii) writing letters and words, (iv) counting objects, (v) learning poems by heart?" Parents assessed the frequency of engaging in those activities on a seven-point Likert scale ranging from "never" to "more than once a day". Cronbach's alpha as an indicator of scale reliability was estimated to be 0.78.

The informal practices scale offered the following items: "How often did you or other members of your family engage in the following activities with your child: (i) reading books, (ii) telling fairytales and stories, (iii) discussing daily chores, (iv) reading street signs aloud, (v) solving puzzles, (vi) playing board games, (7) drawing?" Cronbach's alpha of this scale was 0.85.

Figures 1 and 2 show the distribution of responses across the two scales and the histograms representing the distribution of responses on a logit scale, where 0 corresponds to average difficulty of all the scale items, positive values correspond to more involved parents and negative ones to those less involved.

### **7.2. Third-Grade Parenting Scales**

The parental involvement scale included six statements, agreement with which was assessed by parents on a five-point Likert scale: "I ask the teacher or tell them any special things about my child", "I donate books or some other stuff to be used in the classroom", "I volunteer for school activities", "I volunteer for school or extracurricular events that my child participates in", "I have messaged my child's teacher",

Figure 1. **Distribution of Scores on the Informal Parenting Practices Scale**

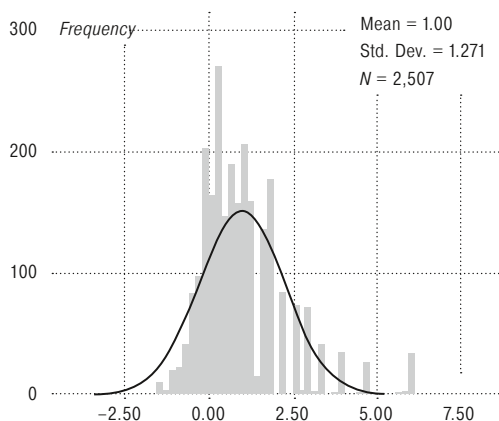
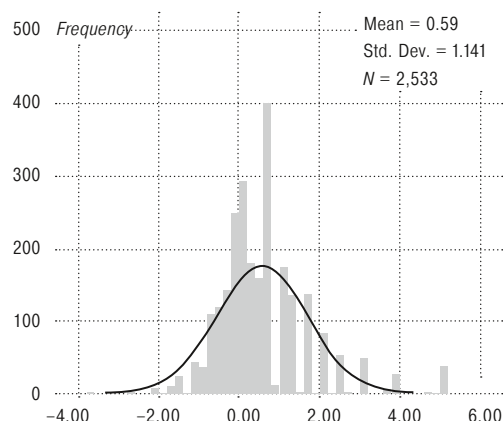


Figure 2. **Distribution of Scores on the Formal Parenting Practices Scale**



“I have visited the school to have a talk with my child’s teacher.” Cronbach’s alpha of the parental involvement scale was calculated to be 0.65. The distribution of scores on a logit scale is shown in Figure 3. A slight leftward (negative) shift of the responses demonstrates that a lot of parents were more likely to select the “seldom” and “very seldom” options.

The at-home academic involvement scale included the following statements: “I make sure that my child does his/her homework”; “I play games with my child or engage in activities that are of interest to her/him”; “I ask my child how their day at school was”; “I take my child to supplementary classes or special school events”; “I help my child do their homework in the subjects that are hard for them”; “I engage in friendly conversations with my child”; “I ask my child about his/her plans for the upcoming day”; “I talk to my child about her/his friends”. The respondents assessed their agreement with the statements on a five-point Likert scale. Cronbach’s alpha for the at-home academic involvement scale was 0.85. The distribution of scores on a logit scale is shown in Figure 4. A conspicuous rightward (0–5) shift of the responses demonstrates that the overwhelming majority of parents reported being involved in their children’s at-home learning activities “often” or “very often”.

The school communication climate scale (Fig. 5) is designed to evaluate how comfortable parents felt communicating with the child’s teacher. The scale includes five statements: “I feel welcomed at my child’s school”; “I feel that the teacher listens attentively to what I have to say”; “I like talking to my child’s teacher”; “I feel that the teacher cares about what is going with my child”; “I feel that the teacher is interested in getting to know me better.” Cronbach’s alpha of the school communication climate scale is 0.9.

Figure 3. **Distribution of Scores on the At-School Parents' Academic Involvement Scale**

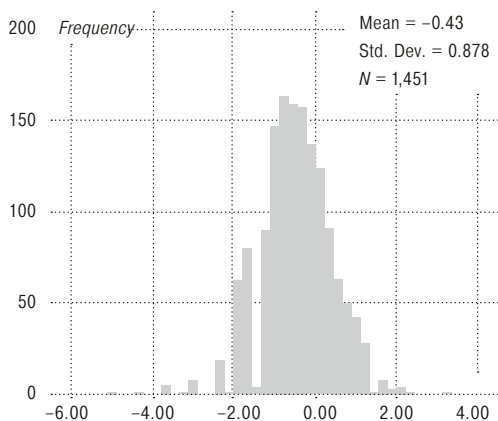


Figure 4. **Distribution of Scores on the At-Home Parents' Academic Involvement Scale**

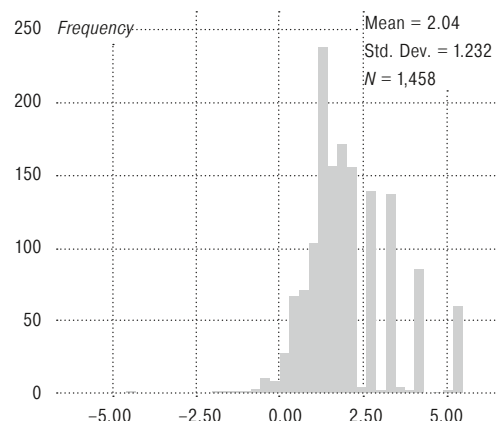
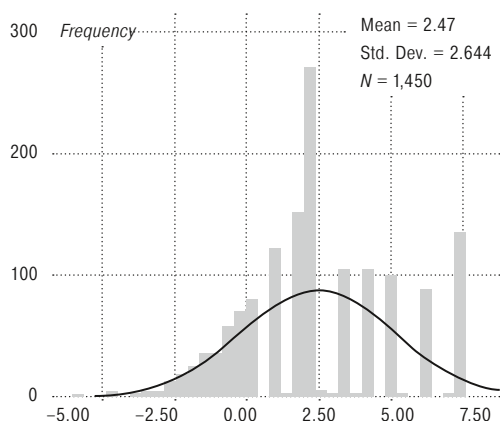


Figure 5. **Distribution of Scores on the School Communication Climate Scale**



Despite matching well with the model, distributions in all the scales are different from normal (Kolmogorov–Smirnov test), so non-parametric methods will be used to analyze the statistical differences across the scales.

The resulting scales correlate weakly with one another (Table 1), except for the moderate relationship (0.4) between the scale of at-school parents' academic involvement and that of school communication climate (parents who engage in school activities more often tend to have higher levels of perceived satisfaction with family-school communication).

Table 1. **Correlations among the First- and Third-Grade Parenting Scales**

	Formal Educational Parenting Practices (1st Grade)	Informal Educational Parenting Practices (1st Grade)	At-Home Parents' Academic Involvement (3rd Grade)	At-School Parents' Academic Involvement (3rd Grade)	School Communication Climate (3rd Grade)
Formal Educational Parenting Practices (1st Grade)	1				
Informal Educational Parenting Practices (1st Grade)	0,811**	1			
At-Home Parents' Academic Involvement (3rd Grade)	0,233**	0,208**	1		
At-School Parents' Academic Involvement (3rd Grade)	0,188**	0,188**	0,297**	1	
School Communication Climate (3rd Grade)	0,172**	0,161**	0,290**	0,435**	1

\*\* Correlation significance level:  $p = 0,01$ .

## 8. Factors Affecting Parental Involvement

The findings reveal that parental involvement in school life in both the first and third grades varies depending on the sociodemographic characteristics of families and students.

*Student gender.* Significant differences ( $p < 0.001$ , Mann–Whitney U test) are observed on the “formal practices (1st grade)” and “communication climate (3rd grade)” scales: girls’ parents were significantly more likely to report having purposefully prepared their children for school. Meanwhile, there is no significant gender-related difference on the informal practices scale. Girls’ parents also felt on average more comfortable when visiting the school and gave higher estimates of the quality of family-school communication.

*Number of children in a family.* At-home parents’ academic involvement was significantly higher in families that had two or more children ( $p < 0.05$ , Mann–Whitney U test).

*Parental education.* Respondents were free to specify the level of the other parent or step-parent’s education. The distribution of educational levels in the sample is displayed in Table 2.

Since 66 percent of the mothers and 55 percent of the fathers had college degrees, further analysis compared the consolidated groups of college-educated and non-college-educated parents.

College-educated mothers score better in all the scales in both the first and third grades: they engage more in formal and informal school preparation activities, demonstrate higher at-home and at-school ac-

Table 2. **Distribution of Parental Education Levels in the Sample**

	Mother's Education		Father's Education	
	N	%	N	%
Some high school	12	1	20	2
High school	44	3	70	6
Vocational school	317	26	366	31
Some college education (at least three years of college)	45	4	73	6
College degree (Bachelor's/Specialist's)	728	59	587	49
Master's degree	58	5	52	4
PhD or higher	19	2	22	2
Total	1,223	100	1190	100

ademic involvement and tend to be more satisfied with teacher-parent communication.

*Family's financial situation.* The questionnaire asked parents to evaluate their family's financial situation on a seven-point scale. Next, their answers were divided into two groups: parents who selected the items "We hardly make the ends meet. We do not have enough money even for food" (3%); "We have enough money to buy food but buying clothes causes financial difficulties" (11%); or "We have enough money to buy food and clothes. But purchase of durable goods (a TV-set, a refrigerator) is problematic" (43%) were assigned to the lower-income group, and those who answered, "We have no trouble buying durable goods, but purchase of really expensive things like a car is hard without getting a loan" (17%); "We can afford everything except real estate (apartment, dacha) without getting a loan" (4%); or "We can afford everything including apartment, dacha and other things without getting a loan" (1%) to the higher-income group. Questions about financial situation are ranked among the most sensitive ones, being omitted more often than others. In our sample, this question was left unanswered in 48 percent of the questionnaires. Parental involvement in learning varies significantly across wealth levels in all the scales except "at-school parents' academic involvement (3rd grade)".

*Involvement in preparation for the first grade.* The respondents were divided into three groups based on the indicators of formal and informal involvement in children's education in the first grade: the 30th percentile (low involvement), the 31st-69th percentile (medium-level involvement), and above the 70th percentile (high involvement). These three groups keep differing significantly ( $p < 0.05$ ) in the third grade, i. e. parents who were more involved in school in the first grade remain so two years later.

*First-grade non-cognitive abilities: obedience to rules.* Apart from testing cognitive skills, the iPIPS system was used to obtain, via IRT modelling, children's scores on the scales of "obedience to rules" and "communication". Non-cognitive skills of first-graders were assessed using a teacher survey. In October, as teachers had already had a chance to get to know children better, they were asked to complete questionnaires in which they assessed children's non-cognitive skills based on highly detailed items. The "classroom behavior" scale includes such items as obedience to classroom rules, self-help skills, level of adjustment, and concentration in self-directed and teacher-directed learning activities. Parents of children who scored low on the "classroom behavior" scale in the first grade (the 30th percentile) were less likely to evaluate communication climate at school as supportive and reported significantly higher levels of at-home academic involvement than parents of children who scored better on the non-cognitive abilities scale (above the 70th percentile).

*First-grade non-cognitive abilities: communication.* Another scale of non-cognitive abilities assessed at baseline—"communication"—measures the child's ability to make new friends, behave and interact appropriately with adults and peers, and respect basic communication rules (e.g. wait for their turn to speak). Poorly-developed communication skills in the first grade (the 30th percentile) correlate with significantly higher levels of at-home parents' academic involvement in the third grade. It might be that the lack of communication skills makes parents pay more attention to homework and offer some learning activities within the family, i.e. in the communication field that the child is used to. Hence, low at-home parents' academic involvement is probably not always a negative characteristic, as sometimes it is the result of the child doing well at school.

*Cognitive skills: first-grade reading and mathematics, third-grade reading.* Perception of the school communication climate differs between the parents whose children had low reading and basic mathematics scores in the first grade (the 30th percentile) and the parents of high-scorers (above the 70th percentile). It can be thus assumed that low academic performance of children makes their parents perceive school as a hostile environment. However, no difference in parental involvement is observed depending on third-grade academic achievement.

As we can see, the characteristics of parental involvement in elementary school are affected by a number of factors, some of which can be influenced.

## **9. Regression Analysis**

Regression analysis was conducted to provide a comprehensive assessment of the factors of parental involvement. When analyzing samples divided into groups (classes of students in this case), it is important to remember that respondents within the same group may be



more homogeneous in terms of the indicator measured than across the groups, which means that multilevel regression models should be applied. However, it is hard to predict theoretically whether parental behavior is affected by which class their child is in, so the choice of analysis method implied testing whether the available data is fitted better by a one- or two-level nested null model. Analysis was run using R1.1.423 software and nlme package [Pinheiro et al. 2018]. The random intercept (two-level) model was statistically significantly more suitable for analyzing all the three parenting scales (at-home parents' academic involvement, at-school parents' academic involvement, and school communication climate) based on the  $-2LL$  indicator ( $p < 0.001$ ) as well as AIC and BIC indices. Consequently, it is advisable to assess parenting scales using two-level models, with parents on the first level and student classes on the second.

#### **10. Predicting At-Home Parents' Academic Involvement**

Table 3 presents the results of two-level regression analysis of the factors of at-home parents' academic involvement. Model 1 only uses the baseline predictors: mother's education, financial situation, first-grade parental involvement, level of cognitive and non-cognitive development in the first grade, number of children in the family, and type of school. First-grade parental involvement in school is estimated as the arithmetic mean between formal and informal practices, as these two scales correlate at 0.8 and including them into the model separately is undesirable. The level of cognitive development in the first grade is estimated as the arithmetic mean between reading literacy and mathematics literacy, and that of non-cognitive skills as the arithmetic mean between the scales of "communication" and "obedience to rules". The final model also includes the third-grade predictors of "communication climate" and "at-school parents' academic involvement".

The significant predictors of third-grade at-home parents' academic involvement (Model 2) included financial situation, first-grade parental involvement in learning, school communication climate, and third-grade at-school parental involvement. The variable "mother's education" was introduced to the model with a random slope, as its relationship with at-home involvement varies across student classes.

The model includes a few significant variables describing the interaction:

- (i) Between mother's education and children's non-cognitive abilities: across the sample, parents of more outgoing and obedient children have significantly lower levels of at-home academic involvement, yet non-cognitive development correlates positively with at-home involvement in learning among college-educated mothers;
- (ii) Between parental perception of school communication climate and non-cognitive skills in the first grade: on the whole, the more

Table 3. **At-Home Parents' Academic Involvement: Regression Analysis**

	Null model	Model 1 First-Grade Predictors (Standard Deviation)	Model 2 First- and Third- Grade Predictors (Standard Deviation)
Fixed effects			
Intercept	–0.01 (0.04)	–0.11 (0.08)	–0.07 (0.08)
Mother's education (1—college degree, 0—college degree)		0.03 (0.07)	–0.004 (0.07)
Financial situation (3rd grade: 1—high income, 0—low income)		0.22 *** (0.06)	0.17*** (0.06)
Parenting practices (1st grade, z-scores)		0.25*** (0.03)	0.19*** (0.03)
Cognitive skills (1st grade, z-scores)		–0.06 (0.04)	0.02 (0.05)
Non-cognitive skills (1st grade, z-scores)		–0.17** (0.06)	–0.21*** (0.06)
Siblings (1—yes, 0—no)		–0.08 (0.06)	–0.08 (0.06)
Type of school (0—regular, 1—gymnasium/lyceum)		0.04 (0.07)	0.04 (0.07)
Communication climate (3rd grade, z-scores)			0.18*** (0.03)
At-school parents' academic involvement (3rd grade, z-scores)			0.11** (0.04)
Interaction: mother's education * first-grade non-cognitive skills		0.14* (0.07)	0.16* (0.07)
Interaction: first-grade non-cognitive skills * school climate			–0.07* (0.03)
Interaction: first-grade cognitive skills * siblings			–0.15* (0.06)
Interaction: financial situation * at-school parents' academic involvement			0.12* (0.06)
Random effects			
Parents level	0.86	0.87	0.83
Classes level	0.05	0.39	0.39
Mother's education		0.30	0.25
Covariance between the intercept and the random slope "mother's education"		–0.904	–0.927
Model characteristics			
AIC	2,824.45	2,741.203	2,646.165
BIC	2,839.27	2,805.426	2,735.089
logLik	–1,409.22	–1,357.602	–1,305.083
Pseudo R2		0.07	0.18

satisfied parents are with the communication climate at school, the more actively they engage in at-home learning activities, but parents of children who demonstrated high baseline levels of non-cognitive skills tend to get involved less in the third grade of elementary school;

- (iii) Between cognitive skills in the first grade and the number of siblings: higher baseline levels of cognitive development in children who have siblings is related to statistically significantly lower levels of parental involvement in the middle of elementary school;
- (iv) Between financial situation and at-school parents' academic involvement: as at-school parental involvement in learning goes up, the increase in at-home involvement is significantly greater in higher-income families than in the lower-income subgroup.

The fact that the covariate "type of school" (regular school or gymnasium/lyceum) turned out to be insignificant appears to be an important finding, which shows that parents of elementary school students attending schools of different types demonstrate the same levels of at-home academic involvement, all other factors being controlled for.

### **11. Predicting At-School Parents' Academic Involvement**

Table 4 presents the results of regression analysis for the variable "at-school parents' academic involvement". Among the first-grade predictors (Model 1), statistically significant variables included mother's education, first-grade parenting practices, and two variables of interaction:

- (i) Between financial situation and the number of siblings: at-school parental involvement tends to be higher in wealthier multi-child families, while having two or more children in a lower-income family is related to lower levels of at-school parents' academic involvement;
- (ii) Parenting practices and non-cognitive development in the first grade: parents who invested more time and effort in preschool activities and whose children demonstrated high levels of non-cognitive development at baseline normally tend to get involved in education less by the middle of elementary school. The coefficient of this relationship is low, rather revealing a curious tendency than being a good predictor. Model 2 assessed, among other things, the third-grade predictors. The significant variables included mother's education, financial situation, the number of siblings, communication climate, and third-grade at-home parents' academic involvement.

Some of the variables show significant interactions:

- (i) Between financial situation and the number of children in a family,

Table 4. **At-School Parents' Academic Involvement: Regression Analysis**

	Model 0	Model 1 First-Grade Predictors (Standard Deviation)	Model 2 First- and Third- Grade Predictors (Standard Deviation)
Fixed effects			
Intercept	0.01 (0.08)	–0.03 (0.08)	0.02 (0.08)
Mother's education (1—college degree, 0—college degree)	0.20* (0.08)	0.16* (0.06)	0.21** (0.08)
Financial situation (3rd grade: 1—high income, 0—low income)		–0.06 (0.09)	–0.16* (0.08)
Parenting practices (1st grade, z-scores)		0.19*** (0.03)	0.09*** (0.03)
Cognitive skills (1st grade, z-scores)		0.19 (0.03)	–0.03 (0.03)
Non-cognitive skills (1st grade, z-scores)		0.03 (0.04)	0.02 (0.03)
Siblings (1—yes, 0—no)		–0.11 (0.08)	–0.15* (0.07)
Type of school (0—regular, 1—gymnasium/lyceum)		–0.01 (0.08)	0.17 (0.11)
Communication climate (3rd grade, z-scores)			0.46*** (0.05)
At-home parents' academic involvement (3rd grade, z-scores)			0.08 (0.04)
Interaction: financial situation * siblings		0.27* (0.12)	0.26* (0.11)
Interaction: first-grade parent involvement * non-cognitive skills in the first grade		–0.08* (0.04)	
Interaction: mother's education * communication climate			–0.14* (0.06)
Interaction: at-home parents' academic involvement in the third grade * siblings			0.13* (0.06)
Interaction: mother's education * type of school			–0.24* (0.12)
Random effects			
Level 1 (parents) variance	0.87	0.88	0.81
Level 2 (classes) variance	0.08	0.27	0.28
Cognitive skills in the first grade		0.25	
Correlation between level 2 variance and the variable "cognitive skills in the first grade"		–0.004	
AIC	2,857.14	2,809.749	2,597.556
BIC	2,871.97	2,878.912	2,676.599
logLik	–1,425.57	–1,390.874	–1,282.778
Pseudo R2		0.05	0.24

- just as in Model 1: having two or more children is related to higher at-school parental involvement in higher-income families;
- (ii) Between mother's education and communication climate: college-educated mothers who are more satisfied with the communication climate at school are less involved in school life. This is a critical finding, as the covariate "communication climate" alone yields the highest positive regression coefficient, yet the direction of the relationship changes as soon as mother's education comes into play;
  - (iii) Between third-grade at-home parental involvement and having two or more children: overall, parents in multi-child families tend to engage less in their children's school life (the negative coefficient of the "siblings" covariate), but the more such parents are involved in at-home learning activities, the higher their at-school academic involvement;
  - (iv) Between mother's education and the type of school: college-educated mothers whose children attend gymnasiums/lyceums are less likely to get involved in schools.

## 12. How to Predict Parental Perception of School Communication Climate

Table 5 presents the results of regression analysis for the "communication climate" scale. Among the first-grade predictors (Model 1), the significant variables included mother's education, financial situation, preschool parenting practices and the number of children in a family. In Model 2, which also included third-grade variables, only at-school involvement, at-home involvement and having two or more children were significant. Therefore, parents tend to rate the overall school climate and the quality of family-teacher communication higher when they engage in their children's at-home and at-school academic activities. In cases where parents with high levels of at-school academic involvement had engaged in preschool activities with their children, they tend to be even more satisfied with family-school communication (the significant interaction variable: first-grade parenting practices \* at-school third-grade parent involvement). There is a curious thing about the variable of interaction between first-grade cognitive skills and family's financial situation: in higher-income families, higher baseline levels of children's cognitive development are related to greater satisfaction with school communication climate.

## 13. Results and Discussion

The findings show that the level of parental involvement in schools is affected by a number of family and school characteristics. Moreover, the same factor may affect parental involvement in different ways depending on other circumstances. For instance, having two or more children in a family was expected to correspond to lower levels of all types of parental involvement (Hypothesis 3). This assumption was confirmed only partially: parents of two or more children were involved

**Table 5. Communication Climate as Perceived by Parents: Multilevel Regression Analysis**

	Model 0	Model 1 First-Grade Predictors (Standard Deviation)	Model 2 First- and Third- Grade Predictors (Standard Deviation)
Fixed effects			
Intercept	0.002 (0.04)	–0.33** (0.09)	–0.20** (0.07)
Mother's education (college degree—1, no college degree—0)		0.29** (0.09)	0.09 (0.06)
Financial situation (3rd grade: high income –1, low income—0)		0.16* (0.06)	0.08 (0.06)
Parenting practices (1st grade, z-scores)		0.18*** (0.03)	0.05 (0.03)
Cognitive skills (1st grade, z-scores)		0.05 (0.04)	0.02 (0.05)
Non-cognitive skills (1st grade, z-scores)		–0.01 (0.05)	0.06 (0.04)
Siblings (1—yes, 0—no)		0.30** (0.10)	0.12* (0.05)
Type of school (0—regular, 1—gymnasium/lyceum)		–0.0002291 0.08427175	–0.0002 (0.08)
At-school parents' academic involvement (3rd grade, z-scores)			0.38*** (0.03)
At-home parents' academic involvement (3rd grade, z-scores)			0.17*** (0.03)
Interaction: first-grade parenting practices * third-grade at-school parents' academic involvement			0.07* (0.03)
Interaction: financial situation * first-grade cognitive skills			0.13* (0.06)
Interaction: mother's education * siblings		–0.28* (0.13)	
Interaction: financial situation * first-grade non-cognitive skills		0.16* (0.07)	
Random effects			
Level 1 (parents) variance	0.96	0.92	0.68
Level 2 (classes) variance	0.28	0.28	0.07
Model characteristics			
AIC	2,905.951	2,852.378	2,636.883
BIC	2,920.771	2,911.661	2,706.046
logLik	–1,449.975	–1,414.189	–1,304.441
Pseudo R2		0.07	0.24

less in at-home learning activities in the third grade only if their child had shown a high level of cognitive skills assessed at baseline. In addition, at-school academic involvement among multi-child parents was only decreasing in lower-income families and in families with lower levels of at-home parents' academic involvement. On the contrary, having two or more children increased the level of at-school academic involvement among wealthier parents or those involved in at-home academic activities. Satisfaction with school climate was significantly greater in multiple-child families; it is probable that parents who have two or more children interact more often with educational institutions, which makes them more experienced in parent-teacher communication and helps them avoid unrealistic expectations.

Mother's education was expected to be related positively to all types of parental involvement (Hypothesis 1). However, it turned out to be an insignificant predictor of at-home parents' academic involvement. What is more, college-educated mothers of obedient and outgoing children (i. e. those with higher levels of non-cognitive abilities) tended to engage significantly less in at-home learning activities. The role of the mother's education in at-school parents' academic involvement was proved to be significant, with some exceptions though. Some college-educated mothers were less likely to get involved in their children's school life, namely those satisfied with school communication climate and those whose children attended gymnasiums/lyceums. Some rational explanations could be found to support this finding: it might be that college-educated mothers let themselves "relax" a little and engage less in school activities as soon as they are on good terms with the school, but further qualitative research is required to test assumptions like that.

As for the level of children's skills assessed at baseline (Hypothesis 2), the relationship with at-home parents' academic involvement was only negative for non-cognitive skills: parents of obedient, outgoing and self-organized children tend to engage less in at-home learning activities, all other variables being controlled for. The hypothesis that higher levels of cognitive development would be related to lower levels of at-home parents' academic involvement was only confirmed for the subgroup of parents who had two or more children, hence less time resources. The predictive power of cognitive and non-cognitive abilities for at-school parents' academic involvement was found to be insignificant. Neither was Hypothesis 2 confirmed in assessing school communication climate: all other variables being controlled for, the level of cognitive and non-cognitive development was found to be an insignificant predictor of satisfaction with school climate for all parents except the higher-income subgroup, where higher baseline levels of mathematics and reading literacy were positive predictors of satisfaction with teacher-parent communication.

The analysis results indicate that parental involvement in schools is largely dependent on school characteristics. The extremely high re-



gression coefficient for the covariate “communication climate” (nearly 50 percent of the standard deviation) in explaining at-school parents’ academic involvement and the coefficient of at-home involvement comparable to that of parental involvement at the start of schooling show that parental behavior relevant to children’s education depends very heavily on a set of school-related factors.

The absence of differences in parental involvement depending on the type of school (regular school or gymnasium/lyceum) allows for the conclusion that parental practices in elementary school vary very little across schools of different types.

The differences in  $R^2$  (coefficient of determination) between Models 1 (only first-grade predictors) and Models 2 (first- and third-grade predictors) on the three scales analyzed are of particular interest. A few indicators similar to  $R^2$  in linear models, often referred to as “pseudo- $R^2$ ”, have been designed specifically to be used in multilevel models. This study uses the coefficient proposed by Shinichi Nakagawa and Holger Schielzeth, which “can be interpreted as variance explained by the model as a whole” [Nakagawa, Schielzeth, 2013]. The fact that first-grade variables explain a very small proportion of the variance in parent-related variables (5–7%) allows for the assumption that it is more appropriate to explain levels of at-home and at-school parents’ academic involvement by the circumstances that develop during school years instead of baseline student and parent characteristics. Adding the third-grade variables, particularly communication climate, to the model increases the proportion of explained variance considerably.

The diversity of interaction variables in the models indicates that there are no universal patterns of parental involvement in schools. It is highly likely that the school’s ability to “shape” parental behavior is more limited than researchers seem to believe—as long as the process of such “shaping” is approached through a uniform set of practices, without making allowance for the diversity of family, personal and social characteristics of parents. A more comprehensive explanation of parent-related variables requires gathering more information about schools and the existing teacher-student and family-school relationships in order to expand the scope of predictors of parental involvement.

#### **14. Recommendations**

The results obtained in this study provided the basis for developing a set of practical recommendations designed to improve the school learning environment by involving parents in schools.

It appears vital to consider the relationship between different types of parental involvement in practice. At-school parents’ academic involvement is related to school climate, so improving informal teacher-parent communication might be effective.

The relationship between at-school and at-home parental involvement cannot be called strong. Chances are, not every parent involved in at-school academic activities will engage actively in at-home learning, and vice versa. Parents cannot be characterized as uninvolved only because they participate little in school life, since they may invest a lot of effort into their child's learning and motivation at home.

It is important to take into account the differences in involvement between parents with different educational backgrounds when building family-school relationships. Non-college-educated parents are more likely to feel uncomfortable and unconfident at school as they lack energy, time and sometimes motivation to keep track of all the different aspects of their children's lives. It is critical that teachers and school administrators be patient, tactful and friendly in dealing with such families. To involve them in school life, it might be better to start with activities that they will find positively pleasant to participate in as well as projects that will help them use their strengths. Teachers must assess family resources adequately and avoid situations that unearth the weak points or deficiencies of such families. It is also vital that families of different backgrounds and with different levels of involvement in school should be treated equally.

Differences in the academic involvement of parents whose children performed differently in the first grade should also be taken into account when developing personalized strategies to improve parental involvement. Parents of children with lower levels of self-regulation and sociability tend to demonstrate higher levels of at-home academic involvement. It is very important to perceive such parents' attitude to the school adequately: they are willing to invest in their child's academic performance at home but may feel extremely uncomfortable participating in everyday school life directly. It would be reasonable to propose acceptable formats of involvement to such parents and, most importantly, to support their efforts in promoting their child's academic achievement.

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# Defining the Problem of Choosing Extracurricular Activities in Russia

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Received in  
July 2018

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**Abstract.** The article provides an overview of international studies on parental involvement in extracurricular activities, which identify the major factors affecting the choice of such activities: family income, cultural capital, parental education and habitus, local educational in-

frastructure, and the possibility of making informed choices. The empirical basis of the research was provided by the findings from semi-structured interviews with parents of Moscow preschool and school-aged children involved in extracurricular activities conducted in spring 2017. The study also makes use of the quantitative data obtained by the 2017 Monitoring of Education Markets and Organizations. We analyze the frequency of using particular sources of information in choosing extracurricular classes, the criteria of parental choices and expectations, and the types of choice scenarios. The findings call into doubt the feasibility and potential benefits of a number of extracurricular activity initiatives envisaged by the national policy.

**Keywords:** extracurricular activities of children, parental involvement, choice of extracurricular activities, educational goals, national policy in extracurricular activities.

**DOI:** 10.17323/1814-9545-2018-4-261-281

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Extracurricular activities (ECA) of children have been a focus of experts and the public at large over the recent years. Promotion of extracurricular activities is a pivotal item on the national education policy agenda<sup>1</sup>.

On the one hand, families associate extracurricular activities with the opportunity to satisfy the educational needs for which a rather lim-

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<sup>1</sup> Executive Order of the Government of the Russian Federation No. 792-r of May 15, 2013 On Approving the State Program "Education Development", 2013–2020.



ited set of options is offered by schools. At the same time, extracurricular activities provide ample opportunities to prepare children for adult life in the new phase of society's technological and socioeconomic development, which implies encouraging 21st-century skills in children, such as critical and creative thinking, sociability and teamwork skills<sup>2</sup>. The government's efforts are focused on increasing children's participation<sup>3</sup> in extracurricular activities by expanding the array of up-to-date learning programs, in particular by creating the Quantorium network of technology parks for children (53 parks in 37 regions)<sup>4</sup> and a network of centers for youth innovation creativity (325 centers in more than 40 regions)<sup>5</sup>.

On the other hand, extracurricular activities and edutainment become more and more attractive to businesses. According to the Federal Statistical Monitoring, the number of private sector companies offering extracurricular activities increased by almost 78 percent between 2015 and 2017 (from 816<sup>6</sup> to 1,454<sup>7</sup>). Traditionally available courses in foreign languages and child and youth development centers (classes in dance, music, etc.) are neighbored by classes in robotics, programming and sports. A number of Russian cities have seen the spread of such new forms of extracurricular participation as "profession cities" and interactive science museums [Kosaretskiy, Kudryavtseva, Fiofanova 2018]. Dozens of cities have been covered by franchised chains, the most prominent examples being Junior, Chempionika (sports), Liga Robotov ("League of Robots"), ROBBO CLUB (robotics), Amakids, IQ007 (intellectual development), and others<sup>8</sup>. Chempionika and Junior were ranked among the Forbes Top 30 Russian Franchises with the Highest ROI in 2018<sup>9</sup> and the BEBOSS Top 100 Franchises of 2018. The latter ranking also includes Unium, Amakids and Russian Ballet (ballet classes for kids)<sup>10</sup>.

Therefore, consumers now have access to a wide variety of extracurricular options, both in terms of form and content. Availability

<sup>2</sup> Executive Order of the Government of the Russian Federation No. 1726-r of September 4, 2014 on approving the Conception of Promoting Extracurricular Activities of Children.

<sup>3</sup> Decree of the President of the Russian Federation No. 599 of May 7, 2012 On Measures to Implement the National Policy in Education and Science.

<sup>4</sup> Passport of the national priority project Affordable Extracurricular Activities for Children was approved on November 30, 2016 at a meeting of the Presidium of the Presidential Council for Strategic Development and Priority Projects.

<sup>5</sup> Federal Target Program for Education Development, 2016–2020.

<sup>6</sup> Federal Statistical Monitoring. Extracurricular Activities (form 1-DOP), 2015.

<sup>7</sup> Federal Statistical Monitoring. Extracurricular Activities (form 1-DOP), 2017.

<sup>8</sup> Mordasov M. (2018) Obrazovatel'nye franshizy: energiya i vzryvnoy rost [Educational Franchises: Energy and Explosive Growth]. *EDexpert*, no 4.

<sup>9</sup> The Top 30 Russian Franchises with the Highest ROI. <http://www.forbes.ru/rating/363769-reyting-franshiz-2018>

<sup>10</sup> Ranking of Franchises in Education and Learning. <https://www.beboss.ru/rating>

of choice is regarded by the government as a pivotal characteristic of extracurricular participation and as a key prerequisite for improving the quality and accessibility of extracurricular activities [Loginova 2015]. Regional governments have introduced personalized learning grants for extracurricular activities, allowing families to choose classes and schools of interest and attend them using student-specific government-funded scholarships [Abankina, Slavin 2016]<sup>11</sup>. Aggregator platforms containing information on ECA programs and providers are created to make choices more informed.

An increased range of opportunities makes it difficult for families and children to choose from the extracurricular activities available in the market. Research interest becomes focused on family behavior in this situation, i. e. on how families navigate the sophisticated map of offers and what they care about when making their decisions. At the same time, educational, cultural and sports authorities as well as private educational institutions are concerned about solving the rather practical issue of attracting customers and helping families choose classes and clubs in the ever more saturated and competitive ECA market.

The choice of ECA programs in Russia remains understudied. A number of research papers devoted to extracurricular participation have touched upon such specific aspects as the relationship between activity participation and academic achievement or barriers restricting families' access to extracurricular activities [Ivanyushina, Aleksandrov 2014; Sobkin, Kalashnikova 2014; Vakhshayn, Stepantsov 2012]. International research in this field is much ampler and based on solid methodologies, but differences in the systems of informal education (extracurricular activities) and social stratification make it impossible to translate the specific outcomes obtained by foreign researchers directly to the Russian context.

This article aims at describing the process of choosing extracurricular activities by Russian families and identifying the main problems in this domain. An overview of Russian and international studies serves as the basis for systematizing the possible ways of explaining the choice of classes, clubs and other extracurricular activities by parents and children. An empirical survey based on interviews with parents of children involved in extracurricular activities and the 2017 Monitoring of the Education System allowed for a classification of choice scenarios. The findings are used to develop recommendations to adjust the national policy in extracurricular activities.

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<sup>11</sup> Personalized learning scholarships assign a specific amount of funds to a specific child, which is transferred to the selected educational institution (public or private) providing extracurricular activities. The existing model only allows allocating funds to educational institutions under "pre-choice" governmental (municipal) contracts, i. e. the "money follows the student" policy is in place.

**International  
Research on  
Choosing Extracurricular Activities for  
Children**

Researchers around the world usually approach the choice of extracurricular activities from the perspective of inequality. Numerous studies stress the effects of socioeconomic characteristics on the structure of educational preferences. Analysis of relevant literature allows for distinguishing conventionally between two lines of research differing in their rationales and feasibility but complementing each other rather than being in conflict.

The first line of research is focused on the socioeconomic characteristics, studying the differences in ECA choice and the structure of extracurricular participation in the context of families' socioeconomic backgrounds. It has been shown, for instance, that low-income families rely more on school-based options, while middle- and high-income parents are involved more in out-of-school activities, their choice being unaffected by the geographical proximity of ECA institutions [Bennett, Lutz, Jayaram 2012].

Some researchers zero in on the social context in which families make their choices and develop educational strategies. Social context is broader than socioeconomic status as a concept, encompassing neighborhood and community effects as well [Luster, Okagoti 2009]. Living in a safe neighborhood and having an abundance of ECA institutions in the neighborhood are the drivers of higher extracurricular participation rates. Proximity of ECA institutions to home is the reference point in parental decisions on sending their children to extracurricular activities. Parents in safer neighborhoods allow their children to spend more time outdoors and try to involve them in extracurricular activities. Such parents consider various participation options, express interest in the development prospects offered by different institutions, and use the options available [Bennett, Lutz, Jayaram 2012]. Parents living in unsafe neighborhoods stick to the "preventive" policy on their children's education. Being concerned about safety primarily, they normally try to reduce the time that their children spend outside of home and school or even avoid engaging their children in such activities [Furstenberg 1999].

In addition to financial standing and social and community contexts, researchers pay attention to parental education as well. Children of better-educated parents tend to be involved more in extracurricular activities (mother's education being a more significant factor in terms of child development) [Bartko, Eccles 2003; Fredricks, Eccles 2006; Lareau, Weininger 2008; Randall, Bohnert 2009].

The choice of extracurricular activities is affected by both subjective and objective factors [Bennett, Lutz, Jayaram 2012]. The subjective ones include parents' initial perceptions of the opportunities to engage in extracurricular activities and the types of such education. As a rule, lower-income families have less access to information and communication channels and less developed information skills. In particular, a study of knowledge about college requirements among families from low socioeconomic backgrounds revealed that

such families have inadequate information on the size of tuition and may decide to reject college education because they overestimate the size of tuition. The authors conclude that more effective measures are required to bring adequate information about college tuition to families of low socioeconomic backgrounds [Grodsky, Jones 2007]. Counseling of parents whose children are eligible for government-funded college education revealed the lack of information skills among certain categories of parents: counseling assistance was necessary to make potential consumers seek information on government funding [Bettinger et al. 2012].

Lower-income parents tend to rely less on third-party ECA institutions and follow either the path of avoidance, by refusing to seek any opportunity to involve their children in formal or informal education, or that of least resistance, by making random choices [Chin, Phillips 2004].

The objective factors of choice include availability of social connections, financial resources and having the time to enrich children's lives with extracurricular activities.

The second line of international research on extracurricular activities is focused on the cultural and value characteristics of choice, exploring the mechanisms of inequality reproduction. Emphasis is laid on cultural capital, cultural orientations, family values and parenting practices as the fundamental factors of the strategies for choosing extracurricular activities [Furstenberg 1999; Lareau, Weininger 2003; 2008; Lareau, Weininger, Conley 2015]. Financial standing receives a lot of attention too, but it is not considered the only factor affecting the decision-making process. Differences between lower- and higher-income parents are analyzed first of all in the context of values, cultural patterns and standards that they adhere to.

Among the cultural and psychological factors affecting the choice of ECA programs, it is parent-child relationships and parental influence on children's choices that are of specific interest to researchers. Degree of freedom and parental involvement affect the choice of the type, form and provider of extracurricular activities. For example, parents from low socioeconomic backgrounds are more likely to let their children decide for themselves which extracurricular activities to engage in and less likely to stress the importance of attending extracurricular classes [Lareau 2002]. Conversely, parents of higher socioeconomic statuses seek to make education-related decisions for their children and attach more importance to the types of extracurricular activities. Middle-class parents see extracurricular participation as a way to make their child's development customized, or personalized [Bennett, Lutz, Jayaram 2012]. They try different things in order to choose the one that their children will be passionate about, and activities are often entertaining rather than educational. As we can see, attitudes toward extracurricular activities differ depending on parents' cultural capital, cultural orientations and social class [Lareau, Weininger, Conley 2015].

To summarize, international findings reveal a few major factors affecting the choice of extracurricular activities by parents: family income, cultural capital, parental education, neighborhood quality, local educational infrastructure, and possibility of making informed choices.

### **Research on Choosing Extracur- ricular Activities in Russia**

No large-scale studies have been dedicated to ECA choice so far. Meanwhile, behavioral patterns of parents and children in choosing extracurricular activities are of interest not only to market participants, i. e. various educational institutions, but also to the researchers and practitioners analyzing changes in the system of extracurricular activities and working to improve it. The existing literature provides no answer to the question of how exactly parents and children get involved in ECAs, or what factors they rely on to make decisions, or whether they remain satisfied with the choices made. Over recent years, meaningful inferences have been made in a number of studies concerning the relationship between parents' socioeconomic background, parental education and participation of children in extracurricular activities [Sobkin, Kalashnikova 2014; Aleksandrov, Ivanyushina 2014; Kosaretskiy, Kupriyanov, Filippova 2016]. It is postulated that the differences revealed cannot be explained by geographical and financial barriers alone but may be related to low levels of parental involvement in learning, low awareness of the opportunities available, and unwillingness to use them [Vakhshtayn, Stepantsov 2014; Kosaretskiy, Kupriyanov, Filippova 2016].

In Russia, the problem of choice has been studied in the contexts of preschool, school and professional education. The main criteria for choosing a public (municipal) kindergarten include location, teacher competence, "good care", reputation, and recommendations from friends and relatives [Abankina, Filatova, Mikhaylova (Kozmina) 2017:19]. Recent years have seen teacher competence becoming a more important criterion and convenient location losing its significance. Parents continue to pay attention to recommendations and take into account the school's prestige and social composition [Mertsalova 2015a:4]. Socioeconomic characteristics play a crucial role in choosing a higher education institution. "Financial standing is a significant factor determining academic achievement (candidate's performance in the USE<sup>12</sup> terms), college choice and preparation strategies" [Prakhov, Yudkevich 2012:145]. Therefore, when choosing educational institutions of various levels and types, the decision-making process is affected by location, teacher competence and socioeconomic characteristics of the family.

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<sup>12</sup> Unified State Examination

## **Empirical Basis of Research**

The study is based on the results of a series of semi-structured interviews with parents conducted in spring 2017. The interviews involved parents whose preschool or school-aged children were involved in extracurricular activities. The sample was drawn from middle- and high-income families living in Moscow. The respondents were invited to interviews in crowded places, such as shopping malls. Before being interviewed, they were asked to complete screening questionnaires which allowed for evaluating the compliance of potential respondents to the sampling criteria (based on the information submitted by the respondents). The sample consisted of parents aged from 29 to 55, of whom three were males. A total of 30 interviews were conducted, five for each segment defined by three student cohorts (preschoolers, students of grades 1–6, and students of grades 7–11) and two household monthly income per person categories (<RUR60,000 and ≥RUR60,000).

Having obtained the information on family characteristics and the structure of time devoted to extracurricular activities, the interviewer asked respondents to recall and describe chronologically the process of choosing a specific extracurricular activity and ECA institution. Using their memories, the respondents provided retrospective descriptions of their choices and reconstructed their motivations. In cases where it was hard for respondents to recall the details, the interviewer asked clarifying questions on the sources of information they had used and the specific criteria of choice they might have taken into account. Interviews lasted from 45 to 90 minutes. Thematic coding (see, for example, [Flick 2014]) was applied to analyze the interview transcripts. The essential limitations of the data collected are those of the geographic scope (all the respondents live in Moscow) and the absence of low-income parents in the sample.

The quantitative data from the 2017 Monitoring of Education Markets and Organizations (MEMO) was also used to discuss the choice scenarios discovered in interviews. The MEMO, conducted by the Higher School of Economics in cooperation with Yuri Levada Analytical Center since 2002, is designed to systematically gather information on the economic behavior of education market participants. It involves a survey of parents whose children are involved in extracurricular activities, asking about their experience of making choices and uncovering the main criteria of choice and the problems that parents encounter when searching for extracurricular activities, classes or clubs for their children. In 2017, the survey involved 1,669 parents representing families where at least one child attends an ECA institution (whether public or private). The MEMO data does not allow for assessing qualitatively the popularity of the choice scenarios and ECA types reported, but it provides an opportunity to comment on them and complement the interpretations.



**Information on  
Extracurricular  
Activities: Ade-  
quate and  
Accessible**

Chronologically, one of the first steps in choosing an extracurricular activity or an ECA institution is to find out about classes. Parents of Moscow school students report using mostly the following channels of information: school teachers, friends with kids, teachers in ECA classes that the child already attends, websites of ECA institutions, websites providing reviews about ECA providers (including social media), and the Moscow portal of municipal services. Parents of preschool students mention the same sources of information, school teachers being replaced by kindergarten teachers and teachers of extracurricular activities the child is already involved in.

The MEMO findings allow for ranking the popularity of different sources of information in choosing ECA institutions. Informal channels have prevailed over formal ones in the last four years. Over half of the respondents consistently pay more attention to recommendations of their friends and acquaintances whose children attend ECA institutions, voting this factor as the most important one. Only one third of the respondents use the information directly provided by ECA teachers, presented on open days or available on official websites.

The information obtained from interactions with school/ECA teachers and other parents is referred to as the “information that found us itself”, while obtaining knowledge from other sources implies active searching. This difference in perceiving information from different sources allows for the assumption that channels of information on extracurricular activities are unequal in their outreach: of all the knowledge that is potentially available to families, that which is communicated at school or kindergarten will be more likely to reach the recipient than, for example, online advertisements.

The interview results also suggest that sources of information are ranked by their trustworthiness. On the whole, parents consider the information obtained via personal interactions more credible than that which comes in from mass or social media. It is likely that the institutional trust, which has been undermined by drawbacks in school education and negative attitudes towards the commercialization of extracurricular activities<sup>13</sup>, is substituted for interpersonal trust. If that is the case, it sheds light on the seeming contradiction when the same respondents criticize the child’s school and report their choice of extracurricular activity or ECA institution having been greatly influenced by the teacher’s recommendations. In other cases, extremely skeptical attitudes toward private ECA institutions’ self-descriptions—“...*many will fall for brands or big names... all this infamous marketing...*”—is compensated for by trust to friends’ reviews about the specific ECA provider. All other things being equal, parents are more likely to trust opinions of real people with whom they interact personally than rec-

<sup>13</sup> Such negative attitudes are manifested by some of the respondents when they compare fee-based sports to publicly funded sports classes succeeding to the Soviet tradition, the latter being idealized.



ommendations coming from institutions when choosing extracurricular activities for their children. Ultimately, this is an advantage for schools as institutions, as personal teacher-parent relationships are hardly avoidable.

Parents' experiences of choosing extracurricular activities or ECA institutions for their children differ by the depth of information analysis. Otherwise speaking, the amount of information perceived as sufficient to make a choice varies across families. However, perceived adequacy of information is not always related exclusively to the level of source trustworthiness. Identical messages may result in making a decision or searching for more details. Such differences can be described using the category "involvement in the choice-making process". Parents who are heavily involved in choosing an extracurricular activity or ECA institution compare information obtained from different sources and try to make sense of nuances by scrutinizing reviews, resorting to additional counseling services (e. g. vocational orientation) and seeking the opportunity to try out various sorts of activities. Under-involved parents accept the minimum amount of information as sufficient, or adequate. These two parenting positions represent extremes of a continuum on which all the empirically observed situations of choice can be placed. To a certain extent, low involvement aggravates the inequality of information channels described above (dominance of teachers' and other parents' recommendations): when the minimum amount of information is considered sufficient to make a choice, the probability of obtaining information that should be actively searched for becomes particularly low.

The MEMO findings indicate that college-educated mothers are more likely to use online resources—both formal (websites of ECA institutions and education authorities) and informal (discussion of ECA institutions on forums and in social media)—when choosing an ECA institution, while less educated mothers are more willing to rely on recommendations of kindergarten and school teachers as well as local print media. As a result, schools and kindergartens enjoy more credibility among families with lower cultural capital, who use recommendations received from school teachers as a guidance in selecting ECA institutions. Representatives of better-educated social classes make more independent choices and use a broader scope of sources, using both formal and informal online platforms.

#### **Choice Criteria and Parents' Perceptions of the Goals of Extracurricular Activities**

Analysis of the interview transcripts allows for splitting the ECA choice criteria into two groups: (i) criteria mentioned by all the respondents, regardless of their informedness and involvement in the choice-making process; and (ii) a wide range of institution characteristics which are only taken into account all together in situations where parents demonstrate high levels of involvement. Such criteria as location, tuition, availability of ECAs of interest, and class schedules were men-

tioned by all the respondents. If an institution does not conform to these initial requirements, the other characteristics may be left unconsidered, so let us refer to these fundamental requirements as “basic”. The other group of criteria includes, depending on the case: teacher competence (expertise, qualifications, personal interest in the subject/activity, and communication style), availability of unconventional activities, group size, assurance of safety during classes and in transit, availability of the try-out period, potential outcomes (progress promised at baseline), overall comfort for the child (decent building, friendly environment, cafeteria), payment scheme, website usability and design, etc. The significance of these criteria depends on a concrete situation, determined not only by the level of parents’ involvement in the choice-making process but also by their perceptions of the goals of extracurricular participation.

The continuum of such attitudes reconstructed from the interviews is defined by control orientation, on the one hand, and the belief that the freedom of self-determination and all-round development are what matters the most in extracurricular activities, on the other hand. Control orientation manifests itself in the following parental motivations: (i) keep the child engaged and supervised, *“involved in something useful instead of being a couch potato watching TV or playing computer games”* (more typical of parents choosing ECA for younger children); (ii) achieve success in a predetermined educational and (prospective) career trajectory. For instance, one of the respondents told the interviewer that their goal was to get the child admitted to a specific university and work as a financial director in the future. Emphasis on freedom finds expression in parents’ desire to make their children’s lives more enriched and fulfilling and encourage them to be active (more typical of parents choosing ECA for younger children) as well as to help them develop professional self-determination skills and *“find their true self”*. In the latter case, extracurricular activities may be opposed to school education: *“...I saw a video on education saying how everything’s changed and how schools just go on producing factory workers, that “bell-to-bell” instruction... these <extracurricular activities> are, in fact, opportunities to find one’s true self.”* Differences in perceptions of the goals of extracurricular activities entail differences in preferences. While some parents associate a good teacher with unconventional approaches and the ability to engage students and inspire their interest in the first place, others value affiliation with the university of choice most of all.

The MEMO results show that freedom orientation in choosing ECA institutions slightly prevails over control orientation among Russian parents, terms of instruction being ranked second as a criterion of choice. The child’s desire to participate in a specific activity was reported to be the reason for choosing a particular ECA institution by about half of the respondents (42%). Parents also seek to help their children achieve personal fulfillment (50%, according to the MEMO 2017), im-

prove their physical development and health (37%) and engage them in communication (34%). Only a small proportion of the respondents regard extracurricular activities as an opportunity to prepare their children for exams, pull up their grades in specific school subjects or promote civic consciousness and patriotism in them (less than 4% each).

Motivations differ across social classes, too. According to the MEMO 2017 findings, control orientation is typical of low-income parents, who are more likely to want their children to stay supervised (this response was provided by 46 percent of the lowest-income parents, as compared to 12 percent among the wealthiest ones). Intellectual development and aesthetic education are valued more by high-income families. Middle- and high-income parents are also somewhat more likely to see the goals of extracurricular participation in personal development and self-determination of their children (on the whole, this was a popular response among half of the parents whose children were involved in extracurricular activities).

### **Types of Choice Scenarios**

The interviews focus on the situations of choice in which parents were informed to different degrees and pursued different goals. Each situation, if analyzed through the variety of specific aspects described by the respondents, may be represented as unique. Nonetheless, the situations of choice can be classified using the categories “level of involvement” and “perceived goals of extracurricular activities”<sup>14</sup>, which yield four generalized choice scenarios.

*Scenario 1. Low involvement, control orientation.* This scenario is characterized by strong influence of school on the decision-making process. “*Information that found us itself*” is sufficient to make a choice. Terms of instruction and potential outcomes are the characteristics that are taken into account most often, while everything else may be left unconsidered due to the lack of information. Preference is given to conventional activities over innovative ones (e. g. robotics), because parents may have little knowledge of the new technology and be skeptical about future applications of such education.

*Scenario 2. Low involvement, freedom orientation.* In this case, the process of making a decision to engage in extracurricular activities is either initiated by children (the child’s opinion plays a greater role than in any other scenario) or prompted by school teachers’ recommendations. Random ECA institutions may be selected, the most important thing being conformance to the basic requirements (affordable price, convenient location, etc.), while the other characteristics may be completely disregarded, as in scenario 1. Decisions on the types of activities are made by children.

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<sup>14</sup> This is a classification of choice scenarios, not parents. The same family may follow different scenarios in different situations.

*Scenario 3. High involvement, control orientation.* When parents are control-oriented and heavily involved in the choice-making process, potential outcomes become the decisive choice criterion. All the other characteristics of ECA institutions are only considered in the context of their effectiveness, being actively compared to those of the competitors. Attractive institution characteristics include strict but progressive teachers connected to or affiliated with the universities of potential choice. Importance is attached to the performance monitoring system (e. g. mid-term tests) and maximum “targetedness” of the payment scheme (per-class rates being preferred). When choosing activities, parents are guided by whether the knowledge obtained can later be used in college or capitalized when entering the labor market.

*Scenario 4. High involvement and freedom orientation.* In this situation, parents want to make sure that the terms of instruction are in line with the requirements imposed on the ECA institution, provided that the institution is attractive in every other aspect. They see the goal of extracurricular activities in gaining experience (educational and social) that cannot be provided by schools and deepening children’s knowledge in the school subjects of their interest. In some cases, extracurricular activities may be considered to be a less standardized alternative to school. Teachers must be passionate about what they teach, likeable to children and able to inspire their interest. Parents seek innovative learning formats, new types of activities, vocational orientation tests and try-out periods allowing children to make their choice as consciously and independently as possible.

The above classification of choice scenarios is consistent with Annette Lareau’s ideas of cultural capital affecting parental involvement in schools [Lareau, 2002]. Low-involvement scenarios correspond to the strategy of natural growth in Lareau’s system, and high-involvement ones to that of concerted cultivation. Scenarios 1 and 4 show the differences in perceived goals within the two strategies. In scenario 1, parents seek to organize their children’s everyday life, which is typical of the concerted cultivation strategy, but they retain a directive style of communication with their children, which is a feature of the natural growth strategy. Scenario 4, where high involvement is combined with freedom orientation, may be considered the result of some parents’ ambition to enrich their children’s experiences while avoiding helicopter parenting, which is criticized by the proponents of slow parenting and the slow movement<sup>15</sup>. Along with parenting strategies, scenarios of choosing extracurricular activities are important for understanding the mechanisms of family influence on educational trajectories. If the revealed types of scenarios are used to different extents by families from different socioeconomic backgrounds, they can also be studied

<sup>15</sup> See, for example: <https://slowparentingmovement.wordpress.com/welcome-to-slow-parenting/>

as a mechanism of inequality reproduction. Further research is needed to provide quantitative assessment of the popularity of the scenarios described in this study across different categories of families.

**Conclusion** The findings of this study suggest that the widespread idea of extracurricular activities providing a greater freedom of choice than in school cannot be considered implicitly correct. In fact, freedom of choice is available to families with specific levels of cultural capital and socioeconomic resources. Parents' attitudes towards extracurricular participation are determined more often by their cultural orientations and value systems than by the amount of social and financial resources that they have access to. The process of choosing an ECA institution requires time and information skills, in the absence of which choices tend to be much more stereotypic and dependent, primarily on the school environment. The idea of active and rational parental choice of ECA programs/institutions should be promoted with due regard to the educational strategies and the types of scenarios pursued by families at different levels of the education system.

The aspects of ECA program choice identified in this study question the feasibility of some national educational policy initiatives.

First of all, doubt is cast on the system of information distribution in education. The government has lately been focused on online channels, i. e. promotion of ECA-related information through websites of educational institutions, municipal services portals and dedicated aggregator platforms. However, the interview results show that the use of online channels by parents choosing ECA programs should not be overestimated. Quite the contrary, it appears necessary to make active use of the potential of interpersonal trust that develops in personal interactions between parents and, for example, school teachers. Development of the online infrastructure of raising awareness should go hand in hand with measures to develop trust in such information among parents. Efficiency of the national policy on transparency in education is largely debatable [Mertsalova 2015], so research on information and communication interactions in the domain of extracurricular activities may contribute to its improvement.

Second of all, the findings of this study indicate that, while upgrading the content of extracurricular activities and the technology that they employ, one should avoid being too optimistic about the readiness of families to involve children in science- and technology-related ECA programs. In the control-oriented choice scenarios, parents tend to select activities that they can "understand". Traditionally popular activities (dance, sports, foreign languages) are preferred to innovative types of classes, where the benefits of participation may seem unobvious to parents, especially if they are little involved in the choice-making process and do not scrutinize all the pros and cons of specific ECA options.

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# Creativity for Everyone:

## Integrating Encouragement of 21st Century Skills in Russian Schools

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Received in  
March 2018

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**Abstract.** This study is part of the OECD Center for Educational Research and Innovation's project Teaching, Assessing and Learning Creative and Critical Thinking Skills in Education and uses action research methods. It seeks to elaborate a teaching format to develop 21st century skills within the framework of a particular school subject, making participation in such classes available for as many teachers and students as possible. The study puts forward an approach to designing contextual problems that students are offered to solve collaboratively in the classroom. Key components of such assignments are described, which allow for fostering creativity within specific school subject domains. The results from testing the validity of such assignments are presented. Accessibility of subject-specific teaching practices enhancing 21st century skills is assessed by analyzing the outcomes of focus groups consisting of teachers and students who participated in the assignment validity assessment.

**Keywords:** creativity, 21st century skills, collaborative problem solving, contextual problems, assignment design, schooling practices.

**DOI:** 10.17323/1814-9545-2018-4-282-304

The study was conducted with the support of the Sberbank's *Contribution to the Future* Charity Foundation. Translated from Russian by A. Gurariy.

Discussions on 21st century skills development within educational processes started before the beginning of the XXI century and are still ongoing. They are supported by international organizations which have an influence on educational policy in different countries such as the World Bank, the Organization for Economic Cooperation and Development etc. There are discussions taking place at numerous international conferences, summits, and strategic sessions with business representatives etc.: what these skills are; how they should be developed. These debates have finally begun to focus on the school education regarding the issue of 21st century skills implementation into general education schools and the importance of student's access to the pedagogical approaches developing these skills. Encouragement of 21st century skills development and its further implementation are a challenging task in Russia. Some stand-alone innovative pedagogical practices of the 1980–1990s did not become a panacea for domestic education [Safronov, Sidorova, 2016]. The implementation of the Federal State Educational Standard in General Education in 2009–2012 was an important step towards changing school reality, however, it can hardly be expected that the learning process, which has taken such a long time to develop, will change at once. The suggested innovations, regarding not only the educational process itself but also technical and organizational issues, are often met with some resistance in general education schools: from non-traditional placement of desks during the lesson to identifying subject domains instead of particular school-subjects; from using technology as a learning tool to the lesson conducted outside the school building. We do not deny the existence of a significant number of innovative teaching practices, which in some cases can even be extended to the level of a specific region [Akhmadgaliyeva, 2014], but the difficulties connected with the implementation of teaching practices developing metasubjective skills are hard to ignore. The study presented in this paper attempts to solve this ongoing problem.

## Methodology

The study was conducted by the team from the Institute for Strategy of Education Development of the Russian Academy of Education (ISRO RAO) and HSE with the support of the Sberbank's *Contribution to the Future* Charity Foundation in 2016–2017 in the framework of the international study *Teaching, assessing and learning creative and critical thinking skills in education* conducted by the Center for Educational Research and Innovation of the Organization for Economic Cooperation and Development (OECD). The methodology of so-called *action research* was used—an investigation of school and its everyday life that has both scientific and practical goals. The study included collaborative planning, observation and analysis of experimental actions made by the developers and teachers of the schools that participated in the study. Constant feedback enabled flexible and timely correction of assignment design and its adaptation to the capabilities of the students.

The action research method is based on the works of K. Levin, describing the results of the research which had taken place at industrial enterprises in the United States [Zhukov, 2015]. The application of this method in relation to education is usually associated with the work of P. Freire in Brazil, where with the help of the action research method not only original teaching methods, but also liberation of education were developed, for example, anti-racism. There are several types of action research distinguished in modern social science: knowledge generating, practical and emancipatory [Newton, Burgess, 2008]. By its nature, action research in education often serves as a platform for strengthening the dominant discourse in educational policy. The study also aimed at improving teaching practices, contributing to teachers' introduction to new teaching standards.

The action research method should be distinguished from the problem solving method. The methodology is based not only on the involvement of all research participants in the problem solving process. It is believed that the validity of the action research appears when the entire research process is thoroughly observed; theoretical input is presented to the participants; data is collected; and reflection is conducted.

Action research at the school level suggests the following initial steps [Kenneth S. Volk, 2009]:

1. Identifying the problem that needs to be solved.
2. Outlining specific issues and figure out the steps towards their solution.
3. Determining the method of collecting feedback to define the impact of efforts made.

The next steps are the following: the interventional effect itself according to a predetermined plan, observation, and discussions of the process with participants; data collecting in a predetermined way; analysis and reflection. Next, there is an assessment of the cycle and, in many cases, a new cycle with a revised goal is planned, taking into account the revision made during the reflection.

This methodology is suitable both for solving local applied tasks of a separate school administration and for conducting research to find answers to global questions that can be only received in close cooperation with schools [Pavlova, Pitt, 2001]. Perhaps the teachers and administrators who participated in the study were looking for answers to their own questions. In recognizing the main problem to be the absence of schooling practices developing metasubjective skills in general education schools, the authors focused on the following goals:

- to design an assignment, which would include the development of 21st century skills on the material of a specific school subject;
- to make such activity available to most teachers;

- to make participation in such an activity accessible to most children.

The first goal is due to the fact that the subject-centered curriculum of the national school determines an assignment design and schooling process during the lesson, leaving little time and opportunity for the purposeful development of metasubjective skills. The development of 21st century skills based on a specific subject domain is already a challenge for Russian schools.

The second goal was defined after we took into account the less than successful experience of innovative pedagogical approaches towards teaching practices in general education schools in 1980s-90s, which focused on a new type of a teacher him- or herself.

The third goal is due to the understanding of the main risk that innovations face: it is the risk of remaining locally applied or acquiring an elite character. Therefore, the new type of assignment design should be applicable not only in specialized classes or schools that have student selection procedure.

Returning to the peculiarities of the action research methodology, the researchers' approaches to the study have to be noted [Bezrukova, 2014]. It may be more subjective than it is common for the social sciences. The level of professional training of researchers is also important: how trained they are in the field they want to improve. From this point of view, it is rather important that most authors have some experience in innovative pedagogy, and could interact with teachers more effectively, relying on their professional experience.

### **Conceptual Framework of the Study**

There were 11 countries apart from Russia which were involved at the OECD Center for Educational Research and Innovation's project this study is a part of. The research focus is the development of 21st century skills. This article is dedicated to the creativity development. The OECD researchers proposed *The Five Creative Dispositions Model*, which allows for characterizing the student according to the following criteria [Lucas, Claxton, Spencer, 2013]:

- inquisitiveness (to identify, to raise, to explore and to critically evaluate interesting issues in any creative domain);
- persistence (to persevere through challenges, to show confidence in the face of uncertainty and to take risks in choosing a problem solving strategy);
- imagination (to come up with imaginative solutions, to test and to improve them, to make connections between non-compatible objects, to use intuition);
- collaboration (to share the results of their intellectual activities, to support others and to receive support from them, to cooperate);

- discipline (to develop a creative product using available knowledge and skills and developing new ones necessary for its creation, to reflect critically, to make decisions about improving the product) [Lucas, Claxton, Spencer, 2013].

The conceptual framework of this study corresponds to modern definitions of creativity. Initially, the study of creativity was focused on the analysis of mental operations used in the creative process. The beginning of the scientific research on creativity as a psychological phenomenon is usually referenced to the 1950s and is associated with the works of J. Guilford [Guilford, 1950]. According to Guilford's Structure of Intellect theory there is a difference between the two types of mental operations: convergent and divergent thinking. Convergent thinking narrows all options to one solution. Although, there are varieties of these solutions, their amount is always limited. Divergent thinking is the ability to generate multiple solutions. Guilford describes this type of thinking as "the kind that goes off in different directions". It allows for exploring many possible solutions and may lead to unexpected conclusions and results. Creative decisions usually come at the state of relaxation and not at the moment when attention deliberately focuses on problem solving.

Various tests have been developed to measure creativity identified with divergent thinking. E. P. Torrens, developing the ideas of J. Guilford, used the following criteria to identify the creative person:

- fluency (the ability to come up with many diverse ideas quickly);
- flexibility (the ability to generate ideas, to develop new solutions, to change one's mind during the problem solving process, to abandon the suggested idea, to take the views of others into account);
- originality (the ability to suggest unexpected solutions);
- elaboration (the ability to embellish ideas relating to the activity) [Tunik, 2013; Torrance, Goff, 1989].

Since the time when J. Guilford and E. P. Torrens created their approaches towards creativity, the research on creativity has expanded significantly. Now it includes not only the type of thinking, but also personal qualities, such as self-confidence and openness to new ideas and experience, as well as motivational and environmental components [Lubart et al., 2009]. A. Cropley summarized skills teachers should promote in their students to foster creativity in the classroom [Cropley, 2011]:

- Possession of a fund of general knowledge
- Knowledge of one or more special fields
- An active imagination
- Ability to recognize, discover, or invent problems

- Skill at seeing connections, overlaps, similarities, and logical implications (convergent thinking)
- Skill at making remote associations, bisociating, accepting primary process material, forming new gestalts, etc. (divergent thinking)
- Ability to think up many ways to solve problems
- A preference for accommodating rather than assimilating
- Ability and willingness to evaluate their own work
- Ability to communicate their results to other people.

Thus, the relevance of the framework adopted as the research program is supported by other studies. It describes the creativity as a social and forward-looking phenomenon, manifested in communication with other people and requiring persistence and discipline.

What kind of schooling practices aimed at developing this kind of quality will help to fully promote it, will not be too dependent on teachers' and students' personal characteristics, and can be implemented in an average school? There are some approaches to motivate students to produce new ideas, to create collaborative project, to communicate and to self-reflect in modern pedagogy, taking into account the subject domain context. These are educational projects and studies based on the collaborative problem solving approach. This approach is evaluated in the international comparative study PISA-2015 [OECD, 2017].

### **Assignment Design**

We analyzed *The Five Creative Dispositions Model* to prove that it does not contradict the normative framework of the modern Russian school. We also compared the metasubjective educational results 5th-9th-grade-students have to achieve with those indicated by the OECD team (Table 1).

Thus, modern Russian secondary school regulations include the formation of a creative person among the priority learning outcomes. The education process based on domain specific learning aims to achieve this goal. In this study, we consider encouraging creativity in mathematics classes.

What opportunities does a school subject like mathematics provide? It is not supposed to change the content of mathematical courses to develop creativity, but review the assignments and organization of education process. According to mathematicians and methodologists, the solving of mathematical problems is both the goal and the instrument of teaching mathematics. Therefore, we emphasize the significance of developing such types of assignments, which encourage creativity development.

Scientific study of literature and analysis of teaching experience is the key to understanding the assignment design principles that expand opportunities for developing creativity within domain specific learning. For example, it is possible to achieve the goal with the help

**Table 1. The comparison between The Five Creative Dispositions Model characteristics and Federal State Educational Standard of Basic General Education regarding metasubject educational results of 5th-9th-grade-students.**

The Five Creative Dispositions Model	Metasubject educational results of general education program acquisition (Federal State Educational Standard of Basic General Education)
— inquisitiveness (to identify, to raise, to explore and to critically evaluate interesting issues in any creative domain);	— the ability to determine independently the goals of their schooling process, to set and formulate for themselves new tasks in learning and cognitive activity, to develop the reasons and interests of their cognitive activity; — the ability to define concepts, to generalize, to make connections, to classify, to choose independently the approaches and criteria for classification, to determine cause-effect relationships, to develop logical reasoning (inductive, deductive and by analogy) and to draw conclusions
— persistence (to persevere through challenges, to show confidence in the face of uncertainty and to take risks in choosing problem solving strategy);	— the ability to choose independently the strategy for achieving goals, including alternative ones, to choose consciously the most effective ways to solve educational and cognitive tasks; — the ability to correlate their actions with the goals, to self-monitor the process of achieving the goals, to choose strategy within the specific requirements, to review the strategy in accordance with the changing situation
— imagination (to come up with imaginative solutions, to test and to improve them, to make connections between non-compatible objects, to use intuition)	— the ability to create, apply and transform signs and symbols, models and schemes for solving educational and cognitive tasks
— collaboration (to share the results of their intellectual activities, to support others and to receive support from them, to cooperate)	— the ability to organize educational cooperation and joint activities with the teacher and peers; to work both individually and in a group; to find a joint decision and resolve conflicts based on the harmonization of views and consideration of interests; to formulate, discuss and defend your opinion
— discipline (to develop a creative product, using available knowledge and skills and developing new ones necessary for its creation, to reflect critically, to make decisions about improving the product)	— the ability to assess the assignment as well as his or her capabilities to solve it; — to have self-control, self-assessment, decision-making skills and to make informed choice in educational and cognitive activity.



of contextual problems describing some issues that need solving; assignments with redundant or insufficient data; problems with many solutions, when the best solution has to be chosen.

There is a question if it is possible based on the content of the topic to develop and to implement such types of teaching activities into educational process. Is it methodologically correct to develop assignments with several possible solutions? At first glance, it contradicts the traditional approach to teaching mathematics: usually the student has to find the one correct answer when solving mathematical problems. The analysis of educational material on Mathematics and teaching experience shows the opportunity to develop assignment-promoting creativity almost in every topic.

The clear reference to the type of mathematical activity needed to get the solution simplifies the assignment for the student, and the requirement to choose the solution by him- or herself makes the assignment more difficult. When studying a number of topics, it is necessary to repeat the same actions (operations) to get the skill. It can be assumed that such work is boring for students; they don't have any desire to choose the best solution during the problem-solving process. In this case, it is reasonable to use assignments where the same mathematical operations will be covered by interesting assignment design, while the problem-solving strategy developed by the students will require their repetition.

Below is an example of an assignment for 9th- grade students developed by our team.

At the family meeting, dad asked his daughter Alena to help solve an important problem. The family is going to buy an affordable car during the next three years. However, the available amount of money (300,000 rubles) is not enough to purchase the selected car. 55,000 rubles more are required. In order to save money, dad suggests putting all the money they have (300,000 rubles) into a bank at a certain interest. Mom comes up with another idea: to buy company shares in a well-established small business in order to receive dividends.

The parents have the following information about a small company.

- The cost of producing  $x$  thousand units per year can be represented by the dependence  $y = 0,05 x^2 + x + 1$  (costs are calculated in millions of rubles).
- Products are supposed to be sold at a price of 3,000 rubles per unit.
- The company's profit (in millions of rubles per year) is calculated as the difference between the money received from the sale of products and the production costs.

- The capacity of a small company allows for producing no more than 20,100 units of production per year.
- The company has made an output plan for the next three years. It is assumed not to change the basic parameters of the production process, the scheme to calculate the income and payments on shares.
- When buying company shares in the amount from 200,000 to 300,000 rubles, shareholders are expected to receive annually up to 0,1% of the company's profit.

Determine which strategy for a successful investment should be approved at the family meeting in order to save the required amount of money within three years.

The assignment is accompanied by additional materials presented in various forms. There are some of these materials.

### **Bank *The Last Chance*. Deposits for individuals—2016.**

Bank *The Last Chance* offers several profitable investments for individuals in 2016, their annual interest rate is up to 10.58%.

The Bank *The Last Chance* has deposit programs which are insured by the state in accordance with the Law "On Deposit Insurance".

#### 1. Deposit *The Right Answer*—growth rate according to the period.

The minimum deposit is 100,000 rubles (it is impossible to open a deposit in another currency), for the period of up to 380 days.

As you will see in the table, the growth rate depends on the time period (there are four of them) and ranges from 8.0% to 12.0% per year (the average growth rate during the whole period is 9.75%).

Additional deposits or partial withdrawals are not permitted.

Minimum amount, RUB	From 1 to 95 days	From 96 to 190 days	From 191 to 285 days	From 286 to 380 days
100 000	8.00%	9.00%	10.00%	12.00%

#### 2. Deposit *Maximum Income*—maximum annual growth rate

This deposit allows the maximum annual growth rate in comparison with the bank's other offers; however, the total contribution to receive it is a substantial amount of money.

The minimum deposit is 1,000 RUB, or 100 EUR or USD. The time of the deposit is up to the client and varies from 91 to 1,095 days.

In the case of early withdrawal in the period from 180 days the interest is paid at a fixed rate equal to 60% (see table below).

	The time of the deposit (days)						
	91–180	181–364	365	366–547	548–730	731–1094	1095
from 1,000	7.80/ 7.85%	8.70/ 8.86%	8.70/ 9.06%	8.60/ 8.95%	7.30/ 7.69%	7.10/ 7.61%	6.80/ 7.52%
from 200 000	8.00/ 8.05%	8.80/ 8.96%	8.80/ 9.16%	8.70/ 9.06%	7.40/ 7.80%	7.20/ 7.72%	6.90/ 7.64%
from 550 000	8.10/ 8.15%	8.90/ 9.06%	8.90/ 9.27%	8.80/ 9.16%	7.90/ 8.36%	7.70/ 8.30%	7.40/ 8.26%
from 850 000	8.20/ 8.26%	9.20/ 9.38%	9.20/ 9.60%	9.10/ 9.49%	8.10/ 8.58%	7.90/ 8.53%	7.60/ 8.51%
from 500 000	8.30/ 8.36%	10.10/ 10.31%	10.10/ 10.58%	9.70/ 10.14%	8.30/ 8.81%	8.10/ 8.76%	7.80/ 8.76%

To compare the deposit conditions, we recommend you to search for the “Top Banks on Deposits in 2016” on the Internet and choose the better offer.

The assignment has some significant features:

- it lacks data, so students need to look for additional information (for example, to choose a bank that offers more profitability of deposit) from different sources;
- it is necessary to make a decision regarding the suitable sources of information;
- it is possible that the correct answers of students may not coincide, because of different types of reference materials, different sources of information and different decisions made at each assignment stage (choosing a reliable bank, choosing a deposit, choosing interest rate).

It is important to note that such an assignment not only helps to revise the previously studied material (quadratic functions and the calculation of percentages), but also encourages students to develop non-standard approaches to the solution. Thus, this contextual problem contributes to the development of The Five Creative Dispositions Model while fulfilling the subject didactics.

Together with the schoolteachers, an assignment option for the 8th grade was designed. It does not contain the part with profitability of an enterprise's shares calculations, since quadratic functions are studied most often in the 9th grade. The assignment aims at choosing the bank and deposit(s) and corresponds with the 8th-grade-curriculum. Moreover, it is an opportunity to discuss the reliability of banks in the remaining time.

At the beginning of the lesson, some teachers asked students to write the percentage formulas in order to actualize the knowledge

needed for the assignment (finding the percent number, number by its percent or percentage), since this material was studied two years earlier. On the one hand, the actualization of the material is necessary to calculate capitalization in the problem-solving process; on the other hand, it enables the teacher to assess the students' capability to use subject domain knowledge, if necessary.

The assignment allows for varying certain parts in order to increase students' involvement and to get closer to everyday life situations. For example, it is possible to add currency deposits to make the assignment design more complicated and to increase the amount of possible behavioral strategies. The currency deposits have a smaller interest rate, but students can try to get the required amount of money faster because of the difference in exchange rates. This also increases the range of mathematical calculations. The assignment also allows for adding "attractive" deposits with a higher interest rate (named *Excellent chance* or *Stability* or such). At the end of the assignment, when all students have chosen certain banks and deposits, the teacher announces that all banks offering deposits above a certain interest rate are closed by the decision of the Central Bank. Such a remark may be the reason for a more meaningful discussion about the reliability of banks regarding the everyday life situation, when one's bank license may be revoked due to its unreliability. Different options in assignment design stimulate both discipline, imagination and coherence of team members while developing a deposit strategy in accordance with The Five Creative Dispositions Model, as well as the development of students' general financial literacy and an increase the subject domain activity because of additional mathematical calculations.

The approach to assignment design has to be underlined:

- the story itself is not related to any specific topic in Mathematics;
- the assignment doesn't require students to perform the specific actions they have studied (to do identical transformations, to solve an equation, to plot a function etc.);
- there is no solution method students have to follow.

While developing a strategy, the student has to deviate from the standard and previously studied problem solving procedures, since he or she is under conditions of uncertainty about the theoretical material of the Mathematics required to solve the particular problem.

This type of assignment refers to contextual mathematical problems<sup>1</sup>. However, not every contextual problem requires the student to be cre-

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<sup>1</sup> In the methodology on mathematics, the contextual problem is the problem describing everyday life situations, when the student must him- or herself choose the strategy to solve it. At the same time, the student may be famil-

ative by finding the solution. Requirements of the Federal State Educational Standard of the basic general education force almost all the authors to use applied assignments on Mathematics while presenting topics and sections in textbooks. There are common *stereotypical* applied assignments in textbooks and teacher's manuals to illustrate the use of Mathematics in solving everyday life problems. The potential of these assignments to encourage creative thinking is a controversial issue.

While conducting the research, 24 assignments on mathematics and natural sciences (ecology, biology, physics, and geography) were developed for elementary and secondary school.

The principles of contextual problem design aimed at promoting students' creativity are presented below. They were used within our study and proved to be successful. During the study, colleagues from the OECD developed their own criteria for an assignment to be classified as promoting creativity, and they are quite similar to ours.

- The problem described in the assignment should be quite *uncertain, unclear*: if the assignment refers to mathematics, if there is a certain mathematics topic suitable for solving the problem, etc. A student faces a situation when there is no *prescribed problem-solving strategy*.
- The problem described in the assignment should *require knowledge from different mathematical topics to solve it*. So, for example, the assignment refers students to the study of functions, to write numbers in a standard form, to review involutions, percentage formula and percentage math problems.
- It is obligatory for contextual problem design to be based on the prescriptions of the Federal State Educational Standard and curriculum framework for schools. The teaching experience and experimental verification of educational materials allow for claiming that the current mathematics curriculum provides wide opportunities for contextual problem implementation. The assignment presented above proves the connection between the specific school-subject domain (the earlier acquired knowledge and skills) and metasubject skills (a search for information, an approach to presentation of the information, data analysis, synthesis of knowledge founded in different sources), which is also documented in educational standards. The design of the assignment presented above meets the requirements of the "The graduate will learn" section and the "The graduate has an opportunity to learn" section of the curriculum framework. These knowledge and skills are

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iar with the situation described in the assignment based on personal experience, literary sources, etc.

significant in a problem solving process *with nonstandard, unusual design*.

- The contextual problem design demonstrates to the students that there is *not enough (or it is redundant) data* in order to solve the problem. Thus, there is an opportunity to promote creativity while analyzing the initial data (discipline and inquisitiveness), searching for the information (persistence), making decisions (imagination, collaboration). The same assignment design principles encourage critical thinking development during the process of analyzing the initial data and selecting the most relevant information, choosing reliable sources of information, and understanding decision making.
- The contextual problem design deliberately *limits the opportunities for problem solving* because of *the given context*. This requirement partially facilitates the contextual problem development, because it puts the student in a new situation compared to what he or she may know from personal experience, studying information sources. However, the restrictions may be a pretext for additional questions that do not arise in a classic assignment.
- The developed contextual problem assumes various *correct solutions to the problem* in contrast to the only possible solution in classical assignments on Mathematics. In this case, the student is required to explain his or her decision making strategy, which contributes to the critical thinking development.
- The contextual problem design involves *different ways of presenting information* (text, table, diagram, drawing, chart, etc.), using the Internet or other sources to get the missing information. This assignment design principle contributes to the development of almost all the qualities that promote creativity. Along with the generation of new solutions, it is important to be able to evaluate their viability, productivity and efficiency.
- So, these are the characteristics of contextual problems contributing to the creativity development. The principles of assignment design presented above are found in Russian methodology [Feigenberg, 2010].

### **Lesson Requirements**

The development of the creative abilities of students can be encouraged not only by specific assignment design, but also by the learning climate in the classroom. The Five Creative Dispositions Model supposes to promote collaboration, which can be achieved through teamwork. The methodology on mathematics describes the teaching experience within both homogeneous and heterogeneous learning groups. The teamwork is usually used as the didactic method to review the material during the skill formation process: it should help to provide conditions for gaining new knowledge during the systematization process. Within the traditional approach teamwork is usual-

ly used as extracurricular project activities for students. The contextual problem solving supposes students to work in groups during the lesson and to feel free to communicate without the teacher's direct instructional guidance. The teaching experience allows us to recommend a group size of 4–5 students. This amount allows participants to share their views (to listen and to hear each other) regarding the problem solving process; to share activities based on personal characteristics and the experience of the participants; to jointly develop the problem solving strategy.

The classroom observations showed that teamwork provided collaboration and an exchange of views, which helped students to find their own problem solving strategy; there were also discussions and disagreements with new ideas or uncommon approaches to the problem solving process. The partnership aiming at solving the problem promotes an atmosphere of learning and cooperation. The participants had to be persistence and disciplined in order to find the best solution.

Thus, the analysis of students' activities necessary for contextual problem solving has shown that teamwork develops inquisitiveness, persistence, imagination, collaboration and discipline, which contributes to creative problem solving.

The teaching process should be organized in a certain way to encourage creativity:

- the assignment is based on an everyday life (rather than theoretical) situation, when students are supposed to solve the problem using the approach of the specific school subject, to choose knowledge required for the problem solving, to identify the missing data and to select the sources to collect it;
- the students are interested in the problem solving process;
- the teaching process consists of practical activities and therefore differs a lot from traditional lessons, which also attracts students' attention;
- teamwork is used, suggesting an independent problem solving process by students;
- the usage of additional sources of information is supposed.

### **The Assignment Implementation**

Lessons similar to those described above were conducted by teachers at schools in three city districts of Moscow and at one school in New Moscow. The teachers conducted four lessons in each class. Table 2 shows the characteristics of the schools taking part in the study.

After assignment implementation the seven focus groups with teachers and students were conducted to determine the success of the study: if the assignment design was sufficient to promote creativity based on subject domain knowledge; if the participation at assignment activities was accessible to most teachers and children.



Table 2. **The characteristics of the schools taking part in the study.**

City districts, school type (all schools taking part at the research are state schools)	Amount of classes
Central Administrative District. Lyceum with in-depth study of mathematics and science	4 classes of elementary school: three 3rd grade-classes and 4th grade-class; 5 classes of secondary school: three 8th grade-classes and two 9th grade-classes
North-Western Administrative District. School with in-depth study of the English language	2 classes of elementary school: 3rd grade-classes; 2 classes of secondary school: 8th grade-classes
Southern Administrative District. General education school	5 classes of elementary school: two 3rd grade-classes and three 4th grade-classes; 2 classes of secondary school: 8th grade-classes
New Moscow. Gymnasium with a complex student body with low socioeconomic and cultural backgrounds	6 classes of elementary school: three 3rd grade-classes and three 4th grade-classes; 2 classes of secondary school: 9th grade-classes
Total	28 classes with an average of 25 students per class

### Focus Groups with Teachers

Each focus group consisted of teachers from the same city district. The teaching experience was discussed as well as the usefulness of suggested educational activities, the level of student engagement, and the possibilities to vary the assignment design. The teachers shared their experience in changing the assignment design depending on curriculum by grade, in analyzing both the predictable and unexpected behavior of their students they faced with during educational process.

The teachers also noted the possibility to develop both metasubject and subject skills within conducted lessons. In general, the idea of developing competences within the subject domain is interesting for them, but the development of such assignments is a time-consuming process, which requires teachers to do more theoretical background. Primary school teachers emphasized that such lessons can provoke discipline problems, if students are not used to teamwork. A new lesson design leads to a transformation of the teacher's role, where they become not the only one knowing the right answer, which was sometimes uncomfortable for teachers.

The teachers noted that the teaching materials were clearly presented and well-organized. The teachers gave different assessments regarding the accessibility of instinctual materials according to their own teaching experience: if they were used to implementing practical activities during the lesson, to organize teamwork and to give students an opportunity to find a solution to the problem themselves.

As for the similar assignment implementation in the educational process, the majority of teachers stated that they are ready to use such assignments no more than once a month. During the lesson design process, teachers independently chose the appropriate time and the main goal of the lesson: someone used them for topic introduction, someone reviewed the material, and someone used them as a tool to motivate students using an interesting and unusual task. Some teachers supported the idea of interdisciplinary tasks and used them for integrated lessons.

On the other hand, the focus groups have shown that teachers are concerned about the discrepancy between the new assignments and the tests used for the external quality control of education. Despite the fact that the assignment design corresponds to the Federal State Educational Standard, the skills they develop are not assessed during such tests. Teachers and schools find themselves in the situation of a difficult choice between the lesson design they find interesting and useful for students and the external quality control, which has great importance for the school.

None of the teachers during the focus groups reported that the tasks were difficult for the students or that the students did not cope with them and did not take part in the educational activities. On the contrary, they stressed that students with low academic performance often realized themselves in tasks aimed at developing creativity. During teamwork, they were often the most active students who clearly demonstrated their knowledge within the subject domain. Unexpected activity in students with low academic performance can be explained by the significant difference in lesson design required for contextual problem solving, which may help to overcome a teacher's perception about those students.

Thus, the focus groups with teachers allow us to conclude that the new assignments and lesson design are not challenging for both teachers and students and do not conflict with their educational experience. The main obstacle to such assignment implementation from the teachers' point of view is not their untraditional design or contradiction with the school program, but the mismatch of skills formed by contextual problems with skills tested with external evaluation.

### **Focus Groups with Children**

We conducted four focus groups with children: two with students of two 8th-grades and two with students of one 3rd-grade. In the second case, two moderators divided the students of one class into two groups and held a conversation with them separately. Students were briefly reminded what activities they had during the study. After the students had expressed their first emotional response, they were asked to describe assignments they were interested in, assignments, which were useful for them and to specify the criteria. The children shared their experience about the difficulties they had during the prob-

lem solving process, about their classmates' behavior: whether it was expected or unexpected. They also expressed their opinions about the frequency of such assignments during the educational process.

The students showed great interest in teamwork, they believe that it is useful in learning, and even expressed a desire to acquire skills to organize such activity by themselves. Primary school students are more sensitive to small conflicts that occur during the problem solving process; secondary school students already know how to solve conflicts, but they also need the teacher's help.

Some students were also surprised by those classmates who were not usually interested in the learning process, but who had participated in teamwork. The activity of such students contributes to the group result and enhances their own motivation to study, if the group choose a strategy to support any ideas, regardless of previous academic success or failure: «I didn't think that <name of the classmate> would start to work so actively. He doesn't care, really. Maybe he was interested, maybe he was cheered up by the team. When someone had difficulties in mathematics or could not solve the problem by him- or herself, we said: «Let me help you, we can do everything together». There was a girl in our team, who had to order figures. She could not do it, it did not work. We helped her to do it, we ordered it together, and it worked out».

Students explain their own learning activity when performing contextual problems by their interest in the task, its untraditional design, their desire to learn something new as well as by the external evaluation and competition within the groups. Younger students noted that it was interesting for them having a particular role to play:

S1: [You feel yourself] like a real ... seeker.

S2: ... or a traveler.

All students noted that the developed assignments were untraditional for a school lesson. On the one hand, they seemed simple, on the other hand it was not always clear how to solve the problem, and it was quite unusual that there could be several correct answers. Such statements from students that contextualise problems—"teach to think", "develop the imagination", "teach to work in team"—prove that such assignments develop 21st century skills and can be used in everyday life situations.

**Conclusions** Based on the results of action research, we have shown that it is possible to design lessons aiming not only at knowledge acquisition within the subject domain, but also at 21st century skills development. The assignment implementation has shown that an ordinary teacher can at least give such a lesson developed by others taking into account the criteria of the contextual problem we have presented above. The

assignment availability for children is out of doubt. The assignment availability to teachers may vary depending on their skills in developing innovative lessons.

It seems to us that the unwillingness of teachers to conduct non-traditional lessons significantly limits the contextual problem implementation. The focus groups both with primary and secondary school students support this conclusion. It is still common practice to distinguish between education and entertainment in the Russian school system. Educational practices, which can develop creativity, even if they are used within the subject domain, are often perceived by teachers and students as entertainment, irrelevant to the traditional school system and more appropriate for extracurricular activities or additional education. This can be considered both as a barrier towards the modernization of the education system and as a specific structural characteristic of the Russian school. The popularization of the best approaches to developing 21st century skills within a specific school subject is necessary to make teachers and children believe that achieving effective knowledge acquisition is possible along with the development of imagination and curiosity in children.

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