ПЕДАГОГИКА ВЫСШЕЙ ШКОЛЫ

Flipped Classroom for Doctoral Students: Evaluating the Effectivness

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Abstract. The demand of Industry 4.0 for creative researchers able to adopt to the changing world and think out of the box puts forward the question of education technologies used to prepare such specialists. Though many new education technologies have appeared recently their effectiveness has not yet been proved to be introduced into tertiary education in a large scale. The author presents the evidence for the flipped classroom technology effectiveness. The paper describes the rationale and content of the doctoral program course "English for Research Purposes" delivered using flipped classroom approach. The course was piloted in September-May, 2017/2018 academic year with 197 doctoral students participating. Both quantitative and qualitative evaluation of the flipped classroom was made. Direct education outcomes (students' scores at the end of the course and attendance rates) and indirect education outcomes (students' attitudes, perceptions, and feelings towards the course; students' empowerment and development in the course) were measured using analysis of variance with repeated measures and Likert Scale surveys. The results showed that a general increase in students' ratings of the effectiveness of the flipped classroom elements was observed during the course, the students' scores increased 11,3% in comparison with the results of the 2016/2017 academic year where a traditional approach was used. The results of the research can be used to modernize the education process of doctoral students' training based on flipped classroom technology both at the universities of Russian Federation and at foreign universities.

Keywords: Education 4.0, education technology, flipped classroom, doctoral students, study modules, language learning

Nowadays most educators realize that, whereas in industrial society the focus of education was to contribute to the development of factual and procedural knowledge, in the digital era, with all the innovations introduced by the fourth industrial revolution, the development of conceptual and metacognitive knowledge is becoming crucial. A key instructive reaction to constant change is to center the education process on building up the skills and attitudes that give future innovators and researchers the necessary tools to adapt to novel, complex conditions. Consequently, a change of education paradigm has been proclaimed and the need for the development of new education technologies has been recognized. However, tertiary education is too slow to introduce innovations into the education process because of a number of factors. They are: lack of investment, obsolete IT facilities, not enough number of tech savvy specialists among the academic staff, and resistance to change, to name a few. The task of the educators in the situation is to turn challenges into opportunities and to find the technologies

that will equip future researchers with the necessary skills in conditions of resource scarcity.

The conceptual framework of education technologies 4.0 is emerging and the literature on the topic is diverse. Some researchers connect the future of education with the advances in neuroscience supposing that knowledge of how the brain works will improve classroom practices and enhance learning. However, most experts are cautious about the implications of neuroscience for teaching [1]. U. Goswami states: "there is a gulf between current science and direct classroom applications" [2]. The Society for Neuroscience's Education Summit Report reports: "… it is clear that brain science is not the driving force behind improving education practices" [3].

The majority of educators concentrate on modifying the classical teaching methods like interactive learning. Some of them investigate the promising methods that embrace mobile and Internet technologies like blended learning and flipped classroom [4–6], others develop new forms of cooperative learning like peer learning admitting the unused potential of learning from people who are equal to each other [7; 8]. For the purpose of our research we evaluated the effectiveness of a flipped classroom technology as it is both innovative for Russian system of tertiary education and promising in terms of constant development triggered by the advances in IT.

The paper presents a theoretical analysis and practical evaluation of the flipped classroom as a mode of blended learning. It describes the didactic possibilities of flipped learning for doctoral students, outlines the realization of the flipped learning approach in the form of an online course developed and evaluates the results of its piloting in Autumn-Spring 2017/2018 at *South Ural State University*.

The concept of flipped classroom

Flipped classroom approach presupposes that "what is done at school done at home, homework done at home completed in class" [5]. In a traditional flipped classroom approach students come to class by watching the lecture video of previous night or studying the materials assigned by the instructor. A lesson starts with short questions and answers to check students' comprehension. The rest of the time, the lecturer creates activities to develop high cognitive skills and provides support to students. Flipping the classroom is emerging as a unique approach to improving learner retention and transfer, and making efficient use of class time. M.D. Estes, R. Ingram, J.C. Liu highlight that the essence of flipped learning is that this student-centered approach places the "burden" of active learning squarely on the shoulders of the student. Students in the flipped classroom are expected to show initiative, be proactive, inquire, collaborate, and contribute new knowledge in observable ways [9].

Flipped classroom approach proved to be efficient in the literature. In the study at the University of Michigan A. Berrett describes a flipping approach for an introductory calculus course. Compared to the results obtained in the traditional course, students in the flipped course "were able to make gains at twice the rate" [10].

Proponents of the flipped classroom present several advantages of the approach. J. Enfield notifies the flexibility and individualization of the flipped model as students can access lecture videos whenever and wherever they want, and they can learn at their own speed. Students appreciate the ability to view videos at their convenience and pace [11]. Another critical thing is that the approach increases the interactive period within the class. N. Milman [12] argues that the most important benefit of flipped learning approach is to support team working within class, while J. Enfield [11] refers to this advantage as the collaborative nature of the flipped classroom providing students with various skills and abilities to learn from and support each other.

Though flipped classroom is a promising approach it has some pitfalls in implementation. Researchers admit the significant amount of time needed to prepare videos, and the low motivation of students to change the format of study and take the responsibility for their own learning.

Moreover, planning for effective in-class activities is vital but may prove challenging for faculty comfortable with a traditional style of lecture. Another issue is the digital divide as to view videos may be a challenge for economically disadvantaged students. Furthermore, video quality may be poor, and students may not understand the video content and may be unprepared for learning activities. Nevertheless, the advantages of flipped learning overweigh its disadvantages, and with time will help to raise the quality of content delivery. Nevertheless, flipped classroom might become an effective education technology for doctoral students as they are future researchers and they need to develop a certain set of skills mastered through self-paced and deep learning.

Doctoral students' needs analysis

The demand for doctoral students has increased lately in the academic environment, though C. Schroeder [13] believes that most doctoral students are now unable to cope with abstract ideas and are less independent in thought and judgment. Many doctoral students enter postgraduate studies with some basic research skills, but still they have low level of cognitive academic thinking skills, critical reading and writing skills required for postgraduate scholarly writing and speaking. While A. Brew states that academic staff expect postgraduate students "already have had considerable experience in investigation, in project research, and in inquiry based learning" [14], the real situation requires additional training for doctoral students to meet the expectations. This can result in a gap between the expectations of academic staff and the actual performance of the students, which has been linked by A. Froese, B. Gantz and F. Henry [15] to poor instructional delivery.

The gap even becomes wider when the necessity to demonstrate the research skills in English arises. Doctoral students lack the knowledge of English. They all come with different backgrounds and different experience of using English. Moreover, 76% of doctoral students at South Ural State University have low command of English, 67% of postgraduates have a vague idea of what research skills they need to master to succeed in their study. Concerns about the difficulties found by many doctoral students in writing and communicating pose a greater challenge at the postgraduate level. Novice researchers with a research-oriented profile require not only effective writing and speaking competencies, but also a comprehensive understanding of academic public speaking techniques, the scientific publication process, genre conventions of research articles, publication ethics, and the evolving information technology tools for literature analysis and organization.

Much has been done in Russian system of tertiary education to introduce academic writing in doctoral studies curriculum and to support young researchers in their publishing activities with several MOOCs developed on Coursera platform available for a wide audience [16]. A network of Centers of Academic Writing (CAWs) has been established at leading universities that turned into the Consortium of CAW's. The Consortium aims to create a professional network of experts in academic writing; to support the creation of new CAW's; to extend experience of the best practices in academic writing training; to initiate projects in academic writing by attracting grants and subsidies of the Ministry of Education and Science of the Russian Federation; to develop national standards in academic writing training; to inform the academic community on the events of Consortium and increase awareness in academic writing on the territory of the Russian Federation [17]. Still academic writing is an emerging field of study in Russian tertiary education and needs a thorough interdisciplinary research embracing Linguistics, Philology, Rhetoric, Logic and Philosophy [18]

The research of Russian scholars in academic writing and the results of the doctoral students' needs analysis made us rethink the format, delivery and content of the English language course for doctoral students. To develop the course content the survey of 197 doctoral students enrolled in 2016/2017 academic year was

conducted. The aim was to define the needs the doctoral students have. The results show that though 100% of doctoral students admit that in the near future they plan to write papers in English for peer-reviewed journals and participate in international conferences they are unaware of the basic concepts of critical reading and writing strategies. They lack internet research skills, they do not know what criteria to use to evaluate information, how to spot logical fallacies and how to make your message clear and understandable even to a layman, that is how to adjust your speech to the audience.

As educators we realize that it is beyond the scope of English language instruction to develop the whole set of skills a scientist needs but the very nature of language as the means of communication and the basic way to articulate ideas is the rationale for integrating transferable research skills into language learning. Transferable skills naturally developed by learning the language are the analytic and communication ones. Analytic skills: to synthesize and understand complex content, problem-solving tools and experience; to see the big picture while still retaining attention to details; to use advanced research methods/skills; to make decisions consistently about abstract information (grading); to exercise good judgment. Communication skills: to coherently organize material; to write at different levels: from brief abstracts/book reviews to book-length manuscripts; to write successful grant/fellowship proposals and secure funding; to edit and proofread academic texts; to verbally convey complex information to non-expert audience; to speak before large groups; to facilitate discussions, to speak up new ideas.

These are the transferable skills to be focused in the course «English for Research Purposes» that has been devised to bridge the gap between the underdeveloped research skills of doctoral students and the expectations of their scientific advisors.

Doctoral students' course content

The learning objective of the course is to develop transferable research skills in doctoral students by means of English language instruction in a flipped classroom. A set of learning outcomes has been identified to reach this objective:

✓ students will learn how to read critically: define premise, conclusion, logic fallacies; evaluate argument; learn the ways to develop paragraph; analyze the content of paragraph; define indicator words;

✓ students will gain competency in presenting and discussing research ideas at international conferences; create various types of oral presentations: reports, elevator speeches; learn how to chair a meeting;

✓ students will be able to find relevant and reliable references according to indicators in research databases for a subject of interest; students will be able to prepare a paper with an appropriate structure, writing style, and ethical considerations required by scientific publishing; students will demonstrate substantial knowledge of peer-review criteria to review works by others and to exercise self-criticism.

To achieve the learning outcomes the course design requires intensive online practice in addition to classroom activities. As the course presupposes the development of the research skills of three types, namely, critical reading skills, academic speaking skills and academic writing skills, the appropriate content for each module has been developed and it is presented in *Table 1*.

The course «English for Research Purposes» is organized into three modules developed for three terms – each term is 36 hours of classroom work and 36 hours of self-study online work, which makes the 208 hours of learning activities. The first module deals with developing critical reading skills. The second module introduces students the strategies to present at international conferences. The third module is developed to study how to write scientific texts. Table 1 shows the distribution of activities and the content of each module.

The flipped learning approach that we used can be called a modified version of the classical model. The difference is that videos were not the only type of material used as pre-class ac-

Table 1

Content of the course modules

Modules	Content
Module 1. Developing Critical Reading Skills	1. Reading techniques. Retention strategies 2. Reading Research Papers. Comprehending information 3. Identifying the argument 4. Distinguishing degrees of validity 5. Evaluating the argument 6. Avoiding logical fallacies 7. Critical Reading checklist
Module 2. Presenting at International Conferences	1. Academic Conferences 2. Networking 3. Calls for Papers 4. Conference Proposal 5. Making a speech. Creating an Elevator speech 6. Poster Presentation
Module 3. Writing a Research Paper in English	1. Writing process. Steps 2. IMRAD format 3. Introduction 4. Literature review 5. Methods 6. Results 7. Discussion 8. Conclusion

Table 2

Classroom and online components of the course

Classroom components	Online components
Communicative tasks to develop speaking skills and writing sub-skills Brainstorming activities Debates Team project work Peer assessment of the projects done Consultations Discussions of difficulties met	Lecture materials for study Academic vocabulary online training exercises Grammar in academic context online training exercises Annotated bibliography for each module Forum discussions Listening practice Peer-review discussions Written feedback Online tests Quizzes

tivities. Such routine activities as grammar and lexical exercises were the students' responsibility and they had to practice these skills at home. In the classroom we used communicative tasks with the focus on productive skills: speaking and writing. A set of videos was made to explain the grammar rules and vocabulary usage and the students had to watch them before going to class. Moreover, Youtube videos of high quality were incorporated into the online course.

Another difference is that we actively used peer-learning instruction and the students had to comment and evaluate each other's work posted online. A forum in Moodle system was organized where the doctoral students could send the comments, improve each other's performance by giving pieces of advice and conducting peer assessment. *Table 2* discloses the distribution of classroom activities and students' assignments they had to do.

Results of Doctoral students' course piloting

Quantitative and qualitative evaluation of the flipped classroom approach was made. The author adopted a mixed approach in evaluat-

Table 3

Average passing grade and improvement comparison

Course name	2016/2017 academic year	2017/2018 academic year	Improvement
English for Research Purposes	75,4%	86,7%	11,3%

Table 4

Attendance rate comparison

Course name	2016/2017 academic year	2017/2018 academic year	Improvement
English for Research Purposes	62%	75%	13%

ing the effectiveness of flipped classroom, i.e. analyzing both direct and indirect educational outcomes that made the evaluation procedure more comprehensive. Direct education outcomes were students' scores at the end of the course and attendance rates. Indirect education outcomes included students' attitudes, perceptions, and feelings towards the course; students' empowerment and development in the course, e.g., development of high order thinking skills, such as creativity, problem-solving and critical thinking skills.

Quantitative techniques included the comparison of final grades in the flipped course delivery of the 2017/2018 academic year to completion rates of the 2016/2017 academic year where traditional approach was used; the comparison of the attendance rates of 2017/2018, 2016/2017 academic years; ANOVA with repeated measures that evaluated the change in doctoral students' perception of the flipped classroom elements during the course; Likert Scale surveys of doctoral students at the end of the course. Qualitative evaluation was conducted using open-ended questions included into the course satisfaction survey, where doctoral students anonymously expressed their attitudes to the new model of learning.

The focus of the evaluation is to compare the education outcomes. The average grades were used as a comparative assessment element for the purposes of this study. The results showed that the grades improved in the pilot course as compared to the traditional course delivered in 2016/2017 academic year. *Table 3* shows that the average passing grade of doctoral students has improved by 11,3% when the outcomes of 2016/2017 academic year and 2017/2018 academic year were compared. The study also demonstrates the increase in attendance rate that comprises 13%.

Table 4 shows that the doctoral students expressed more interest in the study with the introduction of a flipped classroom approach.

The study used two Likert-scale surveys. The first Likert-scale survey asked the students to rate the effectiveness of different elements of the flipped classroom. The students rated elements on a scale of 1 to 5 (1=very ineffective, 2=somewhat ineffective, 3=neither effective nor ineffective, 4=somewhat effective, and 5=very effective). The first Likert-scale survey measured the students' perceived effectiveness of the flipped classroom at three distinct time points in the term and the extent to which their perceptions changed, either positively or negatively (*Table 5*). Repeated-measures ANOVAs were conducted to estimate the change within participants' perceptions at all three time points of the study.

Overall, it was found that the students entered into the class with high expectations for how effective they felt the flipped classroom would be, as evidenced by ratings ranging from 4.2–4.6/5.0 on four of the five items considered on the first time point. However, by the second time point, students' expectations decreased and they rated four of the five components of

Doctoral students' ratings of the effectiveness of the flipped classroom

Please rate your general effectiveness of:	Mean		
	First point	Second point	Third point
	(s.d.)	(s.d.)	(s.d.)
Lecture in-class discussion	4.27/5.00 (0.73)	3.98/5.00 (1.1)	4.07/5.00 (1.1)
Practice problem-solving questions together in class	4.55/5.00 (0.6)	4.37/5.00 (1.0)	4.62*/5.00 (0.7)
Group discussions	4.25/5.00 (0.8)	4.25/5.00 (0.9)	4.27/5.00 (0.9)
Communication situations (role-plays)	4.57/5.00 (0.6)	4.23/5.00 (1.0)	4.43/5.00 (0.8)
Video instructional materials	3.90/5.00 (0.9)	3.56/5.00 (1.2)	3.66/5.00 (1.1)
On-line Quizzes/Tests	N/A	4.39/5.00 (0.8)	4.59*/5.00 (0.8)
Group presentations	N/A	3.77/5.00 (1.0)	3.66/5.00 (1.1)

* Significant at 0.05; n = 60;
Likert scale: 1 = very ineffective to 5 = very effective.
N/A = Not Applicable.

the flipped classroom lower when compared to the first time point. At the third time point, a general increase in students' ratings of the effectiveness of the flipped classroom was observed when compared to the second time point.

Repeated measures ANOVA showed that students' ratings of the effectiveness of working collaboratively on problem-solving activities in class differed significantly between the three time points, $V=0.1$, $F(2, 58)=3.23$, $p<0.05$. Post-hoc tests also revealed that the students were significantly more likely to rate the in-class activities as being more effective in the post-term survey (i.e. third time point) in comparison to the midpoint of the class (i.e. second time point). Meanwhile, at the third time point, the students rated the elements of the lecture in-class discussion, applying concepts to real-life studies, and video lectures higher in comparison to the second time point, though their ratings remained lower than the ones recorded in the first time point.

As for the quizzes and group discussions it was found that the students were significantly more likely to rate the effectiveness of quizzes higher at the third time point in comparison to the second time point ($z= 3.36$, $p<0.05$). Conversely, the students rated the effectiveness of the group presentations to be marginally less effective in the third time point when compared to the second time point.

The qualitative assessment of the flipped classroom approach was performed in the form of the second Likert-scale survey that studied the general attitudes of the doctoral students to flipped classroom and comprised seven close statements and three open questions. The questions were: What did you like about the flipped learning approach? What skills did it help to develop? What are the disadvantages of the flipped classroom?

The results of the second survey presented in *Table 6* show that the majority of the doctoral students found the flipped classroom approach more interactive than the traditional one.

With the content selected to satisfy the needs of a future researcher the online components studied at home helped the students to develop their learner autonomy. The possibility of studying the course materials at their own pace empowered the doctoral students with the reflective practice and provided deeper understanding of the material.

The answers to the open questions revealed that the doctoral students liked that they felt more responsible for their own study than they usually did in terms of preparing for practical classes, being active during classroom time, presenting for their peers. They reported that the flipped approach made them more in control of their learning process. The freedom to prepare for the practical classes and to be able to influ-

Results of the course satisfaction survey

№	Statements	Students' answers				
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	Flipped classroom encouraged my interest to the course	0%	0%	2%	38%	66%
2	The content of the course satisfies my professional needs	0%	0%	0%	73%	27%
3	Flipped classroom helped me to develop my autonomy as a researcher	0%	0%	6%	62%	32%
4	Online components helped improve my learning	0%	0%	0%	68%	32%
5	Feedback on assignments and/or in-course tests was generally helpful	0%	0%	0%	81%	29%
6	I like that flipped classroom offers more interaction with my peers and with the instructor	0%	0%	0%	65%	35%
7	The lecturer encouraged my interest in the course	0%	0%	10%	55%	25%

ence the content of classroom activities gave some students a feeling of control and empowerment.

The students state the flipped classroom helped them to develop their research skills as they had to search for, sort out and analyze additional resources. They also reported that their soft skills were enhanced, as they had to offer and negotiate about the content of group presentations, give feedback to their peers and put their reflections on issues to discuss online.

The problems expressed by the students were mostly related to the shift in paradigm. Some students said to succeed in a flipped classroom you should have self-discipline to allocate time for self-study. Another issue noted was that students are not professional teachers and when they present in the class their misunderstanding of the material mislead the other students. In summary, the problems expressed by the students were related to their unfamiliarity with the flipped approach and lack of self-study skills.

Conclusion

The advances of Industry 4.0 put much pressure on researchers and require new skills and qualities to be developed where creativity and flexibility are of highest priority. The education system should respond to the challenges and introduce new ways of learning or modify the existing ones. Flipped learning is one of the approaches that, when wisely introduced, can equip students with the necessary skills.

The flipped classroom approach used in the course "English for Research Purposes" was piloted with the doctoral students of South Ural State University and the results of the course satisfaction survey showed that the students expressed a feeling of increased activity and responsibility when participating in classroom activities. Some even felt encouraged and empowered, as they could influence the content of classroom discussions and choose for themselves when and how to study. Most students enjoyed the flexibility and accessibility aspects of online components, although a few claimed that they demanded a more disciplined attitude and presenters that are more authoritative.

The quantitative results showed that students' attendance rates and students' average passing grades improved in the piloting course in comparison with the traditional classroom approach delivered in 2016/2017 academic year. The post hoc test of repeated measures ANOVA showed that students' ratings of the effectiveness of working collaboratively on problem-solving activities in class, participating in class discussions, applying new concepts to real-life studies, and video lectures were higher in comparison to the first time point; therefore, doctoral students appreciated the new form of obtaining new knowledge and skills.

Thus, qualitative and quantitative evaluation of the flipped classroom approach proves that its introduction into the education process improves the education outcomes; works well in an active learning environment, and has the potential to affect students' outcomes.

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«Перевёрнутый класс» для аспирантов: оценка эффективности

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Аннотация. Потребность индустрии 4.0 в творческих исследователях, способных адаптироваться в меняющемся мире и мыслить нестандартно, выдвигает на первый план вопрос об образовательных технологиях, используемых для подготовки таких специалистов. Несмотря на то, что в последнее время появилось много новых образовательных технологий, их эффективность не всегда доказана для широкого внедрения в систему высшего образования. В статье в рамках обучения аспирантов 1−2-х курсов иностранному языку обоснована и доказана эффективность технологии «перевёрнутый класс». Автором описывается внедрение технологии в курс обучения «Английский язык для научных целей», апробация которого прошла в 2017/2018 учебном году с участием 197 аспирантов. Количественная и качественная оценка эффективности технологии «перевёрнутого класса» показала, что не только повысились результаты обучения (оценки студентов в конце курса, показатели посещаемости), но и улучшилось отношение аспирантов к предмету. Отношение аспирантов измерялось с помощью дисперсионного анализа и проведением опросов по шкале Лайкерта. Результаты обучения студентов увеличились на 11,3% по сравнению с результатами 2016/2017 учебного года, когда применялся традиционный подход. Результаты исследования можно использовать для модернизации обучения аспирантов иностранному языку с применением технологии «перевёрнутого класса» как в вузах Российской Федерации, так и в зарубежных вузах.

Ключевые слова: образование 4.0, технология обучения, технология «перевёрнутый класс», подготовка аспирантов, English for Research Purposes, учебные модули, оценка эффективности

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Science Index РИНЦ-2017

Вопросы философии	16,100
Социологические исследования	6,292
Вопросы образования	5,196
Психологическая наука и образование	5,050
Философские науки	4,528
Педагогика	2,412
Вестник международных организаций	2,328
Образование и наука	1,734
Эпистемология и философия науки	1,647
Высшее образование в России	**1,430**
Интеграция образования	1,380
Экономика образования	0,971
Высшее образование сегодня	0,902
Университетское управление: практика и анализ	0,626
Alma Mater	0,542
Инженерное образование	0,420