Skepticism and learning difficulties in a digital environment at the Bachelor's and Master's levels: are preconceptions valid?

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ABSTRACT

There are a number of beliefs and preconceptions concerning online learning in university digital environment. Are they valid? The study aimed to compare perceived learning experiences of students who completed the e-course with flipped design, to identify the set of opinions common to the majority of students and assess differences of perceived experiences between graduate and undergraduate students. The target groups were students at the Bachelor's (N = 183) and Master's (N = 161) levels participating in e-courses in mathematical methods in psychological and educational researches (N = 344 in total). The quasi-experimental study was conducted at the Moscow State University of Psychology and Education (MSUPE). Using cluster analysis method for each of the 5 thematic groups of the survey points, 2 clusters were identified, typical opinions spectrum of the respondents majority was characterized, and differences between learners at the Bachelor's and Master's levels in these clusters were estimated. (1) For only one topic regarding students' learning independence, interaction and engagement, the share of master's programs students in a large cluster significantly prevails, for the remaining 4 topics there were no differences: ca 70–75% of both levels students belonged to a large cluster. (2) Most students confirm the benefits of e-courses, no substantial difficulties were identified. This contradicts the preconception that older Master's level students more troublesome adapt to digital environment learning, experience more difficulties and are more critical. (3) Most students confirm the benefits of e-courses, but they more often perceive deficiency of personal contacts with the instructor and do not agree to replace face-to-face sessions with webinars and communication on forums. This contradicts the preconception that graduate students are more skeptical of e-learning. (4) Most students confirm the benefits of e-courses, but they more often perceive deficiency of personal contacts with the instructor and do not agree to replace face-to-face sessions with webinars and communication on forums. This contradicts the preconception that graduate students are more skeptical of e-learning. (5) Almost all students find the e-course informative and practically useful. (6) Most of the respondents are characterized by careful answers to points concerning the use of dishonest strategies in online learning and the belief that dishonest strategies using is inevitable. Perhaps this is a reflection of their life experiences or an excuse for their own dishonest strategies. This problem requires further investigation.

1. Introduction

In the context of the higher education globalization, the application scope of digital technologies in various formats is expanding: they are blended learning, mass open online courses (MOOCs), and a variety of hybrid models. Modern LMS enable continuous monitoring, visualization and statistical analysis of students' digital traces to facilitate real-time pre-emptive pedagogic practices, and this is an essential feature of modern style of data-based digital education governance (Williamson, 2016). According to (Kuhn et al., 2018), the digitalization of medical education in Germany leads the growing relevance of training platforms, as well as to the use of mobile, interactive and personalized formats that adapt to the changing educational behavior of students. External conditions associated with the force majeure circumstances of the spread of viral infection pandemics force universities to fully switch to distance learning formats as soon as possible. At the same time, bias and preconceptions about online learning are widespread in society, including among instructors and students. That is why empirical investigation of...
various aspects of learning in digital educational space is becoming particularly relevant.

The blended learning (BL) design with flipped classroom (FC) sessions is quite common in higher education. There is a number of studies of its’ impact on students’ academic achievements and on their perceived experience of learning in a digital environment that reveal its’ advantages and limitations The paper (Margolis, 2018) presents a review of modern studies on the effectiveness of blended learning as compared to distance and traditional face-to-face general education. According to (Rajaram, 2019), the FC-approach with an integrated scaffolding support system with real-time learning interventions using electronic resources and interactive methods for organizing students’ activities increases their engagement and critical thinking. The article (Afri and Omar, 2019) also confirms the increased motivation of students and their engagement in learning English. According to (Pardo et al., 2019) using learning analytics based on students’ digital traces has a positive impact on students’ perception of feedback quality and on academic achievements. Students confirmed that BL-environment enhanced their language proficiency (Gulnaz et al., 2020). The research (Gero et al., 2014), which used quantitative instruments alongside qualitative ones, indicates a significant gap between the achievements of students who studied the operation of the bipolar junction transistor by means of computer animation as compared to the achievements of their peers who learned it using static diagrams. Additionally, students who studied the subject through animation express significantly more positive attitudes towards electronics than their peers. The key findings of our previous study (Sorokova, 2020) are: there is association between the students’ perceived academic outcomes and their positive attitude to the BL-format; academic outcomes after passing the e-course significantly improved; BL-format students’ academic achievements are significantly higher as compared to face-to-face ones.

The technology satisfaction model reported in (Islam and Sheikh, 2020) shows the association of perceived usefulness, computer self-efficacy and perceived ease of use with postgraduate students’ satisfaction of using online research databases. The results presented in (Wu and Chen, 2017) show that students’ perceived usefulness is a significant mediator of the effects of perceived ease of use, task technology fit, reputation, social recognition and social influence on continuance intention also using MOOCs. Chesser et al. (2020) stress that to find the best fit between student and the learning environment, it is important to identify personality characteristics indicative of success in online and traditional face-to-face courses.

Positive perceiving BL-cooperative learning design, students still need more encouragement to be more independent in learning (Sukawati et al., 2020). Students positively assessed the cooperation and interaction with peers and educators in teaching physiotherapy according to FC-approach, however, not all groups worked optimally, and accountability to other group members did not always provide preparation for the seminars (Roe et al., 2019). According to (Awidi and Paynter, 2019) refinements of the flipped design components, such as the pre-recorded lectures and the structure of the in-class sessions, may further enhance the student learning experience.

Some studies emphasize the importance of digital environments’ elements providing human contact with the instructor. According to (Li and Canelas, 2019) learners’ expressions of feeling a human connection to the instructor in videos had important implications for video editing decisions. The focus group interviews conducting by (Scheerer et al., 2016) reveal that despite some students trusted faculty and valued the flipped learning experience, but one that is still highly social within learning communities. Baldwin (2019) stress that instructors adapt to the online environment by using strategies to mimic elements of face-to-face courses.

Some studies reveal interesting facts regarding e-learning perceived experiences. According to (Klimenskikh et al., 2018) the older the student, the more critical he is with respect to the content of educational courses in both full-time and online format. The study revealed significant weak negative correlations of students’ assessment of the level of knowledge compared to the beginning of training with age and year of study. The higher the year of study and age, the lower the students’ assessment of the level of knowledge compared to the beginning of training in both full-time and online format. The authors of the study explain this finding by the fact that, as experience is gained, a person becomes more sophisticated, tuned for comparison and criticism. “Obviously, older students have a more pronounced level of critical thinking, this is well known to university teachers” (Klimenskikh et al., 2018, p. 149). The article (Zakharova and Tanasenko, 2019) shows that the instructors see advantages of MOOCs in the opportunity to provide better organization of the learning process and learning materials, higher education accessibility and academic mobility, realization of instructors’ career and personal goals, and resource efficiency, and disadvantages in pedagogical imperfections of the format, special requirements for the education system, resource intensity, and career risks for instructors.

The aim of our article, however, is not to study the full range of teachers’ opinions about e-courses and online learning: they are different, and many of them are positive. We focused on some preconceived opinions of instructors and intended to assess them from the students’ point of view who experienced the e-learning. Indeed, among university faculty there are beliefs and common points of view regarding e-courses and online learning. They are not always expressed openly, but they can often be heard in private conversations. Opponents of using digital technologies in universities believe that with online learning, students lose the unique opportunity of personal contact with the instructor, the quality of education is reduced, and the use of e-courses is a tribute to fashion, and this fashion will pass, like many “innovations” in education.

It is believed, for example, that the use of e-courses will create especially many problems for older Masters’ level students, as they are less adapted to the use of digital technologies than the “generation of millennium”. In other words, it is more difficult for older graduate students to adapt to learning in a digital environment, they experience more problems and are more critical. In addition, online learning can create a conflict of interest for faculty. Indeed, students get the opportunity by learning at the university to study some subjects at partner universities, but this creates competition in the educational services market, and not all instructors like it. The attitude to the course of mathematical methods in psychological and educational researches is also ambiguous. It is believed sometimes that students studying in the fields of psychology and psychological and pedagogical education cannot master this course even in applied aspects or do not need mathematics at all. The latter opinion is especially harmful, since it contradicts the evidence-based approach in psychology and education. Are these beliefs valid and can they be trusted?

The study aimed to compare perceived learning experiences of students who completed the e-course with flipped design, to identify the set of opinions common to the majority of students and assess differences of perceived experiences between graduate and undergraduate students.

Research Questions:

RQ1: What opinions are typical for most students concerning difficulties and benefits of studying in the e-course and what is their attitude to this format?

RQ2: How do most students assess their independence, engagement in the learning process and the practical usefulness of the e-course, do they use dishonest strategies in online testing?

RQ3: Who prevails among the majority: the share of undergraduate or graduate students? Are there differences between them in terms of totality of opinions?

1.1. Description of the e-courses used in the study

Both e-courses are hosted on the https://e-learning.mgpu.ru platform. The e-course “Mathematical Methods in Psychology” for undergraduate students amounts to 2 credits and consists of 3 modules. Module 1 “Introduction to Mathematical Statistics” includes measurement scales
classification in psychology and education, descriptive statistics methods, and general points of testing statistical hypotheses. In Module 2 “Analysis of one or two samples” students learn to practically apply statistical hypothesis testing methods in authentic research cases in psychology and education using the SPSS, for example, the Mann-Whitney test, the Chi-square test, the Student’s t test for independent and connected samples, etc. Module 3 covers correlation analysis, nonparametric univariate analysis and ANOVA in SPSS.

The e-course “Statistical and Mathematical Methods in Psychological and Educational Research” for graduate students amounts to 3 credits and, in addition to the 3 listed modules, contains Module 4 “Multidimensional Statistical Methods” for advanced students. The test score for this unit is not included in the final course grade. This made it possible to compare not only opinions, but also academic achievements of students of both levels of education: no statistically significant differences were found. A comparative analysis of educational results is presented in our article (Sorokova, in press), the database is available in the repository Mendeley Data (Sorokova, Mendeley Data).

The educational results of students were assessed using 5 tests and a case-task, while the results of the pre-test were not taken into account in the final grade. Only upon completion of the course, students filled out a questionnaire “Students’ opinions on the e-course”. The questionnaire author and also developer and instructor of both e-courses is the author of the article Marina G. Sorokova, Doctor of Education, PhD in Physical and Mathematical Sciences, Professor of the Chair of Applied Mathematics, Faculty of Information Technology, MSUPE.

2. Methods

The empirical data analysis was carried out using the Hierarchical Cluster Analysis with Average Linkage Within Group method and the Chi-Square Test for assessing the differences between the two distributions. The analysis was performed in the SPSS of the 23rd version.

The quasi-experimental study was conducted at the Moscow State University of Psychology and Education (MSUPE) in the framework of the research project “Digital Technologies in Higher Education: Development of Technology for Individualizing Learning Using E-Courses” in the fall semester 2019/2020. The project design was discussed and approved by the MSUPE Scientific Expert Council and by the MSUPE Scientific Council.

The total sample size is N = 344 students of 5 faculties of the university. The target groups were students at the Bachelor’s and Master’s levels participating in e-courses in mathematical methods in psychological and educational researches (Table 1).

As the Table 1 shows, the 1st intervention group (IG1) includes N = 161 students of master’s programs, of which 17.4% are male and 82.6% female, the 2nd intervention group (IG2) consists of N = 183 undergraduate students (EG2), of which 18.6% are male and 81.4% are female, there are not significant gender differences (Chi-square test with Continuity correction, p = 0.884). Both groups significantly differ in age (Chi-square test, p < 0.001). The IG1 group is mainly adults: 17.4% are students aged 20–24, 13.0% are 25–29 years old, 24.8% are 30–34 years old and 44.7% are 35 years old and older, while in IG2 youth predominates - 16.9% under the age of 20 years, 81.4% - 20–24 years old, and only 1.6% are respondents 25 years old and older. Both groups also significantly differ in the nature of employment (Chi-square, p < 0.001). Compared to IG2, in IG1, work is related to the program track they participate at 51.6% vs 5.5%, not related at 31.7% vs 41.5%, and 16.8% vs 53.0% currently do not employed at all.

The blended learning with FC-design involves transition from teacher-centered to student-centered model, supporting students’ independence and engagement in the learning process, enhancing their interaction and developing digital competencies. The flipped sessions comprised pre-recorded lectures, online quizzes, online textbooks and tutorials, authentic case assignments and in-class group activities in the course design. LMS Moodle platform was used. The totality of all these technical means, teaching methods and learning environment, we call below the “e-course format”.

### Table 1. Demographic information on Intervention Groups students.

| Parameter                  | IG1 (Master's level) | IG2 (Bachelor's level) | p-value |
|----------------------------|----------------------|------------------------|---------|
| Program track/field        | Psychological and pedagogical education, psychology | Psychological and pedagogical education, psychology |         |
| Completed e-course         | Statistical and mathematical methods in psychological and educational research | Mathematical methods in psychology |         |
| Gender                     |                       |                        |         |
| male                       | 28                    | 34                     | 0.884   |
| female                     | 133                   | 149                    | 81.4    |
| Age                        |                       |                        |         |
| Under 20 years old         | 0                     | 31                     | 16.9    |
| 20–24 years old            | 28                    | 149                    | 81.4    |
| 25–29 years old            | 21                    | 2                      | 1.1     |
| 30–34 years old            | 40                    | 0                      | 0.0     |
| 35 years old and over      | 72                    | 1                      | 0.5     |
| Employment                 |                       |                        |         |
| Currently not employed     | 27                    | 97                     | 53.0    |
| Work is related to the program track they participate | 83 | 10 | 5.5 |
| Work is NOT related to the program track they participate | 51 | 31.7 | 41.5 |
topics. The 1-st group, “Possible difficulties and advantages of studying at the e-course”, comprised 11 points, the 2nd group, “Attitudes toward the e-course and online-learning”, also included 11 points. The points of the 3rd group - total 7 - related to the independence of testing and case-tasks solving and also the use of dishonest strategies by students in online learning. The 4th thematic group points concerned the learning independence and engagement - total 10. In the last 5th group there were 3 points about perceived usefulness of the e-course for preparing masters' thesis or graduation qualification paper. Alpha Cronbach coefficients are presented in the Table 2.

2.2. Main idea of the study approach

We aimed to create a “group portrait” of students who form the majority of the sample, not on separate issues, but on the totality of opinions on each of the 5 topics. Is it possible to divide students into 2 clusters according to the totality of questions included in each topic and to interpret meaningfully what opinions are typical for respondents of each cluster? What opinions are specific for respondents of a larger cluster, that is, for the majority of respondents? Considering the points of each topic as clustering variables, we distributed students into 2 clusters of larger (LC) and smaller (SC) size using the method of hierarchical cluster analysis, and then compared the responses distributions of subjects from 2 clusters and looked for differences. So we identified a set of typical perceived learning experience attitudes that are characteristic of the subjects of each cluster. Then we compared the distributions of graduate and undergraduate students across these clusters to understand which of the 2 categories prevails in the LC. We believed that if, for example, the share of graduate students prevails in the LC, then for them these opinions are more characteristic in general, and we get their group point of view that distinguishes them from undergraduate students.

3. Results and discussion

Clustering according to the points of the 1st topic “Possible difficulties and advantages of studying at e-course” identifies 2 clusters: “large” (LC, N = 257) and “small” (SC, N = 87). A comparison of the 2 distributions of answers to the point “It is convenient to prepare for classes using e-course” for these clusters (Chi-square = 47.953, p = 0.000, p < 0.001) is presented in the Table 3.

As the Table 3 shows, in LC as compared to SC, the share of absolutely affirmative answers (77.8% vs 41.4%) prevails significantly, but the share of answers “rather, yes” is much lower (17.9% vs 47.1%) and “rather, no” is slightly lower (2.3% vs 11.5%). Negative answers almost never occur (1.9% vs 0.0%).

The generalized results of the 2 clusters comparing for all 11 clustering parameters of the 1st topic are reported in the Table 4. If the difference in the proportions of a certain type answers in the LC cluster as compared to SC was more than 10%, then its value is indicated, and if less than 10%, then it is marked as “equally”. For example (compare Table 2), respondents in the LC give 36.4% more answers “Yes”, 29.1% less answers “Rather, yes” than respondents in SC, and the difference in answers “Rather, no” (less by 9.2%) and “No” (more by 1.9%) make up less than 10%, therefore they are marked “equally”.

What assessments of possible difficulties and advantages of studying at e-course are more typical for respondents from LC compared with SC? The overwhelming majority of them confidently confirm the convenience of preparing for classes using EC options, deny the difficulties of learning without helping of an instructor and the complexity of time management. They more definitely confirm the convenience of listening to lectures in the video instead of face-to-face attendance, the ease of repeating insufficiently understood content or self-study of the missed information in the EC, and more often they believe that the tests do help to remember the EC-content better. At the same time, they more often deny technical difficulties and adaptation problems, as well as complexity of learning without instructors' helping. And only the opinion that EC makes it easy to track their individual trajectory is supported by almost all respondents from both clusters - there are no differences. Note that the differences between LC and SC are only in modalities of answers: the general trends are the same for both clusters.

According to our idea, if a certain cluster is characterized by a set of specific attitudes and it is dominated by students of one of the studied categories, for example, Masters’ level, that is, their percentage in this cluster is significantly higher, then this set of attitudes is more characteristic for them. Comparison of the distributions of IG1 and IG2 students in the 2 clusters did not reveal any differences: 75.2% of graduate students vs 74.3% of undergraduate students belong to LC, 24.8% vs 25.7% to SC, respectively (Chi-square with Continuity Correction = 0.003, p = 0.957).

This finding contradicts the stereotypical view that it is more difficult for older graduate students to adapt to learning in a digital environment.

Table 2. Alpha Cronbach coefficients.

| # | Thematic group | Number of points | Cronbach’s Alpha | Comment |
|---|----------------|------------------|------------------|---------|
| 1 | Possible difficulties and advantages of studying at e-course | 11 | 0.803 | Good internal consistency |
| 2 | Attitudes toward the e-course and online-learning | 11 | 0.747 | Good internal consistency |
| 3 | Independence of assignments completing and testing and the use of dishonest strategies in online learning | 7 | 0.526 | Weak internal consistency for 5 points |
| 4 | Learning independence and engagement | 10 | 0.738 | 7 points are well consistent |
| 5 | Perceived practical usefulness of the e-course | 3 | 0.730 | 2 points are well consistent |

Table 3. Comparison of the 2 distributions of answers to the point “It is convenient to prepare for classes using e-course” for 2 clusters according to Chi-square test.

| Cluster | It is convenient to prepare for classes using e-course | Total |
|---------|----------------------------------------------------|-------|
|         | No | Rather, no | Rather, yes | Yes |
| Large LC | Frequency | 5 | 6 | 46 | 200 | 257 |
| % in LC | 1,9% | 2,3% | 17,9% | 77,8% | 100,0% |
| Small SC | Frequency | 0 | 10 | 41 | 36 | 87 |
| % in SC | 0,0% | 11,5% | 47,1% | 41,4% | 100,0% |
| Total | Frequency | 5 | 16 | 87 | 236 | 344 |
| % in total | 1,5% | 4,7% | 25,3% | 68,6% | 100,0% |
they experience more problems and are more critical. Indeed, computers, smartphones and the Internet are necessary attributes of our lives, the vast majority of students use them in their professional activities, so why can they be more difficult to learn with their help? The attitude of the instructors towards the tests is ambiguous, but it is already well known that tests cannot be the only form of competencies control. However, tests can and should perform educational functions, this is confirmed by the students themselves [Sorokova, 2020], and we were able to implement this idea in our e-courses. The difficulties of independent study of the course by students, in our experience, are often associated with the unsuccessful framework and insufficiently thought out selection of e-course elements, deficient digital competencies of the instructor, didactic errors and the lack of systematic moderation of the learning process. If students constantly communicate with the instructor in a digital environment, (s)he is much more accessible to them than in full-time sessions.

The cluster analysis according to the parameters of the 2nd topic “Attitudes toward the e-course and online-learning” reveals 2 clusters with another ratio of respondents in LC (N = 239) and SC (N = 105). The generalized results of comparing 2 clusters for all 11 clustering variables of the 2nd topic are presented in Table 5.

There are no differences between the distributions of 2 education levels' students in the 2 clusters: 71.4% of graduate students vs 67.8% of undergraduate students belong to LC, 28.6% vs 32.2% to SC, respectively (Chi-square with Continuity correction = 0.384, p = 0.535).

Here’s what a overall portrait of students from LC looks like in comparison with SC. The overwhelming majority of them are more interested in blended learning using ECs than in the traditional face-to-face classes, more than 40% are absolutely sure of this. For the most part they want to study other subjects in the EC-format, confidently claim that they liked this approach and it is high time to use e-courses. They want to study ECs at other universities in Russia and abroad, including in English. They do not agree that ECs reduce the quality of education and make it less accessible. Most of them believe that the use of ECs solves the problems of employed students, but they are somewhat less than students in SC, sure that using of ECs is a necessity of contemporary life, although the shares of absolutely affirmative answers in both populations coincide.

Despite that the share of graduate students slightly predominates in the LC cluster, the differences are not significant, and more than two-thirds of the students in both levels belong to the LC. This again clearly contradicts the stereotypical belief that more experienced graduate students are more skeptical of e-learning than youth. On the contrary, for most of them, ECs is a modern trend and opens up additional opportunities for online learning at partner universities, including foreign ones.

The 3rd group of 7 clustering parameters regarding the independence of assignments completing and testing and also the use of dishonest strategies in online learning made it possible to find out the following 2 clusters, the ratio of respondents in which is: in LC (N = 233) and in SC (N = 111). The generalized results of comparing 2 clusters for this group of clustering parameters are presented in Table 6.

Distributions comparison of students of both categories in the 2 clusters did not reveal any differences: 66.5% of graduate students vs 68.9% of undergraduate students belong to LC, 33.5% vs 31.1%
A slightly smaller share of them is absolutely contradictory. Why does strict control, for example, solving tests in front during testing to combat such strategies. The latter point of view seems prevent using of dishonest strategies, and somewhat less often, but in increasing or possibility of several attempts to pass the test will help to testing? Students from LC predominantly deny that testing span with the latter statement. How to deal with incorrect strategies when students completed assignments on their own, but they most likely agree that no matter what, there will be students who use dishonest strategies control over themselves? At the same time, the share of those who think restrictions can be circumvented? Or do students just don't want strict audience, not help solve the problem of dishonest strategies? Because any but the reason may be the justi

respectively to SC (Chi-square with Continuity correction = 0.128, p = 0.720).

They are somewhat less likely to deny that the results of online tests are falsified, but more often they give a more careful answer “rather, no.” A slightly smaller share of them is absolutely confident that students independently perform tests, and that more than half of their fellow students completed assignments on their own, but they most likely agree with the latter statement. How to deal with incorrect strategies when testing? Students from LC predominantly deny that testing span increasing or possibility of several attempts to pass the test will help to prevent using of dishonest strategies, and somewhat less often, but in almost 70% of cases, deny the need for strict control over the student during testing to combat such strategies. The latter point of view seems contradictory. Why does strict control, for example, solving tests in front of the camera or offline, in the presence of an independent observer in the audience, not help solve the problem of dishonest strategies? Because any restrictions can be circumvented? Or do students just don't want strict control over themselves? At the same time, the share of those who think that no matter what, there will be students who use dishonest strategies in testing is higher in the LC. Perhaps this is a reflection of their own life experiences, a demonstration of a kind of cynicism or disappointment, but the reason may be the justification of their own dishonest strategies. The problem of dishonest strategies requires further investigation. There are approximately two thirds of students in IG1 and IG2 in the LC, there are no differences either.

Cluster analysis according to the parameters of the 4th topic regarding learning independence and engagement reveals 2 clusters that are more similar in the ratio of respondents in the LC (N = 194) and SC (N = 145) than in the 3 previous cases. The generalized results of comparing 2 clusters for all 10 clustering parameters of the 4th topic are presented in the Table 7.

When comparing the distributions of students of both categories under study in the 2 clusters, statistically significant differences were revealed for the first time: 68.3% of students participating in master's programs but only 47.8% in bachelor's programs belong to LC, and the ratio of students of the same 2 levels in the SC is 31.7% vs 52.8%, respectively (Chi square corrected for continuity = 14.571, p = 0.000).

Learning independence, students’ engagement and their interaction are very important, as they partially reflect success of the transition from the teacher-centered to the student-centered model. Ca 60% of students believe that they studied at the seminars (or webinars) in BL-format much more intensively than at full-time traditional training, there are revealed for the Table 7.

| Questionnaire point | Share in LC and differences | Answer | Chi-square | p-value |
|---------------------|-----------------------------|--------|------------|---------|
| Learning using EC is more interesting than face-to-face format only | % in LC (N = 239) | 4.6 | 11.7 | 41.4 | 42.3 | 79,163 | .000 |
| Using of ECs reduces the quality of education | % in LC (N = 239) | 57.3 | 37.2 | 4.2 | 1.3 | 52,170 | .000 |
| EOs and online learning make education less accessible | % in LC (N = 239) | 77.4 | 16.7 | 2.5 | 3.3 | 70,223 | .000 |
| I want to study other subjects in the EC-format | % in LC (N = 239) | 2.9 | 11.7 | 43.1 | 42.3 | 106,354 | .000 |
| Please indicate if you liked this e-course | % in LC (N = 239) | 1.3 | 1.7 | 18.8 | 78.2 | 96,732 | .000 |
| Online learning solves the problems of employed students who can't attend classes | % in LC (N = 239) | 0.4 | 0.8 | 11.7 | 87.0 | 70,223 | .000 |
| It is high time to use e-courses | % in LC (N = 239) | 2.5 | 8.4 | 43.5 | 45.6 | 85,377 | .000 |
| I would like to study some e-courses at other universities in Russia if certificate to be recognized at our university | % in LC (N = 239) | 2.5 | 6.3 | 25.5 | 65.7 | 76,910 | .000 |
| I would like to study some e-courses in English | % in LC (N = 239) | 17.6 | 16.3 | 24.7 | 41.4 | 53,427 | .000 |

| Table 5. Distribution of answers to the points of the 2nd topic “Attitudes toward the e-course and online-learning” in a large cluster (LC) as compared to the small cluster (SC). | Shares differences compared with SC (%) | 24,782 | .000 |
| Shares differences compared with SC (%) | 239) | 57,3 | 37,2 | 4,2 | 1,3 | 85,377 | .000 |
| Shares differences compared with SC (%) | 239) | 0.4 | 0.8 | 11.7 | 87.0 | 70,223 | .000 |
| Shares differences compared with SC (%) | 239) | 2.5 | 8.4 | 43.5 | 45.6 | 85,377 | .000 |
| Shares differences compared with SC (%) | 239) | 2.5 | 6.3 | 25.5 | 65.7 | 76,910 | .000 |
| Shares differences compared with SC (%) | 239) | 17.6 | 16.3 | 24.7 | 41.4 | 53,427 | .000 |

| Would it be interesting and useful for me to take a course at a foreign university if to be recognized at our university | % in LC (N = 239) | 7.9 | 7.5 | 27.6 | 56.9 | 35,131 | .000 |

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instructors which support the teacher-centered model. Indeed, when working in e-courses, face-to-face lectures become unnecessary, the classroom load of faculty is reduced, so they are worried about lowering their salaries. In this situation, the concern about the loss of students’ personal contacts with the instructor is probably just a rationalization of the fear of their own possible uselessness. Here it is necessary, first of all, to develop digital competencies of instructors and their ability to apply active and interactive teaching methods. It also seems reasonable to change the forms of instructors’ reward and to transit to a more differentiated system of its’ stimulation.

In our experience, the lack of personal contacts between students and an instructor when studying in a digital environment is an argument, first of all, of the instructors themselves, but not the students. Flipped classroom design does not imply the absence of personal contacts, the only question is whether the teacher himself can organize learning process in an interactive mode, using the various capabilities of the digital environment, and this is a field for improving his/her professional competencies.

Finally, the 5th group of parameters included only 3 points concerning perceived practical usefulness of the e-course. 2 clusters are found: LC (N = 263) and SC (N = 81). The generalized results of comparing 2 clusters by 3 clustering parameters are presented in Table 8.

When comparing the distributions of students of both levels in the 2 obtained clusters, there were no differences again: 73.9% of graduate students vs 78.7% of undergraduate students belong to LC, 26.1% vs 21.3% to SC, respectively (Chi-square with continuity correction = 0.836, p = 0.361).

Note that more than 90% of the students in the LC think that the e-course is informative and practically useful, but much more often than in the SC, they do not yet know what mathematical methods should be used in their qualification paper. Perhaps this is due to the fact that first-year graduate students and third-year undergraduate ones have not yet conducted an empirical study.

Here are the proportions of respondents in LC and SC to the total sample size (N = 344): 1st topic - LC 75% and SC 25%; 2nd topic - LC 69% and SC - 31%; 3rd topic - LC 68% and SC 32%; 4th topic - LC 56% and SC 44%; 5th topic - LC 76% and SC 24%.

### 3.1. Overview of students’ answers to an open-ended question

At the end of the questionnaire, students were asked to express their overall assessment of the e-course, comments and suggestions. Of 344 respondents, 186 (54.1%) gave the highest rating to the course, noted its high quality, thanked the instructor and did not make any reproaches. Only 10 students, i.e. 2.9% of the sample, gave no comments at all or gave an extremely negative assessment.

Among the advantages of the e-course, students consider its practical nature: “while studying statistical criteria, one immediately thinks about what interesting research can be done with their help”. They note the structure, clarity and accessibility of the presentation of the subject and call the course “interesting, detailed and entertaining.” Students appreciate “the opportunity to choose the time for classes on their own”, the possibility of refusing to attend face-to-face seminars “if the student is sure that he does not need them”, as well as in case of inability to attend full-time classes due to health problems or living far from the university. They also find useful to have the technical ability to “stop the video recording of the lecture, write down what is useful, return to what you did not understand”. They note that this is “a high-quality course and a high standard, it was pleasant to study the course”, “the course is very informative and useful for further education and the profession in general”, “it’s a pity that before I did not have the opportunity to study such e-course.”

Students noted the shortcomings and made a number of suggestions for improving the course. For example, instead of lectures, they suggest making short video clips, improving course navigation, and introducing training tasks in addition to control tests. Some of the proposals contradicted each other. For example, some students considered it unnecessary to discuss topics presented for self-study with the instructor in face-to-face sessions and suggested instead that more time be devoted to solving case-tasks in SPSS. Others noted that it was uncomfortable for them to study on their own, since they used to studying at the university, and at home there was no stimulus for them and control over them.

In conclusion, give a bright statement from a student: “This e-course is simply beyond praise! Very clear and structured. It seems to me that even a fifth-grader turn on the course - and he will understand everything. After completing the modules, I had almost no difficulty in passing tests or solving problems.”

| Table 6. Distribution of answers to the points of the 3rd topic “Independence of assignments completing and testing and the use of dishonest strategies in online learning” in a large cluster (LC) as compared to the small cluster (SC). |
| Questionnaire point | Share in LC and differences | Answer | No (%) | Rather, no (%) | Rather, yes (%) | Yes (%) | Chi-square | p-value |
|---------------------|-----------------------------|--------|--------|----------------|----------------|--------|------------|---------|
| Online test results are often falsified, as there is no control over who performs the test | % in LC (N = 233) | 23,2 | 54,1 | 18,0 | 4,7 | 26,132 | .000 |
| | Shares differences compared with SC (%) | less by 27,3 | more by 18,1 | Equally | Equally |
| Many students do not execute online tests on their own | % in LC (N = 233) | 16,3 | 58,4 | 19,7 | 5,6 | 16,147 | .001 |
| | Shares differences compared with SC (%) | less by 17,9 | Equally | Equally | Equally |
| Most (more than half) of my classmates carried out the assignments on their own | % in LC (N = 233) | 0,9 | 6,0 | 43,3 | 49,8 | 10,165 | .017 |
| | Shares differences compared with SC (%) | Equally | Equally | more by 14,5 | less by 17,8 |
| To prevent students from using dishonest strategies in testing, one need to increase the testing span | % in LC (N = 233) | 35,6 | 48,9 | 15,0 | 0,4 | 207,580 | .000 |
| | Shares differences compared with SC (%) | more by 34,7 | more by 38,1 | less by 14,7 | less by 58,2 |
| To prevent students from using dishonest strategies in testing, one should allow several test attempts | % in LC (N = 233) | 11,2 | 13,3 | 41,2 | 34,3 | 77,835 | .000 |
| | Shares differences compared with SC (%) | more by 11,2 | more by 10,6 | more by 28,6 | less by 50,4 |
| To ensure that students do not use dishonest strategies in testing, one need strict control over the student passing the test | % in LC (N = 233) | 23,6 | 45,9 | 24,5 | 6,0 | 25,467 | .000 |
| | Shares differences compared with SC (%) | less by 11,5 | less by 13,0 | more by 19,1 | Equally |
| No matter what, there will be students who use dishonest strategies when testing | % in LC (N = 233) | 3,4 | 6,0 | 50,2 | 40,3 | 43,354 | .000 |
| | Shares differences compared with SC (%) | Equally | less by 26,4 | more by 14,2 | more by 13,3 |
3.2. Limitation of the study results

Validation of the instrument will continue on a larger sample, and in this study it is used only as a questionnaire. This may be a partial limitation of the study results. Note, however, that, generally speaking, cluster analysis allows the use of any set of clustering variables.

4. Conclusions

The study of attitudes of students who completed the e-course to various aspects of training in a digital environment identified 2 clusters - large cluster (LC) and small cluster (SC) - for each of the 5 thematic groups of points considered as clustering parameters. The LC, as a rule, comprised from 2/3 to 3/4 of the respondents, i.e. represented the majority opinions. Only for the 4th topic regarding learning independence and engagement, a little more than half of the respondents belong to the LC.

For only the 4th topic, the share of master's programs students in the LC significantly prevails compared to bachelor's programs ones: more than two-thirds vs less than half. For the remaining four topics, there were no differences between IG1 and IG2: ca 70–75 percent of students belonged to LC, 25–30 percent of students in both groups belonged to SC.

Students of LC confirm the advantages of e-courses: the convenience of tracking their educational paths and self-study of the subject using the means of a digital educational environment, available at any time. They deny the difficulties of learning without the help of an instructor and the...

| Table 7. Distribution of answers to the points of the 4th topic “Learning independence and engagement” in a large cluster (LC) as compared to the small cluster (SC). |
| Questionnaire point | Share in LC and differences | Answer | Chi-square | p-value |
|---------------------|-----------------------------|--------|------------|---------|
| I studied at the seminars (or webinars) in BL-format much more intensively than at full-time traditional training | % in LC (N = 194) | 10,3 | 31,4 | 32,0 | 26,3 | 2,224 | .527 |
| | Shares differences compared with SC (%) | Equally | Equally | Equally | Equally |
| I have systematically studied from the very beginning | % in LC (N = 194) | 2,6 | 11,9 | 38,1 | 47,4 | 43,662 | .000 |
| | Shares differences compared with SC (%) | Equally | less by 25,3 | Equally | more by 23,3 |
| I didn’t get involved in the training with EC immediately, but from ca the middle of the time assigned for its study | % in LC (N = 194) | 42,3 | 27,3 | 20,6 | 9,8 | 80,861 | .000 |
| | Shares differences compared with SC (%) | more by 35,4 | more by 10,7 | less by 20,1 | less by 26,1 |
| At the seminars I helped classmates | % in LC (N = 194) | 5,7 | 12,9 | 30,4 | 51,0 | 52,611 | .000 |
| | Shares differences compared with SC (%) | less by 17,1 | less by 17,4 | Equally | more by 31,0 |
| At the seminars, classmates helped me | % in LC (N = 194) | 11,3 | 12,9 | 28,9 | 46,9 | 10,512 | .015 |
| | Shares differences compared with SC (%) | Equally | Equally | Equally | more by 17,2 |
| At seminars (webinars) I often answered the instructor's questions | % in LC (N = 194) | 5,7 | 25,3 | 37,6 | 31,4 | 44,674 | .000 |
| | Shares differences compared with SC (%) | less by 20,5 | less by 10,5 | more by 11,6 | more by 19,7 |
| I studied almost completely independently, attending no more than 2 face-to-face seminars or webinars | % in LC (N = 194) | 62,4 | 29,4 | 3,1 | 5,2 | 211,073 | .000 |
| | Shares differences compared with SC (%) | more by 60,3 | more by 16,3 | less by 23,8 | less by 52,7 |
| In EC, I had not sufficient personal contacts with the instructor | % in LC (N = 194) | 30,4 | 26,3 | 26,8 | 16,5 | 18,115 | .000 |
| | Shares differences compared with SC (%) | less by 13,0 | Equally | more by 12,3 | Equally |
| Face-to-face sessions or webinars with an instructor are not needed at all, videos and contacts through forums are quite enough | % in LC (N = 194) | 58,8 | 31,4 | 5,7 | 4,1 | 79,078 | 0,000 |
| | Shares differences compared with SC (%) | more by 40,2 | Equally | less by 24,0 | less by 14,5 |
| It would be more convenient if there were only webinars instead of face-to-face classes in the EC | % in LC (N = 194) | 37,6 | 40,2 | 12,9 | 9,3 | 24,595 | 0,000 |
| | Shares differences compared with SC (%) | more by 23,1 | Equally | less by 9,9 | Equally |

| Table 8. Distribution of answers to the points of the 5th topic “Perceived practical usefulness of the e-course” in a large cluster (LC) as compared to the small cluster (SC). |
| Questionnaire point | Share in LC and differences | Answer | Chi-square | p-value |
|---------------------|-----------------------------|--------|------------|---------|
| I learned a lot of new and useful regarding the application of mathematical methods in psychology and education | % in LC (N = 263) | 1,9 | 4,9 | 29,3 | 63,9 | 21,066 | .000 |
| | Shares differences compared with SC (%) | Equally | Equally | more by 19,4 | less by 26,2 |
| The information of this EC will help me use mathematical methods to analyze empirical data in my graduation qualification paper | % in LC (N = 263) | 3,8 | 5,7 | 32,7 | 57,8 | 23,249 | .000 |
| | Shares differences compared with SC (%) | Equally | Equally | more by 21,6 | less by 28,6 |
| I don’t know yet what mathematical methods I use in my graduation qualification paper | % in LC (N = 263) | 0,4 | 2,7 | 37,6 | 59,3 | ,000 | .000 |
| | Shares differences compared with SC (%) | less by 32,9 | less by 64,0 | more by 37,6 | more by 59,3 |
complexity of time management, and, as a rule, do not experience the difficulties of adaptation and technical problems by blended learning in the EC-format. This set of attitudes is typical for ca 3/4 of students in both masters’ and bachelors’ levels.

Thus, students of LC demonstrate positive motivation to learn in a digital environment. The learning independence and self-study, students’ engagement and interaction are various aspects of the transition from the teacher-centered to the student-centered model. This result contradicts the preconception that it is more difficult for older graduate students to adapt to learning in a digital environment, they experience more difficulties and are more critical.

Students of LC demonstrate positive motivation to learn in a digital environment. They believe that it is high time to use e-courses and this is a necessity of contemporary life, prefer this format over traditional full-time approach and would like to study e-courses at other universities, if certificates will be recognized at their university. They do not agree that e-courses reduce the quality of education and make it less accessible. Most of them believe that the use of ECs solves the problems of employed students.

More than two-thirds of students in both levels of higher education share the majority opinions. This again clearly contradicts the stereotypical belief that more experienced graduate students are more skeptical of e-learning than youth. On the contrary, for most of them, online learning is a modern trend and opens up additional opportunities for online learning at partner universities, including foreign ones.

The learning independence and self-study, students’ engagement and interaction are various aspects of the transition from the teacher-centered to the student-centered model. Students in the LC, as a rule, systematically studied the course content from the very beginning and immediately got involved in the training. Their answers indicate the interactive nature of the activities at flipped sessions, that is, mutual assistance and interaction with classmates and with the instructor. This result is in good agreement with the findings of (Rajaram, 2019) and (Arif and Omar, 2019). A positive assessment by students of cooperation and interaction with peers and the instructor in the blended learning format was also revealed in (Sukumawati et al., 2020) and (Roe et al., 2019). A little less than two thirds of students confirm a higher intensity of training at seminars in a mixed format than in traditional full-time, there are no differences between the clusters. Almost all LC-students confirm that they attended seminars, but at the same time they more often believe that they had not sufficient personal contacts with the instructor, and do not agree to replace face-to-face seminars with webinars and contacts in forums. This set of opinions is more characteristic of graduate students.

The situation looks contradictory, because blended learning means that only face-to-face lectures are reduced but not seminars. Perhaps this is partly a reflection of bias of instructors who support traditional full-time education approach. It is necessary to support the improving the instructors’ digital competencies and using active and interactive teaching methods by them, as well as to develop more differentiated reward system of faculty.

Almost all LC-students find the e-course in mathematical methods in psychological and educational researches informative and practically useful. Considering the positive attitude expressed by the majority of students towards e-courses and online learning, including at partner universities, this result is in good agreement with the findings of (Islam and Sheikh, 2020) and (Wu and Chen, 2017).

Finally, the majority of respondents are characterized by the following attitudes regarding the use of dishonest strategies in online learning. Students in LC more often carefully answer the question about falsification of test results and are less confident in the independence of performing of tests and assignments by classmates. They believe that neither increased span, nor the increased number of attempts to test, nor strict control during testing will help to combat students’ dishonest strategies. Most believe that the use of dishonest strategies by some students is inevitable. Perhaps this is a reflection of their own life experiences, a manifestation of a kind of cynicism or disappointment, but the reason may be the justification of their own dishonest strategies. The problem of dishonest strategies requires further investigation.

Learning independence, students’ engagement and their interaction are very important, as they partially reflect success of the transition from the teacher-centered to the student-centered model.

Declarations

Author contribution statement

M. G. Sorokova: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Additional information

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