The relationship between students' psychological security level, academic engagement and performance variables in the digital educational environment

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Abstract

In connection with the situation with COVID-19 almost all universities in the world were transferred to e-learning format, therefore new factors started to influence academic engagement and performance. Psychological security is one of these factors. Many researches have studied the importance of psychological security level among students, some of them proposed the methodology of assessing the indicator. Nevertheless, there are few studies that demonstrate the relationship between psychological security level of students and their academic engagement and performance. The aim of the current study is to close this scientific gap. For the assessment the Trustworthiness Factors survey, Academic Engagement Scale and academic performance results were used. A total of 351 students aged between 19 and 21 (M = 19.57, SD = 0.59), mainly female (57%), were integrated in the sample. Online surveys were conducted to reveal the level of students' psychological security, their academic engagement and performance in the process of e-learning and analyze the associations between these variables. The female students analyzed showed higher levels of psychological security, and especially in the communication of own ideas in webinar rooms. The same tendency was found in the levels of academic engagement and performance. The findings obtained by using the linear regression analysis technique indicated that psychological security predicted academic performance positively. In contrast to earlier studies, student safety is considered not only as an aspect of personal data security, but more as a psychological one. It was possible to conclude that the influence of psychological security on students' engagement and academic performance is particularly visible in the online educational environment.

Keywords Psychological Security · Behavioral Engagement · Cognitive Engagement · Emotional Engagement · Academic Performance · Digital Educational Environment · Trustworthiness Factors Scale · E-learning

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1 Introduction

In connection with the situation with COVID-19, in March 2020, almost all universities in the world were transferred to e-learning format, including Peter the Great St. Petersburg Polytechnic University (SPbPU). Before only 4% of all university courses were online, 14% were partly online and 82% were full-time, so changes had to be made urgently (Authors & Khalyapina, 2019; Authors, 2020). The full transition to learning in a digital environment has caused many difficulties in various fields of education (Authors & Khalyapina, 2019). According to Buzzetto-More and Koohang (2009) and Jorge Miguel Moneo et al. (2015), among the affected areas are the psychological state of students and teachers, students' engagement, and an equally important point is academic performance. Many researchers studied various indicators that may directly and indirectly influence students' attitude towards educational process, their academic involvement and performance (Miguel Moneo et al., 2015). The one of the main university tasks in the transition to e-learning was to create a secure and comfortable digital environment for students, so that students feel psychologically safe. It was also important to keep the students' interest and desire to continue their studies and actively participate in the learning process.

Research gap Many researchers studied the importance of psychological security level among students, some of them proposed the methodology of assessing the indicator (Volodarskaya et al., 2019). Nevertheless, there are few studies that demonstrate the relationship between psychological security level of students and their academic engagement and performance. This study addresses a valuable contribution to the literature by comprehensively assessing psychological security level of students and their academic engagement and performance, investigating whether psychological security influences an academic engagement and performance, considering the university students perceptions. The following research questions are presented in order to address the need to generate actions to set an effective educational environment:

1. Is there a great difference in the levels of psychological security, academic engagement, academic performance between males and females?
2. How do students' varying degree of psychological security relate to their behavioral, emotional, and cognitive engagement?
3. How do students' varying degree of psychological security relate to their academic performance?
4. To what extent does the level of psychological security predict students' academic performance and engagement?

Therefore, this study pursues as main goals to: a) determine the relationships between the levels of psychological security, academic engagement, academic performance and the sex of a sample of university students; b) establish the associations between psychological security level, academic engagement and performance.

1.1 Theoretical background

E-learning E-learning, which is considered as a new approach of learning, covers all the ways of learning and teaching supported by technology (Tavangarian et al., 2004), and includes all definitions related to increased accessibility of sources, flexibility towards the learner, and extension of abilities (Lowenthal et al., 2009). In addition, it is considered the fastest and least costly way, making it affordable for everyone to participate in the learning process. Nazarova (2018) argues that Dynamic e-Learning covers innovative information accessible to all learners. The concept of e-learning offers educational organizations using this technology a number of benefits, incorporating short and efficient learning curve, flexibility and modularity. Weaknesses of e-learning are high dropout rates, high design and maintenance costs (Iacob, 2011).

Several studies have been conducted on student and user perception of e-learning. Buzzetto-More and Koohang (2009) conducted a study of students' perceptions of various components of e-learning. They discovered that e-learning can improve students' understanding of the course content they are taking, and this will have an influence on higher education. Selim (2007) showed that students perceive teacher characteristics as the most important factor in the success of e-learning. Mohd Alwi (2009), who studied the perception of e-learning specialists, uncovered that their respondents agree that there are security risks in e-learning, and good safety supervision in e-learning is significant to ensure a secure e-learning environment.

An important factor is also the preparation of the university for the transition to the e-learning system. It is important to note that universities must meet all modern requirements for organizing e-learning, including providing proven software, technical equipment and, last but not least, a developed work plan that takes into account the specifics of the educational environment (Authors & Khalyapina, 2019; Lowenthal et al., 2009; Volodarskaya et al., 2019).

It should be noted that modern educational institutions strive to use e-learning in order to be skilled to satisfy all requests, among which psychological safety is of para-mount importance. As indicated in the works of many researchers studied, e-learning not only opens up new educational boundaries, but also creates risks associated with the results of educational activities and the psychological state of students and teachers.

Psychological security Security is acquiring the newest strategic and socio-economic role, including to guarantee the consistent functioning of any organization that aims to protect the environment and sustainable progress in existing conditions (Kovacova & Vackova, 2015). Security is a major part of human needs; therefore, it is important to recognize its important role in education and training (Kovacova & Vackova, 2015).

Students are the largest users of e-learning. Students are disturbed about their privacy and safety when using the e-learning system. They are concerned that sensitive information, such as their ratings and what they do, might be disclosed to others. They also need a reliable system so they don't get frustrated when using a system

that could affect their academic performance. It is important to consider the needs and opinions of students as the largest users of the e-learning system in order to ensure the successful implementation of the system in any educational institution. One of the reasons people reject the online system has to do with computer security concerns. Availability, integrity and confidentiality are the building blocks of computer security (Buzzetto-More & Koohang, 2009).

Psychological safety as a mental feeling of acceptance, love, receiving help and as an emotionally oriented system has been considered by some authors as something that contributes to the satisfaction of emotional requirements, satisfaction and a sense of be-longing (Rafei et al., 2010, pp. 5–12). This leads to harmony with society, detection and recognition of realities and adaptation to them, the disclosure of inner talents and, finally, the promotion of a healthy lifestyle among societies (Sadeghian & Heidariyann, 2010, pp. 71–81).

Online users of the system fear that they will lose their privacy, the privacy of their personal information, and the availability of the system when they need it. In an e-learning system, users will feel more confident in interacting and collaborating with others when mechanisms are in place to ensure confidentiality, trust, and a secure environment. Students' perception of the service quality of the e-learning system is important as students can offer insights into the conditions that reduce the quality of service in e-learning and they experience the institution's service delivery system day after day (Hilmi et al., 2011).

In the considered studies, special attention is paid to the psychological state of all users of the electronic environment, especially when it comes to educational platforms. The feeling of security promotes effective and open communication, motivates to participate in educational activities, and promotes psychological comfort. It is also worth noting that a secure e-learning environment can have advantages over face-to-face classroom learning if the right online environment is created.

Students' engagement A significant assessment for students in a digital environment is engagement. Fredricks and McColskey (2012) noted that while some researchers explain it in terms of views and principles about the significance of learning, others define it as an effort beyond the bare minimum.

Based on an analysis of digital learning publications Halverson et al. (2014) discovered that about half of their publications mention the term "engagement". Their outcomes also presented that, despite the common usage of the term, in very exceptional cases, research is directly linked to involvement in digital learning.

Several scientists have proposed a multidimensional interaction model (Abuaisheh et al., 2016; Mader & Bry, 2019; Puritat, 2019). According to this theoretical model, engagement is multidimensional, which can embrace behavioral, emotional and cognitive aspects (Eccles & Wang, 2012; Sinatra et al., 2015). According to Fredricks and McColskey (2012), behavioral engagement underlines involvement, stubbornness, and participation in academic activities. Emotional engagement centers on positive and negative reactions to peers, professors, and institutes, as well as evaluating learning results. In terms of cognitive collaboration, it comprises the student's engagement to the understanding of the topic. "Cognitive engagement draws on the idea of investment; it incorporates thoughtfulness and willingness to exert the

effort necessary to comprehend complex ideas and master difficult skills" (Fredicks & McColskey, 2012, p. 73).

Academic engagement expects numerous long-standing positive effects such as pursuit of higher education, steadiness in learning modes, enhanced job prospects, positive self-perception and welfare, and less depressive indications (Li & Lerner, 2011; Salmela-Aro & Upadyaya, 2012; Salmela-Aro & Upadyaya, 2014; Tuominen-Soini & Salmela-Aro, 2014; Wang & Peck, 2013). Thus, participation can have positive and wide-ranging results even outside the educational environment. In addition, academic participation was discovered to be strongly associated with academic inspiration and performance: students rate their studies, score higher, and report lower levels of academic abstinence and effort avoidance (King, 2015).

Log records from electronic learning management systems can keep independent and related data, such as how many times a student has logged in. Although scholars have concentrated on log files for various points, they infrequently used these log archives for analysis interactions. It is only lately that Gobert et al. (2015) have established procedures to notice engagement in the online study environment for examining scientific questions. Hence, other methodologies, such as interviews, have their benefits. Scientists can use interview techniques to get comprehensive material about why students partake or do not partake in certain events, why students vary in communication performance and contextual aspects that can lead to student engagement or disengagement (Ketonen et al., 2019). Taking into account the point that each method to dimension has its pros and cons, a number of academics recommend using numerous techniques to measure engagement (Appleton et al., 2006; Demidov et al., 2021; Greene, 2015; Lin, 2018).

It should be noted that in the previously mentioned studies, much attention is paid to the availability of an electronic educational platform, namely, the availability of the necessary resources for active and effective educational activities of students. An electronic educational platform with the right interface and content can motivate students and increase their engagement.

Engagement and academic performance In recent years, there has been interest in exploring the role of engagement as a key factor in academic success. It has been suggested that the influence of positive emotions may be indirect, through motivational processes such as engagement (Carmona-Halty et al., 2021; Zhou et al., 2010). Engagement is associated with motivational processes. It is assumed that engagement plays an important role in achieving work goals. For example, interested students tend to devote more effort to academic tasks. In such situations, it is more likely that the task will be completed successfully and the academic performance will be improved. Engagement is a construct that has mostly been studied in work environments and is considered to be a work-related state of mind characterized by energy, dedication, and absorption (Schaufeli et al., 2002). Energy is characterized by a high level of energy and mental mobility during work. Dedication refers to a sense of worth, enthusiasm, inspiration, pride, and challenge. Absorption is characterized by full concentration and happy preoccupation with one's work, so that time passes quickly. This concept has also been applied to a scientific context and defined with a focus on student tasks and activities (Schaufeli et al., 2002). Engaged students

feel energized, passionate about their studies, and involved in their academic life (Carmona-Halty et al., 2021). Empirical evidence has shown that engaged university students performed better (Bakker et al. 2015; Martínez et al., 2019; Sadoughi & Hejazi 2021; Slåtten et al. 2021; Vizoso et al. 2018). This pattern of outcomes was also obtained using experimental designs, where a positive relationship was found between engagement and academic performance (Salanova et al., 2003).

Thus, it seems possible for us to analyze the mutual influence of student engagement on their academic performance. However, during the pandemic, given the fact that education is completely digitalized, a new dimension emerges that affects both student engagement and academic performance. Unfortunately, no relevant studies on this topic have been found. In the current study the goal is to share the experience and to fill the existing research gap using a quantitative methods approach to take into account all factors: students' psychological security level, students' engagement and learning outcomes in a digital environment.

2 Materials and methods

2.1 Participants and procedures

The study involved university undergraduate students (2nd year of study) of Humanitarian Institute of Peter the Great Saint-Petersburg Polytechnic University aged from 19 to 21 years (M = 19.57, SD = 0.59), 57% females. It was the 2nd year students who were selected for the study, since these students are all adults, already adapted to the educational process in a higher educational institution and will sharply feel the difference between full-time education and online education. Senior students have many online projects in their curriculum, which implies intensive implementation of e-learning tools, regardless of the full transition of the university to online mode. Thus, it is the 2nd year students who can fully reflect the impact of online education on academic performance, a sense of security and engagement in the educational process. The total number of participants in the sample was 351. A survey of students was conducted online using the Moodle platform. Consent was obtained by all participants in this study. The results were collected at the end of the spring semester 2020 after 4 months of distant learning due to COVID-19 situation. Analyses were carried out on the depersonalized data.

2.2 Measures

For the assessment of students' psychological security in online educational environment, the Trustworthiness Factors survey was used (Miguel Moneo et al., 2015; Miguel et al., 2017). It includes 10 statements that explore interpersonal trust in work groups identifying trust-building behaviors ranked in order of importance, and it is divided into two categories: Trustworthiness Building Factors (TBF) and Trustworthiness Reducing Factors (TRF).

The present study measured students' Academic Engagement Scale using the three most common dimensions identified by researchers (behavioral, emotional, and cognitive engagement). Behavioral engagement was measured through students' attendance records of online lectures in Microsoft Teams (MS Teams) and records of online logins to the Moodle platform (results are presented in 10-points scale). To identify emotional engagement, Motivation Questionnaire was used (Authors, 2019). Special statements were created to clarify the students' perceptions about teaching and learning offered, defining five indicators: desire of learning after university, anxiety, positive attitude to learning, self-esteem, and self-demand. The answers were measured by five-point Likert-scale. To investigate students' cognitive engagement, a conducted survey included three items defining cognitive criteria, which index the extent to which students are attending to and expending mental effort in the learning tasks encountered (Authors, 2019). The Cronbach's internal reliability coefficient obtained in this study for the Academic Engagement Scale was 0.84.

The students' semester grades in professional disciplines were used as measures of academic performance.

All parameters used in the research are presented in the Table 1.

A Kolmogorov–Smirnov test of collected data was implemented and it showed that data were normally distributed, skewness and kurtosis were close to 0. To analyze the data IBM SPSS Statistics, version 21: ANOVA, correlation and regression analyses were used.

3 Results

3.1 Descriptive statistics and gender differences

Having collected the data this research started with descriptive statistics of all variables that are presented in Table 2.

The results reflect that girls have significantly higher indicators of the Academic Engagement Scale compared to boys. This fact is consistent with earlier data, for instance, Guay et al. (2000) and Ayub (2010). However, there were no significant gender differences in Trustworthiness Factors, but boys show higher rates of Trustworthiness Building Factors, while the indicator of Trustworthiness Reducing Factors was lower by boys.

3.2 Correlation analysis

Also, a Pearson correlation analysis was conducted to identify whether TFS scores impact the academic engagement scores of the students. The results are shown in Table 3.

When Table 3 is examined, it is seen that the TFS scores and the academic engagement scores of the students have a significant and positive correlation. At the same time the Trustworthiness Building Factors and Trustworthiness Reducing Factors both had a quite high influence on students' academic performance ($R2 = 0.21$;

Table 1 Data collection

Measures	Parameters/Items	Sort of data collection	Type of data
Trustworthiness Factors Scale	Trustworthiness Building Factors	I communicate honestly, without distorting any information; I listen to and value what GS (group of students) say, even though I might not agree; I show confidence in GS's abilities; I keep promises and commitments; I cooperate with GS and looks for mutual help	Online Survey	Quantitative
	Trustworthiness Reducing Factors	I act more concerned about own welfare than anything else; I send mixed messages so that GS never know where I stand; I avoid taking responsibility; I jump to conclusions without checking the facts first; I make excuses or blame others when things do not work out	Online Survey	Quantitative
Academic Engagement Scale	Behavioral engagement	Attendance records of online lectures in MS Teams; Records of online logins to the Moodle platform	MS Teams and Moddle platform	Quantitative
	Emotional engagement	Desire of learning after university; Anxiety; Positive attitude to learning; Self-esteem; Self-demand	Online Survey	Quantitative
	Cognitive engagement	I put a lot of effort into preparing for classes on Moodle; I was engaged with the topics at hand in lectures; I spend much time for accomplishing all assignment	Online Survey	Quantitative
Academic Performance	Students' average semester grade on professional disciplines	Students' semester grades in professional disciplines	Score Sheet	Quantitative

Table 2 Results by gender

Measures		ALL (N=351)		Females (N=200)		Males (N=151)		ANOVA effects F (p-value)
		M	SD	M	SD	M	SD	
Trustworthiness Factors Scale	Trustworthiness Building Factors	3,83	0,71	3,87	0,74	3,78	0,69	0,65 (0,58)
	Trustworthiness Reducing Factors (R*)	3,24	0,68	3,11	0,68	3,35	0,66	1,21 (0,23)
Academic Engagement Scale	Behavioral engagement	8,3	0,91	8,71	0,87	7,62	1,12	13,93 (0,005)
	Emotional engagement	4,17	0,76	4,31	0,72	4,02	0,97	0,89 (0,38)
	Cognitive engagement	3,93	0,81	4,01	0,77	3,69	1,14	6,87 (0,03)
Academic Performance	Students' average semester grade on professional disciplines	3,86	0,68	4,09	0,71	3,67	0,66	9,57 (0,01)

*Reversed results

Table 3 Pearson's correlation results for the variables under study ($N=351$)

	1	2	3	4	5	6
1.Trustworthiness Building Factors	1					
2.Trustworthiness Reducing Factors (Reversed)	0.81***	1				
3.Behavioral engagement	0.79***;	0.74***	1			
4.Emotional engagement	0.72***	0.77***	0.58**	1		
5.Cognitive engagement	0.53**	0.49*	0.41	0.26	1	
6.Academic Performance	0.46*	0.48*	0.46*	0.44	0.50*	1

* $p<0,05$; ** $p<0,01$; ***$p<0,001$

R2=0.23), that confirms the importance of psychological security for students' academic success during e-learning.

3.3 Regression analysis

The results of the linear regression analysis conducted to analyze whether the psychological security level of the university students predicted the academic engagement are presented in Table 4.

According to Table 4 the TFS scores predict the academic achievement levels of the students significantly in a positive way ($\beta=0.35$, t=7.88, $p<0.001$). The variance of the academic engagement scores can be explained by the TFS scores (R2=0.67, adjusted R2=0.64).

The results of the linear regression analysis conducted to analyze whether the psychological security level of the university students predicted the academic performance are presented in Table 5.

In Table 5 it is shown that the TFS scores predict the academic achievement levels of the students less significantly than academic engagement scores but also in a positive way ($\beta=0.15$, t=4,14, $p<0.01$).

These findings show that feeling of the psychological security has an enhancing effect on the academic engagement and academic performance levels of the students.

Table 4 Trustworthiness Factors Scale scores as a predictor of academic engagement

	B	SEB	β	t	F	R2	Adjusted R2
Constant	2.71	.10	.35	8.89***	37.29**	0.67	0.64
TFS	.01	.00		7.88***			

Dependent variable: Academic engagement, **$p<0.001$

Table 5 Trustworthiness Factors Scale scores as a predictor of academic performance

	B	SEB	β	t	F	R2	Adjusted R2
Constant	2.09	.09	.15	3.78*	7.73*	0.24	0.22
TFS	.01	.00		4.14*			

Dependent variable: Academic performance, *$p<0.01$

4 Discussion

The rapid transition of the educational process to the digital environment has caused excitement among both teachers and students. Students' anxiety stems not only from novelty, but also from a disturbed sense of security. In this study, the impact of psychological safety of students on academic performance and student engagement in the educational process was examined.

For the analysis the Trustworthiness Factors survey, students' attendance records of online lectures in MS Teams and records of online logins to the Moodle platform, Motivation Questionnaire and cognitive criteria survey were used. Also, students' semester grades in professional disciplines as measures of academic performance were analyzed.

The obtained results determined the substantial interconnection between the degree of psychological security and all indicators of academic engagement— cognitive, emotional and behavioral. The results of the analysis also confirm the importance of psychological safety for the academic performance of students during e-learning as factors of increasing reliability and factors of decreasing reliability had a rather strong influence on the academic performance of students according to Pearson's correlation results. Regression results indicate that the level of psychological security predicts the academic engagement and the academic achievement levels of the students significantly in a positive way. These findings show that feeling of the psychological security has a significant effect on the academic engagement and academic performance levels of the students. Thus, the results and conclusions of the current study as a significant addition to the upcoming literature can be applied by future researchers in this field.

In contrast to earlier studies (Buzzetto-More & Koohang, 2009; Sadeghian & Heidariyann, 2010; Selim, 2007), this research considered student safety not only as an aspect of personal data security, but more as a psychological one. The study confirmed that the psychological security of students affects the behavior of students during the educational process, namely, the activity of their participation in the classroom, enthusiasm for the process, the feeling of comfort and the effectiveness of learning in a digital environment. The direction of current research is similar to the works of Rafei et al. (2010) and Miguel Moneo et al. (2015).

Researches (Appleton et al., 2006; Greene, 2015; Ketonen et al., 2019; Lin, 2018) on students' engagement assessment allowed to choose the best methods for analyzing this factor. However, unlike all previous studies, this study focuses on the relationship between the psychological safety of students and their willingness to take an active part in the educational process.

The present study allowed us to highlight the important role that the psychological security plays in the e-learning, considering the perceptions of the studied university students. The focus on the relationship between the level of psychological security, academic performance and engagement level constitutes an added value of this paper, since most international researches have focused mainly on the methodology of assessing the psychological security level and defining the borders of its definition. It was possible to conclude that the influence

of psychological security on students' engagement and academic performance is particularly visible in the online educational environment. Practically the conclusions of the study can be used by managers and faculty of the universities who will be able to direct all their efforts to increase students' psychological security level in e-learning. This is an important result that should be consequently considered extremely valuable, influencing the design of e-learning and technologies in the Russian university context. To boost students' psychological security level universities should provide a high quality LMS (learning management system) environment, including Wi-Fi zones, m-learning (using smart phones), and an online mentor system. At the first seminar/lecture, teachers should spend 15–20 min getting to know students online, clarifying their academic interests and what results they expect from the course, thereby increasing the level of confidence on the part of students. It is necessary to initiate the inclusion of cameras during classes by students (or make it a mandatory rule for attending a course). Also, the introduction of group tasks, for instance, the division of working groups into different rooms in MS Teams, can contribute to the rapprochement of students with each other and, accordingly, increase the level of psychological safety.

It should be noted that this study has limitations. Only students from Russia were analyzed, therefore, these students had a similar mentality, which can differ from representatives of other countries and affect the psychological security state. Also, the study was conducted on a short time frame basis since e-learning was introduced in March 2019, which is a short period. Furthermore, the transition to the distance format was made very abruptly, literally in a week the educational process completely switched to a digital environment. Such drastic changes could negatively affect the psychological state of students and affect the results. Thus, with a smoother transition with advance preparation of students, the results may differ.

This research could be useful for future scientific work. This direction is promising, since distance education continues at the present time. It is important to study separately the adaptability of students to the digital environment over time, the selection of educational technologies specifically for the digital environment, in order to improve the academic performance of students and their sense of security. In addition, it seems important to study aspects of the psychological health of teachers, as participants in the educational process.

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