

Factors Affecting High School students' Remote Online Exam Results in Vietnam due to the COVID-19 Pandemic

Nguyen Xuan An, Luong Dinh Hai, Ngo Thanh Thuy, Tran Bich Hang, Tran My Ngoc

¹ annx@vnies.edu.vn, ² luongdinhhai@vnies.edu.vn,

³ thuyngothanh@vnies.edu.vn, ⁴ hangtb@vnies.edu.vn, ⁵ ngoctm@vnies.edu.vn,

The Vietnam National Institute of Educational Sciences (Vietnam)

ABSTRACT

The outbreak of the COVID-19 pandemic has hit education globally hard. Students could not go to school due to the social distancing measures taken by governments to prevent the spread of the pandemic. Therefore, in order to ensure that the learning process of students is maintained, online learning has become the key solution for this circumstance. As a result, periodic testing for students has also been changed into the remote online exams (ROEs). While the benefits of ROEs are widely recognized, the urgent use of this test presents problems and challenges for both students and teachers. This research aimed to explore a number of factors that may affect the results of online remote tests performed by high school students in Vietnam, thereby examining how those factors affect their test results compared to the traditional testing method. By using exploratory factor analysis (EFA), the research identified five potential factors affecting the online remote exam results of Vietnamese high school students with 17 items that met statistical standards, namely: Attitude towards ROEs, Preparedness, Anxiety, Technical Problems, Perceived ROEs Software. The analysis results of the linear regression model show that the only factor namely attitudes towards ROEs is positively correlated with their exam results. The results of this study not only provide a foundation for the online education and online examination research community, but also provide recommendations for educational practitioners, school administrators, and technical service providers on how to effectively support the remote online examination of high school students in Vietnam.

KEYWORDS: remote online exams, online learning, COVID-19, Vietnam.

1. Introduction

The outbreak of the COVID-19 pandemic at the beginning of 2020 caused a global health emergency (WHO, 2020) and brought major changes to all aspects of the socio-economic aspects of all countries in the world (Gradišek & Polak, 2021). Regarding the education sector, according to a report by UNESCO (2020), more than one billion students, accounting for more than 98% of the world's students, have been heavily affected by the closure of schools due to tactics to prevent the spread of the SARS-CoV-2 virus.

In this urgent circumstance, global education has been changing dramatically to minimize the disruption of teaching and learning with the increasing use of

technology in educational activities (Chiu, 2021). Online learning has been applied mainly since the beginning of the pandemic when measures such as social distancing and social isolation were carried out (Nguyen et al., 2021). Then, blended learning was used as a more appropriate approach for educational institutions to establish a “new normal” state for global education (Dao & Le, 2020).

In Vietnam, since the outbreak of the COVID-19 pandemic, the school system has been shut down, in which schools switched from face-to-face classes to online learning to ensure that all students would not experience an interruption in their studies and that the school year plan would not be affected. Suffering three waves of COVID-19 infection from March 2020 to February 2021, schools in Vietnam urgently switched from a traditional teaching environment to an online teaching environment and gradually adapted to the government’s pandemic prevention and control regulations. However, the outbreak of the fourth wave of infection at the end of April 2021 brought the education system into a state of emergency because at that time, all Vietnamese high school students were supposed to sit in the final exams and university entrance exams. An urgent question was raised – how should high schools organize the assessment of the second semester for students in the context of social distancing? With the goal to adapt to the uncertainty and urgency of the pandemic and to the new context of education, the Ministry of Education and Training studied and issued the Circular No. 09/2021/TT-BGDĐT dated March 30, 2021, regarding regulations on management and organization of online teaching in general education institutions and continuing education institutions (Ministry of Education and Training, 2021). This regulation creates a crucial legal corridor for localities and schools to be proactive in online teaching and learning, including the issue of online examinations for high school students. Therefore, a number of local high schools in areas affected by the outbreak (such as Ha Nam, Hanoi, Da Nang ...) had to switch from the traditional, face-to-face testing method to remote testing regarding the final exams in order to proactively assess students’ final-year learning results.

In the context of the pandemic-induced educational crisis, the term emergency remote teaching was coined by researchers and experts in online education (Bozkurt and Sharma, 2020). This approach has been proposed as an alternative way to maintain the teaching and learning process (Shamir-Inbal and Blau, 2021), and has been associated with the term emergency remote learning (Hash, 2021). Milman (2020) describes the situation with a new term that encompasses both processes above, namely “pandemic pedagogy”. As a result, the method of “remote online exams” (ROEs) was launched and became popular (Mastour & Ghalibaf, 2020). This method is understood as an assessment of students’ learning progress via virtual or online platforms, in which learners conduct their own exams at home settings, or places outside the school. Their performances are supervised by the school or the teachers with the support of online monitoring tools. The effectiveness of ROEs has been researched in recent years in parallel to the development of learning methods associating with online elements, including distance learning, remote emergency learning, blended learning, online learning, and e-learning (Butler-Henderson & Crawford, 2020). This assessment method has become increasingly popular over the

years due to the rapid growth of online-based education. Especially during the time of the raging COVID-19 pandemic, online examination, specifically remote online examination, has shown its importance via the fact that many countries around the world have forced the use of ROEs as the primary assessment of student learning during the pandemic (Mastour & Ghalibaf, 2020).

While the benefits of ROEs are widely recognized, the urgent use of this method in the context of the COVID-19 pandemic also presents problems and challenges for learners around the world. A number of studies reported that besides the advantages of ROEs, this approach has limitations and challenges which need to be addressed appropriately, that includes technical-related issues (Ngqondi et al., 2021); mental health of learners (Elsalem et al., 2020); fraud or dishonesty (Li et al., 2021); technology skills and competencies of learners (Ngqondi et al., 2021). In addition, studies and publications on this issue mainly focused on higher education but lack of attention on general education. For Vietnamese high school students, the transition to remote online exams in the form of synchrony might also create certain advantages and disadvantages which might affect their final-term test results. Acknowledging that the understanding of those issues is essential to provide appropriate solutions to improve the quality of remote online exams, this research aims to explore certain factors that potentially affect the test results of high school students in the remote online testing environment, and how these factors affect students' test results compared to before the use of ROEs.

The research questions are created as follows:

What are the factors that may affect students' exam results in the online remote exam environment?

How do these factors affect students' exam results compared to before the use of ROEs?

The findings of this study are expected to provide educators and educational administrators with an understanding of the remote online exam method as well as of the factors that potentially affect the test results of high school students in Vietnam. Suggestions are also provided for schools, families and other stakeholders to take appropriate measures to improve the quality of ROEs.

2. Methodology

2.1. Instrument/Measurement

The survey used in this study was divided into two parts. The first part focused on students' demographic information and the number of times ROEs were performed by the students. The second part of the survey contains items that examine the factors influencing students' online remote exam results.

To construct items for the second part of the survey, 22 semi-structured interviews were conducted with students who participated in the ROEs for the mid-term test or end-term test. The interviews were carried out from March 6, 2022, to March 10, 2022. The interview transcripts were then analyzed according to the qualitative data analysis process

(Saldaña, 2020, 2021). From the preliminary analysis results, the research constructed 20 items for the questionnaire, related to factors affecting students' results via ROEs from students' points of view (Table 1). 09 items (from I1 to I9) were measured with the Likert scale of 5 levels with specific values: 1-Never; 2-Rarely; 3-Occasionally; 4-Regularly; 5-Always. The rest of the items (from I10 to I20) were also measured with the Likert-5 scale with specific values: 1-Strongly disagree; 2-Disagree; 3-Neutral; 4-Agree; 5- Strongly agree.

Table 1. Items list

Items code	Items
I1	I often feel confused by the test questions
I2	I prefer the online exam compared to the face-to-face exam
I3	I like to take the remote online exam
I4	I feel quite comfortable taking the remote online exam
I5	I feel the face-to-face exam is more stressful than the remote online exam
I6	I feel nervous when I take the remote online exam
I7	I am tired of taking the remote online exam
I8	I don't concentrate on answering the questions
I9	I feel excited when I take the remote online exam
I10	I am supported by the teacher in preparation for the remote online exam (knowledge and equipment)
I11	I review thoroughly to prepare for the online exam
I12	I practice with the software many times to prepare for the remote online exam
I13	I usually test the network connection and the devices for the online remote exam
I14	I often have sudden power outages
I15	I often have problems with unstable network connection
I16	The device for remote online exam helps me ensure test completion
I17	I do not have a monitoring device during the remote online exam
I18	I have difficulty using the remote online exam applications that the school uses to organise the test
I19	I find the software which supports remote online exam effective and responding to my test taking
I20	For me, accessing the applications for remote online exam is easy

2.2. Sample

Respondents of the survey were high school students who have been studying online and taking the remote online mid-term or final-term exams during the social distancing period. The chosen sampling method was the convenience sampling

method, which involves the selection of individuals who are closest to the research requirements, and then continuing the selection process until the ideal sample size is achieved (Cohen et al., 2012). In total, 158 students completed the questionnaire; however, only 140 responses were valid (based on Hair Jr.'s suggestion). Table 2 below describes the characteristics of the sample by gender, grade, and a number of online remote exams.

Data from Table 2 shows that the percentage of male students (44.3%) participating in the survey was lower than that of female students (55.0%). In addition, only one student chose "others" for gender preference, which accounted for 0.7%. The percentage of 10th graders was much higher than 11th graders in this survey (74.3% and 25.7% respectively). Regarding statistics of students with the number of times taking ROEs, there were 17 students who have never taken the test by the remote online method (accounting for 12.1%), and only 4 students (2.9%) have taken the test by this method only once. The majority of students participating in the survey (119 students, or 85%) took the midterm or final term exams twice or more by the remote online method.

Table 2. Characteristics of the survey sample

Variable	Frequency	Percentage
Sex	140	100.0
Male	62	44.3
Female	77	55.0
Others	1	0.7
Grade	140	100.0
10th	104	74.3
11th	36	25.7
Times of remote online exams	140	100.0
Never	17	12.1
Only once	4	2.9
Twice or more	119	85.0

Regarding the information of students' ROE results (Table 3), out of 140 students who responded, the majority agreed that the test results were unchanged (44.3%) or higher compared (35.7%) to the pre-test expectations. Only 20.0% of students reported that the results from the ROEs were lower than their expectations before the test.

Table 3. Students' ROE results compared to pre-test expectations

Remote online exam results	140	100.0
Lower	28	20.0
No change	62	44.3
Higher	50	35.7

2.3. Data collection

The research data was collected using Google Forms. All questions were made mandatory to ensure that participants did not miss any questions. The link to the questionnaire was sent to appropriate subjects according to the research's requirements via Mail, Facebook, Messenger, and Zalo (a Vietnamese chatting app). The data were collected within a week, from March 29 to April 3, 2022. At the end of the data collection period, the data was downloaded in the *.csv format of Microsoft Excel to be later used for analysis in the SPSS software.

2.4. Data analysis

To answer the given research questions, data analysis was carried out in three steps. First, the exploratory factor analysis method was performed. There were three observed variables removed during this stage. The remaining seventeen observed variables formed five factor groups (see Table 4). Next, descriptive statistics were provided for each factor group as well as for the observed variables of each factor group. The analysis results show the real state of these factor groups in the ROE process (see Table 5,6,7,8,9). Finally, the linear regression analysis method was applied, in which the change in online exam results was the dependent variable. The linear regression model shows the factors affecting the learning outcomes of high school students in Vietnam (see Table 10).

3. Results

3.1 EFA

Through the exploratory factor analysis (EFA), five groups of influential factors were identified based on observed behaviors of Vietnamese high school students in the remote online exams. Table 4 represents the results of Exploratory Factors Analysis process. Methods were used include Extraction Method: Principal Component Analysis (Abdi & Williams, 2010) and Varimax with Rotation Method (Kaiser & Rice, 1974). Test results of Kaiser-Meyer-Olkin (KMO) and Bartlett show that this model was suitable (KMO value = .682, df = 136, p < .001) (see Appendix 1). In addition, elements in the analytic model show 62.81% of the bias of data (see Appendix 2).

Table 4. Results of the Exploratory Factors Analysis

Items	Component				
	1	2	3	4	5
I2	.748				
I3	.847				
I4	.700				
I5	.616				
I6			.745		
I7			.804		
I8			.760		

Items	Component				
	1	2	3	4	5
I9	.680				
I10		.671			
I11		.776			
I12		.684			
I13		.747			
I14				.833	
I15				.601	
I18				.782	
I19					.801
I20					.664

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

The results of the factors analysis in Table 4 show that the groups of factors extracted include: (1) attitudes towards accepting ROEs consisting of 05 observable variables; (2) preparation for ROEs consisting of 04 observable variables; (3) anxiety about ROEs consisting of 03 observable variables; (4) technical problems during ROEs consisting of 03 observable variables; and (5) awareness of ROEs software consisting of 02 observable variables.

3.2. Description of factors

In Table 5, the first group of factors demonstrates the attitudes towards ROEs through 5 items (I2, I3, I4, I5, I9). Specifically, the most noticeable item was I5 (“I feel the face-to-face exam is more stressful than the remote online exam”) (M=3.64), followed by I4 (“I feel quite comfortable taking the remote online exam”) (M=3.45). The item I2 (“I prefer the online exam compared to the face-to-face exam”) (M=3.11) and the item I3 (“I like to take remote online exams”) (M=3.06) were the two factors that received the average level of interest. The item I9 (“I feel excited when I take the remote online exam”) obtained the lowest average value in this group of factors with a mean of 2.91. Overall, the first factor - attitudes towards ROEs reflected by high school students - obtained the average mean of 3.23.

Table 5. The Factor of Students’ Attitudes towards ROEs

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Attitudes towards ROEs	140	1	5	3.23	.939	.211	.205	-.596	.407

I2	140	1	5	3.11	1.361	-.092	.205	-1.088	.407
I3	140	1	5	3.06	1.313	-.010	.205	-.982	.407
I4	140	1	5	3.45	1.159	-.355	.205	-.621	.407
I5	140	1	5	3.64	1.225	-.534	.205	-.678	.407
I9	140	1	5	2.91	1.306	.259	.205	-.950	.407
Valid N (listwise)	140								

Table 6 describes the factor of students’ anxiety regarding ROEs, which consist of 03 items (I6, I7, I8). This factor obtained a lower mean average (M=2.45) compared to the first factor (students’ attitudes). In particular, students felt strongly related to the item I6 (“I feel nervous when I take the remote online exam”) (M=2.53). The next item was I7 (“I am tired of taking the remote online exam”) with a lower mean value (M=2.49). The item with the lowest mean value was I8 (I don’t concentrate on answering the questions”) with the average mean of 2.34.

Table 6. The Factor of Students’ Anxiety towards ROEs

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
F3_ Anxiety towards ROEs	140	1	5	2.4548	.918	.412	.205	.083	.407
I6	140	1	5	2.53	1.102	.204	.205	-.732	.407
I7	140	1	5	2.49	1.202	.559	.205	-.495	.407
I8	140	1	5	2.34	1.174	.439	.205	-.655	.407
Valid N (listwise)	140								

Table 7 represents the third factor, namely students’ preparedness for ROEs, which consists of 04 items (I10, I11, I12, I13). This factor group obtained the same average mean as the first factor (students’ attitudes towards ROEs), at M= 3.22. In particular, the item I13 (“I usually test the network connection and the devices for the online remote exam”) obtained the highest average mean value (M=3.39) compared to all other items in the group. The following item I11 (“I review thoroughly to prepare for the online exam”) also had a high average mean of 3.35. The other two items I10 (“I am supported by the teacher in preparation for the remote online exam (knowledge and equipment)”) and I12 (“I practice with the software many times to prepare for the remote online exam”) obtained lower average score of 3.11 and 3.06 respectively. However, it is noticeable that the average means of items from this factor group were significantly higher than the items from the second factor group (students’ anxiety regarding ROEs).

Table 7. The Factor of Student's Preparedness for ROEs

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Preparedness for ROEs	140	1	5	3.22	.953	.031	.205	-.690	.407
I10	140	1	5	3.11	1.290	-.243	.205	-.963	.407
I11	140	1	5	3.35	1.150	-.288	.205	-.628	.407
I12	140	1	5	3.06	1.259	-.123	.205	-.891	.407
I13	140	1	5	3.39	1.344	-.375	.205	-.975	.407
Valid N (listwise)	140								

Table 8 describes the fourth factor, namely technical problems regarding ROEs, which includes 03 items (I14, I15, I18). The average mean of this factor was 2.8, which is higher than the 2nd factor (students' anxiety) yet lower than the 1st and 3rd factor (students' attitudes and students' preparedness). The most noticeable issue is I15 ("I often have problems with unstable network connection") with M=3.00. The other two items, including I14 ("I often have sudden power outages") and I18 ("have difficulty using the remote online exam applications that the school uses to organise the test") obtained the average mean of 2.79 and 2.62 respectively.

Table 8. The Factor of Technical-related Problems Regarding ROEs

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Technical Problems with ROEs	140	1	5	2.80	.893	.266	.205	.231	.407
I14	140	1	5	2.79	1.117	.120	.205	-.601	.407
I15	140	1	5	3.00	1.093	.000	.205	-.422	.407
I18	140	1	5	2.62	1.214	.323	.205	-.667	.407
Valid N (listwise)	140								

Table 9 describes the last factor, students' awareness regarding ROEs, which consists of 02 items (I19, I20). The average means that this factor is considered high compared to all other factors. From the statistics, between the two items, students were more likely to find "accessing the applications for remote online exam is easy" (M=3.19), compared to I19 ("I find software which supports remote online examining effective and responding to my test taking") with the mean of only 3.00.

Table 9. The Factor of Perceived ROEs Software

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Perceived ROEs Software	140	1.	5	3.09	.988	.045	.205	-.177	.407
I19	140	1	5	3.00	1.157	.057	.205	-.675	.407
I20	140	1	5	3.19	1.125	-.050	.205	-.619	.407
Valid N (listwise)	140								

3.3. The link between factors affecting students' ROE results compared to their pre-ROE expectations

The Linear Regression Analysis, which was used on dependent variables, shows the changes in students' performances via ROEs. The independent variables represented (1) the number of ROES students have taken, (2) attitudes towards ROEs, (3) Preparedness for ROEs, (4) Anxiety towards ROEs, (5) Technical Problems with ROEs, and (6) Perceived ROEs Software. The ANOVA results (F(6, 133) = 3,863, p = 0.01) indicate that this model is appropriate (see Appendix 4). The analysis data shows that the variability of independent variables may explain for 14.8% of the variability of dependent variables (see Appendix 3). In other words, the changes found in six factors (Table 10) can only explain for 14.8% of the changes in online exam results of Vietnamese high school students.

Table 10 shows the results of the Linear Regression Analysis, in which the slope B co-efficient estimate equals to the average change in the results of ROEs associated with a unit in 06 factors. The results demonstrate that three factors had positive effects on high school students' ROE results: the number of taken ROE exams (B = .121), Attitudes towards ROEs (B = .206) and Perceived ROEs Software (B = .112). In contrast, there were three factors having adverse effects on students' ROE exams: Preparedness for ROEs (B = -.029); Anxiety towards ROEs (B = -.022) and Technical Problems with ROEs (B = -.126). However, only one factor group, namely Attitudes towards ROEs, had a statistically significant correlation with students' pre-ROEs expectations (p = .003).

Table 10. Results of the Linear Regression Analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.436	.351		4.098	.000
Numbers of taken ROEs	.121	.090	.110	1.344	.181
Attitudes towards ROEs	.206	.068	.264	3.030	.003
Preparedness for ROEs	-.029	.072	-.037	-3.97	.692
Anxiety towards ROEs	-.022	.069	-.027	-3.19	.750
Technical Problems with ROEs	-.126	.072	-.154	-1.745	.083
Perceived ROEs Software	.112	.070	.151	1.605	.111

4. Discussion and conclusions

The paper explored a number of factors that may affect the ROE results of high school students in Vietnam, and examined how these factors correlate with students’ test results compared to their pre-ROE expectations. Using EFA, the research identified five factor groups affecting students’ ROE results, namely: Attitudes towards ROEs, Preparedness for ROEs, Anxiety towards ROEs, Technical Problems with ROEs, and Perceived ROEs Software. Description of each factor and of items of the factors was provided to measure students’ behaviors on ROEs. Lastly, the Linear Regression Analysis was used to determine the correlation between these influential factors, including the five discovered factors and the number of taken ROEs, and students’ exam results compared to pre-ROEs. The results indicate that the only factor, Attitudes towards ROEs, showed a statistically significant correlation with students’ pre-ROEs results.

4.1. Findings

Regarding the factors influencing high school students’ ROEs, first, the student’s attitudes towards ROEs were reflected by four items in this study. This factor aims to measure problems related to the students’ motivation, which might be derived from the construct of attitudes toward behavior in the Theory of Reasoned Action. Specifically, the theory argues that an individual’s behaviour is determined by their intention and their negative or positive feelings about performing such behaviour (Fishbein & Ajzen, 1975). The result of the analysis shows that students’ attitudes towards accepting the ROEs were moderate. According to Venkatesh et al. (2003), this factor is a construct which helps predict behavioral intentions.

Second, the anxiety towards ROEs is an issue related to students’ mental health in the ROE environment, especially in the context of social distancing. Anxiety is a mental phenomenon and is defined as a negative experience of individuals throughout his or her daily life. The American Psychiatric Association, on the definition of anxiety, describes anxiety as the anticipation of a future danger or a negative event, accompanied by feelings of dysphoria or physical symptoms of tension (Perrotta,

2019). In particular, exam anxiety is a psychological response, consists of worry, stress, emotionality, lack of confidence, fear of failure, and interference that can be experienced by an individual before, during, and after an exam or similar situations (Roos et al., 2021). Many studies during the COVID-19 pandemic have reported an increase in learner anxiety-related problems during ROEs (Arora et al., 2021; Mastour & Ghalibaf, 2020; Sakka et al., 2020). Indeed, anxiety is one of the most common mental health symptoms experienced by students in stressful situations and tends to influence their learning activities (Popovych et al., 2022). The results of this study suggest that anxiety is likely a factor influencing students' ROE results, especially in the context of social distancing due to the pandemic. However, it is noted that the level of anxiety experienced by the students of this study was only at an occasional level.

Third, perceived ROEs Software refers to students' perception of the use of ROE software, and was measured by two items in this study. This factor is as significant as the "perceived ease of use" construct in the Technology Acceptance Model. To be specific, the factor focuses on understanding how students perceive the ease of use regarding ROE devices and applications. Statistical analysis demonstrates that students felt confused about using the supporting software, and thus the "ease of use" and "responding" constructs were not favoured by the students. In other words, the students may still experience dismay when using the software to conduct their ROEs at some points.

Fourth, the factor preparedness for ROEs, measured by 4 items in this study, examines students' preparation of knowledge, and technical equipment for ROEs. Preparation for the exam is important for students to perform well on the test and achieve the best possible test results. According to Elsalem et al.'s research (2021), students need a sufficient amount of time and effort to be well-prepared for the ROEs in the context of the COVID-19 pandemic. The study validated that students' preparation had a significant effect on students' achievement. However, the current study results showed that students were still neutral and unsure about their preparation for the ROEs (at the average means < 3.00).

Fifth, the factor of technical problems with ROEs consists of 3 items measuring students' experiences with technical issues, including network connection, power supplies, and assisting devices used during ROEs. Previously, a number of research has demonstrated other potential technical difficulties during ROEs, including the speed of Internet connection, the quality of ROE supporting applications (e.g., Learning Management System, Zoom...), hardware infrastructure and so on (Bishnoi and Suraj, 2020; Bisht et al., 2020). However, none of these studies showed how these technical glitches might have affected students' ROE performances. The results of this study, similarly, indicate that not all students experienced technical issues and in average, students in this study had neutral experience regarding technical problems during ROEs.

Regarding the correlation between the above factors and students' pre-ROE test results, the linear regression analysis indicated that the only factor, namely Attitudes towards ROEs, showed a statistically significant correlation. In other words, an increase in the levels of attitudes towards ROEs might lead to an increase in students'

exam results in the future ROEs. A number of studies on the Technology Acceptance Model (TAM) framework (Davis, 1989) also showed that this “ease of use” factor has been significant in predicting behavioral intentions to use (Salloum et al., 2019). According to some studies on the adoption of technology in education (2009), attitudes towards the use of technology in the general learning process, including testing, are influenced by Perceived Ease of Use (PEU) and Perceived Usefulness (PU) (Akman & Turhan, 2017; Salloum et al., 2019). One of Nguyen et al.’s studies (2021) on online learning in the context of the COVID-19 pandemic has also shown that this factor is influenced by computer playfulness. The results of this study further add that when attitudes towards the new technology is positive, students are more likely to have intentions to use the technology. This finding suggests future studies focus on the relationships between students’ perceptions and behaviors towards ROEs technologies and their performances.

4.2. Limitations

Although the study findings have, to a certain extent, contributed knowledge to the research field, the paper still has a number of limitations. First, the convenience sampling method lacks clear generalizability (Jager et al., 2017). Second, the study has not made a comparison between different regions, such as rural, urban and mountainous areas, to provide a more comprehensive picture of the use of ROEs across Vietnam. Therefore, as aforementioned, larger scale studies are highly needed to further investigate this issue.

4.3. Practical Implications and recommendations

ROE is a commonly used method of assessment in the context of social distancing in many countries around the world, including Vietnam. In the context of Vietnam education, this assessment method has shown to be useful as an urgent solution to deal with the impacts of the COVID-19 pandemic to ensure that the teaching and learning processes are not interrupted. This study, therefore, aims to identify the factors affecting the effectiveness of ROEs, as well as how these factors correlate with students’ pre-ROEs results. The findings suggest that there are both advantages and disadvantages to using ROEs. The results of this study are expected to not only provide a foundation for the online education and online examination research community, but also provide recommendations for educational practitioners, school administrators, and technical service providers on how to effectively support the remote online examination of high school students in Vietnam.

For the research community, the results of this study provide an initial foundation for either larger-scale or more specific studies on the use of ROEs. Specifically, studies on how to optimise the effectiveness of ROEs, or how to address the challenges of using ROEs are strongly needed. The study also suggests that researchers to further deepen the study by investigating how each of these newly found factors affects students’ performances. If there are distinguished effects, then in what ways students’ performances are benefitted from the use of ROEs. Moreover, studies on whether the use of ROEs might co-exist with the use of traditional examination method are also highly encouraged.

For the wider education community, for example, educators and teachers at high schools, it is recommended that educators provide strategies and teachers provide appropriate support and learning activities to prepare students for the ROEs. This is because those people have direct influences on students' learning process as well as exam preparation (Brophy, 1986).

As aforementioned, problems related to technical issues such as network connection, power supply, or lack of technical equipment during ROEs might lead to unsatisfactory experiences, as well as influence students' exam results (Ali & Dmour, 2021; Guangul et al., 2020). Therefore, regarding school administrators, in order to ensure effective procedures of ROEs, administrators need to be aware of any potential technical issues and challenges, and provide students with immediate support during ROE process. This might have positive impacts on students' experiences, motivation and attitudes towards the use of ROE. Moreover, it is also crucial that the schools keep in touch with the technology service providers to maintain technical and software quality during the examination period.

Acknowledgements

The article is the product of the Scientific Project at the Vietnam Institute for Educational Sciences on the topic "Research and Develop Assessment for the Measurement of Student's Readiness for Digital Transformation at High School Institutions in Vietnam", Code: V2021-20.

References

- Abdi, H., & Williams, L. J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, 2(4), 433–459.
- Akman, I., & Turhan, C. (2017). User acceptance of social learning systems in higher education: an application of the extended Technology Acceptance Model. *Innovations in Education and Teaching International*. <https://doi.org/10.1080/14703297.2015.1093426>
- Ali, L., & Dmour, N. (2021). The shift to online assessment due to COVID-19: An empirical study of university students, behaviour and performance, in the region of UAE. *International Journal of Information and Education Technology*, 11(5), 220–228.
- Arora, S., Chaudhary, P., & Singh, R. K. (2021). Impact of coronavirus and online exam anxiety on self-efficacy: the moderating role of coping strategy. *Interactive Technology and Smart Education*.
- Bishnoi, M. M., & Suraj, S. (2020). Challenges and Implications of Technological Transitions: The Case of Online Examinations in India. *2020 IEEE 15th International Conference on Industrial and Information Systems (ICIIS)*, 540–545.
- Bisht, R. K., Jasola, S., & Bisht, I. P. (2020). Acceptability and challenges of online higher education in the era of COVID-19: a study of students' perspective. *Asian Education and Development Studies*.

- Bozkurt, A., & Sharma, R. C. (2020). Emergency remote teaching in a time of global crisis due to CoronaVirus pandemic. *Asian Journal of Distance Education*, 15(1), 2020. <https://doi.org/10.5281/zenodo.3778083>
- Brophy, J. (1986). Teacher influences on student achievement. *American Psychologist*, 41(10), 1069.
- Butler-Henderson, K., & Crawford, J. (2020). A systematic review of online examinations: A pedagogical innovation for scalable authentication and integrity. *Computers and Education*, 159(May), 104024. <https://doi.org/10.1016/j.compedu.2020.104024>
- Chiu, T. K. F. (2021). Applying the self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic. *Journal of Research on Technology in Education*, 1–17.
- Chuttur, M. (2009). Overview of the Technology Acceptance Model: Origins , Developments and Future Directions. *Sprouts: Working Papers on Information Systems*, 9(37), 1–23. <https://doi.org/10.1021/jf001443p>
- Cohen, L., Manion, L., & Morrison, K. (2012). Research methods in education. In *Professional Development in Education* (6th ed., Vol. 38, Issue 3). Routledge.
- Davis, F. (1989). *Perceived Usefulness , Perceived Ease of Use , and User Acceptance of Information Technology*. <https://doi.org/10.2307/249008>
- Elsalem, L., Al-Azzam, N., Jum'ah, A. A., & Obeidat, N. (2021). Remote E-exams during Covid-19 pandemic: A cross-sectional study of students' preferences and academic dishonesty in faculties of medical sciences. *Annals of Medicine and Surgery*, 62, 326–333.
- Elsalem, L., Al-azzam, N., Jum, A. A., Obeidat, N., Mahmoud, A., & Kheirallah, K. A. (2020). Stress and behavioral changes with remote E-exams during the Covid-19 pandemic : A cross-sectional study among undergraduates of medical sciences. *Annals of Medicine and Surgery*, 60(October), 271–279. <https://doi.org/10.1016/j.amsu.2020.10.058>
- Fishbein, M., & Ajzen, I. (1975). Strategies of Change: Active Participation. In *Belief, attitude, intention, and behavior: An introduction to theory and research*.
- Gradišek, P., & Polak, A. (2021). Insights into learning and examination experience of higher education students during the Covid-19 pandemic. *Journal of Contemporary Educational Studies*, 72(138), 286–307.
- Guangul, F. M., Suhail, A. H., Khalit, M. I., & Khidhir, B. A. (2020). Challenges of remote assessment in higher education in the context of COVID-19: a case study of Middle East College. *Educational Assessment, Evaluation and Accountability*, 32(4), 519–535.
- Hair Jr, J. F., William, C., Babin, B. J., & Anderson, R. E. (2014). Multivariate data analysis Joseph F. Hair Jr. William C. Black.
- Hash, P. M. (2021). Remote Learning in School Bands During the COVID-19

- Shutdown. *Journal of Research in Music Education*, 68(4), 381–397. <https://doi.org/10.1177/0022429420967008>
- Jager, J., Putnick, D. L., & Bornstein, M. H. (2017). II. More than just convenient: The scientific merits of homogeneous convenience samples. *Monographs of the Society for Research in Child Development*, 82(2), 13–30.
- Kaiser, H. F., & Rice, J. (1974). Little jiffy, mark IV. *Educational and Psychological Measurement*, 34(1), 111–117.
- Li, M., Luo, L., Sikdar, S., Nizam, N. I., Gao, S., Shan, H., Kruger, M., Kruger, U., Mohamed, H., Xia, L., & Wang, G. (2021). Optimized collusion prevention for online exams during social distancing. *Npj Science of Learning*, 6(1). <https://doi.org/10.1038/s41539-020-00083-3>
- Mastour, H., & Ghalibaf, A. M. (2020). Remote online exams anxiety during the COVID-19 crisis: A cross-sectional study among medical students. *Pre-Report Research Square*, 1–13. <https://doi.org/10.21203/rs.3.rs-144112/v1>
- Matthíasdóttir, Á., & Arnalds. (2016). E-assessment: students' point of view. *Proceedings of the 17th International Conference on Computer Systems and Technologies 2016*, 369–374.
- Milman, N. B. (2020). Pandemic pedagogy. *Phi Delta Kappan*, 25.
- Ministry of Education and Training. (2021). Regulations on the management and organization of online teaching in general education institutions and continuing education institutions. Retrieved from <https://moet.gov.vn/Pages/home.aspx>
- Ngqondi, T., Maoneke, P. B., & Mauwa, H. (2021). A secure online exams conceptual framework for South African universities. *Social Sciences & Humanities Open*, 3(1), 100132.
- Nguyen, X., Pho, D., Luong, D., & Cao, X. (2021). Vietnamese students' acceptance of using video conferencing tools in distance learning in COVID-19 pandemic. *Turkish Online Journal of Distance Education*, 22(3), 139–162.
- Perrotta, G. (2019). Anxiety disorders: definitions, contexts, neural correlates and strategic therapy. *J Neur Neurosci*, 6(1), 42.
- Popovych, I., Kokorina, Y., Pyslar, A., Palchynska, M., Pavliuk, M., Raievska, Y., & Torop, K. (2022). Research of the Mental States of Anxiety of Fourth-Graders in Secondary Schools during the Progression of the COVID-19 Pandemic. *Revista Romaneasca Pentru Educatie Multidimensionala*, 14(1), 32–51.
- Roos, A.-L., Goetz, T., Voracek, M., Krannich, M., Bieg, M., Jarrell, A., & Pekrun, R. (2021). Test anxiety and physiological arousal: a systematic review and meta-analysis. *Educational Psychology Review*, 33(2), 579–618.
- Sakka, S., Nikopoulou, V. A., Bonti, E., Tatsiopoulou, P., Karamouzi, P., Giazkoulidou, A., Tsiropoulou, V., Parlapani, E., Holeva, V., & Diakogiannis, I. (2020). Assessing test anxiety and resilience among Greek adolescents during COVID-19 pandemic. *Journal of Mind and Medical Sciences*, 7(2), 173–178.

- Saldaña, J. (2020). Qualitative data analysis strategies. In *The Oxford handbook of qualitative research*.
- Saldaña, J. (2021). The coding manual for qualitative researchers. *The Coding Manual for Qualitative Researchers*, 1–440.
- Salloum, S. A., Qasim Mohammad Alhamad, A., Al-Emran, M., Abdel Monem, A., & Shaalan, K. (2019). Exploring students' acceptance of e-learning through the development of a comprehensive technology acceptance model. *IEEE Access*, 7, 128445–128462. <https://doi.org/10.1109/ACCESS.2019.2939467>
- Shamir-Inbal, T., & Blau, I. (2021). Facilitating Emergency Remote K-12 Teaching in Computing-Enhanced Virtual Learning Environments During COVID-19 Pandemic - Blessing or Curse? *Journal of Educational Computing Research*, 1–29. <https://doi.org/10.1177/0735633121992781>
- Thi Thu Dao, H., & Thi Kim Le, T. (2020). Transitioning from Traditional Learning to Blended Learning at Some Public Universities in Vietnam after the Covid-19 Pandemic. *2020 The 4th International Conference on Advances in Artificial Intelligence*, 85–91.
- UNESCO. (2020). *COVID-19 Educational Disruption and Response*. UNESCO. https://en.unesco.org/covid19/educationresponse/?fbclid=IwAR02k1vFOMp_mi5ruDcuCw_Gs0lz5CgEC_TEEpTZFdwjqR9Kb754Qp1Fivl
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. , 425-478. *MIS Quarterly*, 425–478.
- WHO. (2020). *Rolling updates on coronavirus disease (COVID-19)*. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen>.