Original scientific paper

UDK:
37.018.43:621.395.721.5
165.021-057.87

Received: March, 18.2022.
Revised: July, 19.2022.
Accepted: July, 26.2022.

doi: 10.23947/2334-8496-2022-10-2-51-68

The Development of Critical Thinking Skills in Mobile Learning: Fact-Checking and Getting Rid of Cognitive Distortions

Yulia Gavronskaya[1], Liudmila Larchenkova[2], Anna Berestova[3], Valentina Latysheva[4], Sergei Smirnov[5]*

[1]Department of Chemical and Environmental Education, The Herzen State Pedagogical University of Russia, St. Petersburg, Russian Federation, e-mail: yugavronskaya@rambler.ru
[2]Department of Methods of Teaching Physics, The Herzen State Pedagogical University of Russia, St. Petersburg, Russian Federation, e-mail: llarchenkova@rambler.ru
[3]Institute of Clinical Morphology and Digital Pathology, I. M. Sechenov First Moscow State Medical University (Sechenov University), Moscow, Russian Federation, e-mail: anberestova6@rambler.ru
[4]Department of Sociology, Psychology and Social Management, Moscow Aviation Institute (National Research University), Moscow, Russian Federation, e-mail: valatysheva33@rambler.ru
[5]Department of Philosophy and Sociology, Kazan Federal University, Elabuga Institute, Elabuga, Russian Federation, e-mail: ssmirnov337@rambler.ru

Abstract: The study aims to reveal the attitude of students and teachers to mobile learning; explore the possibility of developing critical thinking skills in mobile learning; and also evaluate knowledge after a short training course involving the use of mobile technologies in the context of the development of critical thinking. The research relies on an interview and a test. It was attended by 275 people (93 teachers and 182 students). The results showed that 58% of teachers and 55% of students believe that mobile learning does not contribute to the development of critical thinking. The test results showed that the study participants who pre-listened to the course of lectures on their mobile devices did not cope with the questions well enough, and cognitive errors were identified. The research has shown that improving the skills of interpreting, analyzing, evaluating and explaining information can increase the effectiveness of mobile learning. The research is a contribution to the study of various aspects of the impact of mobile learning on students and will be of interest to teachers, students, academic administration, parents, as well as to those who are interested in modern pedagogy and educational psychology.

Keywords: cognitive errors, critical thinking, development of critical thinking, getting rid of cognitive distortions, mobile learning.

Introduction

The rapid development of digital technologies, as well as the events of the last two years (the Covid-19 pandemic, lockdown) have made the use of mobile learning almost mandatory for pupils and students around the world (Demir and Akpinar, 2018). Mobile learning is a form of distance learning delivered with the help of handheld devices. This is a new kind of opportunities allowing students to gain new knowledge that occurred due to the development of teaching technologies (Cahyana et al., 2018).

Many researchers, in particular in developed countries, see a number of benefits of mobile learning. For example, both teachers and students in the United States note the positive impact of digital technology on learning. Educators see a number of positive benefits of digital teaching tools; 52% note that their students are more motivated to learn, 36% are confident that students develop creativity, 29% believe that problem solving and critical thinking are improving, 7% say their students put knowledge into practice, 26% believe that students take responsibility for their learning (West, 2013).

Despite the fact that not all countries and not all segments of the population can afford to use mobile devices and the Internet, most people have them. Despite the fact that students demonstrate an interest in mobile learning, they are not yet ready enough to implement it and do not know how it can facilitate the learning process (Ismail, Azizan and Gunasegaran, 2016). Few learners have experience

*Corresponding author: yugavronskaya@rambler.ru

of effective application of mobile learning, solid assimilation of knowledge in the course of such learning; there are also problems with time management, information quality control, etc.

The main and most important practical value of mobile learning is the use of portable technologies and devices in the learning environment to overcome issues of time and place. In addition to this change in education with wide access to information, communication, and cooperation developed a number of skills in students. Among them is the ability to create students' own learning context interacting with each other and the environment in the real and virtual worlds (Al-Adwan, Al-Madadha and Zvirzdinaite, 2018). It is worth defining the difference between variable online learning and mobile learning. The second option involves the use of gadgets both outside the classroom and directly in the classroom (these two formats can alternate in modern realities). Online learning is a purely distance form of education using mobile technologies (Singh and Thurman, 2019).

In the learning process, it is important to observe regular progress; it should maximize the development of useful qualities and skills. It is also important to exclude or minimize the possible negative impact of teaching methods on students, especially on children.

Today one of the most important skills is critical thinking. It allows people to adequately respond to the events of the world around and make the right informed decisions (Hitchcock, 2020). The issue of developing critical thinking in mobile learning is one of the most important in the modern pedagogical environment as in this type of training there is a number of features, such as the lack of direct contact with the teacher, the lack of communication with peers, the problem of the quality of information on the Internet, etc. (Larsson, 2017). These problems often lead to the emergence of cognitive distortions that impede the high-quality assimilation of educational information by students. Due to the fact that mobile learning is almost inevitable today, it is necessary to search for ways and means of its development and application in this type of learning.

Nowadays, information is a commodity and its accuracy should always be checked. Fact-checking is one of the basic elements not only of science but also of any other activity (López-García, Costa-Sánchez and Vizoso, 2021). There are specific methods of verification that are specific to each science, as well as universal methods for any field of activity, such as economics, physics, and chemistry.

This study aims to explore the ways of developing critical thinking skills in mobile learning and overcoming cognitive distortions that arise in its process. The two assumptions (hypotheses) made on the basis of the literature review have been tested: hypothesis 1 – mobile learning significantly contributes to the development of critical thinking, hypothesis 2 – cognitive distortions are often experienced by learners using mobile devices.

The research is a study aimed at studying the benefits and / or harm of mobile learning, its impact on the development of critical thinking in students, emerging cognitive distortions and ways to solve existing problems.

Literature review

Mobile learning is a type of learning that allows learners to make their studies independent of place and time. When using educational technologies, the learner plans, arranges, implements and evaluates their studies as it is them who manage these activities. Accordingly, the student is not a passive person who receives the information needed but a person who uses cognitive and mega-cognitive abilities to complete a task. Therefore, a mobile learning user improves their higher-order thinking skills (Sönmez et al., 2018). One of the studies was aimed at the configuration of hybrid laboratories with a virtual component of strong learning and variables (stationary and mobile). Just such a variable, a physical component, is especially needed at the initial stages of mastering laboratory equipment: stationary devices are studied in educational laboratories and in real geodetic practice, portable counterparts (Hernández-de-Menéndez, Vallejo Guevara and Morales-Menendez, 2019).

Mobile learning is beginning to enter the life of people and the attitude towards it is ambiguous. According to scientists, the introduction of technology to students and their wider application in the learning process contribute to a general improvement in learners' attitude to mobile learning (Cavus and Uzunboylu, 2009). For example, students create a continuous link between place, time, and learning content through mobile devices connected to a wireless network, by their tasks. The portable feature of gadgets makes them a more attractive way to process information. Language learners can combine mobility and the real world by learning unfamiliar words using smartphone apps in transit or anywhere else (Cohen and Ezra, 2018). Thus, most research proves the effectiveness of mobile learning. It, in turn, affects the development of critical thinking skills in mobile learning.

In the 21st century, the major emphases in education are as follows: development of innovation and independent learning skills; critical thinking and problem-solving skills; skills of communication and

cooperation with other people; creativity; media and technical skills; technological (ICT) and information literacy; knowledge and skills that facilitate life and work (Franklin, 2011). Mobile learning can help with most of them. However, today in the context of globalization and digitalization, there is a problem of the quality of information on the Internet as it can be posted by anyone; not all online resources are reliable, valuable and accurate. For example, on social networks, all users can share posts, articles, etc. At the same time, the information may be inaccurate, and sometimes deliberately incorrect in order to mislead people or advertise some products or services. There is a problem with online information assessment skills and a lack of ability to use assessment criteria, including relevance, authority, accuracy and purpose (Parsazadeh, Ali and Rezaei, 2018). This leads to the use of low-quality information for various purposes, including education. Researchers offer the following tools that can help users determine the quality of information on the Internet: a) Performance Monitoring; b) Site Analyzer; c) Traffic Analyzer; d) Web Mining; e) User Feedback (Eppler and Muenzenmayer, 2002). In addition to these tools, the ability to think critically and evaluate independently is also required.

Some scientists have confirmed the development of critical thinking skills in mobile learning. The most popular strategy was a combination of educational technologies. Other strategies (situational learning, expert assessment and project-based learning) can also be applied (Ismail, Azizan and Gunasegaran, 2016).

Learning should (1) empower learners to reach their potential through access to educational resources and experts allowing them to transcend their schools or communities; (2) engage students in a rich and engaging learning experience that develops deeper knowledge and skills, in particular problem solving, creativity, and critical thinking skills that are required in the workplace; (3) provide students with the opportunity to take responsibility for their education and explore knowledge with unlimited curiosity thereby encouraging lifelong learning (Franklin, 2011).

Critical thinking involves the ability to be critical of any statement, not to believe information without evidence, and at the same time be open to new methods and ideas. It builds the foundations for the freedom of choice, responsibility for one's own decisions, and the reliability of forecasts (Hitchcock, 2020).

Critical thinking directly relates to cognitive skills. Critical thinking is seen as a self-regulating process that arises from the development of skills such as interpretation, analysis, assessment and explanation that go beyond technical skills. It can be considered a metacognitive process (Nussbaum et al., 2021).

In the process of mental activity, cognitive distortions are inevitable; these are errors caused by the very mechanism of thinking and the bounded rationality of people.

Various psychologists offer their own lists of cognitive distortions. Some of them are listed below:

1. All-or-nothing thinking (dichotomous thinking): all situations are either black or white.
2. Fortune telling (e.g. catastrophizing): the future is always negative, regardless of other less catastrophic possibilities.
3. Discounting the positive: attention to the negative aspects of the situation and discounting any positive elements.
4. Emotional Reasoning: Too much emphasis is placed on the emotions associated with the situation despite evidence to the contrary.
5. Labeling: the application of a fixed label to a person or situation despite evidence to the contrary.
6. Exaggeration or minimization: exaggeration of the negative aspects of a person or situation and minimization of the positive ones.
7. Selective abstraction (mental filter): attention to one detail of the stimulus at the expense of the whole.
8. Mind reading: believing that a person knows the thoughts of others.
9. Over-generalization: a false conclusion about a person or situation based on previous experience.
10. Personalization: misattribution of the words or actions of others to oneself.
11. Should-statements: assigning rules of behavior to oneself and other people.
12. Jumping to conclusions: erroneous conclusions without considering all aspects of the situation.
13. Blaming: blaming oneself or others for hardship or pain despite evidence to the contrary.
14. What if: negative hypotheses about the situation or the future.
15. Unfair Comparisons: comparing oneself to others in a disadvantageous way (Denton, Baliram and Cole, 2021).

It is necessary to note that the cognitive errors listed above are connected not with a concrete kind of activity, but with features of reception and interpretation of the information during communication with other people.

The development of technology and digital information along with a decrease in civic engagement and citizen confidence can lead to distorted presentation and acquisition of information (Addy, 2020).

The proliferation of fake news, traditional and digital media, as well as civic platforms have initiated departments, working groups and spaces to fact-check information posted on other media, spread on social media, or hailed by political leaders (López-García, Costa-Sánchez and Vizoso, 2021).

The main ways to check information from the Internet are a critical approach, search for the original data source and comparison of different sources, consideration of contrary viewpoints, learning to recognize fakes and check the accuracy of facts (for example, using Fakecheck.ru), etc. (Gorokhovsky, 2017).

Several researchers have noted the relationship between cognitive errors and anxiety. Cognitive errors may be associated with anxiety in adolescents and lead to increased anxiety. Adolescents suffering from teen depression are more prone to cognitive errors of all types (e.g., catastrophizing, personalization, selective abstraction and overgeneralization) compared to their healthy peers (Rehna, Hanif and Tariq, 2012). Cognitive errors account for 78% of the deviations in anxiety among adolescents (Rehna, Hanif and Aqeel, 2020).

A similar thing can be observed in students, especially junior students, as well as in some adults (Salek Ebrahimi et al., 2019). It proves the need to make better the psychological state of children and adolescents in order to reduce rates of cognitive errors.

The process of critical thinking has its own stages and components. There is a classification of scientific knowledge (mathematics, physics), a general analytical framework is created, which includes basic information elements:

- Situational knowledge – initial assumption, parameter
- Conceptual knowledge – guiding principle, theory, concept
- Procedural knowledge – any (e.g. mathematical) manipulation or step-by-step computation to support a solution (Gong et al., 2016).

There is a problem with the relationship between critical thinking and emotion and intuition. The problem is exacerbated by the fact that there are circumstances of a multilingual and multicultural world. The main features of critical thinking are as follows: critical thinking is an exclusively independent process; information is only the beginning of the process of critical thinking, and not a finished product; meaningful argumentation is required; critical thinking is connected with society (everything is checked and improved when communicating with other people) (Hough, 2015; Sapukh, 2014).

Intuition enables one to quickly process multiple pieces of information without appreciable cognitive effort. Intuitive processes in judgment and decision making are responsible for integrating information and shaping response (e.g., preference, choice), where analytical thinking mainly guides the shaping of outcome, e.g., searching, summarizing, and changing information (Betsch and Glockner, 2010).

Critical thinking is one of the prerequisites for creativity. Creativity can be defined in a variety of ways, including by cognitive processes, personality traits, and environmental conditions, as well as the interaction of these components. Critical thinking can be viewed as a multidimensional cognitive construct that involves inductive and deductive reasoning, as well as creative processes that interact at different stages of problem-solving (Wechsler et al., 2018).

Today, creativity is an essential quality and various approaches are used for its development, for example, training, workshops, case studies. Thus, having completed training on creativity, people began to feel more creative, which led to higher confidence in their own creativity, as well as a desire to take more risks with their ideas (Perry and Karpova, 2017).

The literature review shows that mobile learning is popular today and has many benefits, including its positive impact on the development of critical thinking and cognitive skills in learners. Mobile learning does not provide a possibility to communicate with the teacher easily and thus makes students think themselves more. It also provides a large amount of visual information. While listening to the online lectures students can stop the video and review the necessary material. However, it also has a number of disadvantages, some of which will be analyzed in the study.

Setting objectives

Nowadays, the issue of studying various aspects of mobile learning is more relevant than ever before. It is rapidly being introduced into the educational process of pupils, students, and all other people who want to change their profession, improve their qualifications or learn something new. Despite a number positive reviews, there is also an opinion that mobile learning can have a negative impact on students. The study aims to determine the effect of mobile learning on critical thinking and identify whether it develops critical thinking skills and whether there are ways to improve the situation. Since critical thinking is a universal quality of personality, the study of the possibilities of its development should be interdisciplinary in nature, so this study involved specialists in different areas - economics, physics, chemistry.

The purpose of the research is to study the impact of mobile learning on the development of critical thinking skills, identify cognitive errors in this process (if these occur) and offer recommendations for improving the situation.

The objectives of the study include examining the impact of mobile learning on the development of critical thinking skills; verification of information received from other sources; identifying possible methods for improving critical thinking and overcoming cognitive errors in the process of mobile learning.

Materials and Methods

Research design and sample

The research was based on interviews and tests. A similar research method was used by El-Sofany and El-Haggar (2020), Ismail, Azizan and Gunasegaran (2016), Kurniati and Annizar (2017). The study consisted of two parts.

Part 1: The students and teachers were invited to watch a short video on critical thinking (by IFO, https://www.youtube.com/watch?v=MmlhUTvZj30) in a classroom followed by a survey. The video talked about critical thinking, its definition, components, and principles (analysis, justification, assessment). Critical thinking film viewing and the study itself took place on May 2021.

The participants were provided with printed interview questions (9 in total), as some of them contained lists of answer options. Question 1 and question 9 were open-ended, the others (2-8) had answer options.

Part 1 (interview questions):

1. Can you define critical thinking?
2. What do you need critical thinking for? Answer options: “for the formation of an independent opinion”, “for self-development”, “for the development of communication skills”, “for making non-standard decisions”, “for finding the right solution”, “for the development of scientific thinking”, “not to be deceived”, “not to succumb to propaganda”, “for controlling emotions and intellect”, “for the manifestation of one’s own individuality”, “for other reasons”.
3. What’s your attitude to mobile learning? Answer options: “positive”, “negative”, “contradictory”, “neutral”.
4. To what extent do you think mobile learning supports / does not contribute to the development of critical thinking? Answer options: “contributes”, “does not contribute”.
5. Do you think that the disciplines you study at university contribute to the development of critical thinking? (Answer options: “yes”, “no”).
6. Do you think that the subjects you studied in school contribute to the development of critical thinking? (Answer options: “yes”, “no”).
7. Which of the subjects listed do you think will develop critical thinking the most? (Answer options: “logic”, “philosophy”, “sociology”, “history”, “behavior in emergency conditions”, “psychology”, “political science”, “public speaking”, “project activities”, “mathematics”, “ philology and native language”, “the basics of neurolinguistic programming”, “natural science”, “religious studies”, “economics”, “sociology”, “your alternative”).
8. Do you think it is possible to effectively study the above subjects with the help of mobile learning? (Answer options: “yes”, “no”, “not sure”).
9. Share your opinion on developing critical thinking in mobile learning.

Part 2 (examples of the test questions (20 questions in total)) (Studmed, 2021):

1. An insurance contract is a document required to conclude an insurance transaction (+ yes; no);
2. Is there a connection between the average life expectancy and the life insurance rate (+ yes; no)?;
3. Does the insurer know in advance the amount of life insurance policy pay out (+ always; depends on the terms of the policy; never)?;
4. Who has the obligation to prove the value of the loss (+ insured; expert; insurer)?;
5. Is it possible that the insurance sum is greater than the insured value under the contract (yes; + no)?;

Part 2. Students and faculty were required to take a short course in their major on a mobile device. Some participants took a course in economics and insurance (8 lessons, 30 minutes each) and took a test to assess their knowledge (20 questions / 15 minutes). The course was taught and developed by a teacher from Kazan Federal University. Part of research participants studied / taught economics; therefore, the

topic was the basics of insurance. The topics included an overview lecture, insurance contract, types of insurance, and insurance risks. Another part of the participants was studying natural sciences (chemistry, physics); for them an integrated course on conductivity of electrolyte solutions was offered, which also included an overview lecture, description of quantitative relationships, characterization of their constituent quantities, physical and chemical research methods. The course was taught by an instructor from Herzen University. Both courses were taught using Zoom software.

The materials and questions used in the study are our own development.

After watching a film with economic content (insurance) or natural science (electrical conductivity of electrolyte solutions) the participants took a short test. The test determined how well the learners perceived the information displayed on the mobile phone screen. There were no direct answers to the questions in the films, but they were clear from the information provided.

The result was described as positive when 70% of the test was correctly solved. Less than half of all the participants demonstrated such a result. Only 7 out of 20 questions received more than 70% of correct answers (8 by teachers and 5 by students).

Survey

The study involved 93 teachers (24-52 years old) and 182 students of various specialties (19-21 years old), a total of 275 people from Kazan Federal University (the Russian Federation), Moscow Aviation Institute (National Research University, the Russian Federation), Sechenov First Moscow State Medical University (the Russian Federation) and Herzen University (the Russian Federation).

Data analysis and statistical processing

The results of the interview were recorded, transcribed into a Word document, analyzed, and summarized. The test results were entered into an Excel spreadsheet and analyzed, including with the help of the SPSS program.

Ethical issues

The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. The research was approved by the local ethics committees of Herzen University. Each research participant gave their written consent to participate in the study. The invitation leaflets that were previously distributed to the students contained complete research information.

Research limitations

The study can be considered reliable, but it should be noted that it was conducted at four universities of the Russian Federation, and the number of participants was limited. An identical study conducted in other countries may provide different results.

Results

Part 1

The answers to the interview questions are as follows:

1. Can you define critical thinking?

Five per cent of the interviewees noted that they could not answer the question. They were all students. The examples of teachers' answers: "the ability to assess the situation independently", "not to perceive everything in good faith", "to be able to give one's own assessment of the situation", "not to be affected by other people's ideas." The examples of students' answers: "the ability to critically perceive the information received or seen", "to question some facts", "to have one's own opinion about everything."

These results show that both the majority of students and teachers generally understand what critical thinking is. The answers are similar to those contained in the video. The research participants emphasize that critical thinking should protect them from the negative effect of information from the outside, imposed opinions and beliefs. The fact that 5% of students could not answer this question is most likely due to the fact that they were inattentive while watching the video, or the topic was not interesting to them. Therefore, there is a need to explain to university students the importance of acquiring critical thinking skills.

2. What do you need critical thinking for?

The question contained answer options and the students had to choose the most suitable one for them. Answer options: "for the formation of an independent opinion", "for self-development", "for the development of communication skills", "for making non-standard decisions", "for finding the right solution",

"for the development of scientific thinking", "not to be deceived", "not to succumb to propaganda", "for controlling emotions and intellect", "for the manifestation of one's own individuality", "for other reasons" (Zhukotskaya and Chernenkaya, 2019) (Figures 1 and 2).

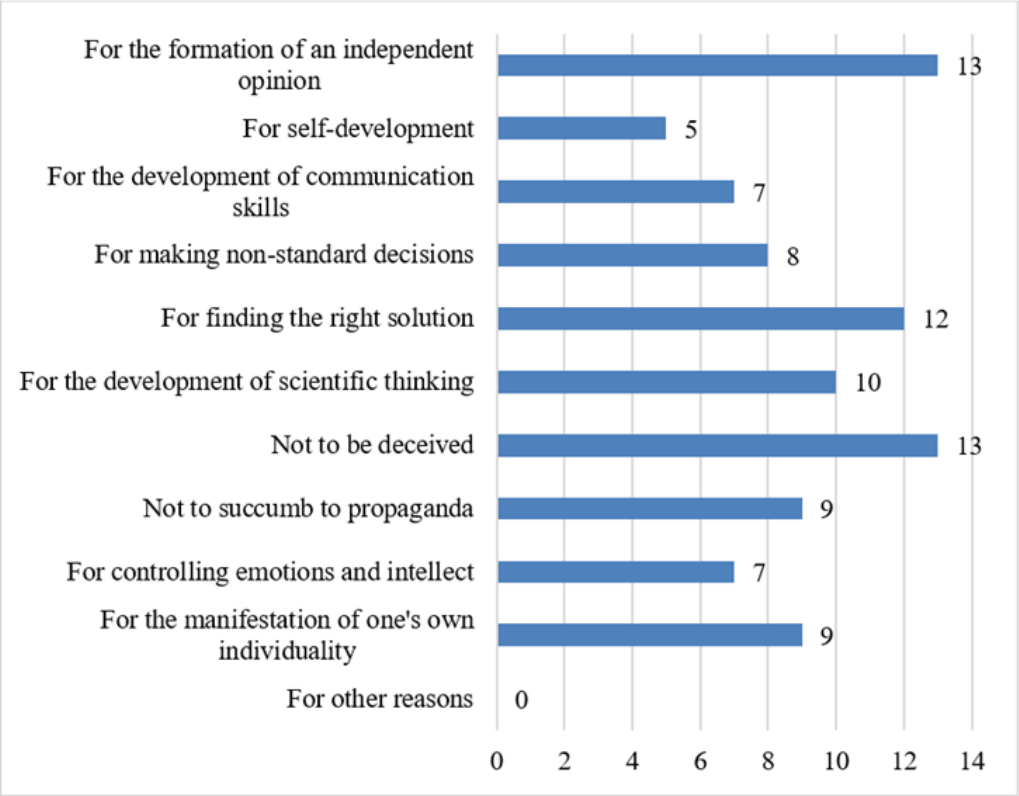


Figure 1. The answers to interview question 2 (teachers)

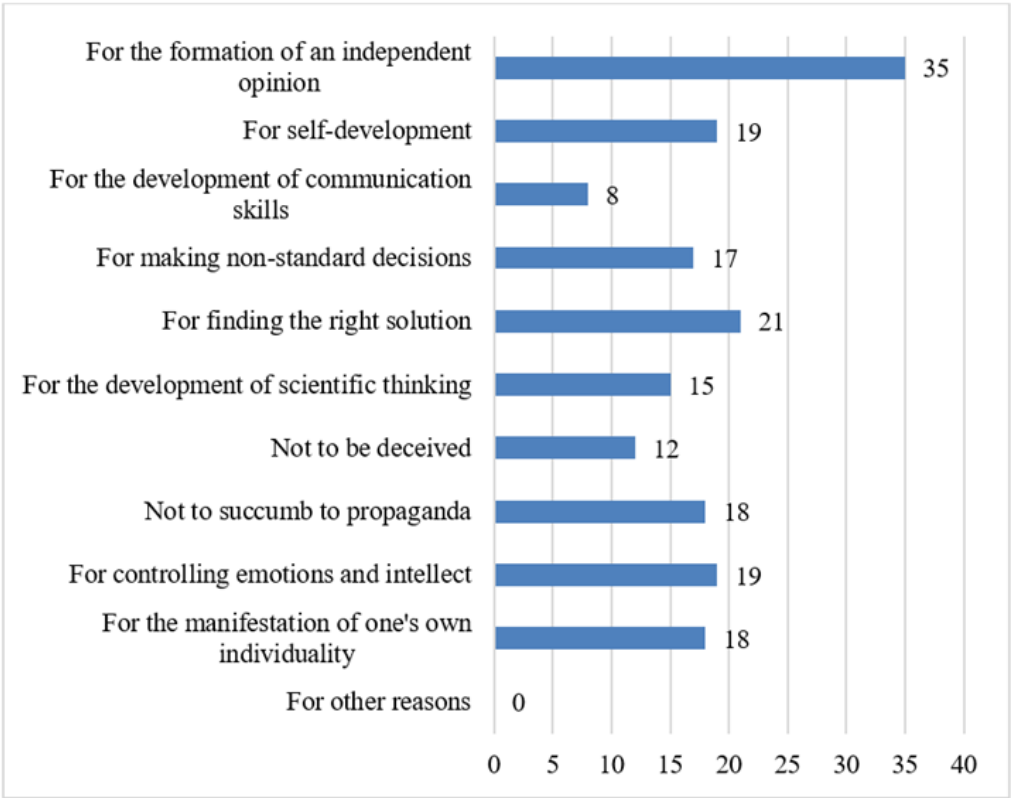


Figure 2. The answers to interview question 2 (students)

Teachers believe that critical thinking is needed to "form an independent opinion", "not to be deceived" and "to find the right solution." Among the students, the most popular answers were "to form an independent opinion", "to find the right solution", "for self-development" and "to control emotions and intellect". The opinions of teachers and students were similar. Goals such as "to make non-standard decisions," "to develop scientific thinking," and "to manifest one's own individuality" were generally found to be less popular among survey participants.

3. What's your attitude to mobile learning?

Answer options: "positive" (28 teachers and 42 students), "negative" (36 teachers and 47 students), "contradictory" (29 teachers and 34 students), "neutral" (0 teachers and 59 students).

As noted above, today the attitude of people towards mobile learning is ambiguous. Only a minority of teachers and students have a positive opinion of it. Due to the fact that there is a need for a large-scale introduction of technologies in the field of education, it is possible to recommend that education authorities work on the opinion of the population and mobile learning, for example, by conducting training, equipping classrooms with innovative teaching tools, contributing to the exchange of experience, etc.

4. Does mobile learning contribute to critical thinking (or not)?

Answer options: "contributes" (39 teachers and 81 students), "does not contribute" (54 teachers and 101 students). As can be seen, the majority of respondents (58% and 55%) believe that mobile learning does not contribute to the development of critical thinking. This partially stems from the problems that were mentioned in question 3. As a solution to this issue, the development of high-quality educational applications for mobile devices can be recommended along with the improvement of technological skills, time management, etc.

5. Do you think that the disciplines you study at university contribute to the development of critical thinking? ("yes", "no").

Fifty-two teachers and eighty-three students answered positively while forty-one teachers and ninety-nine students answered negatively. Accordingly, teachers have a better opinion of university disciplines in the context of developing critical thinking compared to students. Based on these results, it can be concluded that many students are not interested in studying a number of university disciplines as they consider them impracticable. To improve the situation, it is necessary to make the method of presenting the material more interesting with an emphasis on the practical application of the knowledge gained.

6. Do you think that the disciplines you study at university contribute to the development of critical thinking? ("yes", "no").

Sixty-eight teachers and one hundred and one students answered this question in the affirmative. Twenty-five teachers and eighty-one students answered in the negative. Most teachers and students believe that school subjects contribute to the development of critical thinking. The results show that the respondents consider school subjects to be more useful. This is probably due to the peculiarities of teaching methods and tutorial work at school. Accordingly, the teaching methodology of some university disciplines should be revised.

7. Which of the following do you think will develop critical thinking the most?

A list of subjects was given but the participants could also come up with their own options: logic, philosophy, sociology, history, behavior in emergency conditions, psychology, political science, public speaking, project activities, mathematics, philology and native language, foreign philology, the basics of neurolinguistic programming, natural science, religious studies, economics, physics, chemistry, your alternative (Zhukotskaya and Chernenkaya, 2019) (Figures 3 and 4).

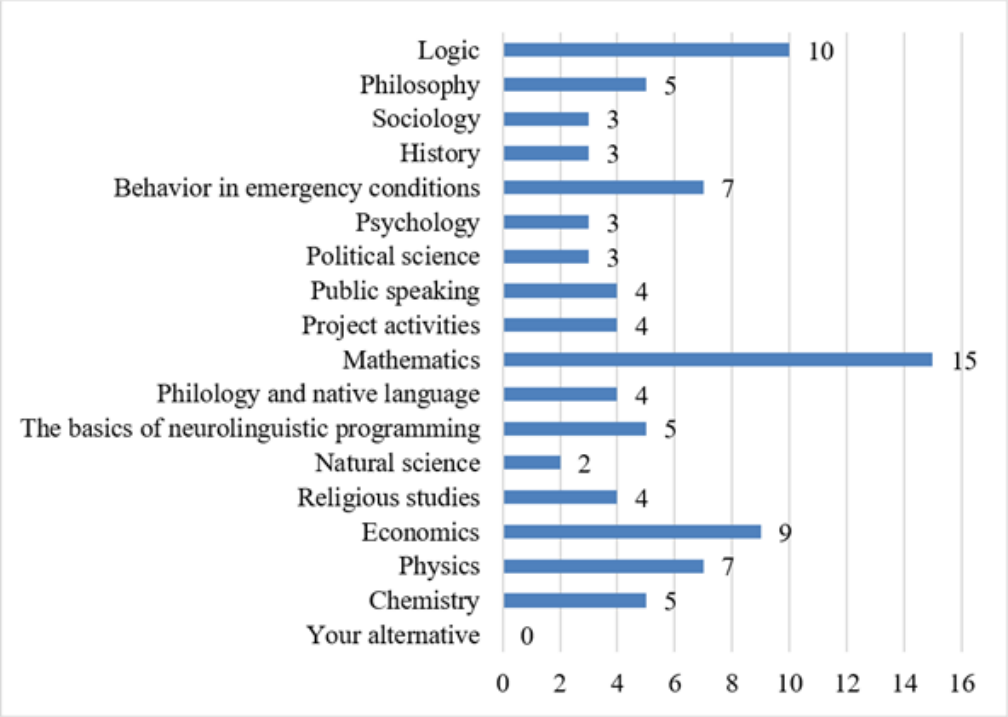


Figure 3. Teachers' answers to question 7

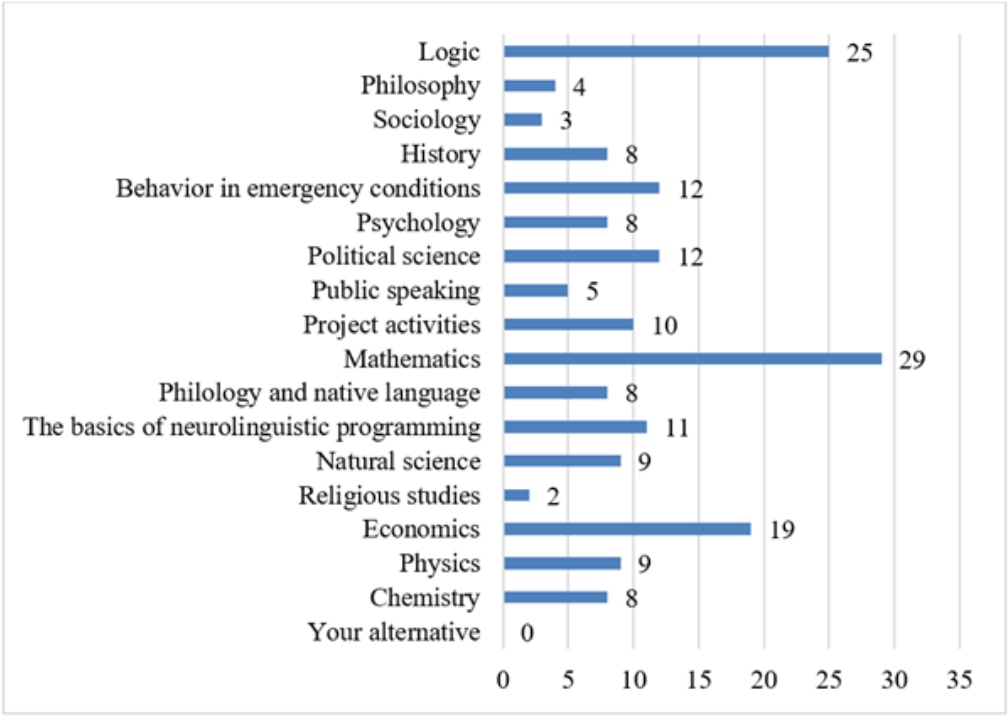


Figure 4. Students' answers to question 7

According to teachers and students, the subjects that develop critical thinking the most are mathematics, logic and economics. It is a common belief that these subjects contribute to the development of critical thinking. It is necessary to explain to students that other subjects (including humanitarian ones) are also important and improve critical thinking skills.

8. Is it possible to effectively study the above subjects with the help of mobile learning? ("yes", "no", "not sure").

Thirty-eight teachers and seventy-two students answered this question in the affirmative; forty-

six teachers and one hundred and two students answered in the negative. The “not sure” option was selected by 9 teachers and 8 students. Most teachers and students believe that these subjects cannot be effectively studied in the context of mobile learning. To solve this problem and increase motivation for mobile learning, we can recommend the development of interesting online courses, the active use of technology in the classroom, a combination of traditional and modern teaching methods. On this point, physicists and chemists are generally against mobile learning because they are experimental subjects, but learning theoretical material is acceptable in such cases as lockdown.

9. Share your opinion on developing critical thinking in mobile learning.

The teachers and students (optional) provided detailed answers to the question, for example:

Respondent 1 (teacher): “In my opinion, mobile learning does not provide an opportunity for live communication between teachers and students, which prevents the development of critical thinking.”

Respondent 2 (teacher): “Critical thinking can only develop if students are serious about mobile learning.”

Respondent 3 (teacher): “I think that in order for critical thinking to develop, it is necessary to combine traditional learning and mobile learning: 70% / 30%.”

Respondent 4 (student): “Mobile learning can promote the development of critical thinking provided that students treat it responsibly and the results are regularly monitored.”

Respondent 5 (student): “I think this type of education does not contribute to the development of critical thinking as it is similar to watching TV; there is no one to talk to or ask questions.”

Respondent 6 (student): “In my opinion, it does not contribute to the development of critical thinking and can only be used as an auxiliary type of education.”

The results show that the study participants have ambiguous opinions about the possibility of developing critical thinking skills. All respondents were from the Russian Federation, where the traditional approach to teaching prevails. To improve the attitude of teachers and students to mobile learning and its ability to develop critical thinking, it is necessary to popularize it among the participants in the educational process, introduce technologies into lesson plans, focus on the convenience of perceiving information from device screens, combine it with traditional learning, etc.

Part 2

Tables 1 and 2 show the results of teacher and student tests. The result is described as positive when 70% of the test was correctly solved.

Table 1

Teachers' test results, %

	Result	Teacher 30	34	Teacher 60	86
Teacher 1	58	Teacher 31	55	Teacher 61	49
Teacher 2	49	Teacher 32	69	Teacher 62	58
Teacher 3	58	Teacher 33	68	Teacher 63	67
Teacher 4	38	Teacher 34	72	Teacher 64	69
Teacher 5	94	Teacher 35	48	Teacher 65	69
Teacher 6	76	Teacher 36	59	Teacher 66	59
Teacher 7	52	Teacher 37	68	Teacher 67	66
Teacher 8	41	Teacher 38	85	Teacher 68	55
Teacher 9	99	Teacher 39	89	Teacher 69	87
Teacher 10	52	Teacher 40	97	Teacher 70	93
Teacher 11	46	Teacher 41	54	Teacher 71	99
Teacher 12	43	Teacher 42	72	Teacher 72	58
Teacher 13	42	Teacher 43	94	Teacher 73	61
Teacher 14	85	Teacher 44	55	Teacher 74	65
Teacher 15	87	Teacher 45	57	Teacher 75	68
Teacher 16	51	Teacher 46	68	Teacher 76	59
Teacher 17	55	Teacher 47	64	Teacher 77	45
Teacher 18	56	Teacher 48	61	Teacher 78	49
Teacher 19	84	Teacher 49	70	Teacher 79	59
Teacher 20	69	Teacher 50	75	Teacher 80	54
Teacher 21	67	Teacher 51	49	Teacher 81	65
Teacher 22	85	Teacher 52	68	Teacher 82	69
Teacher 23	69	Teacher 53	69	Teacher 83	68
Teacher 24	69	Teacher 54	59	Teacher 84	70
Teacher 25	59	Teacher 55	58	Teacher 85	72
Teacher 26	84	Teacher 56	97	Teacher 86	69
Teacher 27	56	Teacher 57	64	Teacher 87	49
Teacher 28	59	Teacher 58	71	Teacher 88	48
Teacher 29	68	Teacher 59	72	Teacher 89	59
				Teacher 90	58
				Teacher 91	97
				Teacher 92	69
				Teacher 93	73

Table 2
Students' test results, %

	Result	Student 46	95	Student 91	59	Student 136	58
Student 1	48	Student 47	28	Student 92	48	Student 137	24
Student 2	49	Student 48	37	Student 93	69	Student 138	35
Student 3	51	Student 49	56	Student 94	39	Student 139	75
Student 4	38	Student 50	49	Student 95	27	Student 140	15
Student 5	67	Student 51	28	Student 96	38	Student 141	95
Student 6	75	Student 52	67	Student 97	34	Student 142	68
Student 7	26	Student 53	68	Student 98	59	Student 143	73
Student 8	91	Student 54	69	Student 99	68	Student 144	54
Student 9	46	Student 55	54	Student 100	71	Student 145	58
Student 10	38	Student 56	37	Student 101	54	Student 146	69
Student 11	46	Student 57	29	Student 102	38	Student 147	57
Student 12	57	Student 58	24	Student 103	69	Student 148	48
Student 13	76	Student 59	58	Student 104	58	Student 149	24
Student 14	78	Student 60	79	Student 105	67	Student 150	38
Student 15	49	Student 61	45	Student 106	49	Student 151	59
Student 16	28	Student 62	43	Student 107	58	Student 152	64
Student 17	39	Student 63	68	Student 108	76	Student 153	57
Student 18	64	Student 64	61	Student 109	92	Student 154	28
Student 19	69	Student 65	38	Student 110	45	Student 155	49
Student 20	73	Student 66	39	Student 111	19	Student 156	56
Student 21	46	Student 67	49	Student 112	56	Student 157	37
Student 22	28	Student 68	57	Student 113	28	Student 158	68
Student 23	39	Student 69	67	Student 114	39	Student 159	57
Student 24	67	Student 70	59	Student 115	67	Student 160	49
Student 25	59	Student 71	54	Student 116	58	Student 161	28
Student 26	49	Student 72	37	Student 117	19	Student 162	79
Student 27	33	Student 73	39	Student 118	28	Student 163	94
Student 28	34	Student 74	68	Student 119	45	Student 164	81
Student 29	56	Student 75	57	Student 120	12	Student 165	56
Student 30	72	Student 76	69	Student 121	59	Student 166	49
Student 31	84	Student 77	69	Student 122	67	Student 167	58
Student 32	65	Student 78	64	Student 123	58	Student 168	27
Student 33	42	Student 79	58	Student 124	49	Student 169	49
Student 34	28	Student 80	37	Student 125	42	Student 170	18
Student 35	19	Student 81	39	Student 126	58	Student 171	59
Student 36	25	Student 82	34	Student 127	56	Student 172	46
Student 37	38	Student 83	29	Student 128	72	Student 173	58
Student 38	67	Student 84	68	Student 129	49	Student 174	67
Student 39	71	Student 85	58	Student 130	58	Student 175	91
Student 40	68	Student 86	67	Student 131	24	Student 176	80
Student 41	59	Student 87	79	Student 132	36	Student 177	49
Student 42	27	Student 88	84	Student 133	57	Student 178	37
Student 43	64	Student 89	28	Student 134	49	Student 179	58
Student 44	75	Student 90	64	Student 135	59	Student 180	69
Student 45	28					Student 181	49
						Student 182	90

The results show that a minority of teachers and students coped with the test. This indicates minor effectiveness of taking an online course. Probably, in order to improve the situation, it is necessary to make the course more interesting, concise, and visual, as well as to provide students with an opportunity to communicate with teachers and peers during the course. Interaction between people is required for the formation of ideas and opinions, as well as understanding of the material. There is also a problem with the perception of information due to the small screen, limited field of view, etc. Taking a short test after each session can also be recommended (for self-examination).

To test how significant or random the observed result is, the null hypothesis is put forward about the absence of statistically significant differences in the results of the knowledge test from the normal expected distribution.

The results of Pearson's chi-square fit test are presented in Table 3. For both students and teachers, statistics p-values are significantly less than the α of 0.05 (.0391 - for students and .0413 - for teachers). Based on the presented results, the null hypothesis about the absence of statistically significant differences in the results of the knowledge test from the normal expected distribution must be discarded. From this, we can conclude that the applied method of mobile learning can lead to statistically significant changes in the quality of learning in the subjects studied.

Table 3

The results of Pearson's chi-square fit test

Students			Teachers		
df	$\chi 2$	p-value	df	$\chi 2$	p-value
92	121.9	.0391	181	212.3	.0413

Discussion

Before the study, two hypotheses were developed: (1) mobile learning significantly contributes to the development of critical thinking; (2) cognitive distortions are often experienced by learners using mobile devices.

Based on the results of the first part of the study, both teachers and students have an ambiguous attitude to mobile learning and its impact on the development of critical thinking. Most teachers noted that critical thinking is needed not to succumb to propaganda. Least popular answers: "for the development of scientific thinking", "not to be deceived." Among students, the most popular answers included "to find the right solution" and "to manifest one's own individuality" while the least popular one was "for the development of scientific thinking". It can be concluded that teachers place an emphasis on independent thinking, and students focus on self-expression. According to both teachers and students, logic, mathematics, and economics have been defined as disciplines that contribute to the development of critical thinking. This indicates that most people believe that liberal arts and learning through mobile learning do not have a significant positive impact on the development of critical thinking. In addition, most respondents believe that all the subjects listed are difficult to learn through mobile learning. This is explained by the lack of experience in such a study and the ambiguous attitude towards mobile learning. Both students and teachers believe that school subjects are more conducive to the development of critical thinking than university ones. This is due to the peculiarities of teaching methods at school and a greater degree of control.

This study confirms hypothesis 2. Based on the analysis of the tests, it can be seen that most mistakes were made at the stage of reflection after the participants recalled and comprehended the material studied.

Scientists distinguish three stages of learning:

- recall (retrieval the information from memory, forming interest, setting the goals of studying the topic); contact with new information and its systematization;
- comprehension (realization of meaning): contact with new information and its systematization;
- thinking (reflection): consolidating new knowledge, rebuilding primary ideas.

The critical thinking development phases have the following functions:

- informational, motivational, communication (recall);
- systematizing, informational (comprehension of the content);
- informational, communication, evaluative, motivational (reflection) (Hitchcock, 2020).

The participants also made mistakes associated with information interpretation, analysis, evaluation

and explanation, which are also related to cognitive errors.

The situation is similar in Indonesia. The weaknesses of students in the context of solving mathematical problems are as follows: they cannot match information with the right concept; do not understand the concept associated with the task; do not present information in the form of tables, graphs or other symbols; have wrong assumptions; have the wrong plan that leads to the wrong strategy; do not check the end result; do not correct the wrong part; do not consider the application of different solutions. Students make the biggest number of mistakes during the reflection phase (Kurniati and Annizar, 2017).

The test results also showed that during online lectures it is quite difficult for students to highlight basic information or outline the most important points. They may pay more attention to less important information and less attention to important information.

In another study devoted to students' critical thinking skills that took place in Slovakia, the participants reported that during lectures they copy the information from the board / screen and that the teachers do not force them to take an active part in the process. Some teachers provide lecture texts (for example, in learning management systems (LMS)). Many students stated that this simplifies the learning process and that they can listen to the lecture more attentively without having to take notes. Some students responded that they have to use only texts to study some disciplines (Straková and Cimermanová, 2018).

There are also cases when participants rely on other sources to prepare for the test; these contain inaccurate information, which results in students' making mistakes. According to a study in Malaysia, information literacy refers to the ability to recognize when the information is needed, then find, evaluate, and use relevant information effectively (Parsazadeh, Ali and Rezaei, 2018).

The lectures gave the students fairly good knowledge of the topic but did not allow them to answer many specific questions. According to the participants, the reasons they failed to answer some test questions are the impossibility of asking the teacher questions and clarifying incomprehensible information, the difficulty of perceiving information from the screen of a smartphone / tablet.

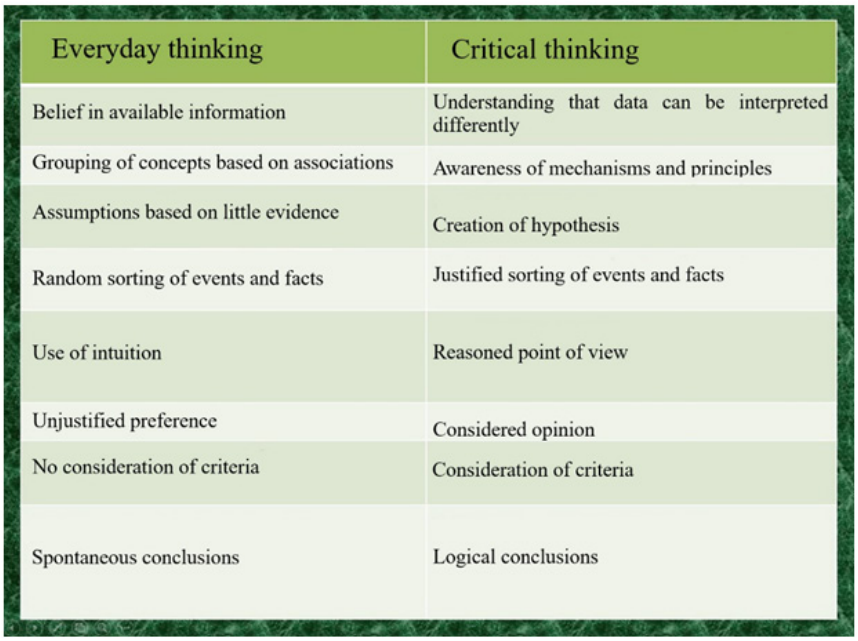
Integrating smartphones into the learning environment is a challenging task. Teachers may need to incorporate smartphones into teaching and learning to create engaging teaching and optimal classroom interaction with students while reducing or at least minimizing distractions that can occur. Potential problems include distraction, addiction, lack of skills, and decreased quality of personal communication. Scholars from Brunei note that in order to avoid any inconvenience when using smartphones in the classroom, proper rules for the use of smartphones in the classroom must be established in advance and followed by students (Anshari et al., 2017).

The study participants also noted that they felt fear and uncertainty during the test. After taking the online course, they were not confident in their abilities and reported that this was associated with the lack of interlocutors and feedback. According to researchers from the Netherlands, one of the most common cognitive errors among adolescents is "underestimating the ability to cope", "personalization without mind-reading, "selective abstraction," "overgeneralization," "mind-reading," which contained a "threat-related conclusion." All cognitive distortions, except for "selective abstraction", correlate with anxiety. The most significant predictors of anxiety are "underestimating the ability to cope" and "mindreading" (Maric et al., 2011).

It should be noted that attitudes towards mobile learning, technology, and the level of technophobia differ in developed (for example, the USA, the Netherlands) and developing countries (for example, Indonesia, India). The main issue of developing countries is weak infrastructure, outdated equipment or its lack. Average Internet prices there are three times higher than in developed countries, and prices for mobile Internet are twice as expensive. In addition, a large part of the population uses devices that are only compatible with the 2G network, which does not allow them to comfortably enjoy all the features of mobile learning (Bukht and Heeks, 2018; Greenhow and Askari, 2017).

According to Cahyana et al. (2018), the indicators of critical thinking are focusing on the issue, taking into account the reliability of the source, observing and recording observation reports, conducting inductive reasoning and considering the results of it, defining a term and considering a definition, deciding on an action. Based on the test and interview results, the participants had difficulty in induction, deduction, and final decision-making.

In order to overcome distortions associated with the lack of critical thinking skills, it is necessary, first of all, to understand the difference between everyday and critical thinking (Figure 5):



Everyday thinking	Critical thinking
Belief in available information	Understanding that data can be interpreted differently
Grouping of concepts based on associations	Awareness of mechanisms and principles
Assumptions based on little evidence	Creation of hypothesis
Random sorting of events and facts	Justified sorting of events and facts
Use of intuition	Reasoned point of view
Unjustified preference	Considered opinion
No consideration of criteria	Consideration of criteria
Spontaneous conclusions	Logical conclusions

Figure 5. Comparison of everyday and critical thinking
Source: Developing students' critical thinking in pedagogy classes (VSEPU, 2009).

In order to be able to use critical thinking, the student must develop a number of qualities. Here the work of a teacher is also important, who not only directs his/her pedagogical actions to ensure that students learn a discipline, but also organizes work on the development of such qualities in them:

1. Ability to plan and arrange thoughts.
2. Be flexible and listen to other people's ideas.
3. Perseverance.
4. Ability to correct mistakes.
5. Awareness.
6. Ability to find compromise solutions (VSEPU, 2009).

This approach is also applicable in the context of mobile learning, which requires critical thinking skills, first of all, to check the quality of information and the reliability of facts.

Cognitive distortions related to information interpretation, analysis, and evaluation, as well as the development and explanation can be fixed based on the following guidelines (Table 4).

Table 4
Recommendations for fixing cognitive distortions

1	Information interpretation	When the information listened to or read is not clear, it should be read several times. It is also necessary to consider practical examples on the topic and try to connect them with the theory.
2	Analysis	It is necessary to try to structure the information, for example, to depict it in the form of a diagram (cluster), try to understand the system, logic, and chronology.
3	Evaluation	In the context of mobile learning, it is necessary to be able to assess the quality of information. In addition to taking a critical look at the information, the reliability of the source and the authority of the author should be checked. You can also find other sources with similar information, compare several sources, etc.
4	Explanation	After viewing, listening, or reading the information, it should be retold or briefly summarized.

To improve critical thinking skills, the following action plan was developed (Table 5).

Table 5
Recommendations for improving critical thinking skills

1	Development of skills to control one's own thoughts	The student must learn to sort, plan and control their thoughts, not to let them go by chance; and demonstrate mindful behavior
2	Learning to communicate with other people	The right ideas are always born and refined when interacting with other people. A person should be open to other people's thoughts and opinions.
3	Persistence	Good skills cannot be mastered quickly. It is a persistent approach that provides an opportunity to achieve success.
4	Error analysis session	The student should be able to find, understand, admit and correct their mistakes, and not be afraid of this.
5	Search for compromises	It should be recognized that there are no completely correct and completely wrong ideas and situations. Each phenomenon must be considered from different angles before making a decision.

The results of the study are interpreted within the framework of pedagogy and psychology and are a good contribution to the study of modern methods and approaches in education.

Conclusions

Due to the fact that mobile learning is gaining popularity, there is a need to explore its positive and negative aspects. One of these aspects is its effect on the development of students' critical thinking skills. The results of the study showed that the attitude towards mobile learning is ambiguous today; among teachers and students there are advocates and opponents of mobile learning. Most respondents believe that mobile learning has both positive and negative aspects and that its use in the learning process should be dosed. Today, only a small number of people completely deny it. The approximate percentage of study time that should be devoted to mobile learning, according to survey participants, is 10-30%.

In the process of mobile learning and assessment of its results, students (and sometimes teachers) can experience a number of cognitive distortions. The distortions can occur during the phases of comprehension and reflection, as well as in the course of information interpretation, analysis, evaluation, and explanation, which also complicates the effectiveness of fact-checking. There are many reasons for these distortions, including the lack of direct contact with the teacher, the inability to ask questions and discuss the topic, the poor quality of information, etc. Critical thinking skills can greatly help students avoid distortions.

To eliminate or minimize the problem of poor-quality information, as well as to improve fact-checking skills, students should use a number of tools, such as checking the credibility of the source and authors, interviewing the opposite party, and evaluating information, as well as automatic verification tools.

To improve critical thinking skills, an action plan that includes the following phases: development of skills to control one's own thoughts, learning to communicate with other people, perseverance, error analysis session, and search for compromises, was developed. These skills can also be developed in the context of mobile learning or its partial application.

This study does not contradict the data obtained by most other authors. It contributes to the study of different aspects of mobile learning, its capabilities, advantages and disadvantages. The results of the study may be of interest to teachers, students, academic administration, parents, as well as to those who are interested in modern pedagogy and educational psychology.

Acknowledgements

This work was supported by RFBR (Russian Foundation for Basic Research) grant 20-013-00884 “The system of cognitive barriers and the model of overcoming them in physics education using information technology”. This paper has been supported by the Kazan Federal University Strategic Academic Leadership Program.

Conflict of interests

The author declares no conflict of interest.

References

Addy, J. (2020). The art of the real: Fact checking as information literacy instruction. *Reference Services Review, 48*(1), 19-31. https://doi.org/10.1108/RSR-09-2019-0067

Al-Adwan, A. S., Al-Madadha, A., & Zvirzdinaite, Z. (2018). Modeling students’ readiness to adopt mobile learning in higher education: An empirical study. *International Review of Research in Open and Distributed Learning, 19*(1), 221-241. https://doi.org/10.19173/irrodl.v19i1.3256

Anshari, M., Almunawar, M. N., Shahrill, M., Wicaksono, D. K., & Huda, M. (2017). Smartphones usage in the classrooms: Learning aid or interference? *Education and Information Technologies, 22*(6), 3063-3079. https://doi.org/10.1007/s10639-017-9572-7

Betsch, T., & Glockner, A. (2010). Intuition in judgment and decision making: Extensive thinking without effort. *Psychological Inquiry, 21*, 279-294. https://doi.org/10.1080/1047840X.2010.517737

Bukht, R., & Heeks, R. (2018). Digital economy policy in developing countries. *DIODE Working Papers, no. 6*, Manchester. https://doi.org/10.13140/RG.2.2.24272.15364

Cahyana, U., Fitriani, E., Rianti, R., & Fauziyah, S. (2018). Analysis of critical thinking skills in chemistry learning by using mobile learning for level x. In *IOP Conference Series: Materials Science and Engineering* (*Vol. 434, No. 1*, p. 012086). IOP Publishing. https://doi.org/10.1088/1757-899X/434/1/012086

Cavus, N., & Uzunboylu, H. (2009). Improving critical thinking skills in mobile learning. *Procedia-Social and Behavioral Sciences, 1*(1), 434-438. https://doi.org/10.1016/j.sbspro.2009.01.078

Cohen, A., & Ezra, O. (2018). Development of a contextualised MALL research framework based on L2 Chinese empirical study. *Computer Assisted Language Learning, 31*(7), 764-789. https://doi.org/10.1080/09588221.2018.1449756

Demir, K., & Akpinar, E. (2018). The effect of mobile learning applications on students’ academic achievement and attitudes toward mobile learning. *Malaysian Online Journal of Educational Technology, 6*(2), 48-59. http://dx.doi.org/10.17220/mojet.2018.04.004

Denton, D. W., Baliram, N. S., & Cole, L. (2021). Understanding why math and science teachers quit: Evidence of cognitive errors. *International Journal of Education in Mathematics, Science and Technology, 9*(2), 163-180. https://doi.org/10.46328/ijemst.1166

El-Sofany, H., & El-Haggar, N. (2020). The effectiveness of using mobile learning techniques to improve learning outcomes in higher education. *International Journal of Interactive Mobile Technologies, 14*(8), 4-18. https://doi.org/10.3991/ijim.v14i08.13125

Eppler, M. J., & Muenzenmayer, P. (2002). Measuring information quality in the web context: A survey of state-of-the-art instruments and an application methodology. In *Proceedings of the Seventh International Conference on Information Quality* (pp. 187-196). ICIQ. Retreived from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.477.4680&rep=rep1&type=pdf

Franklin, T. (2011). Mobile learning: At the tipping point. *The Turkish Online Journal of Educational Technology, 10*(4), 261-275.

Gong, Y., Rebello, N. S., Melloch, M. R., & Brophy, S. P. (2016). Analytic framework for students’ cognitive mistakes in studying electromagnetic fields. In *Analytic Framework for Students’ Cognitive Mistakes in Studying Electromagnetic Fields. 2016 ASEE Annual Conference & Exposition* (Paper ID #15594). American Society for Engineering Education. https://doi.org/10.18260/p.26240

Gorokhovsky, A. (2017). *Fact-checking as a trend in journalistic investigations: opportunities and prospects*. A practical reference guide. Almaty.

Greenhow, C., & Askari, E. (2017). Learning and teaching with social network sites: A decade of research in K-12 related education. *Education and Information Technologies, 22*(2), 623-645. https://doi.org/10.1007/s10639-015-9446-9

Hernández-de-Menéndez, M., Vallejo Guevara, A., & Morales-Menendez, R. (2019). Virtual reality laboratories: a review of experiences. *International Journal on Interactive Design and Manufacturing, 13*(3), 947-966. https://doi.org/10.1007/s12008-019-00558-7

Hitchcock, D. (2020). Critical Thinking. In *The Stanford Encyclopedia of Philosophy*. Stanford. Retreived from https://plato.stanford.edu/archives/fall2020/entries/critical-thinking/

Hough, A. (2015). Affect, critical thinking, and decision making. *Thesis for Masters of Science - Psychological Science*. Retreived from https://www.researchgate.net/publication/321774740_Affect_Critical_Thinking_and_Decision_Making

Ismail, I., Azizan, S. N., & Gunasegaran, T. (2016). Mobile learning in Malaysian universities: are students ready? *International Journal of Interactive Mobile Technologies, 10*(3), 17-23. https://doi.org/10.3991/ijim.v10i3.5316

Kurniati, D., & Annizar, A. (2017). The analysis of students’ cognitive problem solving skill in solving PISA standard-based test item. *Advanced Science Letters, 23*(2), 776-780. https://doi.org/10.1166/asl.2017.7466

Larsson, K. (2017). Understanding and teaching critical thinking—A new approach. *International Journal of Educational Research, 84*, 32-42. https://doi.org/10.1016/j.ijer.2017.05.004

López-García, X., Costa-Sánchez, C., & Vizoso, Á. (2021). Journalistic fact-checking of information in pandemic: Stakeholders, hoaxes, and strategies to fight disinformation during the COVID-19 crisis in Spain. *International Journal of Environmental Research and Public Health, 18*(3), 1227. https://doi.org/10.3390/ijerph18031227

Maric, M., Heyne, D. A., van Widenfelt, B. M., & Westenberg, P. M. (2011). Distorted cognitive processing in youth: The structure of negative cognitive errors and their associations with anxiety. *Cognitive Therapy and Research, 35*, 11-20. https://doi.org/10.1007/s10608-009-9285-3

Nussbaum, M., Barahona, C., Rodriguez, F., Guentulle, V., Lopez, F., Vazquez-Uscanga, E., & Cabezas, V. (2021). Taking critical thinking, creativity and grit online. *Educational Technology Research and Development, 69*(1), 201-206. https://doi.org/10.1007/s11423-020-09867-1

Parsazadeh, N., Ali, R., & Rezaei, M. (2018). A framework for cooperative and interactive mobile learning to improve online information evaluation skills. *Computers & Education, 120*(2), 75-89. https://doi.org/10.1016/j.compedu.2018.01.010

Perry, A., & Karpova, E. (2017). Efficacy of teaching creative thinking skills: A comparison of multiple creativity assessments. *Thinking Skills and Creativity, 24*, 118-126. https://doi.org/10.1016/j.tsc.2017.02.017

Rehna, T., Hanif, R., & Aqeel, M. (2020). Moderating role of gender on the relationship between cognitive errors and anxiety among adolescents. *Foundation University Journal of Psychology, 4*(1), 86-102. https://doi.org/10.33897/fujp.v4i1.68

Rehna, T., Hanif, R., & Tariq, S. (2012). Cognitive errors and anxiety: A comparison of depressed and non-depressed adolescents. *European Journal of Social Sciences, 27*(3), 309-318.

Salek Ebrahimi, L., Mousavi, S. E., Gharraee, B., Mohammadi Bytamar, J., & Saberi Isfeedvajani, M. (2019). Cognitive errors and psychological resilience in patients with social anxiety and obsessive-compulsive disorder: A cross-sectional study. *Hospital Practices and Research, 4*(1), 25-30. https://doi.org/10.15171/hpr.2019.04

Sapukh, T. (2014). Development of critical thinking as a basis for student-centered education. *Contemporary Social Research, 9*(41), 202-216. https://doi.org/10.12731/2218-7405-2014-9-18

Singh, V., & Thurman, A. (2019). How many ways can we define online learning? A systematic literature review of definitions of online learning (1988-2018). *American Journal of Distance Education, 33*(4), 289-306. https://doi.org/10.1080/08923647.2019.1663082

Sönmez, A., Göçmez, L., Uygun, D., & Ataizi, M. (2018). A review of current studies of mobile learning. *Journal of Educational Technology & Online Learning, 1*(1), 13-27. https://doi.org/10.31681/jetol.378241

Straková, Z., & Cimermanová, I. (2018). Critical thinking development—A necessary step in higher education transformation towards sustainability. *Sustainability, 10,* 3366. https://doi.org/10.3390/su10103366

Studmed (2021). *Tests with answers on Insurance.* Moscow State University of Economics, Statistics, and Informatics. Retreived from https://www.studmed.ru/testy-s-otvetami-po-strahovanie-mesi_6eead98.html

VSEPU (2009). *Development of students' critical thinking skills in pedagogy classes.* Nizhny Novgorod. Retreived from https://pandia.ru/text/77/28/94426.php

Wechsler, S. M., Saiz, C., Rivas, S. F., Vendramini, C. M. M., Almeida, L. S., Mundim, M. C., & Franco, A. (2018). Creative and critical thinking: Independent or overlapping components? *Thinking Skills and Creativity, 27*, 114-122. https://doi.org/10.1016/j.tsc.2017.12.003

West, D. (2013). *Mobile Learning: Transforming Education, Engaging Students, and Improving Outcomes.* Center for Technology Innovation in Brookings. Retreived from http://www.scienceisaverb.com/Mobile%20Learning%20Transforming%20Education,%

Zhukotskaya, A., & Chernenkaya, S. (2019). Critical thinking and its role in the formation of professional competencies of students of a pedagogical university. *Philosophy of Education, 4*, 67-81. https://doi.org/10.25688/2078-9238.2019.32.4.08