



# Building Research Skills Using Digital Educational Technologies

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## ARTICLE INFO ABSTRACT

Change in social demands requires knowledge and skills that can be applied across disciplines. Professionals who can analyse problems, think critically, solve problems, communicate effectively, and take leadership are essential to meet new challenges in today's society. In this context, not only the area of expertise is important, but also the ability to think and learn, communicate and collaborate. Tackling complex interdisciplinary challenges requires professionals trained in creative thinking, problem solving, self-learning, team building, and other high skills. Among them, research skill is obligatory. Its development is important especially for future teachers. The ability to find new information and apply new methods for teaching children in school forms an integral part of the teacher's competence. In the context of distance learning, the development of such skills is fulfilled using digital technologies. The purpose of the study is to investigate the impact of digital technologies on the development of research skills of future primary school teachers. In this study, methods such as analysis, synthesis, survey, and case study were used. The study was conducted in the context of online learning at the Faculty of Pedagogy by students of the educational programme 6 B01 301 "Pedagogy and methods of primary education" based on the Buketov Karaganda State University. This study found that students acquired research and creative thinking skills through an open interprofessional distance learning course with digital adoption. This will increase the effectiveness of training and develop a new programme with the inclusion of digital technologies for higher educational institutions of the country.

**Keywords:** research skills, future primary school teachers, Internet technologies, the development of new competences.

## Introduction

Every person has a desire to fulfil oneself and tap into the innermost secrets of life from a very early age. The child's need for research is biologically determined, the child is born as a researcher (Abylgazova *et al.*, 2023). An unquenchable thirst for new experiences, interest, a constant desire to observe and experiment (Nestulya and Shara, 2023). It is in elementary school that it is necessary to help those who are interested in various fields of science, help to fulfil their plans and dreams, help to fully unleash their abilities (Ostrovskaya, 2022; Kozhasheva *et al.*, 2022). Interest, developing into curiosity, constitutes, as it were, the primary basis of future research activities (Nesterenko, 2023). Students are imbued with various knowledge, while they are completely unable to apply it in practice. Hence, the direction that makes provision for the participation of schoolchildren in scientific and research-to-practice activities is gaining increasing importance (Sansyzbayeva *et al.*, 2022; Molnar and Ryabets, 2019). In conditions of socio-economic instability in the CIS countries and competition in the labour market in a wide range of specialties, this leads to an increase in the competences and requirements for workers in the industry, and, as a consequence, increases their social responsibility (Nagymzhanova, 2019; Nagymzhanova *et al.*, 2020). So, what is research activity? Educational research activity

is a specially organised educational activity under the guidance of a teacher, aimed at the study of various objects in compliance with procedures and stages that are close to scientific research, but adapted to the level of cognitive capabilities of schoolchildren. Studies of many scientists in the field of pedagogy and other fields of knowledge have covered this issue (Drueke and Streckfuss, 1997; Meerah *et al.*, 2012; Lyman *et al.*, 2014; Karyukina, 2014; Khairutdinova, 2015; Chen, 2016; Ferderer and Krueger, 2017; Ashimova, 2020). Research activity is a process of searching for a solution unknown to a teacher and a student, a solution that does not have a predetermined algorithm of actions, aimed at gaining new knowledge by the student and at developing his or her personality. Activity, the result of which is the formation of something new (material or ideal), is creative. Therefore, research activity is a special case of creative activity. This definition suggests that research activity is also a type of educational activity, since it is aimed at acquiring knowledge and improving the student's personality.

Students need to acquire research skills during their undergraduate studies in order to acquire the competences to conduct research in their professional field. The availability of information brought about by the development of information communication technologies has made it necessary for future graduates to be able to handle information (Boichenko *et al.*, 2020). Universities currently require students to take courses in using computers to find information, as well as mandatory courses in research methodology in order to be able to benefit and understand research (Ongarbayeva *et al.*, 2021; Opanasenko and Chernenko, 2022). Universities have committed considerable resources and staff to help students acquire research skills and prepare them for the future of human capital as a knowledge-based specialist (Kulakhmet *et al.*, 2022; Kulyk, 2023). Research has demonstrated that learning outcomes in methodology and other related research courses were not readily available to most social science and education students during their undergraduate and graduate programmes. It is not easy for students to acquire research skills in the use of statistics. Others reported general difficulties with research methodology. Research plays an important role in the development of a country in terms of economy and welfare.

It is important for students to develop their research skills as early as possible in preparation for admission to the master's programme. One of the main reasons for graduate students to experience difficulties is their lack of research skills before starting research work. A review of studies on the research skills of developing researchers has highlighted some important skills that appear to be important to be capable of conducting proper research. Admittedly, research requires a certain set of skills. The main among these are information retrieval, communication skills (as well as presentation and writing skills), methodological skills, and data analytics (skills in using appropriate analysis and statistics). However, the need for the development of research skills among students may be less if they do not plan on engaging in research work, but regardless of the level, this is important for undergraduates and doctoral students alike, especially if a person is engaged in research or works in a professional environment.

The purpose of this study is to explore the impact of digital technology on the development of research skills among students who will become teachers in the future.

### Materials and methods

Within the framework of this study, theoretical methods were used. The authors investigated the features of the development of various skills among students who are preparing to become teachers, analysed the existing classification of skills. The studies on the development of research competences of students were examined, including the proposed means to implement new techniques more effectively. The method of analysis was used, which is a way of cognising an object by studying its parts and properties. The studies on the influence of digital technologies on learning and the development of skills necessary for a student were investigated. This study uses data collected in 2020 in the course of a research conducted in the context of distance education of the Buketov Karaganda State University. The study was conducted among students of various specialties in the first and second years of study. The authors paid special attention to future teachers. A study conducted over 3 months of distance learning in the spring of 2020 examined classical teaching methods and the use of digital technologies to increase learning efficiency.

The case method is a method of investigating individual facts, events or examples in a given context and deriving obvious evidence. The case study method does not imply a universal application procedure. The content of this procedure is specified depending on the research objectives, theoretical foundations, the specifics of the object-subject area. This method was used to investigate the development of research competence in a student of teacher education in the learning process using digital technologies in the context of distance learning. Therewith, the authors proceeded from the interpretation of the teacher's research competence as the ability and readiness to effectively solve methodological problems in the process of fulfilling the learning goals related to the establishment of communicative competence, education, upbringing, and development of students. A skill has the following characteristics:

1. Application of knowledge; one can call the skill knowledge in action, thereby emphasising that the basis of the skill is the knowledge acquired by the student. Skill is impossible without knowledge.
2. Conscious execution of actions; skill is always based on active intellectual activity and necessarily includes thought processes. Conscious intellectual control is one of the main characteristics of a skill. The psychological

basis of the skill is an understanding of the interrelation between the purpose of the activity, the conditions and methods of its implementation.

3. Focus on goal achievement.

4. Use of existing skills. There is no unequivocal interpretation of the terms “skill” and “ability” among teachers and psychologists. There are two opinions regarding the essence and correlation of these concepts:

- skill is only a transitional stage from knowledge to abilities, a non-automated stage in the development of educational actions. A skill is considered as a completed ability that occurs automatically.
- skill is a combination of different knowledge and abilities. Within the framework of this approach, an ability acts as a component of a skill that is fulfilled based on unconscious control. Students' research skills can be divided into five groups:
  - skills of organising one's work (organisational skills);
  - skills related to the implementation of research (search skills);
  - skills of working with information (informational skills);
  - skills of arranging and presenting the result of one's work;
  - skills related to the analysis of one's activities and evaluation activities (evaluative skills).

Next, the authors of the study determined what skills are included in each group. Organisational skills include: setting a research goal and organising its achievement, being able to explain, argue the goal; to plan educational research activities; to organise the learning process; to choose a personal research path. One can also highlight the following search skills: take into account and correlate all the data in the problem statement with each other and with the task requirement, find out their consistencies and inconsistencies; identify redundant and missing data; correlate the steps of finding a solution between themselves and the question of the problem; prove every conclusion; strive to exhaust all possible evidence and determine its sufficiency; strive to exhaust all possible conclusions in accordance with the question of the problem; check the solution and its compliance with the requirements of the problem.

Searching skills must be instilled in students to teach them how to search for evidence, how to build it rigorously and provide guidance for solving any problem. The main didactic functions of educational research are as follows:

- the function of discovering new knowledge (in the course of the study, the student can establish the properties of mathematical concepts, identify mathematical patterns, prove a fact);
- the function of extending knowledge (during the study, the student can obtain equivalent definitions of a concept, generalise the studied theorems, find various proofs of the studied theorems);
- the function of systematising the knowledge learned (in the course of the study, the student can establish relationships between concepts, identify the interrelations between theorems, structure the educational material);
- function of the student's development, the formation of his or her unassisted self-government: self-education, self-cultivation, self-fulfilment. Three levels of educational research can be distinguished, depending on the degree of independence in the activities of students. Level I: problem detection and hypothesis are made either by the teacher or under his or her supervision. At this stage, the student's share of independence is small; Level II: the problem is posed under the guidance of the teacher, the rest of the stages are performed by the students unassisted (in individual or group activities); Level III: the study is carried out by students unassisted. Distinctive features of the listed levels are presented in the table below (Table 1).

**Table 1.** Correlation between levels of research activity

Level	Problem/Solution Method	Solution
I	+	+
II	+	
III		

*+ means the presentation of this element of research activity by the teacher in a finished form.*

Thus, at the first level, the teacher identifies the problem and outlines a plan for its solution, involving students only in separate links of reasoning. By highlighting the problem, the teacher gives the children the opportunity to try to solve it based on the already existing knowledge and make sure that this knowledge is insufficient to achieve the goal. The teacher deliberately aggravates the conflict, emphasises the contradiction that has emerged, stimulates attempts to solve the current situation and takes part in the solving process. At the second level, the teacher only poses a problem, and the students look for a method of solving it unassisted. The teacher provides students with minimal assistance, only as a last resort, if the students are at a dead end in their reasoning. At the highest, third level, the statement of the problem, the search for a method, and the development of the solution itself are performed by the students unassisted. In addition, educational research can be used in monitoring the knowledge of the main sections of the school course of mathematics, in determining the level of proficiency in various methods of solving problems, in identifying the level of logical thinking, as well as the level of development of skills and abilities.

## Results and discussion

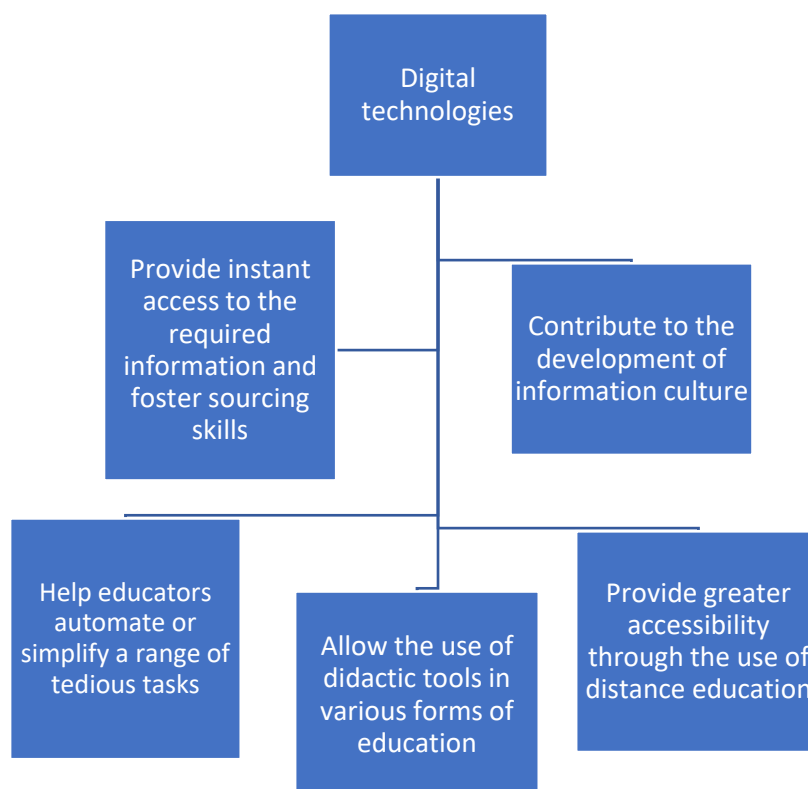
Research training of future primary school teachers contributes to the development of basic knowledge, research creativity skills and professional competences. They are revealed through preparation for seminars; writing projects, term papers; experimental work during teaching practice; speaking at research-to-practice conferences at various levels; publication of research papers (articles, abstracts, research results, experiments); participation in competitions of scientific works (higher, republican, regional, all-Russian, international); provision of graduate qualification works confirming the level of theoretical and practical knowledge, mastering various research techniques.

A student should be involved in research activities according to his or her “good will”, with the constant support of the scientific advisor (leader) as a guarantor of the development of a competent attitude towards scientific work. If practice is any guide, in the second year of study, the teacher “singles out” the student with the potential. By this time, the student adapts to the university mode of study, realises his or her place in the student environment and can prioritise personal interests. At this point, it is important for the supervisor to attract the attention of a student who is eager for new knowledge and impressions, and to motivate his or her participation in research activities. No less important is the good cooperation of teachers and their complex influence on the scientific potential of the student. The main ways of involving students in research activities are as follows: additional forms of education (used in the first years of study); direct educational process (all years of study); research activities (senior courses, postgraduate studies).

For the effective development of research skills, firstly, a teacher who has mastered their research skills and is capable of developing them in students is required; secondly, a training programme is needed, which includes such forms and methods that would allow future specialists to develop research skills, the ability to analyse, compare, evaluate, investigate a process, phenomenon, or situation from different standpoints, teach them to predict their work, etc. The current state of training specialists in higher educational institutions dictates the need to search for new ways to improve the quality of their theoretical training, readiness for independent creative work, and most importantly – the means and methods of preparing graduates for practical and professional activities.

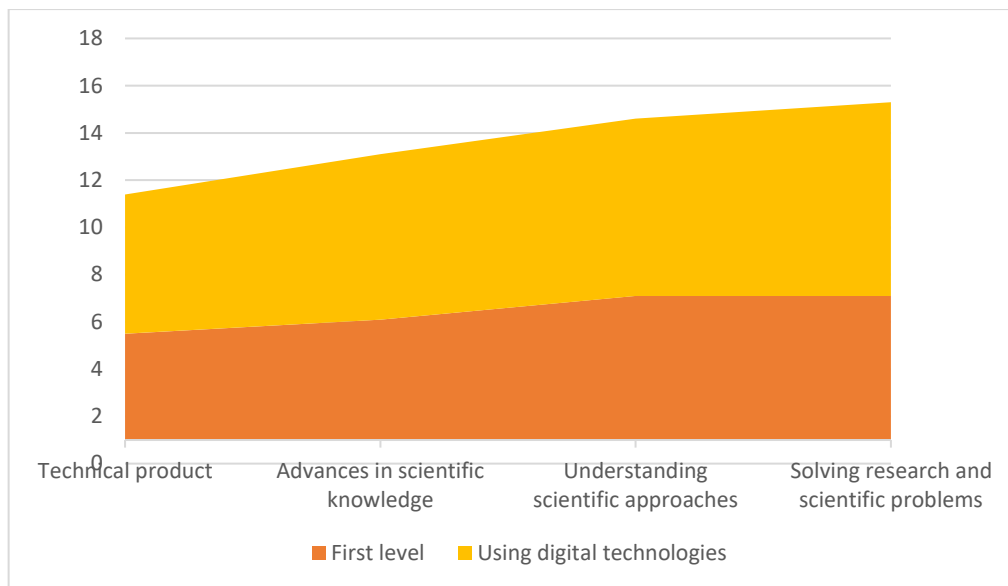
Currently, professional pedagogy and education are at an important stage of digitalisation of the entire education system, the introduction of innovative methods, techniques, and forms of work with students into pedagogy (Popescu and Popescu, 2003; Alenzuela *et al.*, 2019; Kichuk, 2022). The introduction of digital technologies into the theory and practice of pedagogy helps increase the effectiveness of student learning. However, the problem arises of a competent combination of methods for teaching the subject with information, communication, and digital learning technologies. Information technology should satisfy such basic principles of professional pedagogy as preliminary design, reproducibility, goal-setting, and integrity. Despite the fact that digital technologies in professional pedagogy are a fairly new field, they are developing very dynamically. Digital technologies are being actively introduced into the educational process at all levels of education – schools, colleges, and universities. Thus, in a number of Kazakhstani universities, curricula and courses were introduced that actively use digital technologies in the learning process. In addition, the informatisation of education and Internet technologies have led to the rapid development of a new form of education – distance learning, which currently constitutes the highest degree of informatisation of education.

At present, according to specialists in the field of professional education, a modern teacher should be capable of using modern information technologies and multimedia equipment for the educational process. Digital technologies are of great help in the development of several competences of future teachers, one of which is digital competence. The ability to find the necessary information, structure it and prepare educational content for a lesson is one of the factors in improving the quality of education. Digital technologies are a promising direction in the field of developing students' information skills. Fast search and simple perception of the most diverse information in the process of using computer technologies in the educational process of students increases its intensity. New digital technologies, which are actively developing on a global scale, will soon transform our understanding of the possibilities of IT”. The advantages of digital technologies in education include the following (Figure 1):



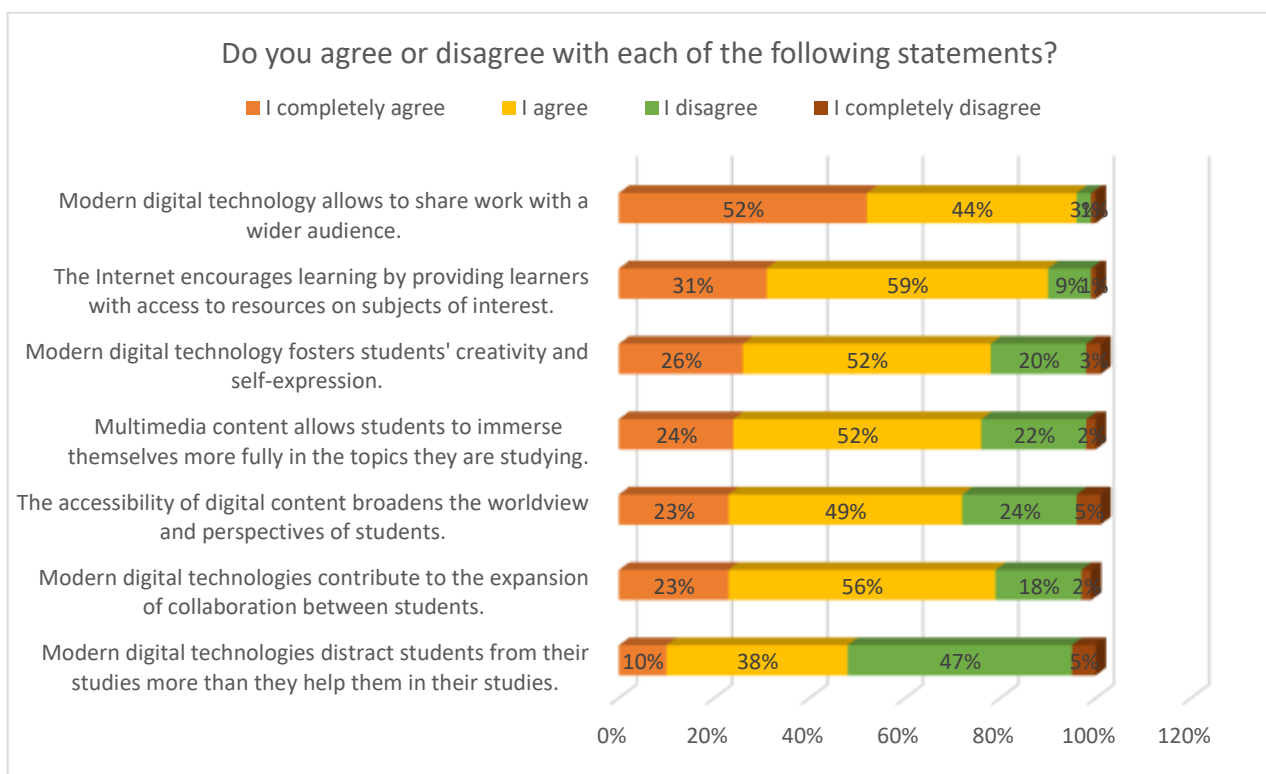
**Figure 1.** The advantage of digital technologies in education

Digital technologies are often used in the form of multimedia. The methodological power of multimedia lies precisely in the fact that it is easier to interest and teach the student when the latter perceives a coherent stream of sound and visual images. Presentations are actively used during speeches at conferences, defence of scientific projects, diplomas, master's and doctoral theses. Electronic presentations can be considered as a visual didactic teaching tool, and a multimedia projector as a technical teaching tool. The electronic presentation of educational information is especially well-represented in electronic textbooks, since electronic textbooks are considered as independent didactic teaching aids that enable students to study the subject unassisted. This is especially actively used in the course of distance learning. To test the effectiveness of digital technologies during distance learning, a case method was applied on the subject "Children, students, and staff who work with children and students should have access to digital tools, taking into account their needs and preconditions". Groups from three different specialties of the Academician E.A. Buketov Karaganda State University acted as so-called individual contact groups, where all teachers and students had access to an individual laptop and a wireless Internet connection. In these educational contexts, teachers had to (a) be competent enough to independently solve minor technology problems and communicate with students, and (b) be able to combine their technological and pedagogical competences to plan and organise teaching and learning in ways that add value of the latter. For example, adding value might include making teaching and learning easier or faster, better visualising problems, taking notes, distributing and storing information and teaching materials, finding information on the Internet, etc. Three groups stated that a constant Internet connection is a convenient method to quickly search for emerging current issues. The degree and importance of access to digital technologies at the university in the context of distance learning is manifested in other ways as well. All three groups of subjects had access to various digital technologies and digital learning resources – smart boards, learning management system (LMS), Google Drive, Moodle, ISpring, WebTutor, Teachbate, e-learning programmes and digital course literature. From a teacher's perspective, broad access to technology also implied knowledge of (a) different educational software, (b) how to find and evaluate new digital learning resources and programmes, and (c) how to teach students to take advantage of different educational programmes. The students felt they had acquired and improved research skills after distance learning. Moreover, the development of research skills was strongly correlated with the students' thoughts about developing new projects and the speed of assimilation of information. The use of digital technologies can improve learning outcomes such as the development of higher-order skills (creativity, critical thinking, and research skills), as well as strengthen the interrelation of teaching and research activities. It can be seen that the level of knowledge and skills of students increased after the introduction of digital technologies in the process of distance learning (Figure 2).



**Figure 2.** The level of growth of knowledge and skills of students when using digital technologies

The figure demonstrates that students' competence has increased due to the use of digital technologies in distance learning. Due to access to information sites, online libraries, and information repositories provided during the quarantine, students have learned to quickly select the necessary information, critically treat the materials found and process them. All this improves their research competence many times faster than with contact training. Research skills can be mastered with varying degrees of success depending on numerous reasons: interest, motivation, the need to engage in research activities, the student's individual characteristics and inclinations, and practical experience. A qualitative transition from a low level to a higher one is impossible with an associative-reproductive form of education and uncoordinated actions of all participants in the professional training of future teachers. It requires continuity in the professional training of students, which implies the use of active, activity-based forms in the process of their education in a pedagogical institution. To study the effectiveness of the introduction of modern technologies in the development of research skills, a survey was conducted among students. The results indicate that more than 50% were satisfied with the introduction of modern technologies in the educational process and consider this an important factor in the development of research competence (Figure 3).



**Figure 3.** Students' opinions on the impact of modern digital technologies on student learning

The programme flourished due to the enthusiastic response of the Faculty of Pedagogy to the work of the research skills group and the ability of its students to absorb material, as evidenced by their successful passing of the final exam and the application of these skills in presentations. Units of research skills are currently included in every section of the "Initial report", and after four semesters, almost all students in the more advanced courses have completed this initial training. When, for example, a local newspaper invited a class of Advanced Reporting students to create a Seward County database, the students knew which sources to turn to. The key to the success of the divisions was the collaboration of the librarian as an expert researcher and the professor of the course as a reporting expert. The librarian suggested using reference tools, and the professor evaluated these tools from the reporter's standpoint and helped design exercises that reflect real-life situations. Together, the librarian and professor discussed how reporters could use reference materials or find answers to specific questions.

This teamwork motivated students to learn new skills. Moreover, the professor's enthusiasm for research and the appreciation of the librarian's experience were clearly conveyed to the students. The programme was time consuming for the librarian who created, updated, and evaluated the exercises and met with each class three times. However, it has proven to be an ideal way to integrate library research into the journalism curriculum, develop instruction beyond the obligatory one-time library visit, encourage other teachers to incorporate more library research into their courses, and foster long-term collaborative college and library projects. Most importantly, students were able to acquire certain skills and see that library research can improve their productivity. Therewith, the adequate digital competence in upper secondary school, which is discussed in this study, appears to be flexible in meaning, is determined by local contextual conditions and manifests itself in various actions, understandings and decisions based on the teachers' individual value system (Olofsson *et al.*, 2020; Mazhuha, 2020). This study demonstrates that the interrelation between research and digital competence is undeniable. For the development of literate digital skills, it is important that the student knows how to properly use information sources, correctly approach the selection of the necessary data and be able to think critically.

Converting two variables with an abnormal distribution to variables with a normal distribution for consistency with the correlation analysis may have slightly altered the results and could be considered as limiting the interpretation of the data. But in reality, the differences were so minimal that they did not alter the meaning of the results. In addition, factors other than the creativity workshop can influence the significant differences found in the graduation grades of students. Possible factors influencing these results can also be postulated lower starting points for promotions in which there was no creativity workshop, student or mentor profiling (Rodríguez *et al.*, 2019).

### Conclusions

This study found that students are very satisfied with the learning experience and find it useful for their learning. Some of the results of this study suggest that digital technology has great potential and can contribute to skills development, albeit limited to a few participants at the same university. Digital technology, as well as the courses it creates, is a promising method of teaching research skills and creativity to senior students. The social challenges of the future will require higher cognitive abilities such as creative and critical thinking, problem solving, and interdisciplinary collaboration, and future research should focus on determining how best to help students develop these abilities.

The qualitative results obtained in the analysis of the implementation of distance learning using digital technologies indicate that seminars in which students could freely express their ideas and receive more independent tasks after them, could be more favourable for the development of research competences than training sessions. Freedom and flexibility in situations where learners need to apply knowledge and solve problems are key to developing research skills and creativity, although qualitative assessment indicates that the development of creative thinking and research skills can be limited by peer pressure, openness and time constraints, or difficulties during a research project. The development of scientific creativity requires tolerance and a secure democratic environment.

However, it is indisputable that digital technologies provide an opportunity to develop one's knowledge from basic ideas and theories that form the structure of construction and thought to intuitive mechanisms that organise life, provide an opportunity to participate and discuss ideas. To summarise the results of the study, new developments in the field of e-learning and increasingly advanced digital learning technologies have had a substantial impact on the entire education system, from schools to universities. It is key to instil in future school teachers, even during their studies at the university, the skills in digital technology and to develop the digital competence during training, since modern children belonging to generation Z are fluent in any gadgets and learning using digital technologies will only motivate them to learn.

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