Digital Tools in Education

The Impact of Digital Tools in Education on Students' Creativity

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Abstract

In recent years, as we have observed, digitisation has remained a consistently debated topic, especially in education. However, we believe that increasing attention needs to be given to the issue of students' digital skills in schools, the use of digital tools in teaching, the development of creativity, and other soft skills expected of young people in the future job market. These skills are becoming increasingly crucial. In this article, we focus on using digital tools in teaching at a vocational school and their impact on the creativity of a selected research sample of students. In the first part of the article, we specifically address the definition of creativity and the specifics of a creative personality. We briefly introduce concepts such as imagination, originality, intelligence, and critical thinking. The second chapter of the article presents selected methods and techniques that support the development of students' creativity. Based on the chosen topic, we highlight the importance of digitisation and the use of ICT in teaching and briefly describe selected digital tools. The article includes an evaluation of the creativity scores of the selected research sample of students at the beginning and end of the observed period.

Keywords: Creativity, ICT, Digital Tools

Creativity

Creativity is the ability of a person to create and exists in everyone at every age. Specific methods and techniques can positively influence, develop, and stimulate it. Creativity produces new and acceptable ideas, solutions, and actions. However, definitions of creativity differ depending on various theoretical concepts, such as behavioural or psychoanalytic, which focus on intellect, process, abilities, and personality.

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According to psychologists like Hlavsa, Jurčová, Pietrasiński, Rubinštejn, and others, creativity can be characterised as an essential mechanism for personality development. It is an intellectual ability that results in creating one's discoveries, connections, new thoughts, solutions, and attitudes. It also involves the ability of logical memory, association, and the transfer of experiences.

The willingness to take risks is a characteristic of a creative personality, along with impulsivity, enthusiasm, independent thinking, and evaluation. The inclination towards "play" is another characteristic of a gifted individual. Originality without extravagance is another hallmark. Creative personalities are characterised by a love for life, broad interests, sensitivity, and a desire for knowledge.

Petrová summarised the personality traits of a creative person, stating that, on average, creative individuals have higher intelligence and intellectual capacity, flexibility, originality, sensitivity to problems, and a propensity for aesthetic feelings. They often improvise and exhibit specific abilities related to a particular type of creative activity. Creatively inclined individuals reject routine and conformity, express themselves more radically, desire freedom, and resist discipline and authority (except for authority they respect and acknowledge).

In her publication "Art Thinking" (2016), Whitaker defines creative artistic thinking as a framework and set of habits that create space for exploration and discovery. It allows dreaming big in a way that transcends reality without forgetting it. Creative thinking separates time for exploration without expecting a specific outcome, allowing for mistakes and failures. With this mindset, it becomes possible to move forward by asking significant, influential, or wild questions, whether they have answers or not.

Amabile's extensive research on creativity and motivation identifies three essential components of individual creativity: abilities related to the field, creativity and work methods, and creative techniques. She argues that creative individuals are hardworking and unafraid of challenging tasks. She also suggests that a person with experience in creative principles is likelier to engage in further creative endeavours than someone encountering them for the first time. However, a newcomer must possess certain personality traits that enable purposeful creation.

Fostering students' creativity is a long-term task of education and training strategies, teacher preparation, and a requirement of modern education. It impacts the motivational system, shapes the emotional aspect of personality, enriches critical thinking, argumentation, and evaluation of facts, and influences students' relationships and practical communication training.

Creativity and Imagination

Imagination is the source and foundation of creative activity. It enriches life and makes it unusual, but it can also serve as an escape from reality. It is connected to imagination, visual thinking, and creativity. Imagination can be developed and exercised, involving the perception

of things and people around us, an unusual view of the world, richness of associations, intuition, and playfulness (Zelina, 1997, p. 78).

Viewegh (1986, p. 12) states that the contribution of imagination to the creative process has exceptional practical significance: imagination is not a peripheral component in the creative process but a central one, and its participation in creating a creative product is undeniable. Adopting a playful attitude, seeking and exchanging new meanings, thinking in extremes, creating analogies, etc., is recommended to activate the imagination.

Other opinions from authors include those of Gawain (1991, p. 15), who describes creative imagination as using imagination to achieve what is needed in life. She considers it an innate ability for visual thinking, the fundamental creative energy of the universe that humans constantly use, whether they are aware of it or not.

Creativity and Intelligence

Giftedness, talent, and intelligence are only to a minimal extent conditioned by heredity but can be acquired and developed considerably until a person is advanced (Tepperwein, 1992, p. 35).

Ďurič (1985, p. 128) defines intelligence as an intellectual ability based on convergent thinking. He also states that the quality of orientation in problem situations, the degree of flexibility and ease in changing focus, and the selection of a suitable proposal for solving a task signalise intelligence.

Creativity and Originality

Psychologists have long discovered that there are two paths leading to success, namely adaptability and originality. Conforming to the crowd and defending the current state of affairs signifies adaptability. On the other hand, originality takes less-trodden paths and advocates unconventional values or ideas. Despite swimming against the current, these unconventional values or ideas ultimately lead to improvement (Grant, 2016, p. 17).

Nakonečný (2009, p. 216) argues that the essence of creativity is originality, but not originality at any cost; it must be socially valuable originality. Because creativity is a source of progress in science, technology, arts, and society, it has become the subject of intense interest.

Creativity and Critical Thinking

Petrová (1999, p. 20) expresses that critical thinking is not just about finding faults, as we usually associate with criticism. However, it involves examining, assessing, and evaluating thoughts, seeking evidence, considering the correctness of information, and not automatically accepting what is presented.

Sitná (2009, p. 9) addresses the topic of critical thinking from the perspective of active learning, in which the student actively engages with information and forms their judgments based on it. The student processes this information and incorporates it into their system of knowledge, skills, and attitudes. Through active approaches to acquiring information, students effectively develop critical thinking. These active teaching methods contrast with most traditional teaching methods. In active teaching methods, the student is at the centre of the educational process in the classroom, co-creating the content and the course of instruction. They participate in assessment and self-assessment; therefore, these methods are increasingly promoted and used.

Methods and Techniques Supporting the Development of Creativity

Zelina (1996, p. 193) categorises eight groups of methods for fostering creativity:
a) Methods and techniques for creating divergent tasks;
b) Teaching strategies to support and develop creativity, such as problem-based, project-based, or exploratory teaching research methods;
c) Methods for developing perception and sensitivity, openness to experience, the world, readiness, and perceptual sensitivity;
d) Methods involving tasks for wit, anti-rigid thinking, and flexible thinking;
e) Training methods for imagination, fantasy, creativity, experiences, intuition;
f) Methods for improving creative evaluation, including options for compromise, discussions, creativity in communication, and agreement techniques;
g) Methods for creative problem-solving – reflective, pragmatic, and heuristic information;
h) Methods for improving fluency, originality, and flexibility.

Activating methods

Activating methods support students' interest in learning, intense experiences, thinking, and actions. They significantly support and develop students' cognitive processes while utilising their acquired knowledge. Activating methods include:
- Dialogical (discussion) methods,
- Group teaching methods as operational learning,
- Project methods,
- Methods for developing critical thinking,
- Case methods (including situational methods),
- Role-playing (dramatisation, staging methods),
- Simulation methods,
- Discovery and guided discovery method,
- Research methods,

- Didactic games.

Classification:

1) Problem-solving methods - emphasise activity, productive thinking, and students' independence.
2) Gamification - educational games, economic games, various crosswords, fill-ins, and quizzes.
3) Discussion methods include brainstorming and brainwriting, Philips 66, Hobo method, and others.
4) Situational methods - based on a reasonable and solvable problem that may have multiple solutions and require a comprehensive approach and knowledge from various subjects.
5) Staging methods or role-playing.
6) Many unique methods, including those that cannot be classified into the previous methods, such as icebreakers or project methods mentioned above (Zahatňanská & Kušnírová, 2017).

Problem-Based Teaching

Pecina and Krištofiaková (2021, p. 61) state that the difference between a traditional teaching unit and a problem-based one lies in its preparation. Preparing a traditional teaching unit involves a project where we plan to provide students with finished knowledge through classical teaching methods such as lectures, illustrative, and practical methods. Problem-based teaching sessions are characterised by not delivering ready-made knowledge to students but guiding them to acquire new knowledge based on their existing knowledge and active cognitive engagement with appropriate teacher assistance.

Didactic Games

Play is the subject of various psychological research and interpretations because it provides an opportunity to analyse and interpret personality development, cognitive processes, and socialisation. In cognitive development in early and preschool age, play is essential for the proper development of exploratory, sensorimotor, symbolic, and later, cognitive and speech expressions. It is not only a matter of childhood and youth but also of adulthood and old age because the need for play persists in various forms (Millarová, 1968, p. 7).

Gamification supports basic human needs such as competitiveness, rewards, and self-expression. Its primary strategy is rewarding for completing tasks with awards, badges, filling progress bars, levelling up, and virtual currency (Brečka & Valentová, 2018, p. 41). These authors further list reasons to use gamification in education, including:

- Learning entertainingly,

- Increasing interaction – instead of just reading text, we are actively involved in doing something (creating),
- Increasing awareness – we can engage in a plot that helps us better understand issues that are difficult to comprehend in traditional teaching methods,
- Reward for completing challenging tasks – meeting deadlines, goals, etc.,
- Feedback for the teacher (Brečka & Valentová, 2018, p. 44).

Didactic games include not only traditional games but also computer-assisted educational games. They are most commonly used in practice for consolidating and reviewing material. These games (not only computer-based) can be verbal, such as memory games, logic games, associative games, abstract games, and written games.

Project-Based Teaching

Project-based teaching is one of the modern activating methods of instruction that allows the development of students' independence in cognitive activities and utilises interdisciplinary relationships. Based on its characteristics, project-based teaching can be classified among problem-solving methods of instruction. Students acquire knowledge and insights through the solution of suitable projects.

Project-based teaching allows for:

- Deepening and expanding knowledge,
- Developing creative thinking,
- Recognizing the significance and meaning of learning,
- Integrating knowledge into a coherent system.

Harausová describes the positives brought by project-based teaching develop the following competencies in students:

- Responsibility for their work,
- Independence,
- Activity and creative work of the student,
- Overcoming obstacles,
- Searching, selecting, and analysing relevant information,
- Communication,
- Collaboration, argumentation,
- Presenting their work,
- Planning,
- Evaluating,
- Tolerate and accept different opinions (Harausová, 2011, p. 28).

Discussion Methods

Through discussion methods, students learn communication, discussion, and the defence of their opinions, thoughts, and arguments, as well as listening to and perceiving the opinions of

others in the group, which can lead to the cohesion of the student group in the classroom. In addition to the discussion, debate can also be utilised, as according to authors Schulcz et al. (2017; cited in Zahatňanská & Kušnírová, 2017), it supports and develops:

- Critical thinking – the ability to work with information, evaluate it, and categorise it, the ability to distinguish credible and essential information;
- Good argumentation – the ability to defend one's opinions;
- General knowledge – acquiring and seeking relevant information;
- Team collaboration;
- Effective dialogue skills – listening to others, being able to express oneself precisely, convincingly, and concisely, asking appropriate questions, and responding to them;
- Presentation skills – learning communication, presentation, and building self-confidence.

Digital Technologies and ICT Tools in Teaching

With the advancement of science and technology, modern approaches in education are coming to the forefront, aiming to streamline individual phases of the teaching process and create a positive and creative atmosphere in education. The gradual incorporation of these attributes into educational processes is slowly moving away from the traditional school approaches (Brečka & Valentová, 2018, p. 28).

Authors Zounek and Šeďová (2009) include modern audiovisual and digital technologies in the group of information and communication technologies (ICT), enabling users to access and work with information further, such as interactive boards, the internet, digital cameras, and various forms of communication like email. The acronym ICT refers to all technologies used for working with information and communication. The concept of information technology has thus been supplemented with a communication element. Information and communication technologies, however, are not just hardware elements (computers and servers) but also include software (operating systems, internet browsers, network protocols, etc.) (in Brečka & Valentová, 2018, p. 49).

According to Kalaš (2011), the acronym ICT generally refers to procedures, means, and knowledge used for processing and communicating information. In education, it involves specific computing and communication tools, information sources, and procedures designed to support teaching, the learning process, and other educational activities (in Brečka & Valentová, 2018, p. 50).

Creative teaching requires the development of the application of information technologies for teachers (knowledge, tools, and methods for creating, storing, searching, and disseminating information about the methodology of creative teaching), the use and creation of didactic programs (computer software for teaching or the use of virtual reality in teaching, etc.), the development of methods for pedagogical creativity diagnostics, and the application of technical teaching tools in creative teaching (Lokšová, 2002, p. 66). Lokšová also adds that

the teacher is a central factor in creative teaching. They understand the theory of creativity and didactic means of developing students' creativity and applying them in the practice of creative teaching. She adds that "new forms and new didactic techniques such as computers, the internet, and multimedia" also enter into this type of teaching (2002, p. 56).

Selected Digital Tools in Teaching

The integration of ICT (Information and Communication Technology) significantly contributes to the development of constructivist education, as it allows students to acquire knowledge independently. However, at the European Commission level, the term IKT (Information and Communication Technology) is replaced by the term digital technology because the term IKT narrows down the meaning, while digital technology provides a broader space for its definition as a means for exploration, creation, and exploration (Bobot & Jakubeková, 2012; in Brečka & Valentová, 2018, p. 50). The platform supports applications and other technologies. By educational platform, we mean interactive online and offline services that provide resources, tools, and information for managing, supporting, and developing education for those involved in the educational process (Brečka & Valentová, 2018, p. 52).

To improve teaching and incorporate digital technologies into specialised subjects, we have selected online and offline tools, collectively called digital teaching tools. Here is a brief description of the selected tools:

Canva
A web platform for graphic design that allows the creation of graphics, social media presentations, video presentations, posters, business cards, invitations, social media posts, brochures, flyers, collages, resumes, book covers, and more. It includes customisable templates and a database of high-resolution photos and images and supports team collaboration.

Prezi
Cloud-based software for designing and creating videos and presentations utilising zoom effects and transitions between points. It offers an EDU version for students and educators at a monthly fee of $3.

Adobe Express
A package of Adobe applications for creating simple videos, websites, social media posts, flyers, logos, posters, invitations, business cards, and more. It includes a database of templates, photos, and editing tools. Various licenses remove watermarks and provide access to templates, images, support, branding, and collaboration.

Mentimeter

An application is suitable for feedback, interactive presentations, voting, polling, and brainstorming. Respondents can participate in real-time using their mobile phones or tablets.

Plickers

A tool for testing, evaluation, or feedback, usable on mobile phones or tablets. It is suitable for quickly testing students and supports importing text from Word, PowerPoint, or the Internet. The free version allows the creation of up to five questions.

Drilleo

It is a simple web application designed to remotely test students' knowledge, sharing, and online assessment. The application was developed by Slovak creators from OpenLab in response to the situation associated with the COVID-19 pandemic to assist teachers and students in schools.

G-sites

Google application that allows the creation of simple websites for those who do not know programming languages and website development. It provides the option of free sign-up through a Google account (Gmail).

Blogger

Google application for creating web blogs allows sharing photos, videos, and text. The application can be downloaded to a mobile device as well. It enables the creation or editing of posts with the ability to publish them instantly, view a list of posts, and switch between multiple accounts and blogs.

Studenthosting

The *Webglobe* platform for schools, teachers, and students is designed to create non-commercial WordPress websites without advertisements, with the option to register a domain. It offers a large variety of templates for easy website creation. The Simple WebEditor package is intended for complete beginners to create small, simple pages and is free of charge. When opting for other packages such as shared web hosting, WordPress hosting, or a Virtual Private Server (VPS), the prices range from €1.99 to €10.16 per month.

Videoscribe

The software from Sparkol is for creating whiteboard animations that can be narrated. It includes many shapes and objects that can be used to create animated videos. License prices vary depending on whether you choose a browser-based license, a desktop version, or a group version.

Actionbound

This online application uses gamification tools that utilise various features, including GPS map content, images, and the ability to create questions, descriptions, and pictures. Upon completion, the application generates a QR code for sharing and accessing the app via a mobile phone. The mobile application can be downloaded from the Google Play Store. An advantage is the ability to track results, the number of participants involved, their ratings, and more. It offers multiple licenses ranging from business to educational.

Jamboard

The Google Jamboard application is suitable for note-taking, labelling, and drawing, offering the option for team collaboration (contributing to a single Jamboard). Completed Jamboards can be saved in PDF format or as an image and shared.

Padlet

It is an online tool for creating digital bulletin boards and sharing them. It allows you to share texts, images, and links, create presentations, and be used as a blog or portfolio. It also enables selecting an environment as a map, timeline, canvas, or bulletin board. In the free version, you have access to three Padlets after registration.

Miro

The platform you describe is likely Miro, a digital collaboration platform designed to facilitate team communication and project management. It shares similarities with Padlet but operates at a more professional level. It offers features like saving in various formats (PDF, image), sharing, linking, and more. Miro allows the creation of different types of maps, including mind maps, and can be used for recording ideas during brainstorming sessions with students.

Kahoot

Kahoot is an educational platform based on gamification. This tool allows the playful creation of quizzes through a PC or mobile phone. It is suitable for testing students' knowledge, formative assessment, or as an entertaining and educational element to make teaching more engaging. Participants can answer questions using Android or iOS mobile devices. Licenses are divided into teacher, private, and business categories.

Learningapps

The platform Learningapps.org is used to create straightforward educational games, offering various options such as Who Wants to Be a Millionaire, crosswords, memory games, horse racing, matching words and pictures, word completion, and many others. The created games can be shared with students.

The Impact of Selected Digital Tools in Teaching on Students' Creativity

We selected third-year students from two study programs at a real vocational high school to implement our research. At the beginning of the 2022/2023 school year, we used Likert scales to assess students' creativity using the Kellogg Creativity Test developed by Northwestern University. We obtained initial data on students' creativity scores before integrating digital tools into teaching. The second testing took place at the end of the school year. Twenty-four third-year students, whom we initially selected as our research sample from the real vocational high school, participated in the testing.

The test consisted of forty questions, and students had to choose from three options: A, B, or C, for each question. At the end of the test, students were shown the creativity score they achieved. They had the opportunity to compare this score in a table:

Table 1: Comparative Data

95 – 116	Exceptionally creative
65 – 94	Very creative
40 – 64	Above-average creative
20 – 39	Average creative
10 – 19	Below average
Below 10	Non-creative

(Source: https://www.kellogg.northwestern.edu/faculty/uzzi/ftp/page176.html)

The selected group of students achieved a total creativity score of 1153 points during the initial testing. The lowest scores were 31 and 32 points. The highest score among the selected group was seventy-two points. Students with learning disabilities in the chosen group collectively scored 184 points.

In the second test at the end of the school year, this group of students achieved a total creativity score of 1355 points. Students with the initially lowest scores showed a significant increase, with one student increasing from 32 to 51 points compared to the first creativity test. Another student who initially scored thirty-one points increased to thirty-seven points by the end of the school year. The highest increase was observed in a student who scored fifty points initially and reached ninety-three points at the end of the school year, an increase of forty-three points. Other students also showed a notable increase of more than fifteen points in their creativity scores. However, out of the research sample, only one student scored four points lower at the end of the year. Students with learning disabilities also experienced an increase, scoring two hundred-eleven points at the end of the school year compared to the initial state, the scores increased by two hundred two points for the selected group of

students, representing an increase of more than 15% in creativity scores. Similarly, students with learning disabilities showed an increase of twenty-seven points.
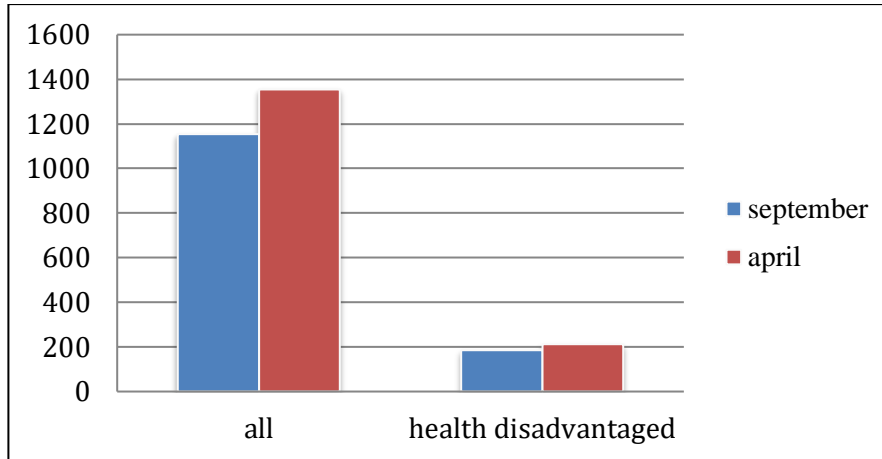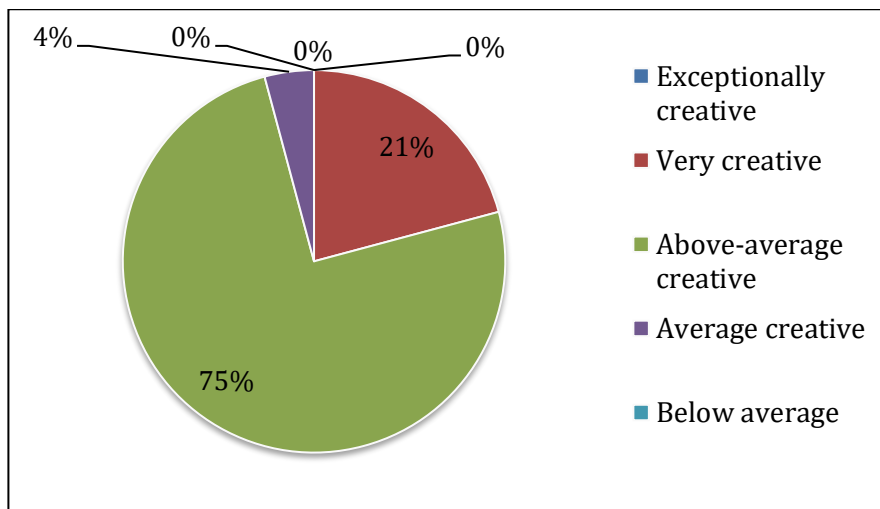

Graph 1: Creativity Scores of the Selected Research Sample of Students

In the following two graphs, we present the distribution of students in the point scale of the creativity test. We can observe that in the first testing, there was a higher number of students with average creativity compared to those who achieved scores in the very creative range. However, this situation changed in the second testing at the end of the school year, where the number of students with average creativity decreased to one, and the number of very creative students increased from two to five. The number of above-average creative students remained unchanged. Their point scores were not the same; upon closer inspection of specific student results, they increased, but not enough for these students to enter a higher point scale into the wildly creative level. A positive aspect, however, is that several students in the selected group significantly improved their creativity.
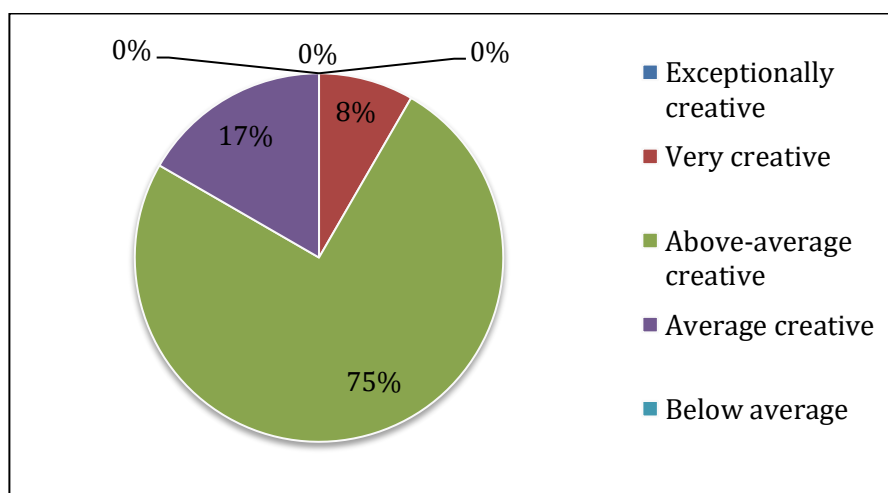
Graph 2: Creativity Scores of the Selected Research Sample of Students at the Beginning of the School Year

Graph 3: Creativity Scores of the Selected Research Sample of Students at the End of the School Year

Conclusion

As Binder (1981, p. 135) notes, a student remembers what he could use in his activities, based on which he solved his problems and what significantly interested him. Like many other authors and experts, he states that a student generally remembers:

- 10% of what they read
- 20% of what they hear
- 30% of what they see
- 50% of what they hear and see
- 70% of what they say
- 90% of what they say about what they did.

Based on these and other findings related to the topic, it can be assumed that using digital tools in teaching and involving students in activities using these tools can improve the teaching and learning processes. Based on the research conducted on a selected sample of students and the results obtained from measuring their creativity scores, in which there was an increase, we assume that integrating digital tools into teaching and implementing activities helps support students' creativity. Their use can be a tool for improving teaching and fostering creativity, not only for healthy students but also for students with learning disabilities, for whom these tools enable better understanding and memorisation of the material because they engage additional senses, stimuli, and learning methods besides listening to the teacher's lecture, reading, and memorisation.

Students become directly involved in various activities through graphical representation and working with graphics and visualisation. This approach can lead to a better understanding of information, improvement of students' abilities and skills, support of

creative thinking, and development of other soft skills, such as enhanced communication and presentation skills, teamwork, and critical thinking. Lastly, modern and engaging teaching can make a subject more attractive and improve the overall teaching quality, which may increase student motivation. We believe that modern technologies and ICT tools are essential in education, and their utilisation has become an integral part of student learning at all levels and fields. The selected digital tools are user-friendly, as working with them is straightforward and interactive without extensive training.

Acknowledgements

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