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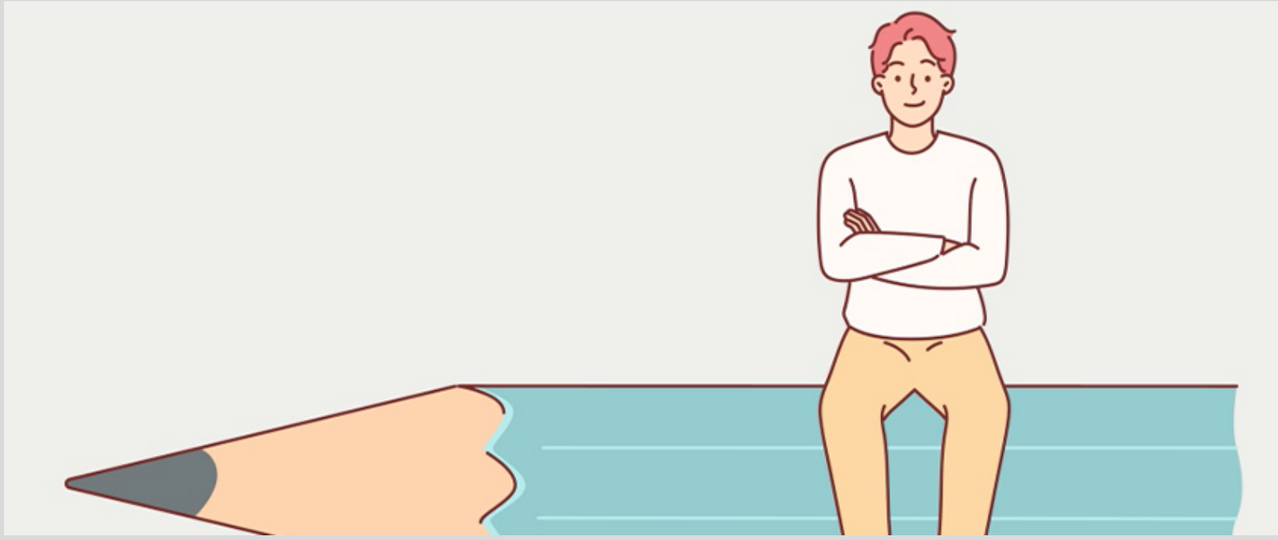

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The Journal on Efficiency and Responsibility in Education and Science publishes papers of the following categories: full research papers, short communications, review studies and book reviews (on invitation only).

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The paper. The paper is carefully formatted according to the template of the journal (see bellow). Special attention is paid to the exact application of the Harvard referencing convention to both continuous citations and list of references. If an electronic source has the DOI number assigned, also it will be provided in the list of references. Manuscripts are submitted via the editorial system in the DOC.

Research highlights. The core results, findings or conclusions of the paper are emphasized in 2-4 bullet points (max. 150 characters per bullet point including spaces). The highlights are submitted as a text into the submission form in the editorial system.

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Authors are responsible for applying all requirements that are specified in the journal's paper template in individual sections. Especially, the paper must provide a short review of current state in the area of the paper's aim in Introduction. The paper should refer significant sources, particularly scientific journals or monographs.
Papers must be closely scrutinized for typographical and grammatical errors. If English is not author's first language then the paper should be proof-read by a native English-speaking person, preferably one with experience of writing for academic use. Spelling should follow the Oxford English Dictionary.
Tables, graphs and illustrations should be drawn using a suitable drawing package. Colour may be used. Place all diagrams and tables where you wish them to appear in the paper. Ensure your diagrams fit within the margins and are resizable without distortion.

Review procedure

Following Editorial recommendation, papers are submitted to a double-blind peer review process before publication. Commentary by reviewers will be summarized and sent by email to authors, who can choose to revise their papers in line with these remarks. Re-submitted papers should be accompanied by the description of the changes and other responses to reviewers' comments (see above), so that the desk-editor can easily see where changes have been made.

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With the last issue of 2024, it is time to summarize some of the ERIES Journal's achievements in the previous 12 months. The ERIES Journal remained evaluated in Q3 in the Education category of the Scimago Journal & Country (SJR) ranking. The journal obtained the SJR score of 0.241, with 2-year citations per document of 1.239 and +5.1% of total citations. Further, we are very pleased that our page on LinkedIn attracted a bigger audience in the scientific field as the number of followers grew by 14.21%, terminating with 418 followers, reaching a total of 5,219 impressions and 139 reactions.

In the last issue of 2024 (Vol. 17, No. 4), we are pleased to present the following seven articles:

The first article, "Technology-Enhanced Thinking Scaffolding in Musical Education," by Marius Banut and Ion Albulescu, aims to test the role of programming as a scaffolding agent in learning music theory by memorizing and understanding musical notation elements. The analyzed sample included 87 students in the 4th grade from Romanian compulsory education in an urban environment in Romania. These students conducted programming activities using the Sonic Pi application in the Music and movement classes, implemented through an educational project with 24 lessons designed for integrated music-programming learning. The analysis confirms the possibility of achieving technology-enhanced thinking scaffolding in musical education.

In the second article, "Examining Social Media Addiction as a Predictor of Academic Achievement and Academic Procrastination: A Cohort of Undergraduate Students," Suleyman Avci, Mustafa Cakir, and Tuncay Akinci examined the effects of self-control and future time perception on social media addiction and academic procrastination. The authors also aimed to determine whether social media addiction affects academic achievement through academic procrastination. For this purpose, the authors analyzed responses from 559 students from Marmara University in Istanbul. The authors observed that social media addiction is not a significant predictor variable for academic achievement or procrastination. On the other hand, self-control is a significant predictor in reducing both social media addiction and academic procrastination. The analysis underscores the importance of enhancing students' self-control and time management skills to mitigate procrastination and promote academic success.

In the third article, "Empowering Futures: Unveiling the Impact of Career Readiness on Job Seeker and Creator through Self-Efficacy," Dian Rachmawati, Sheerad Sahid, and Mohd Izwan Mahmud analyzed the relationship between education and management as undergraduate education students will become job seekers and job creators in the future. The analyzed sample consists of 455 undergraduate economics education students at seven of the best teaching universities in Indonesia. The authors used the Structural Equation Model (SEM) with the IBM-SPSS AMOS 26 program to examine the data. The results prove that career readiness is not only important for job seekers but also necessary for those who will become job creators. Career readiness partially influences the tendency among undergraduate economic education students to become job seekers and creators of jobs. Moreover, the positive coefficient indicates that increasing career readiness can significantly increase the propensity to seek and create jobs.

The fourth article, "Data Envelopment Analysis as a Tool for Identifying Reference Schools: A Study in the Context of High School in a Brazilian State," from Denilson Junio Marques Soares and Wagner dos Santos, uses Data Envelopment Analysis to evaluate the efficiency of 222 high schools administrated by the State of Espírito Santo in Brazil. For this purpose, the authors used the Basic Education Development Index (Ideb), widely used in Brazil as a strategic management tool. The analysis shows that 17 schools operated on the production frontier in 2017, which increased to 18 out of the 222 schools in 2019. Applying the Malmquist Index, the results revealed that most schools experienced modest improvements in technical efficiency during the analyzed period, effectively utilizing resources to achieve similar or better outcomes.

In the fifth article, „A Cross-sectional Study Analyzing the Integration of the Moving School Concept at Secondary Schools in Germany," Paul Englert, Jonas Wibowo, Martin Niedermeier, and Yolanda Demetriou aimed to analyze the degree of the implementation of the Moving school concept at Gemrna secondary schools and also investigate associated factors with the intention of teachers to implement it in practice. The authors asked 345 physical education teachers by questionnaire about their knowledge of the concept, their attitude towards it, and their assessment of the current situation in everyday school life. The analysis

observed that the concept is well-known among physical education teachers. Teachers' expectations regarding effort and performance, social influence, and, in particular, facilitating conditions are positively associated with using the concept.

The sixth article, „ Factors Influencing the Mental Health of University Students in the Czech Republic," written by Kristyna Vltavska, Kristýna Krejčová, and Zdeněk Šulc, focuses on the mental health of university students in the Czech Republic based on the annual reports data and data from the EUROSTUDENT 8 survey. To do so, the authors used binary logistic regression to look for factors that influence the mental health of university students. The analysis consists of information linked to 10,086 students in the Czech Republic. The results show that the number of students with mental health problems at universities in the Czech Republic has been increasing in recent years. In addition, mental health problems depend on the gender of the student (women are a more vulnerable group than men), their financial situation (students with financial problems are more vulnerable), and their field of study.

In the seventh article, "Digital Classroom Innovations: Leveraging Smartphone-Based Application to Stimulate Students Creative Thinking Skills," Sukatiman, Ida Nugroho Saputro, and Mochamad Kamil Budiarto investigated the effectiveness of an Articulate-based mobile application in helping students improve their creative thinking skills. The authors used quasi-experimental models and a one-group pre-post-test design of 60 students in total. The research data was collected through tests of creative thinking skills conducted before and after implementing the smartphone-based application. The analysis indicates that implementing application media has proven effective and significantly improves students' creative thinking skills, which underlines its potential as a tool that contributes positively and plays a role in stimulating students' thinking abilities.

We hope all our readers will find this last issue of 2024 interesting. We also hope that the ERIES Journal will contribute to the field of efficiency and responsibility in education and science as it has contributed during the last few years. With the end of the year 2024, we would like to thank all the authors who have submitted their manuscripts to the ERIES Journal, to all reviewers who carefully reviewed all these manuscripts and provided helpful recommendations to improve the articles' quality, as well as to all members of the Editorial board who contributed to ERIES Journal bigger visibility. Their ongoing work is a huge responsibility for the Executive Editors to keep improving the journal's quality.

We wish you a Merry Christmas and a Happy New Year 2025.

Sincerely

Martin Flégl
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CONTENT

Full research paper

TECHNOLOGY-ENHANCED THINKING SCAFFOLDING IN MUSICAL EDUCATION

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ABSTRACT

In pedagogical language, "scaffolding" is frequently used to replace the expression "support in learning". In didactic terms, the practice in the classroom shows that various types of support, such as the teacher, colleagues, and technologies, contribute to more efficient learning. In terms of technologies, the present study aims to test the role of programming as a scaffolding agent in learning music theory by memorizing and understanding musical notation elements. In this sense, a sample of 87 students (N = 87) from an urban environment in Romania carried out programming activities using the Sonic Pi application in the Music and movement classes, implemented through an educational project with 24 lessons designed for integrated music-programming learning. The study results describe the acquisition of knowledge, in terms of recognition of musical notation elements, achieved under the influence of cognitive capacities scaffolded by digital technologies. Better post-test results and homogeneous variances between and within the three classes of the participant's sample confirm the possibility of achieving technology-enhanced thinking scaffolding in musical education. The results of the music-programming integrated learning framework could be translated into a more efficient use of teaching time and an increased flexibility of interactions.

KEYWORDS

Cognitive processes, music-programming learning, primary education, scaffolding, Sonic Pi

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Highlights

- *Primary school students (11 years old) can convert the game of generating sounds through programming into acquisitions of learning music theory.*
- *Digital technologies can scaffold the cognitive processes (memorization, understanding) involved in the achievement of musical education.*

INTRODUCTION

Music has always been a force that creates social cohesion and strongly influences human beings, especially young people. A study where children aged 11-14 were involved in which it was intended to "ascertain how regular involvement in music activities can cultivate mindfulness, integrating body, mind and spirit, subsequently facilitating holistic development that will enable children to overcome their challenging social circumstances" (Auerbach and Delport, 2018: 3) found that those activities carried out in a non-formal environment, optimize the educational process. Children were engaging in activities with pleasure.

Computers are considered to produce the same effect on young people, they are a subject of interest to them, especially because "interest in computers seems to begin at around age 4" (Webster, 2002: 233), only that these devices, which produce good mood among young people, are more modern means with a short history. This means that the experience of interactions with digital technologies, at this time, is not one that is inherited and passed down over generations. Today, computers have entered our lives, and we find them in various objects around us that we call "smart objects". This process has just begun, and in the future, "we will see more sophisticated virtual worlds; Second Life is today's Mosaic" (Wing, 2008: 3723). Thus, what we live, and experience today is already a digital habitat, and the future will increase the degree of integration of the real world into the virtual one. Computers are being used on an ever-increasing scale, and everything that a computer display is virtual, even the smallest information because in reality and in the processes they carry out, there are only 0 and 1, i.e., absence and presence of a signal, these being the basic units of information in the binary system. Learning, like any other activity that the individual or groups of people are engaged in, will be part of this new reality, which grows and develops quickly, like a child.

In the teaching-learning process, integrating music with computers can result in a relevant educational object for the digital age, allowing the student to explore or deepen sound parameters, all done with pleasure and enthusiasm. In such an integrated scenario, "the learning environment should be able to represent activity-oriented musical experiences, where students - properly sustained by scaffold elements - are involved in the process of music construction/deconstruction" (Ludovico and Mangione, 2015: 452). Thus, digital technologies are equated with supporting elements in formal education in this specific context of understanding musical works, digital musical reproduction, or the construction of completely new melodic fragments. Under the influence and reality of technological advancement, "there's always new information about the usage of music and people, especially parents, should be regarded as the ones in the front row to find out about the modern and original ways in which music is practiced and applied" (Simion, 2015: 489). A modern way to practice, learn, and apply music includes the use of the computer, and because the role of parents in enrolling children's education in an up-to-date education was also emphasized, the integration of music education with computer science education addresses all forms of education.

In a formal education setting where the students have experienced sound generation with a computer, the research aimed to test the role of computer programming as a scaffolding agent in learning music theory by memorizing and understanding musical notation elements during their practical use. In this sense, whether certain results of interaction with knowledge from the musical domain can be attributed to computer programming is of interest. Thus, the first made-up research question is:

Q1: To what extent can digital technologies provide scaffolding support in the cognitive processes involved in the realization of music education?

In terms of digital technologies, *Sonic Pi*, the application used in this study, can determine meaningful learning experiences, given the fact that it makes the connection between two different domains, music and programming, with the possibility of mutual support in the student's actions to improve knowledge in one of the domains. It has been stated that *Sonic Pi* was created to support the programming-oriented curriculum in the United Kingdom (Aaron, 2016). Still, it is to be analyzed if such an activity, presented as a musical creation game, is suitable for some students in primary education aged 10-11 years. Then the second research question is:

Q2: What is the evidence that elementary school students can convert the play of electronic sound generation with the *Sonic Pi* software into acquisitions of music theory learning?

Regarding the structure of the paper, at the beginning, a brief review of the evolution of the term "scaffolding" is made, followed by a section assigned for framing the research problem, conceptualizing the use of digital technologies as mind tools for scaffolding thinking. The next section presents the research purpose. The section dedicated to the research includes the study's hypothesis, participants, research design, and explanations for the educational project designed for integrated music programming learning. The section dedicated to the results presents, in a pre-test and post-test comparative analysis, the results of the students obtained after completing 24 lessons that integrated music with programming in the didactic process. Finally, the discussion section compares the results of the study with those recorded in the theoretical foundation, and in the end, the conclusions are presented in the last section.

THEORETICAL FRAMEWORK

The use of social skills requires cooperation and collaboration, which involves the implicit existence of support in the activity carried out. When this activity is one of learning, in pedagogical language, a synonym frequently used to replace the expression of support in learning is the term "scaffolding". The conceptualization of the term scaffolding in pedagogy was carried out by Wood, Bruner, and Ross in 1976 (Kim and Hannafin, 2011) and fits perfectly a sociocultural perspective in which the role of the teacher is emphasized to provide support in learning in accordance with the socio-constructivist type of instruction. At its origin, "the concept of scaffolding refers to temporary and adaptive support, originally in dyadic adult–child interaction" (Smit et al., 2013: 817), but support can also come from other sources, such as a more capable peer. When using the term "scaffolding", we are talking about external support, which can also be of another type. Therefore, "probably the most common way of describing the provision of assistance to learners has been related to the use of the building metaphor, scaffolding" (Yelland and Masters, 2007: 363). Nevertheless, today, human beings benefit from assistants that did not exist a short time ago, and they were created precisely for this purpose, to provide the necessary support at the right time. An example in this sense is virtual assistants, such as Siri or Cortana, who are ready to offer support on certain operating systems at any time. Robotic Process Automation (RPA) is a field on the rise; in fact, we find ourselves at the moment when robots compete with human actions, replace human beings in the field of work, and perform tasks much better. In this sense, digital technologies can provide support as substitutes for human intervention. In such a context, "computers can provide effective *scaffolding* for young children" (Webster, 2002: 233), and perhaps for these reasons, it was stated that: "renewed interest in scaffolding has been evident in education research" (Kim and Hannafin, 2011: 403).

The initial concept indicated the most capable adults or peers as potential sources of support in learning. Still, the concept was expanded and expanded in scope, so the specialized literature mentions even more possibilities of mediating learning under the term "scaffolding". As a result of extensive documentation, through the analysis of a series of studies in this field and the organization of international conferences with the unique theme of scaffolding, it is stated that "in general, multiple agents provide scaffolding in the classroom including the teacher, other students, paper-based artifacts, classroom decorations, technology, and far more" (Davis and Miyake, 2004: 267). These aspects are confirmed by the practice in the classroom, where various types of support such as the teacher, peers, or technologies compete and that make learning more efficient, which is why scaffolding must be seen as a system, as found in the vision of Reiser (2004; as cited in Kim and Hannafin, 2011).

The integration and the natural place of digital technologies in such a system is confirmed by a study carried out over two years, where the participants were students around the age of 8 in primary education and which targeted digital technologies as specific and extended form of providing support in learning, concluding that their "work has also indicated that the computer and the type of tasks used create a context which is a type of scaffold, that may be complemented with suitable cognitive and affective strategies" (Yelland and Masters, 2007: 380). Considering the complementary role of cognitive strategies in an obvious relationship between pedagogy and psychology, "Rogoff (1990) defined scaffolding as a meta-activity that assists learners in separating given tasks into pieces, and this definition can explain supporting learners in *decomposition*, which is among the sub-components of" computational thinking (Kukul and Çakır, 2020: 38).

The use of the term Computational Thinking (CT) is attributed to Seymour Papert (1980; as cited in Agostini, 2020), who first used it in 1980, and was brought back to public attention in 2006 by Jeannette Wing (2006; as cited in Kukul and Çakır, 2020). Meanwhile, computational thinking has become part of the curriculum of several countries around the globe, such as Cyprus (European Education and Culture Executive Agency, Eurydice, 2019) and New Zealand (Petrie, 2021). Computational thinking allows the formulation of problems and viable solutions in both human and computer minds (Selby, 2011). So, computational thinking is the use of cognitive skills to face a problem with the help of the computer, a problem that can be solved in this tandem, human-computer. In the context where, through scaffolding, students are oriented towards identifying the problem along with the progressive structuring of tasks to solve it, as Reiser claims (2004; as cited in Kim and Hannafin, 2011), scaffolding has similar characteristics to computational thinking, in the sense that it accompanies the student on the path from problem identification to its solution. In this context, solving the problem means obtaining the information sought through a thought process supported by scaffolding by digital technologies. Hence, the information determines the human being to think, a process in which computer equipment also participates, by the fact that it causes, in turn, the human being to think and process the information: structured, logical, and algorithmic. Information from various sources can be processed, and this is a complex process that we call learning. This complex process involves, inclusively, auditory processing, and when sound characteristics and patterns of sound groups are processed, learning is included in the realization of music education.

Based on Rogoff's statement (1990; as cited in Kukul and Çakır, 2020), which perceives common points between the role of scaffolding and that of computational thinking, that of being a support for those who learn in *decomposition* and under the evidence of the fact that music is decomposed into elements of form (stanzas/ refrains), musical phrases, measures, musical notes, sound qualities, we understand that digital technologies can have the ability to provide scaffolding support in the cognitive processes involved in making music education. Thus, connections are present between pedagogy, psychology, and music, as Webster (2022) also highlights when he states that using apps to scaffold music composition and improvisation is of a great deal for learning. In this regard, in an analysis of the specialized literature it was concluded that "handheld technology presents an opportunity to scaffold students' musical learning, enhance self-expression, and explore timbral relationships" (Carlisle, 2014: 12). Also, in an empirical investigation that aimed to analyze how computational thinking supports learning objectives set for content areas specific to music and computer programming and in which the *Sonic Pi* application was used during the undertaken activities with 22 students of ages 11 to 12, "appropriate learning outcomes were created to be in line with the main lesson activities and curricula links in the Music Curriculum and DTC in NZ" (Petrie, 2021: 5), DTC being the acronym for Digital Technologies Content, and NZ for New Zealand.

The examples presented promote the idea that "to scaffold students' scientific inquiry, teachers use technologies to access real-world examples to vividly illustrate the nature of science as complex, social, and challenging" (Kim and Hannafin, 2011: 409). In a real-world setting, at the time of 2022, both the student and the teaching staff return post-pandemic to their usual activity. However, following the pandemic experience, which imposed social distancing, the reconsideration or strengthening of social skills requires cooperation and collaboration, which presumes the implicit existence of support in the activity carried out. The introduction of the basics of programming languages in the study of music seems to be a favourable context for cooperation and encouraging the necessary skills for the cultural and artistic expression of students, which we want to use as a strategy to activate the potential of students at the level of the 4th grade. For such a context, "we believe that play for a child or an adult, as well as specifically for a computer science student, includes two key factors. The first is exploring something relevant and interesting to the individual, and the second is doing this in a social environment" (Anderson and Gegg-Harrison, 2013: 499).

With regard to the social environment of the primary classes, a study from Sweden that integrates the teaching of programming with mathematics notes, "the fact that programming trains students' communication skills is another aspect mentioned by the interviewed teachers. They argue that students work often in groups with programming, collaborating on solving tasks" (Stigberg and Stigberg, 2019: 491). By the fact that music is a phenomenon of general interest, which can be explored through computer programming in the social environment, starting from the primary education classes, precisely because it offers the opportunity to explore something interesting and relevant for the learner, where learning to program can be enjoyable and approached with enthusiasm, a comfort zone suitable for the student can be seen for the transition towards proximity development. On a social level, this is a proper context for communication and collaboration, and even more than that, programming can be used for pedagogical purposes and for the development of various non-digital skills from various curricular areas. For example, between the curricular areas *Arts* and *Technologies* - *Computer Science*, in general, but more precisely between music and programming, similar forms

of thinking were observed, "both use concepts around sequence (the order in which notes appear in time; and the order of statements in a computer program) and repetition (in music this includes repeats, as well as forms such as rondo or the structure of popular songs; in computing loops and recursion provide this)" (Bell and Bell, 2018: 152). Thus, digital technologies strengthen the relationship between pedagogy and psychology in the case of developing musical skills.

Because "interactive and experience-based practical exercises present a way to teach theory in art education" (Váradi, 2018: 67), reproducing a sequence of musical notes from a cultural heritage work, implemented in a sequence of computer instructions, is a way of learning music theory by composing digital music. The fact that "technology can socialize learning, encouraging positive behaviors such as asking questions, giving explanations, and discussing disagreements" (Roschelle et al., 2010: 416) emphasizes how pedagogical and didactic aspects reconcile with technology. To make this contribution explicit, it is stated that "technology-enhanced scaffolding can situate problem identification and engagement by providing vivid descriptions, visualizations, and related questions and resources to students' experiences" (Kim and Hannafin, 2011: 409).

The process of realizing music education shows that there is a need for explanations, experiences in working with sound qualities, and answers to questions related to sound phenomenology since, in a study carried out with 286 primary school students, it was shown through the processed data and analyzed quantitatively as well as qualitatively, that the opinions formed on the way sound is transmitted wrong and this could be because, in the case of sound, information cannot be processed visually (Sözen and Bolat, 2011). This is where technologies can interfere with providing explanations, those technologies that have an oscillogram and thus allow the graphic representation of sound vibrations, as well as computer programming as a technique to generate sounds electronically, exploring, in this way, the presence of all relevant parameters in the formation of sounds. The teacher's feedback can sometimes be delayed or absent in the classroom where the teaching-learning process is traditionally approached. Yet, digital technologies can provide immediate feedback, contributing to an effective learning environment. This is addressed in a study that sought to explain scaffolding group feedback using the Eduinnova software made at Pontificia Universidad Católica de Chile (Roschelle et al., 2010). This is an example of the fact that technologies, through the solutions they offer, can have the ability to provide scaffolding support to make learning accessible, of interest in the present case being those actions characterized by problems in learning or understanding music.

FRAMING THE RESEARCH PROBLEM

In the sense of this characteristic of scaffolding, of providing temporary support, technologies can accompany the student on the route described by the dimension of cognitive processes, with six transit zones: memorization, understanding, application, analysis, evaluation, and creation, according to Bloom's revised taxonomy (Krathwohl, 2002), but, in each of these cognitive effort types, the amount of support provided may be different. On the six types of cognitive effort in which thinking skills are ranked from the lowest level (memorization) to the highest level (creating), digital technologies can support learning objectives from the bottom of the hierarchy so that later the support is withdrawn, for this purpose, but used, gradually, for another, which is a more important goal from the top of the hierarchy, where individuals can act creatively using digital technology. In the chapter "creativity", the EU Council Recommendation on key competences for lifelong learning presents digital competence with an emphasis on the importance of understanding how digital technologies can support creativity (The Council of the European Union, 2018). Digital technologies can also support creativity in this way, helping students advance in the complexity of cognitive processes. Creative thinking is the type of thinking that allows students to rescale their knowledge by applying imagination, anchored in theory, to generate ideas. In this sense, the scaffolding with digital technologies for the realization of music education represents the support that can be offered and withdrawn at the time when learning objectives have been met on the route from theory (memorization, understanding) to practice (creativity). Escalation on the dimension of cognitive processes, as presented in the Digital Competence Framework for Citizens (DigComp 2.1.), represents the advancement in levels of competence according to the cognitive challenge in which the student engages (Carretero et al., 2017). This cyclical progress in interacting with information and knowledge for developing digital competence from memorization to creation is supported by digital technologies through a scaffolding presence. In terms of integrated learning, in relation to the field of music, "if children do not know the joy of creating […], then they will not be educated into music" (Váradi, 2018: 67).

Analyzing digital technologies in relation to the scaffolding support they can provide in the classroom, Kang (2018) states that this is a possibility by which students can be given the support they need to better understand and complete tasks in a setting where teachers shape student progress using digital tools. Kim and Hannafin (2011) provide a few examples of technology-enhanced scaffolding, including contextualized learning, vivid descriptions, and visualizations, taking over lower-order tasks, helping students diagnose their misconceptions, and many others. As for the complete or partial taking over of lower-order cognitive tasks by the computer, this frequently happens, for example in cases where statistical research is carried out, the researcher does not have to remember all the formulas for calculating some statistical indices but only apply the formula that the statistical interpretation software will give him, to analyze and interpret/ evaluate the results. Likewise, in the classroom, in a computing context where the student has not memorized all the formulas behind some theorems in Mathematics, they are accessible through the computer, and it is important for the student to find them, recognize them, apply them, and complete the task or flesh out their idea towards a creative outcome. These are examples where lower-order thinking skills can be deliberately delegated wholly or partially to the computer, and the support offered by the computers can be gradually withdrawn as the student works with higher-order thinking skills, which is a desirable aspect of human

personality development since individuals should be able to creatively solve everyday problems. As the student moves up the scale of technology-enhanced thinking scaffolding, outlined in Figure 1, without assuming that the computer support is the same amount for each level, the higher-order thinking skills that the individual puts into work increase progressively as the computer support is withdrawn. This action has the characteristics of scaffolding support. It is a formula that supports creativity and imagination. At the same time, a greater contribution of the computer on the higher levels of thinking can act as an enemy of imagination, which is why, in terms of creativity, the computer is desirable to represent only an instrument by which the human being creates. In this regard, "scaffolding allows children to form cognitive structures so that they can operate at high levels of thinking and work more effectively toward their potential" (Webster, 2002: 233) so that, through an orientation in the work task, its solution is as close as possible, which represents the guidance of students in the space of knowledge to a development area possible to reach with the help of external guidance.

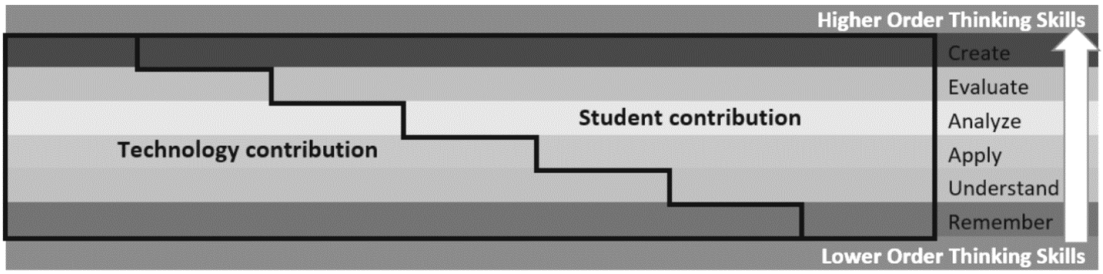

Figure 1: Technology-enhanced thinking scaffolding scale

Considering all these aspects in the relationship of digital technologies with scaffolding support in learning, "the ultimate goal of all teachers should be to facilitate the use of computers and computing technologies as mind tools (cognitive tools) to accompany thinking, reasoning, creating, learning, and inventing" (Hamza et al., 2000: 73). One such relationship is described by Seymour Papert who "argued programming can be used to support the fundamental ability to understand one's own thought processes, and thus suggested integrating simple elements of computer science, such as programming, into primary education" (2005, as cited in Leifheit et al., 2018: 345). Inclusively "at the core of Piaget's theory of development is the process he calls assimilation: when a child takes in new ideas they are first reconstituted to fit the child's mental structures. […] School has to assimilate new ideas to its own structure before these structures can change" (Papert, 2005: 366). Whether it is at an institutional level or an individual level, technologies have the capacity to support creative processes, leading to new products and new or restructured information, situations for which "researchers have studied alternatives to designing and using technologies to scaffold learning" (Kim and Hannafin, 2011: 407).

It is known that today, assessment design focuses on lower-level thinking skills, measuring what the students have memorized, which is opposed to the expression of creativity. (Ben-Jacob, 2017). In the spirit of constructivist theories, where students reframe their knowledge based on meaningful learning experiences, it is much more plausible that they keep in mind and apply what they have learned (Nand et al., 2019), which is also the goal of the current study, that the students store information at the end of a long process of practical training. Retaining and retrieving information stored by memorization in a knowledge base that is formed and can be accessed and retrieved from long-term memory is a process that Krathwohl (2002) calls remembering, while understanding is defined as the meaningful interpretation of the signification and importance of instructional messages. The student's development perspectives are broadened, starting from the assumption that the stored information is a source for new ideas generation, which most likely leads to more creative outcomes (Rominger et al., 2019).

As in any other field, cognition is also present when working with sound, and the tasks tackled by the students fall into one of the six types of cognitive effort included in the dimension of cognitive processes. In music, processing sound information is a natural process that underlies the realization of musical education. Because information determines how human beings think, information can turn into knowledge if it is assimilated and can be capitalized on various levels of thought processes: memorization, understanding, and creation, these being the cognitive processes that the paper is referring to.

PURPOSE OF THE STUDY

The study aims to use the *Sonic Pi* application to analyze the capacity of digital technologies to provide scaffolding support in the cognitive processes involved in the realization of music education for 4th grade students in the mainstream education system in Romania. In relation to the application that is being used in this study, "This makes *Sonic Pi* a language with a steep learning curve, which allows novices to focus on key concepts for which they can see immediate results, and this encourages a creative learning approach" (Traversaro et al., 2020: 144). Regarding the key concepts in the field of music education addressed in this study, these are elements of music theory and notation, which will be processed in a programming language with the help of the *Sonic Pi* application to get immediate audio results for the meanings of the concepts written on a musical stave. Symbols are used in the field of music, and these "are only static representations on a flat surface of dynamic mental processes" (Devlin, 2014, p. 78) of ideas. In fact, these are visual languages, and their recognition will be found in the practical activities in the classroom, which, carried out over a long period of time, aim at memorizing certain elements of musical notation. By transposing

the symbols of a music stave into a digital audio product through programming, the musical notation will be transposed into another symbolism, that of codes, the programming being the one that will dynamize the static symbols from the stave and correlate the visual language with the auditory one, also favoring the understanding of the musical notation which students have operated with.

The use of the *Sonic Pi* learning tool is part of a strategy to activate the potential of students and to form a profile of a creative person. This digital tool, used in this study to provide learning support, has been chosen because it provides immediate sonic feedback for the conceptual knowledge a student is using, regardless of whether it is processing musical symbols from a musical stave or operating with certain basic principles in programming and, of course. After all, *Sonic Pi* is a path to the heart of the principles of electronic music and is also a great way to boost creativity, as it allows students to design and implement personal musical ideas, feelings, or experiences in a relatively immediate way (Agostini, 2020).

The processing of sound information is a basic activity in realizing musical education. In such a context, the presence of sound information causes human beings to make current use of the skills in the hierarchy of cognitive processes. In this sense, the present study aims to analyze technology-enhanced thinking scaffolding for the achievement of music education, which can be provided and withdrawn when learning objectives have been met. The learning objectives, in this context, are represented by the memorization and understanding of certain elements of musical notation, for which the input of digital technologies could be withdrawn later, using the technologies later only as a musical instrument or toy to create melodic fragments.

In summary, the objectives proposed in this study are:

O1: the integration of computer science education contents with music education for the application of musical theory concepts through playing with the *Sonic Pi* application at the primary education level.

O2: Outlining a framework (educational project) for the achievement of integrated learning and music programming within the discipline *of music and movement* from the Romanian core curriculum for the 4th grade.

O3: Functionality testing of digital technologies as scaffolding support in cognitive processes carried out in the didactic process aimed at achieving music education.

RESEARCH METHODS

The Hypothesis of the Study

The analyzed problem raised two research questions, for which the study's hypothesis tries to anticipate possible answers. The aspects involved in the teaching-learning processes are complex and dynamic, and precisely through the prism of the dynamism of the stages and influences during a lesson, the specialized literature analyzed shows that, in the classroom, various types of support, such as the teacher, colleagues or technologies participate in this complex information processing action called learning. All these forms of support, which also include technologies leading to the same goal, have a systemic character, a character also attributed to the concept of scaffolding. Thus, these complex and dynamic aspects, which include technologies in the context of the teaching-learning process carried out for the achievement of musical education, are found at the basis of the hypothesis of the study, which we will express in the following:

By using the *Sonic Pi* application, a tool intended for playing with music composition, students can transform the playing, in a practical-applicative way, into acquisitions of music theory. This is due to the scaffolding support provided by digital technologies for learning objectives such as memorizing or understanding elements of musical notation.

The hypothesis is verified by applying Sonic Pi software in teaching practice, for which a long-lasting didactic scenario was designed. This scenario was carried out during 24 lessons of the object *Music and movement* in the 4th grade Romanian curriculum, implemented through an educational project, the characteristics and participants of which are presented in the following.

Participants and Research Design

The study tracked the extent to which a group of 4th grade students understand and remember a series of elements of musical notation used in a practical-applicative process of learning music theory. A knowledge test was conceived for this, aimed at developing musical knowledge regarding the pitch of the sounds and their duration deduced directly from the musical notation or indirectly from the tempo and the measure. These elements of musical notation are checked through 8 questions, each rated with 1 point, and the test is presented in the Appendix. The measurement tool is, at the same time, a traditional assessment test aimed, like most tests, at what the students remember (Ben-Jacob, 2017), but what differs in the learning framework outlined for this research is the memorizing process that comes at the end of practical activities that will be described in the presentation of the educational project. So, the research method is the test method, and the instrument used is the knowledge test, which was integrated within a quasi-experimental quantitative research design.

The test was applied at two different moments in time: before starting the activities with the students (pre-experimental stage) and after the designed activities had finished (post-experimental stage). It aims to evaluate the contribution of the technologies used in memorizing and understanding the symbols encountered on the musical staves at the end of a practical application process of creating some digital melodic fragments.

The integrated music-programming learning activities were carried out with 3 classes of the 4th grade from Romanian compulsory education. The sample of participants was 87 students ($N = 87$). They were part of the same school in an urban environment (Cluj-Napoca). In the Romanian education system, students turn 11 years old in the 4th grade. The group of 87 participants included 45 girls and 42 boys.

The collected data was processed and analyzed using the JASP statistical interpretation program (Version 0.16.3; JASP Team, 2022).

The Educational Project Is Designed for Integrated Music-Programming Learning

To have access to the sample of participants from public education, an educational project was developed in partnership

with a state pre-university education institution between September 2021 and March 2022. Therefore, the partnership achieved was approved, being designed to have an impact on the educational process, in the context of the priorities set out in the European strategic documents, from the perspective of developing digital competence and achieving the objectives of the Romanian education system, from the perspective of the achievement of musical education. Thus, 24 lessons have been taught, spanned over 24 school weeks in the previously mentioned time frame. The lessons took place within the *Music and movement* object, a discipline subordinated to the Arts curriculum area and compulsory at the level of the 4th grade in the Romanian educational system.

The contents specific to music education applied in the 4th grade and processed over 24 lessons of the educational project were grouped into 12 themes: musical sound/ noise, musical notes/ MIDI notes, musical stave/ octaves, the durations of musical notes, pitch, range/ chords, the timbre of sounds, measures, intensity/ dynamics of sounds, tempo/ rhythm, arpeggio/volts and tone/ semitone/ alterations. At the end of the project, the lesson sheets used in the activities were published in Romanian.

For the operationalization of these contents, in an educational project designed for integrated music-programming learning, the *Ruby* programming language was used alongside the *Sonic Pi* application, which is an integrated development environment created by Sam Aaron, Research Associate at the University of Cambridge Computer Laboratory (Aaron, 2016). Through the *Sonic Pi* software and the lessons, they took part in, students have explored informatics concepts and interacted with the musical notation and scores of 22 songs, which they transformed into digital audio products. This way, students have corroborated conceptual knowledge with procedural knowledge in the field of music education by reproducing the melodies from the musical score of songs from children's folklore or cultural heritage, using the *Sonic Pi* applications all the time. These songs include *Bingo* (the dog), *A Ram Sam Sam* (Moroccan folk song), *Ode to Joy* (music: Ludwig van Beethoven), and other children's songs used at the national level. All this repertoire was obtained with the support of informatics in education, the students exploring, along with the pleasure offered by the musical domain, various programming structures written in the *Ruby* programming language, as seen in Figure 2.

Figure 2: Sonic Pi application interface (version 3.3.1.) with an example of a melodic fragment written with *Ruby* programming language elements

In integrated music-programming learning, *Sonic Pi* has the ability to determine meaningful learning experiences. It makes the connection between two different fields, music, and programming, with the possibility of mutual support for the student's actions, improving knowledge in both domains.

RESULTS

To test the functionality and effectiveness of digital technologies as a scaffolding support in the cognitive processes involved in the realization of music education, the initial level and the level reached in terms of understanding and memorizing certain elements of musical notation were evaluated. So, the same test was applied at the beginning (pre-test) and at the end (post-test) of an educational project aimed at developing integrated music-programming learning, a project carried out over 6 months.

The digital training, dedicated to the processing of sound parameters and musical notation elements through the *Sonic Pi* application, which took place between September 2021 and March 2022, was marked by the Covid-19 pandemic, so at the date of the test, out of the total of 87 research subjects, in

the pre-test stage 82 students were present at school (N_1 = 82), registering five absences, and on the date of the test application in the post-test stage, 76 students were present at school (N_2 = 76), recording 11 absences. George and Mallery (2001; as cited in Creswell, 2008) claim that if up to 15% of the data are missing, the statistical results will not be affected, and in this case, the missing data can be replaced by mean scores. In our case, the absentees from the pre-test are 6% of the subjects and 13% in the post-test, which is why an equally conservative data analysis option was chosen in terms of average scores, without including in the analysis the cases for which data are missing. These cases can be found in the Missing line in Table 1.

	Pre-test	Post-test
Valid (*N*)	82	76
Missing	5	11
Mode	3.000	6.000
Median	3.500	6.000
Mean	3.598	5.474
Std. Deviation	1.617	1.259
Minimum	1.000	2.000
Maximum	7.000	7.000

Table 1: Descriptive statistical analysis of students' pre-test and post-test results

The eight items structured in the test presented in the Appendix represent the eight tasks to be solved included in the configuration of the research tool. So, 8 points is the maximum possible score, and the best score obtained by the tested students was 7 for both stages of the test. If at the upper limit, there are no differences, at the lower limit, there is a difference, the lowest score obtained in the pre-test stage being 1, and in the post-test stage being 2, the score obtained by a single student. Regarding the limits of the scores obtained by the subjects tested in the two moments separated in time, they are slightly different. The descriptive statistics, along with the mean, the median, and the mode and the variation trend of the data, are distinct. For example, the mean of the initial test scores is 3.598 (M_1 = 3.598) with a standard deviation of 1.617 (SD_1 = 1.617), and the average of the scores obtained in the final testing is 5.474 (M_2 = 5.474) with a standard deviation of 1.259 (SD_2 = 1. 259), which is a noticeable difference.
The mean obtained in the post-test becomes a landmark in achieving the goal of analyzing the computer's efficiency for the support offered to students in understanding the symbols on the musical stave. Still, because a descriptive statistic was created in which the results describe a trend for the student's progress with a high degree of generality, the individual results of the subjects will be analyzed in more detail. For this reason, the results were placed in an extended picture like Figure 3. We will analyze these results by observing the absolute frequencies of the scores recorded in the two test stages, which suggest the training of memorization and understanding of the notations on the musical staves, decoded in a digital training process for later use in the creation of melodic fragments with the help of the *Sonic Pi* application. The results obtained in the pre-test and the post-test were compared to highlight the changes that occurred following the implementation of music education in the integrated music programming approach. Thus, the entire distribution of the scores achieved in the two stages is presented in the (a) and (b) parts of Figure 3 by dot diagrams displaying the absolute frequencies of the scores achieved, i.e., how many times a certain score was achieved in each stage.

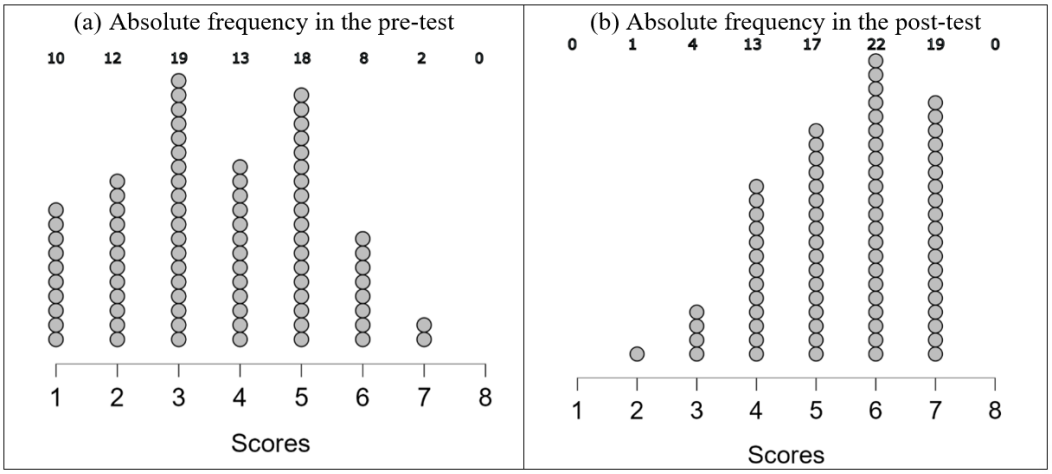

Figure 3: (a) & (b) the density of obtained scores, in absolute frequency, represented for the pre-test and post-test stages

The density of the obtained scores explains the better mean obtained in the post-test when the students' results, unlike in the pre-test stage, tend to move from the lower values of the test to the higher ones. The elements of the descriptive analysis for the two test stages show better results for the subjects in the post-test, and the comparison diagram of this evolution, related to the two means of the group scores, is presented in Figure 4.

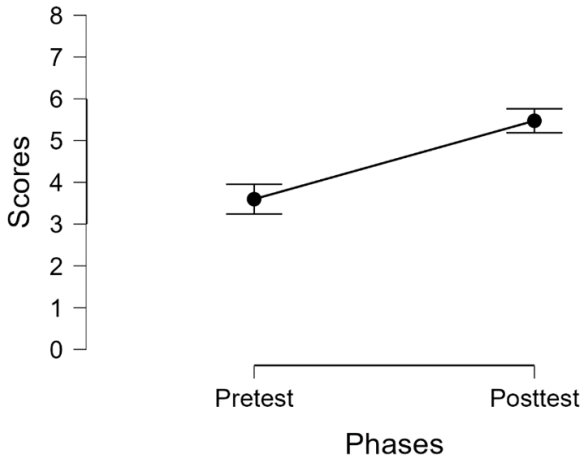

Figure 4: Comparative statistical graph of the average scores obtained during testing in the pre-test and post-test stages

The diagram synthetically shows the two levels of knowledge, initial and final, established by testing and corresponding to the mean scores obtained by students in the pre-test and post-test stages. So, the average score obtained after completing the educational project, which is supposed to be an integrated music-programming learning process, is noticeably higher than the average score obtained before the implications of the digital training process. Of interest in this situation is if there are recorded statistically significant differences between the three classes following the activities carried out on a long-term intervention. The *ANOVA* facility provided by the JASP software was used for statistical interpretation. The alternative hypothesis was formulated (H_1), assuming that there are differences between the three classes, and the null hypothesis (H_0) is the situation where there would be no differences. The significance level was set at 5% ($\alpha = .05$), which allows only 5 cases out of 100 to be associated with results due to chance. The result obtained, following the analysis of variance, is presented in Table 2.

The result obtained with *ANOVA* shows a probability $p > .05$ that verifies and rejects the alternative hypothesis, which will be neglected, so the null hypothesis is accepted. However, before interpreting the *ANOVA*, the assumption that the student's scores have equal variances within the three classes should be checked first, this being the assumption of homogeneity of variance. The results of this check are presented in Table 3.

The probability value ($p = .251$) is non-significant, and the class variability is not statistically significantly different. This matches the assumption that the classes have homogeneous variance. Because no deviations were found, the assumption of homogeneity of variance was not violated.

Thus, following the *ANOVA* analysis, it can be stated that after the digital training period, *there are no differences between the three classes, with F(2.73) = 0.755 and p = 0.473*. Because there are no differences between the classes, so a post hoc test is unnecessary.

Following the same type of *ANOVA* analysis, for the students' scores obtained before the start of the digital training process, we notice statistical differences ($p = .001$) in terms of the variation of results between the 3 classes (according to Table 4), while within the classes there are no notable differences ($p = .141$), the homogeneity of the variations being noticed (according to Table 5).

Cases	Sum of Squares	*df*	Mean Square	*F*	*p*
Classes	2.412	2	1.206	0.755	0.473
Residuals	116.535	73	1.596		

Note. Type III Sum of Squares

Table 2: ANOVA analysis of variance between the three classes of the sample of participants relative to the data obtained in the post-test (after the digital training process)

Test for Equality of Variances (Levene's)			
F	*df1*	*df2*	*p*
1.410	2.000	73.000	0.251

Table 3: Assumption about homogeneity of variance within the three classes at the end of the digital training process

Cases	Sum of Squares	*df*	Mean Square	*F*	*p*
Clasa	32.479	2	16.239	7.157	0.001
Residuals	179.241	79	2.269		

Note. *Type III Sum of Squares*

Table 4: ANOVA analysis of variance between the three classes of the sample of participants relative to the data obtained in pre-test (before the digital training process)

Test for Equality of Variances (Levene's)			
F	*df*1	*df*2	*p*
2.007	2.000	79.000	0.141

Table 5: Assumption about homogeneity of variance within the three classes at the beginning of the digital training process

Differences between the three classes were found at the beginning of the digital training program, and a post hoc test would have been required to see where the differences came from, but this is not necessary, given the purpose of the study. Of interest are the differences at the end of the digital training program, and at that moment, there are no differences between the three classes, an aspect that falls within the study's objectives and which will be discussed in the following.

DISCUSSION

Regarding the applicability of the integrated music-programming learning in the process responsible for the achievement of musical education, the second research question (Q2) sought evidence that primary school students can convert electronic sound generation play with *Ruby* programming language and the *Sonic Pi* software into acquisitions of musical theory learning, it was found that those records are the good results obtained in the post-test stage. Due to the fact that the teaching-learning process, which spanned over 24 weeks in which the educational project took place, was based on the game of musical creation, we can consider that learning musical concepts at an elementary level can be done in an intuitive, accessible way. From the curricular perspective of achieving music education, the use of the *Sonic Pi* application, starting from 10-11 years, leads to results in direct relation to the educational requirements of the object *Music and movement*, the contents processed through the lessons' themes being those specified by the school curriculum in use (MEN, 2014).

Under the incidence of the study limits, carried out during the Covid-19 pandemic and characterized by the sporadic permutation of activities carried out from the classroom to the online space, the study provides empirical evidence on some possibilities of learning music theory, starting with primary education, in the assisted version of technology. For this and to answer the first research question (Q1), which aimed at finding out the extent to which digital technologies can provide scaffolding support in the thought processes involved in the realization of music education. Descriptive statistics were realized, and the role and effect of digital technologies on the processes of memorizing and understanding certain elements of musical notation used in obtaining digital audio products were of interest. The comparative analysis of the mean scores of the subjects at the two test moments distinct in time shows that the digital training process leads to their progress. However, an essential element of analysis is the extent to which didactic actions produce uniform learning across the entire sample of students. Conducting an *ANOVA* analysis, it was found that, at the end of the digital training period, there were no statistically significant differences between the three classes. Even if it was found that there are variations between the three classes at the beginning of the educational project, these are not of interest to us because they are the result of traditional teaching carried out up to the 4th grade. On the other hand, the lack of variations between groups identified by the *ANOVA* test at the end of the digital training period is of interest because, in conjunction with the good results obtained, allowed the verification of the hypothesis, which assumed that if the *Sonic Pi* application is used as a tool for playing with the music composition, the students can transform the playing, as practical-applicative, in acquisitions of learning music theory, a fact that is due to the scaffolding support offered by digital technologies, for learning objectives such as memorizing or understanding elements of musical notation. These are aspects of a meaningful learning experience at the end of a practical learning process.

The study leads to a larger series of findings and conclusions drawn through the lens of the hypothesis. For example, the changes brought about by technological advances occur at high speed and frequency, so that accessing memorized data is not so valuable because that data, to a large extent, is no longer relevant after a short period, which is why it is more important to support actions that require the training of higher thinking skills, such as creativity. *Sonic Pi* is also a stimulus for students' creativity and imagination, useful in scaling up cognitive processes. It has been found that, when used in the classroom, it is a support for memorizing and understanding certain elements of musical notation. Thus, the application's implications can be treated as scaffolding support because once certain learning objectives in the sphere of memorization and understanding have been achieved, the support can be withdrawn and used for another learning objective altogether, more valuable in the cognitive process hierarchy, the musical creation. This route is similar to the route of an individual studying a traditional musical instrument in real life, where the first experiences with the instrument do not lead to a harmonious processing of the sound. Yet, they are a necessary stage for memorizing and understanding some elements of musical theory. The following experiences will lead to much better sound processing and, finally, include playing a musical work without access to the musical sheet because the memorization stage has been overcome and the instrument could be used for musical performance or creation. Experiences of the same nature are also obtained through digital technologies, which is why "computer science is not primarily about computers. The famous aphorism *Computer science is no more about computers than astronomy is about telescopes*, widely attributed to Dijkstra, slightly overstates the case. Still, it has the right idea" (Jones et al., 2013: 4) because both telescopes and computers are heuristics, and the fields to which they belong do not deal with the instruments themselves but their role and applicability on the dimension of knowledge, the present study is an example of computers supporting the knowledge of music.

This means that informatics should not leave students with only assimilated knowledge and memorized information. It should also prepare them for future studies, a consideration found in the statement of Balanskat and Engelhardt (2015), which

corresponds, in the context of the present study, to the concept of scaffolding. From a psycho-pedagogical perspective, the hypothesis of the study is confirmed by the fact that the scaffolding represented by digital technologies and used to achieve certain learning objectives in the field of memorization and understanding can be moved once these objectives have been achieved to support and achieve other learning objectives, such as creation. With *Sonic Pi* putting computational thinking into motion and computational thinking supporting music education learning objectives, this form of support is how technologies and informatics help stimulate thinking in the musical domain.

CONCLUSION

In an integrated approach, reciprocity is a defining characteristic. In real life, it is applied to maintain diplomatic, cultural, or other types of relations, the popular moral lesson of which has on its basis the support. In the present case, music helps the application of programming, and computer programming, in a relation of reciprocity, returns the favour in that it supports and helps students to understand music. These aspects are a conclusion of the use of the *Sonic Pi* application in didactic activities, an application that has the ability to contribute to the assimilation of new knowledge, as well as to transfer it to tasks that require a modern, playful, and different approach to learning, solving problems or creating products.

The use of digital technologies in the study of music represented a way of electronically generating sounds related to a series of their relevant parameters coded in musical symbols and to the contents of the object *Music and movement* for the 4th grade. Computer programming, as a way of generating sounds electronically, helps the meaningful processing of musical information. The classroom practice and the results obtained show that *Sonic Pi* allows students to retain and use, in an applied way, variables related to the quality of sounds (pitch, duration, etc.), as well as to understand the relationships with musical notation. The retained aspects fall under the charge of cognitive processes such as memorization or understanding, for which computer programming is supported in terms of scaffolding music theory learning. Thus, programming, as a scaffolding element, seems to support this development because it participates in the awareness of the relationship between musical notation and its sound meaning when musical language elements symbolized on the musical stave are processed. This way, the contents approached are integrated with the cognitive processes, a characteristic aspect of meaningful learning.

Sonic Pi aims to relate past learning experiences to future experiences and connections between learning outcomes specific to different domains. Thus, future studies could be continued in the musical field, with computers being only a road opener and temporary support, which resonates with the concept of scaffolding. Until the support is removed, this is a context for "the study of music experience with the support of computer technology as an active agent for the young child" (Webster, 2002: 231). By the nature of the study, ways of effectively integrating technologies into everyday teaching practice were considered. The results encourage the continuation of these efforts because, in the context of the simultaneous and interdisciplinary practice of some computer programming skills, the results can be translated into more efficient use of the teaching time and increased flexibility of interactions. These are important points in the development of future adults for a complex life in which existential problems are interdisciplinary, and the involvement of technologies in solving problems is increasingly consistent.

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APPENDIX

Knowledge test

1. What is the syllabic name of the following musical note?

a) Do	b) Re	c) Mi	d) Fa	e) Sol	f) La	g) Si

2. The lengthening point causes the duration of the musical note to ...?

a) increase	b) decrease	c) does not change

3. Which of the following musical notes has a higher pitch?

a) La 	b) Si 

4. How many beats does the next musical note get in $\frac{2}{4}$  measure?

a) 4 beats	b) 2 beats	c) 1 beat	d) 0.5 beats	e) 0.25 beats

5. How many beats does the measure of $\frac{3}{4}$ have? 

a) 1	b) 2	c) 3	d) 4

6. Which of the following breaks has a shorter duration:

a) The quarter break 	b) Halftime break 

7. In which of the following musical measures, the duration of the musical notes is longer?

a) $\frac{2}{8}$	b) $\frac{3}{4}$	c) $\frac{4}{2}$

8. If the tempo increases, the duration of the musical notes ...

a) increases	b) decreases	c) does not change

Full research paper

EXAMINING SOCIAL MEDIA ADDICTION AS A PREDICTOR OF ACADEMIC ACHIEVEMENT AND ACADEMIC PROCRASTINATION: A COHORT OF UNDERGRADUATE STUDENTS

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ABSTRACT

This study aims to examine the effects of self-control and future time perception on social media addiction and academic procrastination and determine whether social media addiction affects academic achievement through academic procrastination. A total of 559 university students participated. The participants' most commonly used social media platforms were WhatsApp and Instagram. Path analysis technique was used to analyze the theoretical model. In the theoretical model created to test the 13 hypotheses in the research, future time perception (value, distance, commitment, and speed) and self-control are exogenous variables, social media addiction and academic procrastination are moderating variables, and academic achievement is endogenous variable. According to the research findings, social media addiction is not a significant predictor variable for either academic achievement or academic procrastination. Self-control and speed are significant predictors of both social media addiction and academic procrastination. Commitment predicts social media addiction, and value predicts academic procrastination. On the contrary, value is not a significant predictor of social media addiction, and commitment is not a significant predictor of academic procrastination. Distance is not a significant predictor of social media addiction or academic procrastination.

KEYWORDS

Academic achievement and procrastination, path analysis, self-control, social media addiction

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Highlights

- *Self-control and the speed dimension of future time perception are significant predictors of social media addiction and academic procrastination.*
- *Social media addiction does not significantly predict academic achievement or academic procrastination.*
- *Academic procrastination negatively impacts academic achievement among university students, with the findings showing that higher levels of procrastination are associated with lower academic performance.*
- *The findings suggest that self-control plays a critical role in mitigating social media addiction and academic procrastination, highlighting its importance in educational interventions aimed at improving student performance.*

INTRODUCTION

Social media is the general name of digital applications that enable people to communicate with each other, share content, and follow news. Although there have been changes over time, the most preferred applications in 2023 are listed as Facebook, YouTube, Instagram, TikTok, Snapchat, X (Twitter), Pinterest, WhatsApp, and Telegram, according to the frequency of use (Ortiz-Ospina and Roser, 2023). Social media tools are used as highly supportive tools in many areas such as promoting healthy living (Chen and Wang, 2021), suicide prevention (Robinson et al., 2016), enhancing learning (Barrot, 2022; Cheston et al., 2013; Luo et al., 2020), and professional development (Bruguera et al., 2019). Each of the different social media tools has positive contributions to individual learning and school

learning. YouTube, one of the video-sharing sites, offers a wide range of educational videos. In addition to supporting formal education, these videos have different uses in the context of broadcast education (Coklar and Cihangir, 2021; Orús et al., 2016; Yaacob and Md Saad, 2020). For example, WhatsApp supports education in teachers' communication with students and students' communication among themselves, repetition of learning, and learning motivation (Malik et al., 2019; Tang and Hew, 2017; Yu and Yu, 2022). Instagram is used especially in language education to develop writing and speaking skills and increase motivation for learning (Erarslan, 2019).

Excessive use of social media leads to problems. According to DSM5 and ICD 11 criteria, persistent and recurrent use of the internet, internet games, and computer games are included in behavioral addictions under the title of Internet Gaming Disorder (APA, 2013; WHO, 2018). Persistent and recurrent use of social media is considered a type of internet addiction (Hou et al., 2019) since its symptoms and consequences overlap with addiction criteria (APA, 2013; WHO, 2018). In order for a behavior to be defined as addiction, six indicators must be present. These are Salience (becoming the most important activity in life), Mood modification (intense emotion experienced during use), Tolerance (constant desire to do more), Withdrawal symptoms (experiencing negative emotions in case of inaccessibility) Conflict (the individual is in conflict with himself and his environment) and Relapse (rapid return to the same and higher level after trying to quit). Long-term use of social media does not always mean addiction and symptoms of addiction may not occur. However, negative consequences of long-term use are also observed (Griffiths et al., 2014). Social media addiction leads to an increase in stress, anxiety, depression, and insomnia and a decrease in subjective well-being (Lee et al., 2023; Lin et al., 2016; Lin et al., 2021; Shakya and Christakis, 2017; Van Rooij et al., 2017). Internet addiction, in general, and social media addiction, in particular, have negative effects on academic achievement (Al-Menayes, 2015; Giunchiglia et al., 2018; Ponnusamy et al., 2020; Zhao, 2023).

Understanding the reasons why social media use turns into addiction is important for identifying risk groups. Al-Samarraie et al. (2021), in their review study, grouped the causes of social media addiction under the headings of behavioral (self-control, gaming, time spent, etc.), technological (customer policies of the sites, ease of phone access, etc.), social (self-esteem, loneliness, etc.) and mental (depression, anxiety, etc.) factors. For example, they state that checking the feedback on posts on social media platform profiles leads to the automatization of this action after a while. Since the widespread use of smartphones facilitates access to social media tools (Aygul and Akbay, 2019) and the decrease in parental control over individual tools, addiction is spreading (Yayman and Bilgin, 2020). Individuals who are afraid of face-to-face communication with people for reasons such as computer games, social phobia, and transportation barriers meet their socialization needs through social media tools, which leads to addiction (Griffiths et al., 2014; Kuss and Griffiths, 2017).

Social media addiction stands out as a significant variable with detrimental implications for academic performance. Among its adverse effects are diminished attention spans and decreased interest in academic lessons (Cain et al., 2016). Students' prolonged use of phones or computers correlates with sleep disturbances, thereby reducing the time available for academic pursuits (Keles et al., 2020; Vernon et al., 2015). Research indicates that extensive social media engagement leads students to postpone studying, resulting in compromised academic achievement (Junco, 2012; Przepiorka et al., 2016). Huang's meta-analysis in 2018 further underscores how social media addiction detrimentally impacts academic outcomes. While existing studies highlight these consequences, there remains a gap in understanding the causal factors underlying social media addiction. Further investigation is warranted to explore its potential mediating role, particularly in relation to cognitive and social characteristics. For instance, social media use has been linked to the desire for immediate gratification (Przybylski et al., 2013). Hence, additional research focusing on the mediating pathways of social media addiction is imperative.

Understanding the reasons for the excessive use of social media and its effects on learning in university students is important in terms of revealing the problem in detail and guiding experts to produce solutions. This study examines self-control and future time perception, their impact on social media addiction and academic procrastination, and the potential indirect influence on academic achievement within the specific cohort of prospective teachers. The study's first aim is to determine the effect of social media addiction on academic procrastination and academic achievement. The second aim is to examine the predictive effects of future time perception and self-control associated with social media addiction. The pattern of explanatory and predictive relationships between variables was analyzed with structural equation modeling through the theoretical model. The theoretical frameworks of the hypotheses put forward within the scope of the research are also discussed in detail.

LITERATURE REVIEW AND HYPOTHESES

Self-Control

Self-control is "the ability to override or change one's inner responses, as well as to interrupt undesirable behavioral tendencies and refrain from acting on them" (Tangney et al. 2004, p. 274). Individuals with high self-control use more self-regulatory resources to control their thoughts, behaviors, and emotions. Self-control involves the regulation of impulse behaviors. Individuals who are unable to control their impulses develop addictions by succumbing to the attraction of actions such as eating, alcohol, drugs, and spending money (O'Donoghue and Rabin, 1999; Tangney et al., 2018). Similarly, self-control has an explanatory effect in internet-based addictions (Muusses et al., 2015). In a study conducted by Akin et al. (2015) on university students, it was concluded that self-control is a significant predictor of internet addiction. In a study conducted by Kim et al. (2008) on adult individuals, self-control was found to be a predictor of online game addiction. Sagar (2021) conducted a study on university students and found that self-control is a predictor of social media addiction. Individuals with high self-control

can also resist external stimuli that may prevent them from goal-oriented behaviors. At the university level, goals such as graduating and finding a better job will be possible by fulfilling their academic duties without interrupting them. University students are surrounded by many stimuli that may distract them from these goals (Duckworth et al., 2019). In such an environment, the activation of self-control can ensure that academic tasks are fulfilled without being postponed. Research results also show that self-control is a significant predictor of academic procrastination (Ariely and Wertenbroch, 2002; Kim et al., 2017; Przepiórka et al., 2019). More evidence is needed to determine the effect of self-control on social media habits and academic procrastination. In this framework, the following hypothesis was formulated:
H1: Self-control has a negative effect on social media addiction and academic procrastination.

Future Time Perspective

According to the time perception theory, an individual's perception of past, present, and future time has an impact on his/her behavior. According to Zimbardo's time perception model (Keough et al., 1999), five time dimensions affect the individual cognitively, emotionally, and motivationally: Past-Positive, Past-Negative, Present-Hedonism, Present-Fatalism, and Future. Future time perception, which is one of the variables of this study, is defined as the effect of the goals that the individual wants to achieve in the near or distant future on his/her actions in the present (Lens, 1988). The formation of an individual's cognitive structure on the basis of a temporal dimension shapes his/her perception of the world. Overemphasis on a particular dimension may lead to the suppression of other domains (Gutpa et al., 2012; Zimbardo and Boniwell, 2004). According to Husman and Shell (1996), there are four dimensions of future time perception: value, connectedness, speed, and distance. This study used the structure defined by Husman and Shell (1996) and the measurement tool developed by the same researchers. Individuals with predominant future time perception are more successful in tasks whose outcomes will be seen in the future, such as academic tasks (Lens et al., 2001; Mello and Worrell, 2006; Peetsma, 2000; Peetsma and Van der Veen, 2011), investing for retirement (Bal et al., 2010; Jacobs-Lawson and Hershey, 2005), and playing sports (Kooij et al., 2018). Individuals with high future time perception can see the negative consequences of alcohol and drug use more easily (Keough et al., 1999; Przepiorka and Blachnio, 2016). Similarly, social media addiction is much less common in individuals with high future time perception (Miceli et al., 2021). Díaz-Aguado Jalón et al. (2018) conducted a study on middle school students and concluded that negative views about the future and time are important predictors of problematic internet use. Przepiorka and Blachnio (2016) conducted a study on Facebook users and concluded that future time perception is a predictor of Internet and Facebook addiction. Miceli et al. (2021) found that future time perception predicts social media addiction significantly. Husman and Shell (1996) argue that individuals with a high perception of future time can easily connect the present and the future and see the effects of their actions on their lives. In this respect, they avoid procrastination behaviors because they know the importance of doing their academic tasks to realize their future plans (Husman et al., 2016). Research results also show that high future time perception reduces procrastination (Li et al., 2023; Nedeljković, 2017; Zabelina et al., 2018). The number of studies on the effect of future time perception on social media addiction and academic procrastination in university students is quite limited. The following hypotheses were formulated to determine the effect of four dimensions of future time perception on social media addiction and academic procrastination:
H2: the future time perception has a negative effect on social media addiction.
H3: the future time perception has a negative effect on academic procrastination.

Academic Procrastination

Procrastination is defined as "to voluntarily delay an intended course of action despite expecting to be worse off for the delay" (Steel, 2007, p. 66). Academic procrastination refers to delaying or postponing academic tasks such as studying and completing assignments. Regular academic procrastination is quite common among university students (Patrzek et al., 2015; Rabin et al., 2011; Solomon and Rothblum, 1984; Schraw et al., 2007). Academic procrastination prevents students from sufficiently learning the information required for specialization (Steel, 2007). A significant negative relationship exists between academic procrastination and academic achievement (Balkis, 2011; Balkis, 2013). Academic procrastination is predicted by many factors, such as academic motivation (Cerino, 2014; Lee, 2005), self-esteem (Rebetez et al., 2015; Yang et al., 2021), fear of failure (Zarrin et al., 2020), perfectionism (Seo, 2008). Studies show that internet addiction (social media, internet, online gaming, Facebook) also affects academic procrastination (Al Shaibani, 2020; Aznar-Díaz et al., 2020; Gurultu and Deniz, 2017; Kandemir, 2014; Muslikah and Andriyani, 2018; Nwosu et al., 2020). In addition to the direct effect of social media addiction on academic achievement, it also has an effect on academic procrastination (Goroshit, 2018; Kim and Seo, 2015). In the study conducted by Ucar et al. (2021), it was concluded that the academic achievement of university students with high levels of procrastination was higher than those with low levels. A similar study conducted by Balkis (2013) concluded that academic procrastination is a significant predictor of academic achievement.
In this framework, the following hypotheses were formulated:
H4: Social media addiction has a positive effect on academic procrastination.
H5: Academic procrastination has a negative effect on academic achievement.

Academic Achievement

Research in the field shows that social media addiction has a negative impact on academic achievement. Addiction studies generally focus on social media addiction (Al-Menayes, 2015; Hou et al., 2019; Zhao, 2023) or individual social media tools (Facebook, YouTube, WhatsApp) (Busalim et al.,

2019; Foroughi et al., 2021; Tufaila et al., 2015; Vashishtha et al., 2017). For example, Al-Menayes (2015) concluded in his study on university students that social media usage time and social media addiction decrease academic achievement. Junco (2012) concluded that time spent on Facebook decreases behaviors toward fulfilling academic tasks. Pekpazar et al. (2021) concluded that Instagram addiction affects academic achievement through academic procrastination in their research on university students.

In this framework, the following hypothesis was formulated:

H6: Social media addiction has a negative effect on academic achievement.

METHODS AND PROCEDURES

Theoretical Model

The theoretical model created for this study (Fig1) was tested using path analysis, a special type of structural equation modeling. The arrows and their directions indicate the explanatory relationship between the variables in the model (Streiner, 2005). The theoretical model identified future time perception and self-control as exogenous variables, social media addiction and academic procrastination as moderators, and academic achievement as endogenous variables. In the model, the effect of social media addiction on academic achievement was measured both directly and indirectly through academic procrastination.

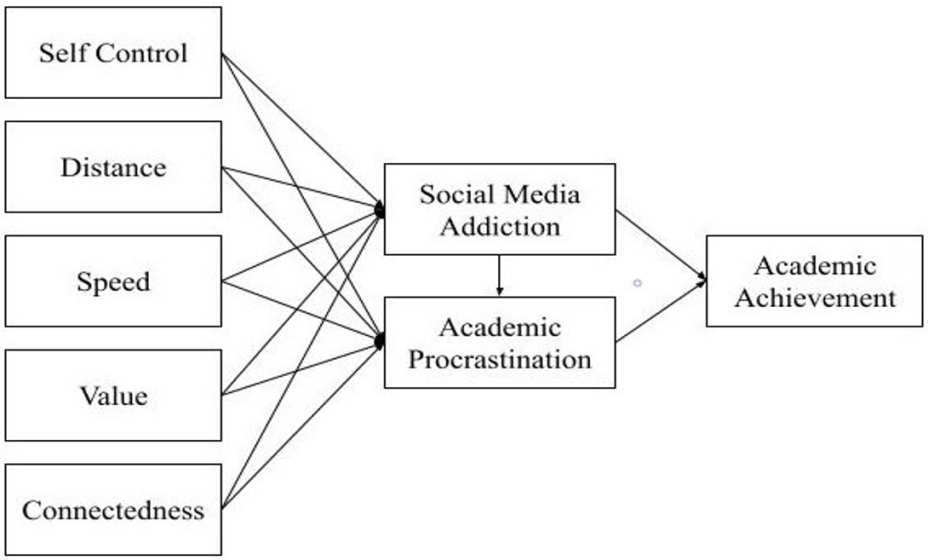

Figure 1: Theoretical model

Participants

University students who are social media users participated in this study. Schreiber et al. (2006) and Nevitt and Hancock (2004) recommend that there should be at least ten observations per variable (10:1) when determining the minimum sample size. Considering these evaluations published in the literature, data were collected from a total of 559 participants for the current study. The participants were university students from Marmara University in Istanbul. Marmara University is preferred by high-achieving students in terms of academic success. The students in this study were enrolled in programs in the fields of Science, Engineering, and Teacher Education. Of the participant students, 35% were male, and 65% were female, with ages ranging between 19 and 50 years (M = 23.5; SD = 5.12). The social media tools to which participants were most frequently subscribed included WhatsApp (95.7%), Instagram (92.7%), X (60.3%), YouTube (52.8%), Pinterest (46.0%), Telegram (40.3%), and Facebook (32.4%). Among these, the most commonly used social media tools were Instagram (40.3%), WhatsApp (34.5%), YouTube (9.7%), and X (7.7%).

The Ethics Committee of the Institute of Educational Sciences at Marmara University first secured ethical approval for the study. Following this, permissions were obtained from the university administration and relevant departments to administer the questionnaire to students who voluntarily participated during class hours. The data collection process took place in October 2023, with each session lasting approximately 20 to 25 minutes.

Data Collection Instruments

Future Time Perception

The scale developed by Husman and Shell (2008) was used to measure future time perception. The scale was adapted into Turkish by Avci and Erden (2009). The scale consists of four sub-dimensions: Connectedness (12 items), Value (7 items), Distance (5 items), and Speed (3 items). Participants responded to each item by rating themselves on the following 5-point scale: (1) strongly disagree, (2) somewhat disagree, (3) neutral, (4) somewhat agree, and (5) strongly agree.

Connectedness is the relationship between an individual's present actions and future goals; Value is the importance an individual attaches to the goals he/she wants to achieve in the near or distant future; Distance is how far into the future the individual sets goals; and Speed is the individual's perception of the speed at which time passes (Husman and Shell, 2008). The internal reliability coefficient was .755 for the whole scale, .853, .773, .735, and .776 for Connectedness, Value, Distance, and Speed, respectively.

Self-Control

The Brief Self-Control Scale developed by Tangney et al. (2004) and adapted into Turkish by Nebioglu et al. (2012) was used to measure self-control. Although the original Likert-type scale consisting of 17 items was unidimensional, a two-dimensional structure emerged in the Turkish adaptation study. The Cronbach's alpha internal reliability coefficient of the scale was.818 in this study. Participants responded to each item by rating themselves on the following 5-point scale: (1) strongly disagree, (2) somewhat disagree, (3) neutral, (4) somewhat agree, and (5) strongly agree.

Social Media Addiction

Bergen Social Media Addiction Scale, developed by Andreassen *et al.* (2017) and adapted into Turkish by Demirci (2019), was used to determine social media addiction. The scale includes six items representing six indicators of addiction. Participants responded to each item by rating themselves on the following 5-point scale: (1) Almost never, (2) Sometimes, (3) About half of the time, (4) Most of the time, and (5) Almost always. The Cronbach's alpha internal reliability coefficient of the scale was .789 in this study.

Academic Procrastination

The six-item short form developed by Balkıs and Duru (2022) based on the academic procrastination scale developed by McCloskey (2011) was used to determine academic procrastination. Participants responded to each item by rating themselves on the following 5-point scale: (1) strongly disagree, (2) somewhat disagree, (3) neutral, (4) somewhat agree, and (5) strongly agree. The Cronbach's alpha internal reliability coefficient of the scale was.898 in this study.

Academic Achievement

Participants were asked to rate their own achievement on a scale of 1-10 to assess academic achievement. This decision was made because the participants came from different disciplines, and their GPA (Grade Point Average) varied according to the difficulty of the field. The use of self-reported grades is quite common in similar studies (Al-Menayes, 2015).

Data analysis

Research data were collected online via Google Forms in December 2023. Extra points were awarded to the students' academic grades for participating in the research to enhance the reliability of measurements. Path analysis, a type of structural equation modeling, was used to realize the objectives of this research. AMOS and SPSS programs were used to analyze the data. In order to conduct path analysis, the data should be normally distributed, there should be no outliers, there should be a relationship between the variables, and there should be no multicollinearity between the variables. The assumption of normality is based on skewness and kurtosis values, and extreme values are determined by Mahalanobis distance. Mahalanobis distance is a statistical measure that calculates the distance of a data point from the mean of a distribution while also accounting for the correlations among the variables in the dataset. It is commonly employed to identify outliers by assessing how far individual data points deviate from the overall data structure (Kline, 2015). Pearson correlation value for the level of relationship between variables, VIF, and tolerance values for multicollinearity were determined (Kline, 2005; Byrne, 2013). This study calculated the means and standard deviations of selected variables as descriptive statistics.

In path analysis, it is first necessary to determine whether the goodness-of-fit indices are within acceptable classes. Frequently used fit values are Chi-square/df, RMSEA (Root Mean Square Error of Approximation), IFI (Incremental Fit Indices), NFI (Normed Fit Index), RFI (Relative Fit Index), CFI (Comparative Fit Index), TLI (Tucker Lewis Index). In this study, the values of the seven indices presented were analyzed to evaluate the model fit from different perspectives, to check the consistency between the indices, and to avoid misinterpretations (Kline, 2015). For a good fit, Chi-square/df must be below 3, RMSEA below.03, and IFI, NFI, RFI, CFI, and TLI must all be above.95. If the fit values are not within the limits, modifications should be made to the model. That modification involves methods like adding/removing causal arrows and adding covariance arrows between exogenous variables (Hu and Bentler, 1999; Kline, 2005; Tabachnick et al., 2013).

RESULTS

At the beginning of the analysis, it was checked whether the data distributions of the variables met the assumptions of path analysis. Since all skewness and kurtosis values were below 1, it was accepted that the variables were highly normally distributed (Hair et al., 2021). The presence of multicollinearity among the exogenous variables in the study was checked through Tolerance and VIF. The fact that all Tolerance values are above .10 and all VIF values are below 10 indicates that there is no multicollinearity between the variables (Miles, 2014) (Table 1).

Pearson Correlation values show that there is a relationship between the variables of the study at different levels. There is a negative correlation of .192 between academic achievement and social media addiction and a positive correlation of .385 between academic procrastination. There is a significant relationship between social media addiction and academic procrastination at the level of .333 in a negative direction. The only variable with no significant relationship between any of the variables is Value. Although there is no linear relationship between Value and other variables, it was included in the analysis because it is a sub-dimension of Future Time Perception (Table 1).

Path analysis was used to test the hypotheses in the theoretical model. The model fit index values obtained within the scope of path analysis are quite high. The chi-square/sd ($1.71 < 2$), RMSEA ($.036 < .05$), IFI ($.997 > .95$), TLI ($.984 > .95$), RFI ($.961 > .95$), NFI ($.993 > .95$) and CFI ($.997 > .95$) values (Table 2) of the tested model are quite good (Hu and Bentler, 1999; Kline, 2005; Tabachnick et al., 2013; Byrne, 2013). Since the obtained results showed that the model was compatible, further analyses were conducted.

	X	Sd	T	VIF	S	K		FTP-C	FTP-V	FTP-S	FTP-D	SC	AP	SMA
FTP-C	4.09	.63	.749	1.334	-.808	.736	r							
							p							
FTP-V	3.21	.67	.889	1.125	.177	-.035	r	.255						
							p	< .01						
FTP-S	3.32	1.07	.577	1.734	-.370	-.571	r	.403	-.042					
							p	< .01	.317					
FTP-D	2.99	.63	.842	1.188	.263	.879	r	.165	.146	.369				
							p	< .01	< .01	< .01				
SC	3.38	.63	.673	1.486	.129	-.375	r	.325	.008	.561	.238			
							p	< .01	.846	< .01	< .01			
AP	2.72	1.06	.889	1.125	-.269	-.751	r	.341	.038	.732	.261	.659		
							p	< .01	.364	< .01	< .01	< .01		
SMA	2.82	.87	.889	1.125	.164	-.433	r	- .011	.011	-.331	-.126	-.372	-.333	
							p	.793	.798	< .01	< .01	< .01	< .01	
AA	6.54	1.62	---	---	-.650	.504	r	.164	-.003	.276	.120	.337	.385	-.192
							p	< .01	.949	< .01	< .01	< .01	< .01	< .01

***< .01, SMA: Social Media Addiction, AP: Academic Procrastination, AA: Academic Achievement, SC: Self Control, FTP: Future Time Perspective, D: Distance, S: Speed, V: Value, C: Connectedness, S: Supported, NS: Not Supported, T: Tolerance, S: skewness, K: Kurtosis*

Table 1: Descriptive values and assumption values for variables

Fit measure	Model fit	Recommended value
Kikare/Sd	1.71	< 2.00
IFI	.997	> .95
TLI	.984	> .95
NFI	.993	> .95
RFI	.961	> .95
CFI	.997	> .95
RMSEA	.036	< .05

Table 2: Fit index values of the model with path analysis (source: Kaynak: (Hu and Bentler, 1999; Kline, 2005; Tabachnick et al., 2013; Byrne, 2013))

Structural Model

Figure 2 shows the path coefficients and total explained variance percentages (R^2) for the moderating and endogenous variables. According to the findings, future time perception and self-control predict 19% of the variance in social media addiction (R^2 = 0.19). Social media addiction, future time perception and self-control directly, and future time perception and self-control indirectly through social media addiction predict 63% of the variance in academic procrastination (R^2 = 0.63). Social media and academic procrastination directly, future time perception, and self-control indirectly predict %15 of the variance in academic achievement (R^2 = 0.15).

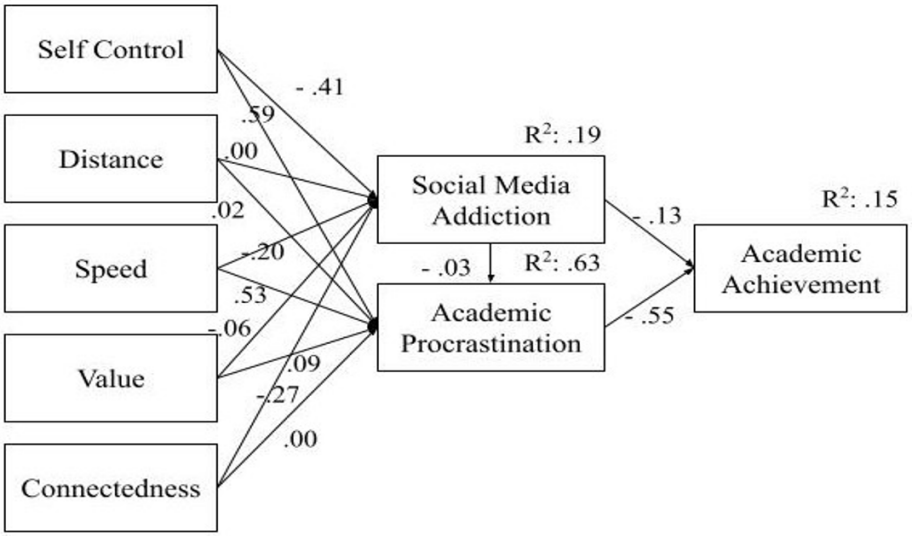

Figure 2: Model tested

Hypothesis number	Path			β	SE	t	p
1	SMA	←	SC	-.409	.064	-6.39	< .001
2	AP	←	SC	.592	.055	10.83	< .001
3	SMA	←	FTP-V	-.062	.053	-1.18	.239
4	SMA	←	FTP-C	-.273	.061	-4.46	< .001
5	SMA	←	FTP-S	-.200	.041	-4.85	< .001
6	SMA	←	FTP-D	.006	.057	.11	.911
7	AP	←	FTP-V	.090	.044	2.07	< .05
8	AP	←	FTP-C	-.001	.051	-.02	.983
9	AP	←	FTP-S	.532	.035	15.4	< .001
10	AP	←	FTP-D	.024	.047	-.51	.609
11	AP	←	SMA	-.035	.035	-1.00	.317
12	AA	←	AP	.549	.063	8.75	< .001
13	AA	←	SMA	-.132	.077	-1.73	.084

SMA: Social Media Addiction, AP: Academic Procrastination, AA: Academic Achievement, SC: Self Control, FTP: Future Time Perspective, D: Distance, S: Speed, V: Value, C: Connectedness,

Table 3: Measurement values of the tested structural model

In structural equation model analysis, the *t*-value provides information about whether each variable is a significant predictor, while the path coefficient (β) provides information about the degree of effect (Hair et al., 2021). While self-control ($t = -6.39$, $p < .001$), speed ($t = -15.40$, $p < .001$), and connectedness ($t = -4.46$, $p < .001$) are significant predictors of social media addiction, distance ($t = .11$, $p > .05$) and value ($t = -1.18$, $p > .05$) are not significant predictors. The effect levels of the variables on social media addiction are, from largest to smallest, self-control ($\beta = -.409$), connectedness ($\beta = -.273$), speed ($\beta = -.200$), value ($\beta = -.062$), and distance ($\beta = .006$) (Table 3).

While self-control ($t = 10.834$, $p < .001$), speed ($t = 4.851$, $p < .001$), and value ($t = 2.07$, $p < .05$) were significant predictors of academic procrastination, social media addiction ($t = -1.00$, $p > .05$), connectedness ($t = -.02$, $p > .05$) and distance ($t = .51$, $p > .05$) were not significant predictors. The effect levels of the variables on academic procrastination are, from large to small, self-control ($\beta = .592$), speed ($\beta = .532$), value ($\beta = .090$), social media addiction ($\beta = -.035$), distance ($\beta = .024$), and connectedness ($\beta = -.001$). Finally, academic procrastination ($t = 8.749$, $p < .05$) was a significant predictor of academic achievement, while social media addiction ($t = -1.729$, $p > .05$) was not. The effects of social media addiction and academic procrastination on academic achievement are $\beta = -.132$ and $\beta = .549$, respectively (Table 3). According to these results, hypothesis H1 is not rejected, hypotheses H2 and H3 are partially rejected, while hypotheses H4, H5, and H6 are fully rejected (Table 3).

		SC	FTP-C	FTP-V	FTP-S	FTP-D	SMA	AP
Total Effects	SMA	-.297	.196	-.048	-.244	.005	...	...
	AP	-.361	.006	-.058	-.540	-.014	.029	...
	AA	.152	-.016	.024	.212	.005	-.082	-.362
Direct Effects	SMA	-.297	.196	-.048	-.244	.005	...	...
	AP	-.353	.001	-.057	-.533	-.014	.029	...
	AA	...	...	...	...	...	-.071	-.362
Indirect Effects	AP	-.008	.006	-.001	-.007	.000	...	...
	AA	.152	-.016	.024	.212	.005	-.010	...

SMA: Social Media Addiction, AP: Academic Procrastination, AA: Academic Achievement, sc: Self Control, FTP: Future Time Perspective, D: Distance, S: Speed, V: Value, C: Connectedness

Table 4: Standardized total, direct, and indirect effect values for the tested structural model

In addition to the significance level, the impact factor is also considered in path analysis. The impact factor shows the effect of each value on the total factor. If the effect factor takes a value other than zero, it can be considered a contribution (Hair et al., 2021). In the model, self-control and speed are the two exogenous variables with the highest impact power. Self-control directly affects social media addiction at the level of -.297, academic procrastination at the level of -.361, and academic achievement indirectly at the level of .152. Speed directly affects social media addiction at the level of -.244, academic procrastination at the level of -.540, and indirectly affects academic achievement at the level of .212. The total effect of social media addiction on academic achievement is .082. Of this value, .071 is direct, and .010 is indirect through academic procrastination. The effect of academic procrastination on academic achievement is -.362 (Table 4).

DISCUSSION

According to the research findings, it has been concluded that social media addiction is not a significant predictor of academic achievement in university students. Despite the prevailing emphasis in the literature on the negative impact of social media addiction on academic achievement (Al-Menayes, 2015; Busalim et al., 2019; Hou et al., 2019;

Junco, 2012; Pekpazar et al., 2021; Paul et al., 2012; Zhao, 2023), numerous studies, including the present research, yield results suggesting a lack of such impact (Fauzi et al., 2021; Othman et al., 2017). Particularly in Turkey, attending reputable universities is contingent upon high performance in entrance exams. The students involved in this study rank high in academic performance, and despite their extensive use of social media, they may still successfully fulfill their academic responsibilities. The composition of the research group with academically successful students indicates their aptitude for coping with challenges. In Turkey, socio-economic status is a decisive factor for academic success, contributing to the resilience of academically successful students. Resilient students are those who achieve academic success despite facing various challenges (Avci, 2022).

Another variable examined for its impact on academic achievement is academic procrastination. Research findings indicate that academic procrastination is a meaningful predictor of academic achievement. Students who complete their academic tasks on time tend to have higher academic achievements. Specifically, students who set goals, plan their time effectively, possess a high level of learning motivation, can easily focus their attention, and make decisions easily (Zacks and Hen, 2018; Grunschel et al., 2013) are likely to achieve higher academic success. The obtained results align with the findings of numerous studies investigating the impact of academic procrastination on academic achievement (Balkis, 2013; Ucar et al., 2021).

The research also explored future time perception and self-control as predictors of social media addiction. While studies on time perception are often evaluated within Zimbardo's five-dimensional framework, this study adopted Husman and Shell's theory, which considers future time perception in four dimensions. The study found that connectedness and speed dimensions are significant predictors, while distance and value dimensions are not. Individuals who establish a connection between their current actions and future goals in terms of connectedness (Husman and Shell, 1996) are less likely to experience problems with social media addiction. Regarding the speed dimension, individuals who manage their time well, do not procrastinate, and work step by step toward their goals (Gjesme, 1979) are likely to have lower social media usage hindering their goals. The value dimension expresses the value an individual places on their goals. If school courses serve as tools for future goals, the value assigned to these courses increases (Husman, 1998; Jenkins-Marsan, 2002). The inability to establish a connection between value and social media addiction may stem from inadequate future goals or a perception that current activities lack value for their goals. Breadth is a dimension that reflects the extent to which an individual sets distant future goals. Individuals with a high future time perception set goals for the distant future (Daltrey and Langer, 1984; Nuttin, 2014). Those with goals plan their current actions accordingly and do not get distracted by tools like social media that may divert them from their goals. Perhaps social media users' goal is to plan for opportunities on that platform.

Self-control is the ability of an individual to manage their emotions, thoughts, and behaviors (Tangney et al., 2018). Individuals with the ability to control themselves can resist the allure of short-term pleasurable activities such as social media usage. The findings of this study indicate that self-control is a significant predictor of both social media addiction and academic procrastination. The explanatory power of self-control is notably high for both variables. High levels of self-control are associated with a lower incidence of social media addiction among students. Furthermore, students with high self-control tend to complete their academic tasks on time without procrastination. These findings are in line with existing literature. Research conducted by Kim et al. (2008) on adults revealed that self-control predicts online game addiction. Sagar (2021) found that self-control is a significant predictor of social media addiction in university students. In a study on university students, Uzun et al. (2020) concluded that self-control predicts academic procrastination. Another study focusing on 21-year-olds engaged in online gaming found that self-control predicts addiction (Kim et al., 2008).

This research examined the direct and indirect effects of self-control and future time perception on social media addiction and academic procrastination, as well as the direct and indirect impact of social media addiction on academic achievement through academic procrastination. The results indicate that social media addiction does not predict academic achievement or academic procrastination. However, academic procrastination emerged as a predictor of academic achievement. Self-control is a robust predictor for both social media addiction and academic procrastination. Among the four sub-dimensions of future time perception, speed strongly predicts both social media addiction and academic procrastination. Additionally, the commitment sub-dimension of the future time perspective predicts social media addiction, while the value sub-dimension predicts academic procrastination. Conversely, value is not a significant predictor for social media addiction, and commitment is not a meaningful predictor for academic procrastination. The distance dimension shows no relationship with any variable.

The findings indicate that future time perception, particularly in connectedness and speed, significantly influences academic procrastination and social media addiction. In light of this, educational programs should be developed to equip students with the skills to set future goals and plan for their achievement, starting from the early stages of education. Such programs can help students become more goal-oriented and reduce procrastination behaviors (Husman and Shell, 2008). Additionally, the study highlights the detrimental effect of academic procrastination on academic achievement, underscoring the importance of universities providing support in areas such as time management, motivation, and the prioritization of academic tasks. Evidence suggests that interventions targeting these skills can mitigate procrastination and improve academic performance (Grunschel et al., 2013). To address the negative impact of social media addiction on academic outcomes, universities could also implement awareness programs that encourage students to manage their social media use more effectively. These programs could aim to mitigate the adverse relationship between social media engagement and academic achievement (Giunchiglia et al., 2018).

LIMITATIONS

The participants in this study are students from a highly ranked university, and therefore, the findings reflect academically successful students. It is necessary to replicate the research on a different sample that includes students from universities with lower entrance scores to ensure the generalizability of the results. Data were collected through self-reported measures provided by the participants. This data collection method presents certain limitations, such as the potential for social desirability bias. Particularly in the context of social media addiction, participants may have reported behaviors that align more with socially accepted norms rather than their actual behavior. Additionally, the findings of this study are based on cross-sectional data, which limits the ability to make definitive cause-and-effect conclusions. The inferences drawn are more reflective of correlational relationships. To establish causal relationships, future research should consider employing longitudinal designs. Lastly, the study did not account for the socio-economic and cultural differences among participants, which may influence the relationship between social media addiction and academic achievement. The dynamics of this relationship could vary across students from diverse socio-economic backgrounds.

CONCLUSION

This study examined the relationships among future time perspective, self-control, social media addiction, academic procrastination, and academic achievement. The results highlight the significant influence of self-control and future time perspective components, particularly speed and connectedness, in reducing social media addiction. These factors indirectly influence academic procrastination and achievement, highlighting self-control's central role in academic outcomes. Although social media addiction did not directly predict academic achievement, its association with academic procrastination indirectly affects achievement outcomes.

The results indicate that self-control and speed are the strongest predictors within this model, significantly contributing to both reduced social media addiction and improved academic performance. These findings underscore the importance of enhancing students' self-control and time management skills to mitigate procrastination and promote academic success. Future research should examine interventions that target self-control and future time orientation to further elucidate their impact on students' academic behaviors and overall achievement.

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Full research paper

EMPOWERING FUTURES: UNVEILING THE IMPACT OF CAREER READINESS ON JOB SEEKER AND CREATOR THROUGH SELF-EFFICACY

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ABSTRACT

Factors that represent the tendency to become job creators are proxied to entrepreneurial characteristics. Meanwhile, factors that represent career readiness include digital literacy, entrepreneurial mindset, work skills, and ICT skills. A population of economic education undergraduate students teaching at universities in Indonesia was used, using 455 samples. Later, the data were analyzed using the Structural Equation Model (SEM) with the IBM-SPSS AMOS 26 program. The findings prove that career readiness is not only important for job seekers but also necessary for those who will become job creators. From the hypothesis test, career readiness has a partial influence on the tendency to become a job seeker and job creator among undergraduate economic education students. The positive coefficient indicates that increasing career readiness can significantly increase the propensity to seek and create jobs. This research opens the view that work skills are also needed to make students become job creators. Therefore, this research has essential meaning as a blueprint for educational institutions to incorporate career development into their academic programs.

KEYWORDS

Career readiness, digital literacy, employability skill, entrepreneurial mindset, job creator, ICT skills, structural equation model

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Highlights

- *Career readiness plays an important role in influencing the tendency of economic education students in determining their future careers.*
- *Self-efficacy partially mediates between career readiness and the tendency to become job seekers and job creators.*
- *It is critical for higher education institutions to integrate career development into their academic programs, meeting the needs of both job seekers and job creators.*

INTRODUCTION

Entrepreneurship and its correlation with career readiness have become a focal point in contemporary discussions regarding workforce development. This is proven by previous research which shows that the entrepreneurial ecosystem has a strong relationship with students' entrepreneurial intentions and new business creation (Narmaditya et al., 2024). The nature and importance of career readiness have changed dramatically over the past several decades and are undergoing an even more rapid evolution (Conley, 2021). Career readiness is an entrepreneurial skill that individuals need to have minimum qualifications for entrepreneurial readiness, especially being competent to scan their abilities and environment to explore its potential (Ruiz, Soriano and Coduras, 2016; Rakicevic et al., 2022). In Indonesia, approximately 57.35% of bachelor's graduates obtain qualified jobs (PDDikti, 2021). At the moment, the number of entrepreneurs in Indonesia is only 3.4 percent, which needs to be enhanced to shift into a developed country that requires 12.

Some early studies acknowledge that career readiness is also a form of developing entrepreneurial skills, attitudes, and behaviors through entrepreneurship education that will help students make the right choices regarding entrepreneurial activities (Mayorga, 2019; Rodriguez and Lieber, 2020). Entrepreneurial culture and entrepreneurial career readiness influence entrepreneurial education (Samuel et al., 2021). Entrepreneurship education begins with an entrepreneurial mindset, which is continued with the formation of creative and

innovative behavior to become creative (Yar, Wennberg and Berglund, 2008; Wardana et al., 2020; Jiatong et al., 2021; Li, Cao and Jenatabadi, 2023). The discoveries that entrepreneurship can produce include wealth creation, business, innovation, change, employment, value, and growth (Morris, Lewis and Sexton, 1994). In this way, entrepreneurial activities can encourage economic growth and job creation in a country (Baumol, 1996; Mair and Marti, 2009; Mehmood et al., 2019).

Over the past few decades, national and worldwide governments have increasingly focused on involving more people in market activities, assuming that markets play an essential role in achieving sustainable living standards (Mair and Marti, 2009). This has been implemented in the university curriculum through mandatory courses, such as entrepreneurship courses taken by all undergraduate students at universities in Indonesia. The concept of entrepreneurship is not just the process of establishing a new business but is a process of value creation and appropriation led by entrepreneurs in an uncertain environment (Rapp and Olbrich, 2020). Entrepreneurship theory integrates ideas from several scientific disciplines, including economics, psychology, sociology, finance, decision science, and strategy, among others, to explain the complex and irregular dynamics of the entrepreneurial process with a parsimonious model (Frese and Gielnik, 2023).

Entrepreneurship theory, for the first time, put forward a new unified and comprehensive theory to enable expanded theoretical views and more rigorous empirical investigation (Mishra and Zachary, 2015). Even though being a job creator is an essential skill that every student must have, being a job seeker is also very important to be prepared to support competition in the job market. It is essential to recognize that different subgroups in society have different probabilities of being impacted by informality. The statistical overview (ILO, 2018) provides a detailed account of the heterogeneity of informality and its prevalence across different groups. The groups most at risk, besides certain occupations with too many informal employment sectors, are young people and women.

There is a positive association between entrepreneurial mindset gains and perceptions of future career success (Rodriguez and Lieber, 2020). In an era where digital transformation and job market dynamics continue to develop, career readiness is the main key for individuals who want to carve out a successful trail. This is not only related to digital literacy but also involves entrepreneurial thinking, work skills, and expertise in information and communication technology (ICT). Interestingly, there is a close relationship between career readiness and a person's tendency to become a job creator or entrepreneur, with self-efficacy acting as an important mediator. Self-efficacy is the belief in one's ability to succeed in a particular situation or accomplish a specific task (Goncalves, 2021).

Several studies have investigated the relationship between self-efficacy and career readiness. For example, a study found that a programmatic intervention to promote entrepreneurial self-efficacy, critical behavior, and technology readiness among underrepresented college students can be effective (Cadenas et al., 2020). Another study investigated whether working on an entrepreneurial project within a Level 7 fashion degree course can improve entrepreneurial self-efficacy and career readiness (Maxwell and Mc Clay, 2020). The study found that the intervention was effective in improving entrepreneurial self-efficacy, which is fundamental to an entrepreneurial mindset (Pihie and Bagheri, 2011; Burnette et al., 2019; Newman et al., 2019; Awotunde and van der Westhuizen, 2021; Adeniyi, 2023). Entrepreneurial self-efficacy (ESE) can stimulate entrepreneurial readiness, and it is a cognitive element that can stimulate entrepreneurial readiness (Adeniyi, Derera and Gamede, 2022). However, several studies have not discussed the role of self-efficacy as an intermediary in connecting career readiness with students' tendencies to become job seekers or job creators in the future.

This study contributes to the theme of the relationship between education and management. Where, in reality, undergraduate education students will become job seekers and job creators. In educational management, this study provides a new perspective on managing higher education curricula in preparing competent graduates. In addition, in the field of entrepreneurship, this study provides important input to policymakers both at universities and the Ministry of Education in considering policies on higher education and job provision regulations and the potential for ease of entrepreneurship among young people. Apart from that, career readiness is also influenced by digital literacy, which has become a mandatory skill in the modern world. The ability to understand, use, and adapt to information technology and digital media is very important in today's work environment. Readiness in digital literacy provides a solid foundation for someone to enter the ever-changing world of work. This not only helps individuals adapt to the latest technology but also expands career opportunities, enabling them to become innovators and business opportunity creators. Employers are looking for new workers with high levels of literacy, such as information literacy, digital literacy, and media literacy (Nikou, De Reuver and Mahboob Kanafi, 2022).

Hypothesis Development

To see undergraduate students' career readiness as an independent variable, which is described in four measurement indicators, namely digital literacy, entrepreneurial thinking, work skills, and ICT skills, which will see the relationship through the mediation of self-efficacy and resilience of job seekers and job creators as the dependent variable. The framework refers to the boundaryless career theory created by Michael Arthur and Denise Rousseau in 1996 as a response to paradigm shifts in the world of work. This framework in career studies describes significant changes in how individuals manage and understand their careers in an ever-changing and global work environment. Apart from the leading theory, this research uses learning theory, career development theory, motivation theory, and entrepreneurship theory as supporting theories to build the conceptual framework below.

Boundaryless Career Theory provides a valuable framework for understanding contemporary career paths and the changing nature of work (Gerli, Bonesso and Pizzi, 2015; Guan et al., 2019; Wang, Liu and Deng, 2022; Adeniyi, 2023). Therefore, this can be a guide in career readiness research. There are several ways that Boundaryless Career theory can be used to guide career readiness research, including stating that understanding

the competencies required to succeed in a boundaryless career. Boundaryless Career theory defines the competencies that individuals need to achieve boundaryless success. career (Gerli, Bonesso and Pizzi, 2015).

Additionally, research could focus on identifying the competencies most important for career readiness in open-ended careers. Boundaryless Career Theory states that individuals must be mobile and self-directed in their careers to be successful in a boundaryless career (Lichtenstein et al., 1998). Boundaryless career theory provides a framework for understanding how individuals can pursue job opportunities across organizations, sectors, and even countries. This theory closely relates to digital literacy, entrepreneurial thinking, work, and ICT skills.

The boundaryless career model requires individuals to be mobile and self-directed (Sullivan, 2010; Chan et al., 2012; Guan et al., 2019; Wang, Liu and Deng, 2022). To achieve this, individuals must be digitally literate to access job opportunities, network with potential employers, and manage their careers online. The digital competencies and skills that individuals need to succeed in a borderless career emphasize the importance of entrepreneurial thinking, which involves taking risks, being innovative, and seeking new opportunities, and requires individuals to have a variety of employability skills that can be transferred to different organizations and sectors (Inkson et al., 2012). This means that individuals must be able to adapt to new work environments quickly and be able to use their skills in different contexts.

Digital technology allows individuals to work remotely, collaborate with colleagues in different locations, and access work opportunities across borders (Brit Astrid Toven-Lindsey, 2017). Therefore, individuals need strong ICT skills to succeed in a career without boundaries. The Boundaryless Career Theory provides a valuable framework for understanding how vital digital literacy, entrepreneurial thinking, employability skills, and ICT skills are for individuals who want to pursue a boundaryless career (Defillippi and Arthur, 1994; Ituma and Simpson, 2009; Chan et al., 2012; Inkson et al., 2012; Guan et al., 2019). These concepts are closely related to the ability to move and direct oneself in one's career, a vital characteristic of the boundaryless career model.

The concept of career readiness is closely related to self-efficacy, which has been studied by several previous studies (Makki, Javaid and Bano, 2016; Maxwell and Mc Clay, 2020; Sholikah et al., 2021). Career readiness is also closely related to the tendency to become a job seeker (Hirschi, 2011). In addition, becoming an entrepreneur is also related to career readiness (Ruiz, Soriano and Coduras, 2016; Rodriguez and Lieber, 2020).

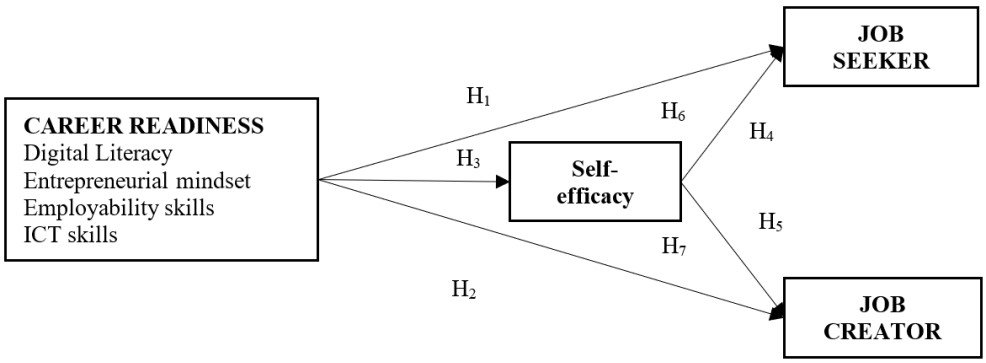


Figure 1*:* **Conceptual framework**

H_1. Career readiness has a significant relationship and influence on the tendency to become a job seeker

H_2. Career readiness has a significant relationship and influence on job creator

H_3. Career readiness has a significant relationship and impact on self-efficacy

H_4. Self-efficacy has a significant relationship and influence on the tendency to become a job seeker

H_5. Self-efficacy has a significant relationship and impact on the tendency to become a job creator

H_6. Self-efficacy mediates the relationship between Career Readiness and the tendency to become a job seeker

H_7. Self-efficacy mediates the relationship between Career Readiness and the propensity to be a job creator

This research contributes to providing different views regarding how self-efficacy mediates the relationship between career readiness and the tendency of students to become job seekers, as well as the relationship between career readiness and the tendency to become job creators in students. Hopefully, this research can significantly contribute to higher education institutions in developing students' careers, whether they become job seekers or job creators in the future.

MATERIALS AND METHODS

The study adopted a quantitative method with a self-administered survey. Therefore, variable-level variation qualifications are reflected in quantitative values rather than narrated in qualitative attribute description sentences. The implementation is classified as survey research with the focus and scope of a sample survey, data obtained from a portion of the population selected as the research sample. Regarding the time dimension, this research was designed as a cross-sectional study because the research was limited to a specific time, namely in 2022.

Population, Sample, and Data Collection Procedures

The population in this study is undergraduate students of Economics Education at seven of the best teaching universities in Indonesia. The sample in this study was developed using

a random sampling technique, totaling 455 undergraduate economics education students based on the population. The population and sample are provided in Table 1 in detail. Data was collected online using an online questionnaire distributed with the help of the coordinator of each university. The target for each university was 100 respondents, but the sample collected was 455. However, this sample exceeded the minimum sample size specified.

University	Population
Universitas Negeri Yogyakarta UNY	569
Universitas Negeri Malang UM	449
Universitas Pendidikan Indonesia UPI	407
Universitas Negeri Semarang UNNES	337
Universitas Negeri Surabaya UNESA	221
Universitas Negeri Jakarta UNJ	616
Universitas Negeri Makassar UNM	453
Total	3.052

Table 1*: Population of research (Source: PDDikti, 2021)*

Instrument Development

The development of instruments for the career readiness variable was carried out by constructing four indicators: digital literacy, entrepreneurial thinking, work skills, and ICT skills. In this research, the definition of Career Readiness uses the definition of skills and attributes that prepare students for success in the transition to the world of work (Muñiz and Eimerbrink, 2018). The indicators in the career readiness concept were adapted based on several sources, including digital literacy (Martin and Grudziecki, 2006), entrepreneurial mindset (Naumann, 2017), employability skills (International Labour Organization, 2013; ILO, 2018), ICT skills (ITU, 2021). Meanwhile, the instrument for the tendency to become a job creator refers to (Meredith, Nelson and Neck, 1982). The instrument was developed based on the adaptation of several reference sources, which will later be tested for content validity by experts.

Test Validity and Reliability

To measure the validity of the content in this research, among others:

1. Researcher designs the instruments or questionnaires covering all essential aspects of the studied concept. This involves selecting questions or statements that are relevant and related to the concept.
2. Expert Consultation: the researcher consults with experts in the field of social research to get their views on whether the instrument covers all the necessary conceptual aspects. Experts can provide input based on their knowledge and experience. In this research, the experts who assisted in testing content validity consisted of 5 experts with expertise in educational evaluation, education, economics, and economic education.
3. Trial: Before being used in the main research, the instrument can be tested first with a small group of respondents to ensure that all critical aspects of the concept have been covered. The test results can be used to make instrument adjustments if necessary.
4. Content Analysis: Content analysis is carried out to analyze whether the questions or statements in the instrument cover all relevant conceptual dimensions. This involves further evaluation of existing theory and literature.

Construct validity is an essential concept in social research. It refers to the degree to which a research instrument (such as a questionnaire, survey, or measurement scale) accurately measures the theoretical construct or concepts it is intended to measure. Before checking construct validity, researchers ensure that the conceptual model describes the relationship between the constructs or variables to be measured. This conceptual model is based on theories and hypotheses that have been developed. Furthermore, this research explains the measurement model, which explains the relationship between theoretical constructs and the observed variables used in the analysis. This includes identifying latent factors or constructs that underlie the measurement of observed variables.

Additionally, discriminant validity is an essential part of construct validity. It measures the extent to which different constructs are genuinely different. Discriminant validity is measured by checking whether latent factors differ significantly in your model and whether correlations between factors make sense. Then, convergent validity measures how well a measurement variable (observation) represents the latent construct. This is tested by testing the loading factors of the variables observed in this research model. High factor loadings indicate good convergent validity. Next, evaluate how well the resulting model fits the data. This involves examining the chi-square statistic, as well as other fit statistics such as CFI (Comparative et al.), TLI (Tucker-Lewis Index), RMSEA (Root et al. of Approximation), and SRMR (Standardized Mean Mean Residual). A good model must have appropriate goodness-of-fit statistics.

In this study, a validity test was carried out to determine whether the questionnaire used for research was valid. A reliable instrument

does not necessarily mean it is valid. According to (Malhotra and Birks, 2007), validity ensures a significant correlation between variables. Factor analysis is used to see the validity of the correlation. Factor analysis is a multivariate method used to analyze variables of mutual importance. The factor analysis used in this research is EFA (Exploratory Factor Analysis) and CFA (Confirmatory Factor Analysis).

Data Analysis

The data analysis approach in this study refers to stages (Anderson and Gerbing, 1988), which involve two main stages: testing the measurement model and the structural model. The Fit Index in SEM for measurement model is divided into three parts: the absolute fit index, the incremental fit index, and the parsimony fit index. Researchers used Structural Equation Modeling (SEM) techniques using AMOS 26 software. The purpose of using Structural Equation Models is to provide a powerful and flexible framework for testing complex hypotheses, understanding relationships among variables, and improving the accuracy of model estimation by accounting for measurement error and latent variables. In addition, testing of the self-efficacy mediator variable was carried out by adopting the (Preacher and Hayes, 2004) procedure.

RESULTS

Before the questionnaire was tested on students, the researcher carried out content validity, i.e., a readability test, and asked for expert judgment regarding the instrument that had been prepared. In this study, researchers sought the help of five experts from several universities in Indonesia and Malaysia. The questionnaire was tested by experts and scheduled using Aiken's formula, explained in Table 2.

Expert	Expertise	*S*	*n*(*c* - 1)	*V*	Category
1	Education Evaluation	2291	2400	0.961	Valid
2	Economics				
3	Education				
4	Economic Education				
5	Economy and business				

Table 2: Instrument Expert Validation Results (Source: own calculation)

The expert verification results above show that the items in each instrument are valid with a V number of 0.961. This is tested using the Aiken (Aiken, 1985) validator formula. Even though the validation results from 5 experts showed high validity of the instrument items, each expert provided input and suggestions for improving the instrument. Therefore, researchers made several improvements in editing items and deleting repetitive items.

		Frequency	Percent %
University	UNNES	103	18.10
	UNY	102	17.93
	UNM	101	17.75
	UM	100	17.57
	UNESA	87	15.29
	UNJ	64	11.25
	UPI	12	2.11
Semester	>8	26	4.57
	7-8	357	62.74
	5-6	169	29.70
	3-4	13	2.28
	1-2	4	0.70
Age	<18	3	0.53
	19-21	319	55.96
	22-24	246	43.16
	>24	2	0.35
Gender	Female	402	70.65
	Male	167	29.35
Domicile	East Java	185	32.51
	Central Java	109	19.16
	West Java	22	3.87
	DIY Yogyakarta	93	16.34
	DKI Jakarta	55	9.66
	South Sulawesi	92	16.17
	others	13	2.28

Table 3: Respondent Demographics (Source: own data processing)

Measurement Model Testing

The number of items in this study is presented in Table 4, which indicates that there are 59 items in the career readiness variable, described through four sub-constructs (digital literacy, entrepreneurial mindset, employability skills, and ICT skills), as well as seven items that measure students' self-efficacy, 14 items that measure the tendency of students to become job seekers, and 11 items that measure the tendency of students to become job creators or entrepreneurs. Based on Table 4, the items in the Career Readiness variable are valid with an SLF of 59 items greater than 0.5 and a reliable variable with a career readiness CR value of 0.963 > 0.7 and AVE 0.866 > 0.5. The Digital Literacy sub-variable has nine valid items, and the reliable sub-variable has a CR value of 0.925 > 0.7 and AVE 0.577 > 0.5. The sub-variable Entrepreneurial Thinking has 13 valid items and reliable sub-variables with a CR value of 0.946 > 0.7 and AVE 0.572 > 0.5. The Employability Skill sub-variable has 15 valid items, and the reliable sub-variable has a CR value of 0.976 > 0.7 and AVE 0.727 > 0.5. The ICT Skills sub-variable has 22 valid items and reliable sub-variables with a CR value of 0.983 > 0.7 and AVE 0.728 > 0.5.

Main Construct	Sub Construct/item	Loading Factor	Construct Reliability *CR ≥ 0.70*	Average Variance Extracted *AVE ≥ 0.50*
Career readiness	Digital literacy	0.892	0.963	0.866
	Entrepreneurial mindset	0.848		
	Employability skills	0.997		
	ICT skills	0.977		
Self-efficacy	7 items	0.769 – 0.827	0.929	0.650
Job seeker	14 items	0.772 – 0.810	0.959	0.624
Job creator	11 items	0.842 – 0.869	0.969	0.738

Table 4*:* Validity and Reliability of Measurement Models

Then, the theme in the Self-Efficacy variable is valid with SLF 7 items more significant than 0.5, and the variable is reliable with a CR value for the self-efficacy variable of 0.929 > 0.7 and AVE 0.650 > 0.5. Apart from that, the items in the Job Seeker variable are valid with an SLF of 14 items greater than 0.5, and the variable is reliable with a CR value for the Job Seeker variable of 0.959 > 0.7 and an AVE of 0.624 > 0.5. Moreover, the items in the Job Creation variable are valid with an SLF of 11 items greater than 0.5, and the variable is reliable with a CR value for the Job Creation variable of 0.969 > 0.7 and AVE 0.738 > 0.5. It can be concluded that the indicators and variables in this model structure are valid and reliable.

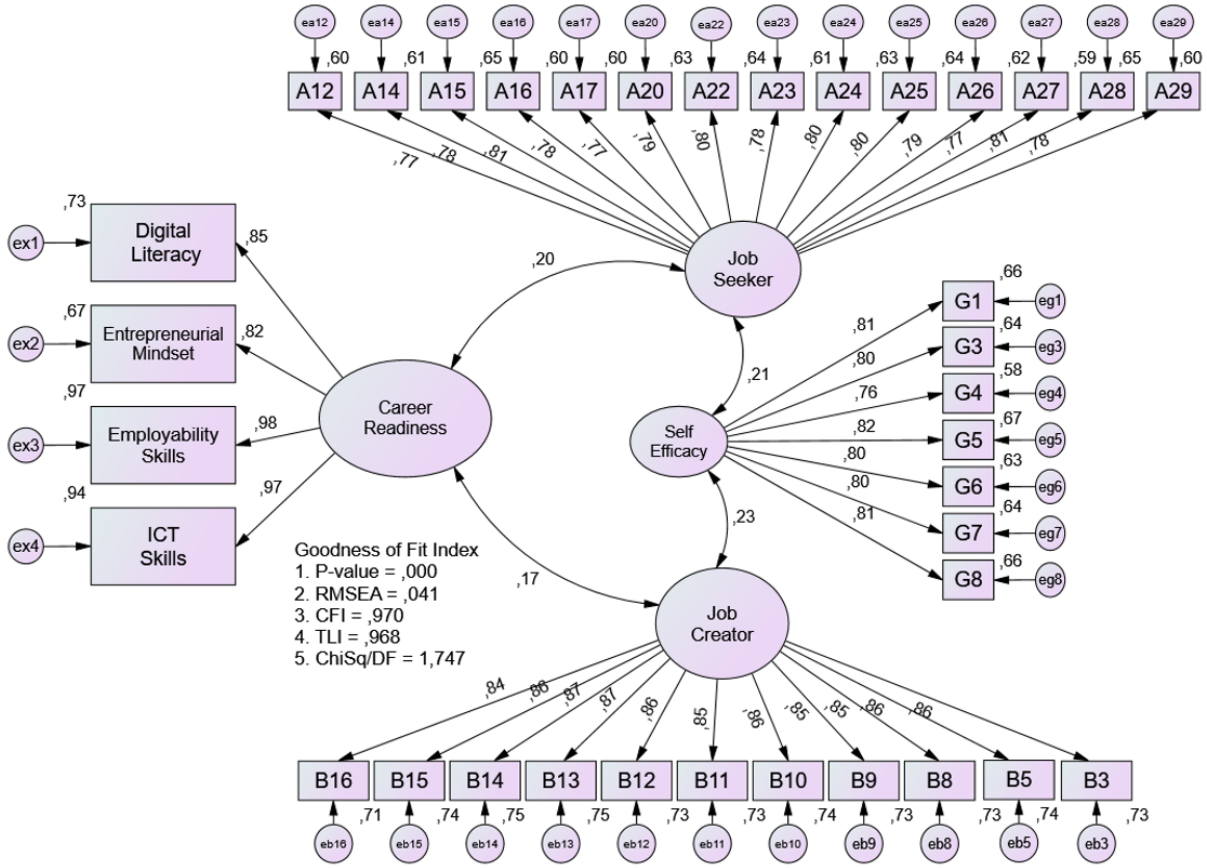


Figure 2*:* Measurement model pooled CFA (Source: data processing results with Amos)

Structural model

Apart from using the results of the standardized loading factor (SLF), AVE, and CR tests, discriminant validity tests were also carried out. In the Fornell-Larcker criterion test, discriminant validity is likely good if the root AVE of the construct is higher than the correlation of the construct with other latent variables. In contrast, the cross-loading test must show that each construct's indicator value is higher than the indicators of the other constructs (Sekaran and Bougie, 2016). The results of the Fornell-Larcker Criterion calculation in this study show that the root AVE value for each construct is greater than the correlation value between one construct and another; discriminant validity is declared good. The following Table 5 presents the results of the descriptive validity of this research. (Fornell and Larcker, 1981) It is said that the AVE value should be greater than 0.50 to meet the requirements for convergent validity and reliability.

Latent Constructs	AVE	Latent Constructs			
		X	*Z*	*Y1*	*Y2*
Career readiness (X)	0.866	**0.930**			
Self-efficacy (Z)	0.650	0.289	**0.806**		
Job seeker (Y1)	0.624	0.329	0.365	**0.790**	
Job creator (Y2)	0.738	0.319	0.367	0.525	**0.859**

Table 5*:* Descriptive Validity Test Results

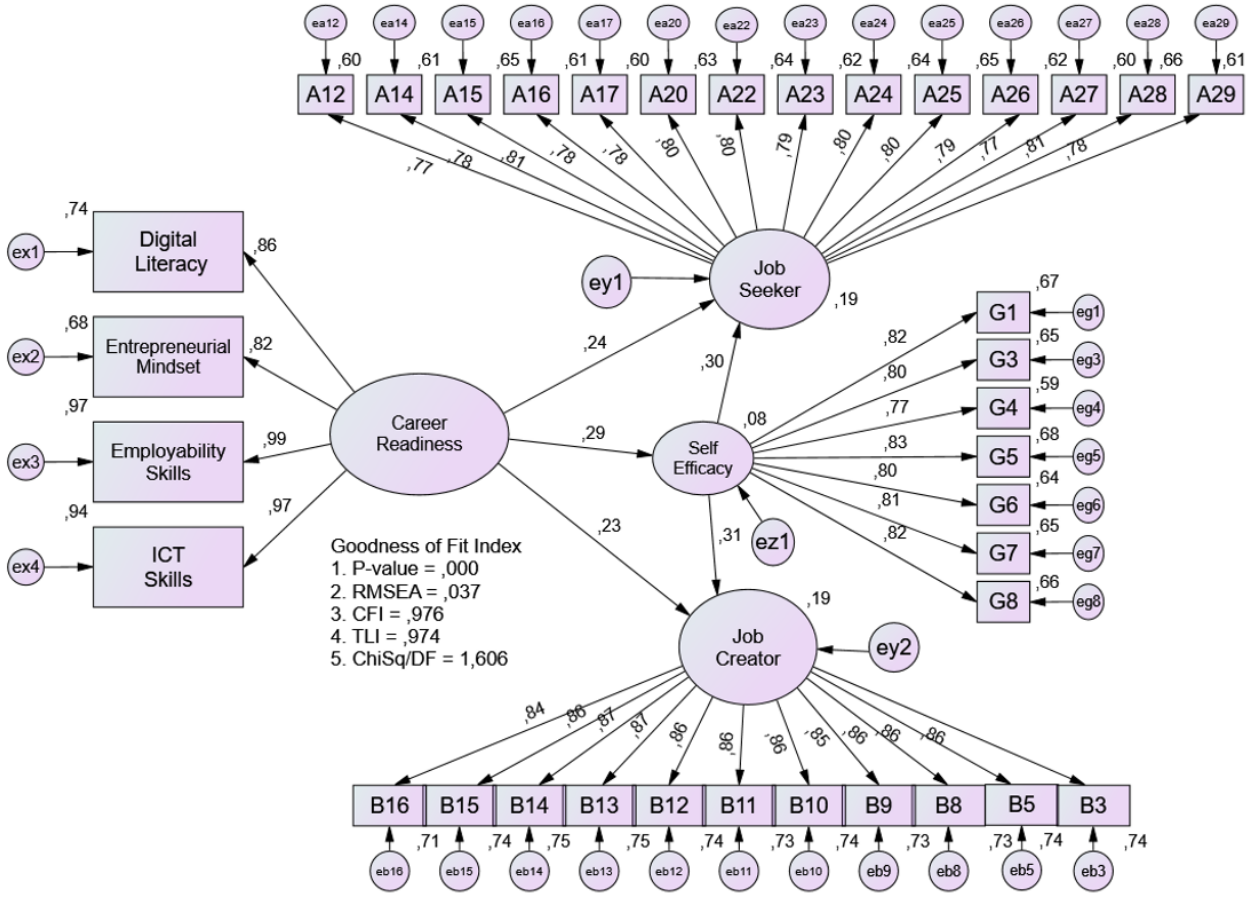


Figure 3*:* A Structured Model of career readiness, self-efficacy, job seeker, and job creator (Source: data processing results with Amos)

Hypothesis 1: Career Readiness has a significant relationship and impact on job seeker skills

In this section, the hypothesis directly between variables is tested based on the significance value of the P-value. The significance value is < .001, which meets the criteria of < .05. Apart from that, the direct effect can be seen based on the absolute value of the path coefficient in the SEM analysis output. The standardized estimated value is known to be 0.290 for the career readiness construct. This shows that if career readiness experiences an increase of 1 standard deviation, it will be followed by an increase in job seekers of 0.176 or 17.6%. This means that the effective contribution of the career readiness construct to the job seeker construct is 17.6%. Meanwhile, the unstandardized estimated value is known to be 0.197; this shows that if there is a change in the career readiness construct of 1 unit, it will be followed by a change in the value of the job seeker construct of 19.7%.

Regression Path	Standardized estimate	Unstandardized estimate	SE	CR	*P*
Self-efficacy ← career readiness	.290	.345	.059	5.826	0.000
Job seeker ← career readiness	.176	.197	.058	3.415	0.000
Job creator ← career readiness	.160	.193	.061	3.148	0.002
Job seeker ← self-efficacy	.287	.291	.047	5.817	0.000
Job creator ← self-efficacy	.292	.295	.049	5.993	0.000

*SE (Standart Error); CR (Critical Ratio); * significant p < .05*

Table 6: Summary of Direct Effect Output Results

Apart from looking at the significant value (p-value) and path coefficient to see the direct influence between variables, you can also look at the CR (critical ratio) value. The effect is declared significant if the CR value is greater than the limit value, and the effect is declared insignificant if the CR value is less than the limit value. Smaller than the limit value or by using a *p*-value, which, if it is less than .05, then it is declared to have a significant effect. Based on the test results above (table 6) show that the Career Readiness variable has a positive and significant influence on the job seeker variable, with a CR greater than the limit (3.415 > 1.96) or a *p*-value less than α 5% (< .001). The positive coefficient indicates that increasing the Willingness to Work variable can significantly increase the job seeker variable.

Hypothesis 2: Career readiness has a significant relationship and impact on job creator skills

The analysis results are listed in Table 6; the significance value is .002, which meets the criteria < .05. Apart from that, the direct effect can be seen based on the absolute value of the path coefficient in the SEM analysis output. The standardized estimated value is known to be 0.160 for the career readiness construct in Table 4.16. This shows that if career readiness experiences an increase of one standard deviation, it will be followed by an increase in job creators of 0.160 or 16%. This means that the effective contribution of the career readiness construct to the job creation construct is 16%. Meanwhile, the unstandardized estimated value is known to be 0.193; this shows that if there is a change in the career readiness construct of one unit, it will be followed by a change in the value of the job creation construct of 19.3%.

Apart from looking at the significant value (*p*-value) and path coefficient to see the direct influence between variables, the CR value is also examined. The effect is declared significant if the CR value is greater than the limit value, and the effect is declared insignificant if the CR value is less than the limit value. Smaller than the limit value or by using a *p*-value, which, if it is less than.05, then it is declared to have a significant effect. Based on the test results above show that the Career Readiness variable has a positive and significant influence on the Job Creation variable, with a CR greater than the limit (3.148 > 1.96) or *p*-value less than α 5% (.002 < .050). A positive coefficient indicates that increasing the Willingness to Work variable can significantly increase the Job Creation variable.

Hypothesis 3: Career Readiness has a significant relationship and effect on Self-Efficacy

The analysis results in Table 6, the significance value is < 0.01, fulfilling the criteria < .05. Apart from that, the direct effect can be seen based on the absolute value of the path coefficient in the SEM analysis output. The standardized estimated value for the career readiness construct is known to be 0.290, as shown in Table 6. This shows that if career readiness experiences an increase of one standard deviation, it will be followed by an increase in self-efficacy of 0.290 or 29%. This means that the effective contribution of the career readiness construct to the self-efficacy construct is 29%. Meanwhile, the unstandardized estimated value is known to have a value of 0.345; this shows that if there is a change in the career readiness construct of 1 unit, it will be followed by a change in the value of the self-efficacy construct of 34.5%.

Apart from looking at the significant value (*p*-value) and path coefficient to see the direct influence between variables, you can also look at the CR value. The effect is declared significant if the CR value is greater than the limit value, and the effect is declared insignificant if the CR value is less than the limit value. Smaller than the limit value or by using a *p*-value, which, if it is less than.05, then it is declared to have a significant effect. Based on the test results above show that the Career Readiness variable has a positive and significant influence on the self-efficacy variable, with a CR greater than the limit (5.826 > 1.96) or *p*-value less than α 5% (< .001). The positive coefficient indicates that increasing the career readiness variable can increase the self-efficacy variable significantly.

Hypothesis 4: Self-efficacy has a significant relationship and impact on job seeker skills

By looking at the analysis results listed in Table 6, the significance value is 0.00, fulfilling the criteria < .05. Apart from that, the direct effect can be seen based on the absolute value of the path coefficient in the SEM analysis output. It can be seen that the standardized estimated value for the self-efficacy construct is known to be 0.287 in Table 6. This shows that if self-efficacy experiences an increase of one standard deviation, it will be followed by an increase in job seekers of 0.287 or 28.7%. This means that the effective contribution of the self-ability construct to the job seeker construct is 28.7%. Meanwhile, the unstandardized estimated value is known to have a value of 0.271, this shows that if there is a change in the self-efficacy construct of 1 unit, it will be followed by a change in the value of the job seeker construct of 27.1%.

Apart from looking at the significant value (*p*-value) and path coefficient to see the direct influence between variables, you can also look at the CR value. The effect is declared significant if the CR value is greater than the limit value, and the effect is declared insignificant if the CR value is less than the limit value, smaller than the limit value, or by using a *p*-value which,

if it is less than.05, then it is declared to have a significant effect. Based on the test results above it shows that the Self-Efficacy variable has a positive and significant influence on the Job Seeker variable, with a CR greater than the limit (5.817 > 1.96) or a *p*-value smaller than α 5% (< .001). A positive coefficient indicates that an increase in the Self-Efficacy variable can increase the Job Seeker variable significantly.

Hypothesis 5: Self-Efficacy has a significant relationship and impact on job creator skills

As in the above section, in this section, the hypothesis directly between the variables is tested based on the significance value of the *p*-value. If you look at the analysis results listed in Table 6, the significance value is < .001, which meets the criteria of < .05. In addition, the direct influence is seen based on the absolute value of the path coefficients (path coefficients) in the output of SEM analysis results. Shown in the Standardized estimate value known to have a value of 0.292 for the self-efficacy construct in Table 6. This shows that if self-efficacy experiences an increase of one standard deviation, it will be followed by an increase in job creators of 0.292 or 29.2%. This means that the effective contribution made by the self-efficacy construct to the job creator construct is 29.2%. While the unstandardized estimate value is known to have a value of 0.295, this shows that if there is a change in the self-efficacy construct of 1 unit, it will be followed by a change in the value of the job creator construct by 29.5%.

Apart from looking at the significant value (*p*-value) and path coefficient, the direct influence between the variables is also done by looking at the CR value. The effect is declared significant if the CR value is greater than the limit value, and the effect is declared insignificant if the CR is smaller than the limit value or by using a *p*-value that is less than.05, then it is declared as a significant effect. Based on the test results above show that the Self-Efficacy Variable has a positive and significant influence on the job creator variable, with a CR value greater than the limit (5.993 > 1.96) or *p*-value less than α 5% (< .001). A positive coefficient indicates that an increase in the self-efficacy variable can significantly increase the Job Creation variable.

Hypothesis Testing with Mediation

This section presents the results of indirect effect testing with the bootstrap method with the hypotheses that will be tested in this study, including:

H6. Self-efficacy mediates the relationship between career readiness and job seeker.

H7. Self-efficacy mediates the relationship between career readiness and job creator.

Relationship	Coefficient	*P*-value	Decision
Career readiness → self-efficacy → job seeker	0.088	0.004	Significant
Career readiness → self-efficacy → job creator	0.090	0.004	Significant

Table 7*:* Regression Analysis Results of Indirect Influence Hypothesis Testing

Based on Table 7, all the paths in the studied construct have significant values at $p < .05$. This means that the requirements for the first stage of the mediation test have met the testing criteria. The next step is to conduct the mediation test by comparing the unstandardized estimated values before and after the mediation of the construct and calculate the bootstrap value with the criteria of the supported hypothesis test or the mediator constructs that can be used as mediator relationships and effects between constructs studied at $p < .05$ or $p < .01$.

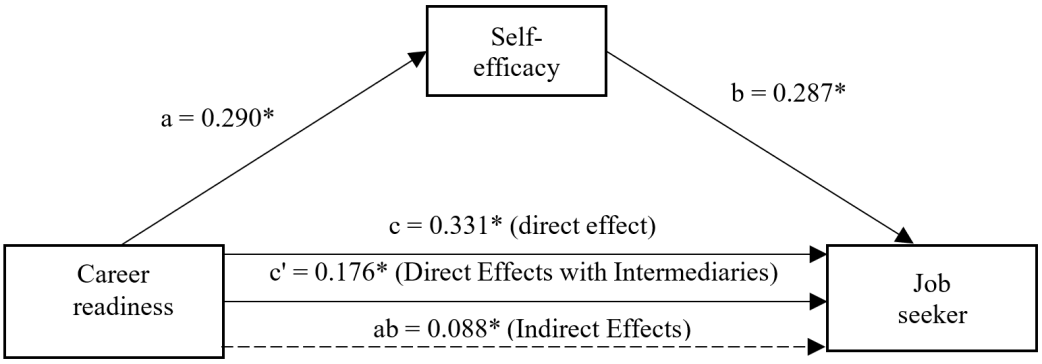
Hypothesis H6: Self-Efficacy mediates the relationship between career readiness and job seeker

The self-efficacy test was used to determine the relationship between career readiness and job seekers after the mediating effect of self-efficacy; this is used to answer hypothesis 6. The results of the analysis show that the relationship between the path career readiness → self-efficacy [$p < .001$] has a significant value at the p-level < .001, and the relationship between the path career readiness → job seeker [$p < .001$] has a significant value at the p < .01 level (Table 7). The requirement for a mediation test in the first stage has met the test criteria. The next step is to conduct a mediation test by comparing the value of the unstandardized estimate before and after the mediation construct and calculate the bootstrapping value with the support of hypothesis testing criteria or the mediation construct can be used as a mediator of the relationship and influence between the constructs studied at $p < .05$.

Regression path			Direct Effect	Indirect Effect	Decision
Career readiness	→	Self-efficacy	0.290	0.000	Significant
Self-efficacy	→	Job seeker	0.287	0.000	Significant
Career readiness	→	Job seeker	0.176	0.156	***a*b* significant**

Table 8*:* Results of Bootstrapping Hypothesis 6

To test hypothesis H6, this study uses the method developed by (Preacher and Hayes, 2004), which was previously developed by (Baron and Kenny, 1986). The analysis for hypothesis (H6) with mediation begins by showing that the direct influence of career readiness on job seekers is significant. The direct influence of career readiness on job seekers is quite strong. However, when we enter the mediating variable self-efficacy into the model, the career readiness coefficient decreases. In other words, the direct effect of career readiness on job seekers decreases when mediators are included in the model. As illustrated in Figure 4, there is a significant decrease in the relationship and direct effect between career readiness and job seekers after self-efficacy is included in the model.



** = Significant; ^{ns} = Not significant*

Figure 4: Intermediate Self-Efficacy Test Results on Career Readiness and Job Seeker

The direct effect of career readiness on job seekers is reduced from 0.176 (*c*') to 0.088 (*ab*) and remains at the significance level [$p < .001$, $p < .05$ in Table 7]. This suggests that self-efficacy can partially explain the relationship between career readiness and job search. This type of mediation is called partial mediation because the direct influence of career readiness on job seekers is still significant after self-efficacy is included in the model. In this context, career readiness has a significant direct effect on job seekers and a significant indirect effect on job seekers through the mediating variable of self-efficacy.

The indirect influence between career readiness on Job Seekers through self-efficacy is significant, with the *p*-value of the results of the indirect bootstrap test being less than α (.004 < .05). Self-efficacy variables mediate the influence of career readiness on job seekers. (This includes the partial mediation category because the direct influence of career readiness on job seekers is significant.)

Hypothesis H7: Self-Efficacy mediates the relationship between career readiness and job creator

The self-efficacy test determines the relationship between career readiness and job creation after the mediating effect of self-efficacy; this is used to answer hypothesis 7. The results of the analysis show that the relationship between the path career readiness → self-efficacy [$p < .001$] has a significant value at the *p*-level < .001, and the relationship between the path career readiness → job creator [$p = .002$] has a significant value at the $p < .01$ level (see Table 7). The requirement for a mediation test in the first stage has met the test criteria. The next step is to conduct a mediation test by comparing the value of the unstandardized estimate before and after the mediation construct and calculate the bootstrapping value with the support of hypothesis testing criteria or the mediation construct can be used as a mediator of the relationship and influence between the constructs studied at $p < .05$.

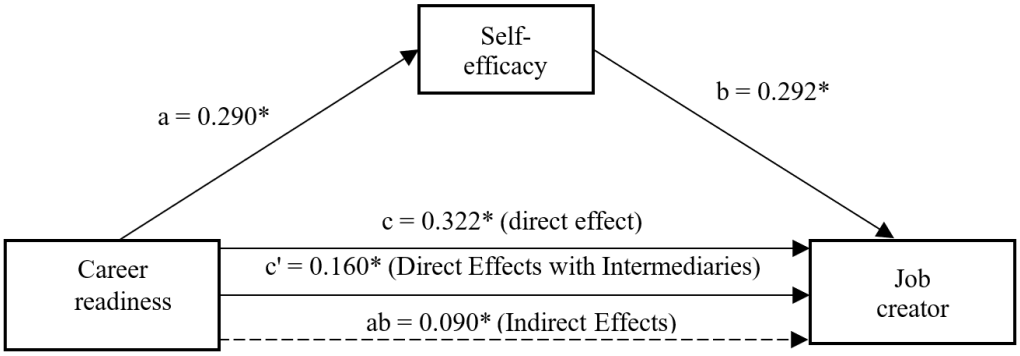
Regression path			Direct Effect	Indirect Effect	Decision
Career readiness	→	Self-efficacy	0.290	0.000	Significant
Self-efficacy	→	Job creator	0.292	0.000	Significant
Career readiness	→	Job creators	0.160	0.162	***a*b* significant**

Table 9*:* Results of Bootstrapping Hypothesis

The analysis for hypothesis (H7) with mediation begins by showing that the direct influence of career readiness on job creators is significant. The direct influence of career readiness on job creators is quite strong. However, when we enter the mediating variable self-efficacy into the model, the career readiness coefficient decreases. In other words, the direct effect of career readiness on job creation decreases when mediators are included in the model. As illustrated in Figure 5, there is a significant decrease in the relationship and direct effect between career readiness and job creation after self-efficacy is included in the model.

The direct effect of career readiness on job seekers is reduced from 0.160 (*c*') to 0.090 (*ab*) and remains at the significance level [$p < .001$, $p < .05$ in Table 7]. This suggests that self-efficacy can partially explain the relationship between career readiness and job creation. This type of mediation is called partial mediation because the direct influence of career readiness on job seekers is still significant after self-efficacy is included in the model. In this context, career readiness has a significant direct effect on job creators and also has a significant indirect effect on job creators through the mediating variable of self-efficacy.

Thus, the indirect influence of the career readiness variable on the job creator through self-efficacy is significant, with the p-value of the results of the indirect bootstrap test being less than α (.004 < .05). self-efficacy variables mediate the influence of career readiness on job creators (Including the partial mediation category because the direct influence of career readiness on job creators is significant).



** = Significant, ns = Not significant*

Figure 5: Intermediate Test Results of Self-Efficacy on Career Readiness and Job creator

DISCUSSION AND CONCLUSIONS

Discussion

Career readiness and tendencies of job seeker and creator

Based on the results of the study, career readiness has a significant direct relationship with and influence on the tendency of Economic Education students to become either job seekers or job creators. This indicates that career readiness, which encompasses digital literacy, an entrepreneurial mindset, employability skills, and ICT skills, plays a crucial role in shaping their inclination toward these career paths. While career readiness has a slightly greater influence on the tendency to become job seekers compared to job creators, the difference, as indicated by the findings, is not very substantial. The results of this study were as previously predicted in the hypothesis study (H1, H2, H3, H4, H5).

It is, therefore, essential to continuously monitor and assess students' career readiness using these factors. By evaluating the extent to which students have developed digital literacy, entrepreneurial mindset, work skills, and ICT competencies, study programs can make necessary adjustments to address students' needs. These considerations should be integrated into the planning and implementation of the Economic Education study program to better prepare students for the challenges of the ever-evolving job market. Additionally, this effort helps students equip themselves for competition in an increasingly digital and dynamic workforce, providing them with the tools to become efficient job seekers or successful entrepreneurs. As stated in several previous studies, career readiness influences the tendency to become a job seeker (Reimers-Hild, 2010; Garrido, Sullivan and Gordon, 2012; Fajaryati et al., 2020; Mushi, 2020; Hu et al., 2022; Iqbal et al., 2022).

The influence of self-efficacy on the connection between career readiness and the tendency to engage as either job seekers or job creators

Based on the study results, self-efficacy acts as a mediator between career readiness and the tendency to become either a job seeker or a job creator (H6, H7). An in-depth analysis was conducted using bootstrapping tests to assess the strength of self-efficacy's role as a mediator. In both cases, significant results were obtained, indicating that self-efficacy partially mediates the relationship. Specifically, self-efficacy influences students' career readiness in shaping their tendency to become either job seekers or job creators. This partial mediation implies that self-efficacy explains only part of the relationship. It contributes to the connection between career readiness and the tendency to become a job seeker, as well as to the connection between career readiness and the tendency to become a job creator. However, other factors not accounted for by self-efficacy also influence these relationships, suggesting the need for further exploration.

As a mediator, students who feel career-ready exhibit greater confidence in their ability to secure employment (high self-efficacy). They are more assured of possessing the necessary skills and knowledge to compete in the job market. Furthermore, high self-efficacy motivates students to be more proactive in their job search and better equipped to overcome challenges encountered during the process. In line with that, self-efficacy also connects or explains how career readiness affects their tendency to become entrepreneurs or job creators. When students feel sufficiently prepared for a particular career and have high self-efficacy related to entrepreneurship, then they will become job creators or entrepreneurs. However, the role of self-efficacy varies from individual to individual and other factors can influence their decisions.

Self-efficacy influencing the job search process and outcomes. Self-efficacious job seekers are more confident and optimistic about their job search process and outcomes, which can lead to more frequent job search behaviors and, ultimately, a higher likelihood of finding employment (Petruzziello et al., 2021). Self-efficacy is an individual's belief in their ability to perform tasks and achieve goals (Safari, Davaribina and Khoshnevis, 2020). It plays a crucial role in the job search process and outcomes, as it encourages people to engage in activities and cope with difficulties, stressful situations, or setbacks during the job search process.

However, the mediation role partially affected the relationship between career readiness, job seekers, and job creators. As several previous studies stated, career readiness influences self-efficacy (Baker et al., 2017; Goncalves, 2021; Pignault, Rastoder and Houssemand, 2023). Self-efficacy's influence on the tendency to become a job seeker has been investigated by several previous authors (Saks, Zikic and Koen, 2015; Liu et al., 2021; Petruzziello et al., 2021; Teye-Kwadjo, 2021). Likewise, self-efficacy also influences the tendency to become a job creator (Caliendo et al., no date; Wei et al., 2020; Ferreira-Neto et al., 2023).

Another study (Haidari, Koçoğlu and Kanadlı, 2023) revealed a robust correlation between self-efficacy and its profound impact on student achievement. This research underscores self-efficacy as the most influential factor in shaping student success and sheds light on its broader implications beyond academic performance. Self-efficacy plays a crucial role in shaping students' attitudes toward their future endeavors, influencing their inclination to become job seekers or creators. Students with high levels of self-efficacy are more likely to exhibit entrepreneurial tendencies and take initiative in creating opportunities for themselves and others, thus contributing to economic growth and innovation. Therefore, cultivating self-efficacy among students is vital for academic success and fostering a mindset conducive to entrepreneurial ventures and workforce readiness.

Career readiness combines self-concept, self-interest in a career, and motivation to learn. It is crucial for every individual to be well-prepared and equipped with the necessary skills and qualifications to enter the job market and pursue the career they desire (Petruzziello et al., 2021). Improvements in the quality of the educational process must be implemented, as they significantly influence students' interest in lessons and courses (Depoo, Urbancová and Smolová, 2022). Therefore, the tendency to become a job seeker is influenced by career readiness because well-prepared individuals with the necessary skills and qualifications will be more active in seeking and pursuing job opportunities. Self-efficacy plays a significant role in the job search process and outcomes, and it acts as a mediator between career readiness and the tendency to become a job seeker. By enhancing self-efficacy, individuals can improve their job search process and outcomes, making them more likely to become job seekers.

Recent studies have explored the mediating role of self-efficacy between career readiness and the tendency to become an entrepreneur or job creator. For instance, a study found that entrepreneurial self-efficacy (ESE) mediates the relationship between entrepreneurship education and start-up readiness (Adeniyi, 2023). ESE is considered a precursor for entrepreneurial action and has been found to influence innovation behavior. Another study found that self-efficacy mediates the relationship between entrepreneurial education and entrepreneurial intention in college students (Li, Cao and Jenatabadi, 2023). Self-efficacy is a critical element that influences a person›s behavior through cognitive processes, proactive personality, and result expectations (Schwarzer and Warner, 2013; Blom et al., 2021; Adeniyi, 2023). Additionally, self-efficacy is essential in affecting entrepreneurial intentions as it fosters commitment and persistence and boosts the possibility of achieving entrepreneurial success (Ferreira-Neto et al., 2023). Therefore, self-efficacy can mediate the relationship between career readiness and the tendency to become an entrepreneur or job creator by influencing entrepreneurial intentions, fostering commitment, and boosting the possibility of achieving entrepreneurial success.

In theoretical studies, career readiness is a concept that is often discussed in the context of career development theory. One such theory is Bandura's Social Cognitive Career Theory (SCCT) (Zikic and Saks, 2009). This study found that career-related activities, such as environmental and career exploration, career resources, and training, were positively related to job search self-efficacy and clarity. This research also examines the contribution of personality, gender, and other factors to job search behavior. Overall, this article suggests that career-related activities play an essential role in job search behavior and that SCCT may be a helpful framework for understanding this relationship. This theory emphasizes individual and environmental changes and sees career selection as a relatively dynamic system that is more adaptable to contemporary society than traditional career theory (Wang, Sun and Wu, 2022). Although SCCT does not explicitly state that career readiness influences the propensity to become a job seeker, it suggests that self-efficacy, outcome expectations, goals, and interests influence an individual's career path. These factors can impact an individual's willingness to pursue a particular career path or job opportunity. Other career development theories, such as Holland's Career Choice Theory, suggest that an individual's personality and environment interact to determine their career path (Nauta, 2010).

Conclusions

Career readiness based on digital literacy, entrepreneurial mindset, employability skills, and ICT skills can also influence a person's tendency to become a job seeker. High digital literacy will provide a competitive advantage for someone looking for work, especially in jobs that require technology. The ability to use digital tools and adapt to technological changes will make this job increasingly sought after by employers. Digital literacy can also help search for jobs online using digital search platforms.

Career readiness can also influence a person's tendency to become a job creator or entrepreneur. Digital literacy includes a person's ability to use information and communication technology (ICT) to access, evaluate, and use information effectively. High digital literacy skills can help students run an online business or utilize technology to expand the reach of their business. Therefore, career readiness based on digital literacy, entrepreneurial mindset, employability, and ICT skills can be critical factors that support a person's tendency to become a job creator or entrepreneur. This combination of skills can help students plan, implement, and manage their businesses more successfully.

In addition, self-efficacy can mediate between career readiness and students' tendency to become job seekers. Students who feel career-ready usually have more substantial confidence in their ability to find work (high self-efficacy). High self-efficacy can motivate students to be more active in looking for work and overcome the obstacles faced in the job search process so that self-efficacy can act as an intermediary that bridges relationships between careers. Students' willingness and tendencies as job seekers. This means that career readiness not only directly affects the tendency to look for work but also has an effect through self-efficacy. Mediation analyses like this can provide a deeper picture of how these factors are interrelated and how self-efficacy bridges career readiness and students' job search tendencies.

Meanwhile, the mediation of self-efficacy in the relationship between career readiness and students' tendency to become job creators or entrepreneurs is a psychological phenomenon that can influence how individuals develop an interest and

commitment to entrepreneurship as a career choice. Hence, in this context, self-efficacy mediation refers to the role of self-efficacy that connects career readiness with students' tendency to become job creators or entrepreneurs. Students who feel they have high entrepreneurial abilities (high entrepreneurial efficacy) tend to be more confident in starting their own business, regardless of how well they feel prepared for a career regarding skills and knowledge. In this situation, self-efficacy mediates career readiness and students' tendency to become job creators. This means that entrepreneurial self-efficacy functions to relate or explain how career readiness influences their tendency to become entrepreneurs.

LIMITATION

This research is limited by the size of the sample used. Therefore, future research should consider using larger and more diverse samples to increase the representativeness of the results. Apart from that, the results of this research only reflect the conditions of a geographical region in Indonesia or a particular educational institution. For stronger generalizations, future research could consider geographic and institutional variations. Time limitations in measuring the long-term influence of career readiness on the tendency to become a job seeker or job creator are also limitations in this research. Thus, longitudinal studies can help overcome this.

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DATA ENVELOPMENT ANALYSIS AS A TOOL FOR IDENTIFYING REFERENCE SCHOOLS: A STUDY IN THE CONTEXT OF HIGH SCHOOL IN A BRAZILIAN STATE

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ABSTRACT

To ensure compliance with students' educational rights and monitor education systems, many countries have developed indicators that assign statistical value to the quality of education. The Basic Education Development Index (Ideb) is widely used in Brazil as a strategic management tool. This study proposes using Ideb, weighted by contextualized educational measures, to identify schools that excel compared to others with similar characteristics (referred to as reference schools). The study employs the output-oriented Variable Returns to Scale approach of Data Envelopment Analysis, along with the Malmquist Index, to assess changes in outcomes over two editions of the indicator. The findings show that, in 2017, 17 schools operated on the production frontier and had at least one partner of excellence. By 2019, this number increased to 18 out of the 222 schools analyzed. Applying the Malmquist Index further indicated that most schools experienced modest improvements in technical efficiency during the analyzed period, effectively utilizing resources to achieve similar or better outcomes. This study underscores the importance of understanding successful school strategies, providing valuable insights for educational improvements, and facilitating the adoption of effective methods in comparable institutions.

KEYWORDS

Basic Education Development Index, Data Envelopment Analysis, educational efficiency, reference schools, Brazil

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Highlights

- *The article presents an alternative to using the Basic Education Development Index in Brazil to identify reference schools, weighting it by educational measures to evaluate the context of basic education.*
- *The study reveals that in 2017, 17 schools operated on the production frontier and had at least one partner of excellence. By 2019, this number had increased to 18 out of the 222 schools analyzed.*
- *The application of the Malmquist Index revealed that most schools experienced a modest improvement in their technical efficiency during the analyzed period, managing to use resources more effectively to achieve similar or better outcomes.*
- *This study emphasizes the need to understand successful school strategies, offering vital insights for educational improvements and facilitating the adoption of effective methods in comparable institutions.*

INTRODUCTION

The educational landscape has significantly transformed the role and importance attributed to external assessments in recent years. These have become instruments for measuring school performance and a fundamental component in formulating and implementing educational policies at national and international levels. In this context, external evaluation has transcended its traditional role, acquiring strategic relevance in implementing initiatives to guarantee the right to education (Rutkowski et al., 2020; Jimenez and Modaffari, 2021; Ehren, 2021).

In Brazil, the pioneering initiative for a comprehensive analysis of the educational system emerged in the 1990s with the creation of the Basic Education Assessment System (Saeb). It is worth noting that the Brazilian Federal Constitution, promulgated in 1988, recognizes education as a universal right (Brasil, 1988). Saeb's performance and learning outcomes provide the state

with evidence of the fulfillment of this right, especially regarding the training of students through the standardized assessments that comprise it, but also considering the academic trajectory of these subjects based on information produced through contextual questionnaires applied since 1995. As expressed by Soares and Xavier (2013), in the absence of a system like this, the subjective public right established in the constitutional text cannot be monitored and, eventually, demanded.

In fact, the emergence of Saeb allowed society to better understand Brazilian educational outcomes in a general context. However, due to its initially sample-type nature, it was impossible to highlight the particularities of each school and municipality, limiting the development of public policies that could meet their specificities. The system underwent a substantial restructuring in 2005 to overcome this situation, resulting in the creation of the National Assessment of School Performance (known as Prova Brasil), which assumed a census application, i.e., with universal coverage for all students in their final years of each cycle of elementary education in public schools (Brasil, 2005).

Thus, Prova Brasil was created to produce metadata on the education offered by schools and municipalities, assisting educational managers in decision-making and allocating technical and financial resources. In light of this assessment, in the national context, there was the establishment of an educational policy based on the accountability of schools and the actors who work in them, who now have to be held accountable (Fernandes and Gremaud, 2020; Jerrim and Sims, 2022) of the outcomes achieved for society, a practice materialized by the document that established the Education Development Plan (PDE), officially launched by the MEC on April 24, 2007. According to Brasil (2007: 11), the PDE established 'unprecedented connections between evaluation, financing, and management, which invoke a concept that was previously absent from our educational system: accountability and, as a result, social mobilization'.

Among the actions proposed by the PDE, we highlight the Target Plan *Compromisso Todos pela Educação*, implemented through Decree No. 6,094, of April 24, 2007 (Brasil, 2007). From it, and inspired by the United States Educational Responsibility Law (No Child Left Behind) (Soares et al., 2023), it was possible to outline measurable parameters for the quality of education in Brazil, given the consolidation of targets for all teaching modalities and in all administrative spheres, supporting the creation of the Basic Education Development Index (Ideb) for its follow-up and monitoring. In the words of Soares (2016: 149), from this movement, 'Brazilian society understood that education has outcomes and that rights without learning outcomes are mere utopia'.

Ideb is a statistical indicator that combines student performance in the Saeb with flow indicators (promotion, retention, and dropout) produced by the School Census. The biennial publication of its outcomes, together with the pre-established targets, gave rise to a practice that, although unofficial, encouraged the ranking of educational units based solely on the performance achieved in the indicator, as advised in several studies in the specialized literature (Richter and Vieira, 2021; Akkari, 2021; Ranieri, 2024).

In summary, in the Brazilian context, schools with the highest scores began to be recognized as a *reference* for the others, disregarding the multiple facets of the Brazilian educational system, assumed to be standardized and uniform. On the other hand, units with lower grades were marginalized and discredited in society, bringing dire and harmful consequences to education. Contrary to this movement, we start from the hypothesis that reconceptualizing this pre-existing idea of reference schools, starting to consider the characteristics of students, the plurality of educational contexts, and the tensions that shape school reality, can corroborate a more systemic analysis of the outcomes of indicators such as Ideb. This practice has been defended by researchers in different countries and at different times, who demonstrated, in their studies, that school performance reflects these factors in a considerably direct way, requiring controlling their heterogeneities before proposing any comparison between the schools in the quest to verify the success of specific educational policies (Henry et al., 2020; Liu et al., 2020; Brown, 2022; Vermunt et al., 2023).

In this regard, this study seeks to answer the following question: Which schools have better educational outcomes in the Ideb than expected, considering their contextual and general working conditions? To answer this question and guide this investigation, this article aims to develop a final reference indicator capable of classifying the relative performance of a set of schools considered as units of analysis. This classification will take into account not only the Ideb of these units but also educational measures that assess the context of basic education. The empirical case of this study includes all high schools administered by the State of Espírito Santo, located in the southeast region of Brazil, using cross-sectional data from the 2017 and 2019 school years. Data Envelopment Analysis (DEA) was used as the methodological approach.

It is important to highlight that, as noted by Koronakos (2019), the use of DEA to evaluate school effectiveness, particularly when schools are treated as Decision-Making Units (DMUs), remains relatively uncommon, especially within the Brazilian context. This perspective is further supported by Soares et al. (2022), who observes that no previous studies in Brazil employ DEA to analyze school effectiveness at the level of basic education schools. This endows our study with a pioneering character due to the innovative application of DEA in a new context and for fostering a deeper understanding of how contextual variables influence school effectiveness. This understanding has the potential to assist in the formulation of more effective educational policies.

In addition to this introduction, the article is structured into four sections. First, a brief theoretical reference is provided on the Ideb, the Educational Indicators for Context Assessment in Basic Education used in the study, and DEA. Next, the materials and methods are detailed. The subsequent sections present the results obtained, followed by a discussion. The article concludes with a summary of the key findings and the implications drawn from the study.

LITERATURE REVIEW

Overview of the Brazilian Basic Education System

In Brazil, the Ministry of Education (MEC) is the federal body responsible for formulating policies and guidelines

for basic education. In contrast, the implementation and management of these policies are shared between state and municipal governments. The Brazilian basic education system is structured into three main stages: early childhood education, elementary school, and high school. Early childhood education serves children up to 5 years old and includes day care and preschool. Elementary school is divided into two segments: the early years (1st to 5th grade) for children aged 6 to 10 and the final years (6th to 9th grade) for students aged 11 to 14. High school serves students aged 15 to 17 and spans three years. Public schools account for the majority of enrollments in basic education, although private institutions also play a significant role, particularly in urban areas (Brasil, 2021).

Despite educational advancements, such as increased enrollment rates and the implementation of conditional cash transfer programs like Bolsa Família (Gangopadhyay, 2020), the Brazilian education system continues to face substantial challenges in ensuring quality education for all students. Regional and socioeconomic disparities still profoundly impact access to education and educational outcomes, highlighting the need for more effective public policies adapted to the diverse realities across the country (Ernica et al., 2024).

The recent release of the 2023 IDEB results has brought critical reflections on the educational performance of Brazil. The data revealed that the national goal set for the first cycle of the indicator (2007-2021) was only achieved in the early years of elementary school. However, in the final years of elementary and high school, the results fell short of the projected targets (Brasil, 2024). This discrepancy signals a challenging scenario, indicating that there is still a long way to go to improve the quality of education in the more advanced stages of basic education.

This challenge is also evidenced by Brazil's performance in the Programme for International Student Assessment (PISA), conducted by the Organisation for Economic Co-operation and Development (OECD). PISA, conducted every three years, assesses 15-year-old students in the areas of Reading, Mathematics, and Science. The results of PISA 2022, presented in Figure 1, reflect the performance of South American countries, comparing them with the OECD average, and underscore the urgent need for educational reforms to raise the quality of education in Brazil (OECD, 2023).

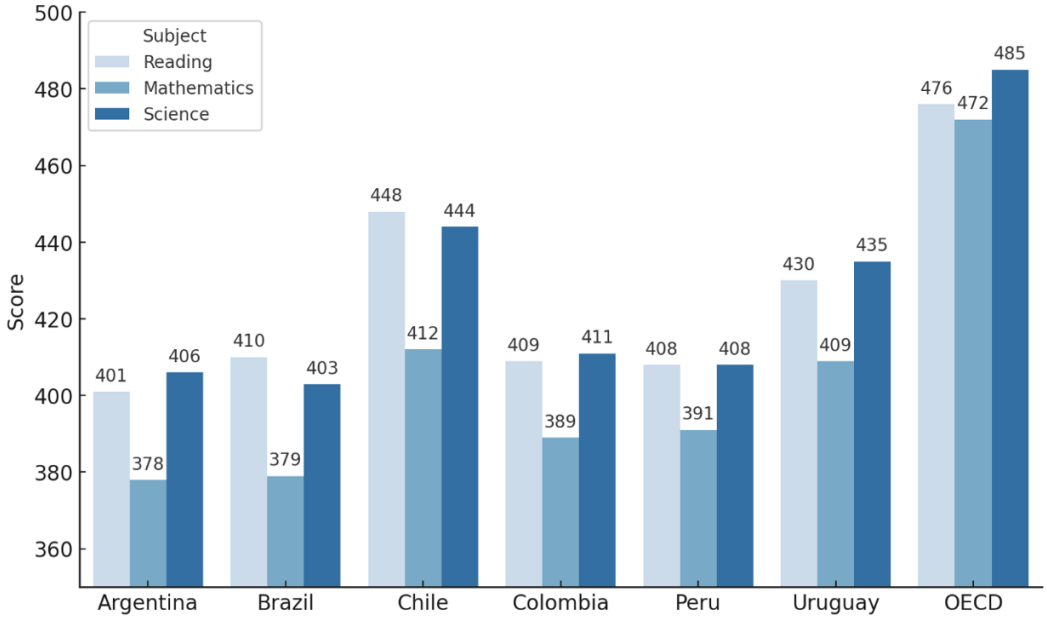

Figure 1: PISA 2022 Results for South American Countries and the OECD Average by Subject (own elaboration based on data provided by the OECD, 2023)

Figure 1 reveals Brazil's poor performance in PISA 2022, where the country ranks last in Science and Mathematics among the South American countries evaluated. This result reflects not only the educational system itself but also the deep social inequality present in the country, which translates into educational inequality. Indeed, numerous studies indicate that the context in which schools are embedded—including factors such as socioeconomic level, access to resources, and school infrastructure—directly influences their educational outcomes (Carvalhaes et al., 2023; Queiroga et al., 2024; Oliveira et al., 2024; Soares and Santos, 2024). Schools tend to face greater challenges in more vulnerable regions, where living conditions are more precarious, resulting in lower performance (Queiroga et al., 2024).

Acknowledging this reality, there is a growing movement among Brazilian researchers aimed at analyzing the effectiveness of schools operating in these adverse contexts (Paschoalotto et al., 2020; Moraes et al., 2021; Silva, 2021; Dias and Zouain, 2023). The goal is to identify schools that, despite the difficulties, manage to achieve superior educational outcomes. These analyses are crucial for understanding how these schools overcome the barriers imposed by their contexts and how their practices can be replicated in other institutions to reduce educational inequality and improve national performance.

Applications of DEA in Efficiency Evaluation

DEA is a non-parametric methodology used to evaluate the relative efficiency of DMUs that convert multiple inputs into multiple outputs (Ferreira and Gomes, 2020).

Initially developed by Charnes et al. (1978), DEA is based on mathematical models of linear programming to create an efficiency frontier against which the performance of DMUs is assessed.

The main value of DEA lies in its ability to evaluate the efficiency of DMUs holistically, considering multiple inputs and outputs without the need to specify a predetermined functional form between them (Flegl et al., 2023). Unlike parametric methods, such as linear regression, which require an explicit assumption about the relationship between variables, DEA allows the data to "speak for itself", identifying the most efficient units operating on the efficiency frontier (Wyszynski, 2024).

In the scientific literature, DEA has been widely used to evaluate the efficiency of organizations and institutions, including hospitals (Pereira et al., 2021; Hajiagha et al., 2023; Zubir et al., 2024), airports (Özsoy and Örkcü, 2021; Zeng et al., 2024), banks (Li et al., 2022; Ullah et al., 2023), local governments (Ryan et al., 2021; Yin et al., 2021), and sports organizations (Guzmán-Raja and Guzmán-Raja, 2021; Gökgöz and Yalçı, 2022; Wyszynski, 2024), among others. This broad applicability highlights the flexibility of DEA in assessing performance across a wide range of sectors, each with its unique set of inputs and outputs.

Application of DEA in Education

The DEA approach has been widely adopted in the educational field, particularly due to its simplicity and effectiveness in contexts involving multiple inputs and outputs, which are typical of the educational environment (Johnes, 2006). The theoretical foundation of these studies holds that school inputs are crucial determinants for achieving educational outcomes (Lima, 2011). Furthermore, Liu et al. (2013) identified that the application of DEA in education ranks among the top five utilization domains, underscoring its relevance and popularity in this field.

For instance, recent publications in the educational field have extensively explored the efficiency of higher education institutions using DEA as a methodological tool. Studies have examined institutions across various countries, including Spain (Salas-Velasco, 2020), Mexico (Moncayo–Martínez et al., 2020), Brazil (Santos Tavares et al., 2021), Canada (Ghimire et al., 2021), China (Jiang et al., 2020; Chen et al., 2021), Colombia (Zuluaga et al., 2023), Turkey (Mammadov and Aypay, 2020; Doğan, 2023), and the Czech Republic (Hančlová and Chytilová, 2023).

Additionally, Popović et al. (2020) used a combination of DEA and Multi-Criteria Decision-Making Methods to evaluate professors' performance at the Faculty of Organizational Sciences, University of Belgrade, Serbia. On the other hand, De la Hoz et al. (2021) applied DEA to assess and predict academic efficiency across 256 engineering programs at universities in Colombia.

From an international comparative perspective, Torres-Samuel et al. (2020) employed DEA to analyze fifteen Latin American countries, considering factors that reflect their progress in research and development, science and technology, education, and innovation. In the context of the European Union, the studies by Dincă et al. (2021) and Halásková et al. (2020) offer valuable insights. The first study seeks to analyze the efficiency of the educational sector at different levels of education. In contrast, the second focuses on evaluating the efficiency of research and development in the public and private sectors in the region. Additionally, from a comparative perspective, Sinuany-Stern and Hirsh (2021) assess the relative efficiency of higher education in OECD countries, considering how these countries utilize their public resources to achieve results compared to their peers.

Regarding basic education, DEA analysis has also been used to evaluate the efficiency of different educational systems around the world. Ramzi et al. (2016) analyzed the efficiency of primary and secondary education in 24 provinces of Tunisia. Halásková et al. (2022) investigated the efficiency of 26 public and private secondary schools in Slovakia. In the Latin American context, Delprato and Antequera (2021) applied a DEA model to compare the efficiency between public and private secondary schools, highlighting the gaps existing in the region. In Mexico, Flegl et al. (2023) explored the efficiency of the educational system and its impact on regional, economic, and social development. In Portugal, Silva et al. (2020) evaluated the performance of secondary schools based on students' outcomes at the end of their first year of university, using data from the University of Porto and the Catholic University of Porto.

These studies collectively emphasize the value of DEA in identifying best practices and areas for improvement within the education system. By providing a comparative analysis of school efficiency, DEA enables policymakers and educators to better understand the factors contributing to successful educational outcomes, even in contexts marked by adversity.

MATERIALS AND METHODS

Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a multivariate technique based on non-parametric mathematical models designed to evaluate the performance of a group of entities known as Decision-Making Units (DMUs). Utilizing linear programming tools, DEA calculates the performance of each DMU in comparison to all other DMUs in the set, establishing an efficient frontier that delineates the top-performing units (Flegl et al., 2023). This analysis identifies necessary adjustments for DMUs operating below this frontier to achieve efficiency through radial projection.

Mathematically, the problem of maximizing the efficiency of a DMU can be expressed as follows:

$$\text{Maximize}\,\theta_0 = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}}$$

Subject to:

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1, \forall j = 1, 2, \cdots, n$$

$$u_r \geq 0, \forall r$$

$$v_i \geq 0, \forall i$$

Where:

- θ_0 is the relative efficiency of the DMU under evaluation.
- y_{rj} is the quantity of the r-th output produced by the j-th DMU.
- x_{ij} is the quantity of the i-th input used by the j-th DMU.
- u^r and v_i are the weights assigned to the outputs and inputs, respectively.

The goal is to maximize the efficiency θ_0 for each DMU under the constraint that all other DMUs' efficiency is less than or equal to 1. When the efficiency $\theta_0 = 1$, the DMU is considered efficient relative to the others in the set. Otherwise, it is considered inefficient.

Two classical DEA approaches stand out: Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS). These approaches differ concerning the proportionality axiom. In the CRS model, any variation in inputs results in a proportional variation in outputs, whereas in the VRS model, this proportionality may not hold true (Ferreira and Gomes, 2020). Both approaches allow for two radial orientations to determine the efficient frontier: input-oriented and output-oriented. The input-oriented approach aims to identify the extent to which inputs can be reduced while maintaining the same level of outputs. In contrast, the output-oriented approach seeks to maximize outputs without increasing the amount of inputs used (Avilés-Sacoto et al., 2021).

Given that relationships in the educational field often do not exhibit constant returns to scale and that, due to budgetary constraints, there is a frequent emphasis on maximizing outputs with existing inputs, this study adopts the DEA-VRS approach, which is focused on outputs.

Malmquist Index

The Malmquist Index is a productivity measure used to assess the performance changes of Decision-Making Units (DMUs) over time. Named after the Swedish economist Sten Malmquist, this index is particularly useful for analyzing DMUs' efficiency changes between two periods by decomposing the total factor productivity change into two components: efficiency change and technological change (Xu et al., 2021).

Mathematically, the Malmquist Index is calculated as follows:

$$M\left(t,t+1\right)=\sqrt{\left(\frac{D_t\left(x_{t+1},y_{t+1}\right)}{D_t\left(x_t,y_t\right)}\right)\times\left(\frac{D_{t+1}\left(x_{t+1},y_{t+1}\right)}{D_{t+1}\left(x_t,y_t\right)}\right)}$$

Where:

- $M(t, t + 1)$ is the Malmquist Index between periods t and $t + 1$.
- $D_t(x_t, y_t)$ represents the distance function at time t, which measures the efficiency of a DMU using the technology available at time t.
- $D_t(x_t + 1, y_t + 1)$ represents the distance function at time t, measuring the efficiency of a DMU in the future period but using the technology available at time t.
- $D_{t+1}(x_t, y_t)$and $D_{t+1}(x_t + 1, y_t + 1)$ are the corresponding distance functions at time $t + 1$.

The Malmquist Index can be decomposed into two primary components: Efficiency Change (EC), which captures the shift in the relative efficiency of a DMU between two periods, reflecting whether the DMU has moved closer to or farther from the efficiency frontier, and Technological Change (TC), which measures the shift in the technology frontier itself, indicating whether the overall production possibility set has improved or regressed (Er-Rays and M'dioud, 2024).

If the Malmquist Index is greater than 1, it indicates an improvement in productivity; a value below 1 suggests a decline in productivity. This index is particularly valuable in longitudinal studies, where the goal is to assess the progress or regression of DMUs over time. In this article, the Malmquist Index was used to analyze the changes in the efficiency of school units between the years 2017 and 2019.

Data

This study encompasses an empirical analysis of 222 schools administered by the State of Espírito Santo, Brazil, which offered at least one high school class during the years 2017 and 2019 and had scores in the Basic Education Development Index (Ideb) for this stage. According to the School Management System, these 222 schools represent approximately 79% of the total institutions administered by the State.

The data utilized were obtained from the electronic portal of the National Institute for Educational Studies and Research Anísio Teixeira (Inep), a federal agency linked to the Ministry of Education of Brazil (Inep/MEC) (Brasil, 2024). For the analysis, four educational indicators developed by Inep/MEC were considered as inputs: age-grade distortion rate (TDI), percentage of students declared as white (PCB), socioeconomic level of the school (INSE), and teaching effort (IED).

The TDI refers to the proportion of students who are two or more years behind in their studies. The INSE reflects the socioeconomic level of the students, considering information on family income, parental education, and possession of durable goods collected through contextual questionnaires from the Basic Education Assessment System (Saeb). The PCB measures the proportion of students who self-identify as white. Meanwhile, the IED assesses teaching effort, taking into account variables such as workload, the number of schools where teachers work, and the stages of education in which they are involved. Table 1 presents the descriptive statistics of these contextual indicators.

Statistic	INSE	TDI	PCB	IED
Minimum	4.070	4.100	4.023	0.000
Average	4.810	25.900	33.548	25.130
Standard deviation	0.279	10.418	17.531	16.148
Coef. of variation	5.810%	40.220%	52.260%	64.260%
Maximum	5.460	60.400	88.000	70.000

Table 1: Descriptive statistics of related context indicators (own elaboration)

The Ideb scores for high schools from 2017 and 2019 were used as outputs in two applications of the DEA model, both employing the same inputs. The goal was to assess the variations in the overall efficiency growth of the analyzed school units using the Malmquist Index.

In both these editions of Ideb, schools in the State of Espírito Santo achieved the highest scores for high school among Brazilian states. In 2017, the state's score was 4.400, compared to the national average of 3.800. By 2019, the state's Ideb rose to 4.800, while the national average increased to 4.200. However, despite these improvements, the results fell short of meeting the targets set for the respective years, which were 5.100 and 5.300.

It is important to highlight that the input indicators used in this analysis were selected based on the study by Soares and Santos (2024), which demonstrated through multiple linear regression analysis that these variables collectively explain 50.8% of the variations in the 2019 Ideb.

Additionally, all indicators showed a statistically significant correlation with Ideb, as illustrated in Figure 2, which presents the frequency distribution of these contextual indicators, scatter plots and correlation coefficients, showing pairwise relationships among the indicators and between each indicator and the Ideb of the evaluated school units.

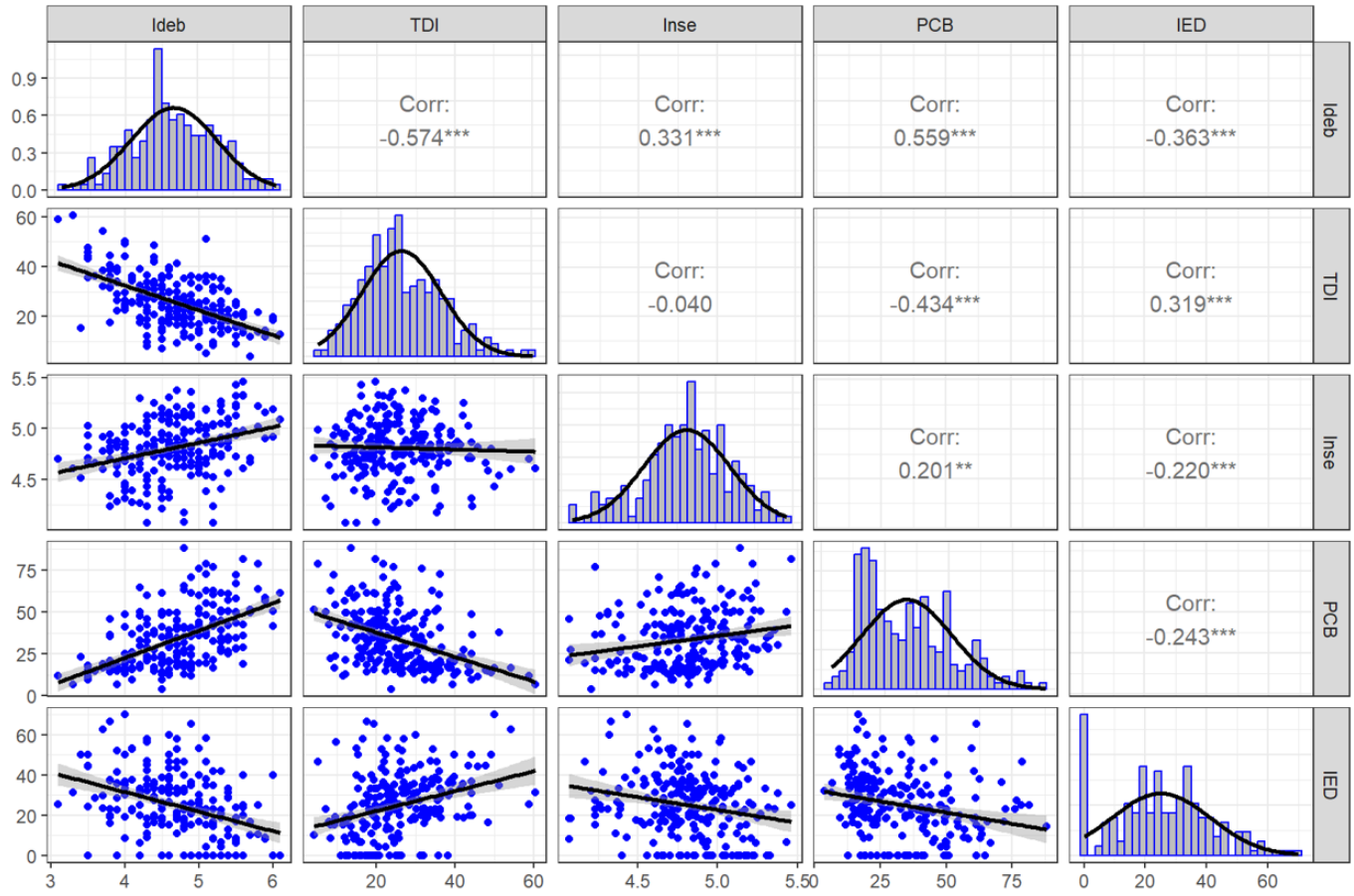

Figure 2: Graphs of frequency distribution, dispersion, and correction coefficients between context indicators related to schools and Ideb (own elaboration based on data provided by the Brasil, 2024)

Notably, the negative sign attributed to TDI and IED indicates an inverse linear relationship with Ideb. Thus, the higher a school's TDI or IED, the lower its Ideb tends to be, on average, as expected. On the other hand, the relationship between the INSE and PCB indicators is direct.

Computational Workflow and Data Transparency

The analyses were conducted using R software, version 4.4.2 (R Core Team, 2023), widely recognized for its statistical analysis and modeling robustness. A significance level of 5% was adopted, ensuring that the results obtained were statistically significant. All source codes used in this study and the database are available in a GitHub repository (https://github.com/denilsonjms/PhD-Thesis/tree/master/Chapter%204). This availability aims to facilitate the replication of the results and allow further analyses by other researchers interested in the topic.

RESULTS

Overall Performance of the Analyzed Schools

The analysis using the DEA method revealed that the schools investigated could potentially increase their 2017 Ideb scores by up to 19.400% while maintaining the same contextual characteristics ($\phi \approx 1.194$). The efficiency of the Decision-Making Units (DMUs), under the variable returns to scale approach, ranged from 58.550% to 100%, with an average of 84.990% and a standard deviation of 9.970%. Figure 3 shows the distribution of efficiency scores among the analyzed units in 2017.

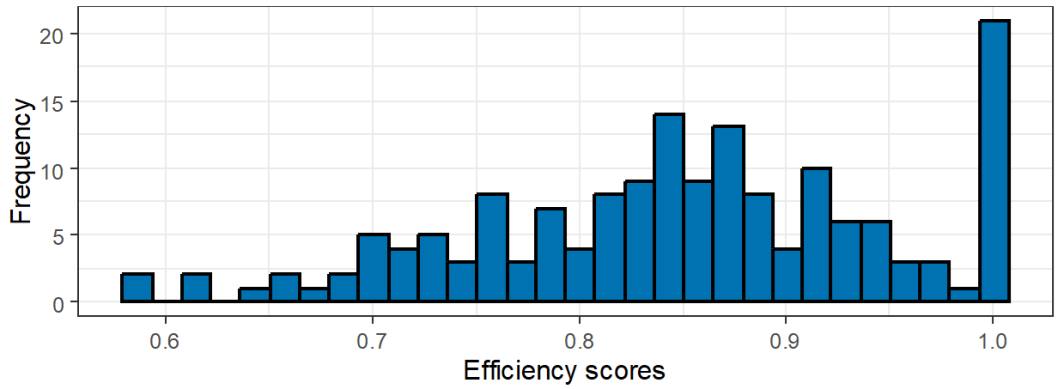

Figure 3: Efficiency scores distribution using 2017 Ideb results as output (own elaboration)

For the model that utilized the 2019 Ideb results as the output, the DEA analysis indicated that the schools could achieve an increase of up to 14.200% in their results while maintaining the same contextual characteristics ($\phi \approx 1.142$). The efficiency of the DMUs in this scenario ranged from 67.320% to 100%, with an average of 88.333% and a standard deviation of 8.111%. Figure 4 presents the distribution of efficiency scores among the analyzed school units in 2019.

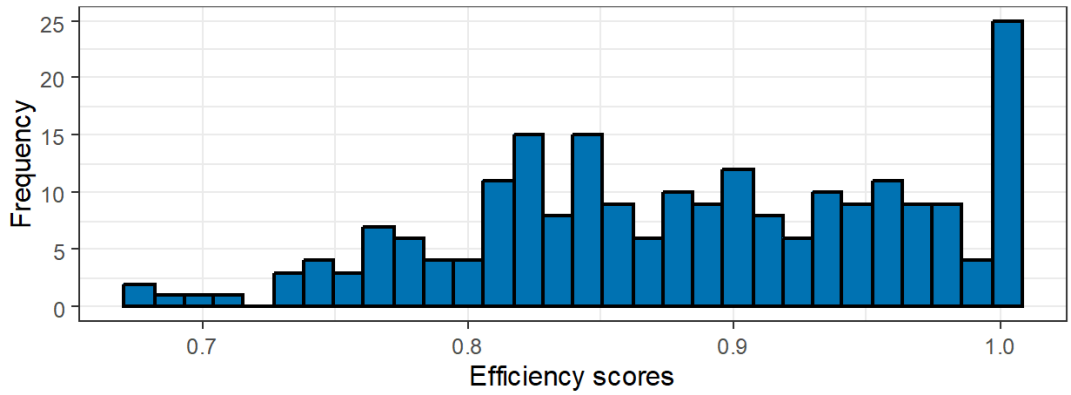

Figure 4: Efficiency scores distribution using 2019 Ideb results as output (own elaboration)

A descriptive analysis of the overall performance efficiency of the analyzed units in each case reveals a slight improvement in average efficiency over time. However, a significant potential for further improvement remains evident among the schools.

Reference Schools

The conducted DEA analysis identified the units operating on the efficiency frontier, meaning those that achieved the maximum technical efficiency score (ϕ =1). In 2017, 21 schools were identified in this condition, representing 10.810% of the analyzed DMUs. Among these, 16 schools (75%) stood out as reference units (reference schools), being considered benchmarks or peers for at least one other school. These schools serve as models of efficiency, offering practices and strategies that can be replicated by other institutions seeking improvement. In 2019, the analysis revealed an increase in the number of efficient units, with 24 schools located on the production frontier, again representing 10.810% of the analyzed DMUs. Among these, 18 schools (75%) were identified as reference units (reference schools), reaffirming their prominent role as benchmarks for other institutions. It is important to highlight that of the 21 schools on the efficiency frontier in 2017, 13 maintained this status in 2019, demonstrating significant consistency in their practices and results over time.

Table 2 presents the schools operating at the efficiency frontier based on the model that uses the 2019 edition of the Ideb. These reference schools are identified along with the number of partner schools. Additionally, the table includes the municipality where these schools are located, the Regional Education Superintendency (SRE) to which they belong, the Ideb scores achieved in the referenced year, and the educational context indicators used as inputs in the analyses.

* the target was achieved; **there was no projected target

Table 2: High school reference schools in the State of Espírito Santo (own elaboration)

	Code	School	Municipality	SRE	P.E.	IDEB	TDI	INSE	IED	PCB
1	32037163	EEEFM Francisco Nascimento	Serra	Carapina	126	5.600	15.000	4.980	40.000	18.770
2	32059310	EEEFM Agostinho Agrizzi	Vargem Alta	Cachoeiro de Itapemirim	105	6.000*	18.700	4.920	40.000	50.720
3	32045360	EEEFM Professor Pedro Simao	Alegre	Guaçuí	86	5.100*	51.200	4.540	35.000	37.770
4	32010745	EEEFM Profa. Carolina Pichler	Colatina	Colatina	63	4.800**	35.400	4.170	46.700	19.310
5	32066333	EEEFM Zumbi dos Palmares	Serra	Carapina	51	4.600**	39.700	4.840	50.000	12.540
6	32078315	EEEM Sobreiro	Laranja da Terra	Afonso Cláudio	48	5.200*	14.900	4.070	8.300	45.740
7	32010702	CEEMTI Conde de Linhares	Colatina	Colatina	48	6.000**	19.900	5.190	0.000	41.500
8	32021550	EEEFM Joao Neiva	João Neiva	Linhares	46	5.400**	30.300	4.910	31.300	26.430
9	32079230	EEEM Mario Gurgel	Vila Velha	Vila Velha	42	4.400*	48.400	4.580	16.200	14.680
10	32003005	EEEFM Ecoporanga	Ecoporanga	Barra de São Francisco	24	4.500*	23.700	4.210	32.100	4.020
11	32078528	EEEM Santina Morosini Cupertino	Linhares	Linhares	16	4.000	50.000	4.430	70.000	16.670
12	32015089	EEEFM DE MUCURICI	Mucurici	Nova Venécia	9	4.600*	30.000	4.320	60.000	20.090
13	32040288	EEEM Gomes Cardim	Vitória	Carapina	6	3.300	60.400	4.610	31.300	6.710
14	32049536	CEEFMTI Braulio Franco	Muniz Freire	Guaçuí	6	6.100*	13.000	5.090	0.000	61.520
15	32052618	EEEFM Profa. Hosana Salles	Cachoeiro de Itapemirim	Cachoeiro de Itapemirim	6	5.100*	22.800	5.020	58.300	35.800
16	32079214	EEEM Profa. Maria Candido Kneipp	Muniz Freire	Guaçuí	5	5.200*	24.400	4.230	27.300	76.740
17	32048459	EEEFM Bernardo Horta	Irupi	Guaçuí	4	4.900*	19.400	4.810	65.400	61.550
18	32051840	EEEFM Horacio Plinio	Bom Jesus do Norte	Guaçuí	1	3.800	44.400	4.230	20.000	36.620
					Average	4.920	31.200	4.620	35.110	32.620
					Standard deviation	0.770	14.600	0.360	21.100	20.700
					Coefficient of variation (in %)	15.610	46.800	7.800%	60.100	63.450

The reference schools identified in Table 2 obtained a 2019 Ideb for secondary education ranging from 3.300 to 6.100, with an average of 4.920, surpassing the State's state schools (4.600) and the proposed target for the year (4.700). The coefficient of variation between grades is classified as medium, according to the classification proposed by Gomes (1985). Of the 14 units that had targets projected for 2019 Ideb, we found that ten achieved or exceeded the objectives, representing a percentage of 71.430%.

Malmquist Index

The Malmquist Index showed a minimum value of 0.864, indicating that some units experienced reduced productivity. In contrast, the maximum value of 1.402 suggests that other units increased their productivity by up to 40.200%. The median of 1.012 reflects a slight productivity gain for most school units. It is observed that 25% of the units maintained their productivity constant (1st quartile equal to 1), while another 25% showed significant improvement, with a productivity increase of more than 5.999% (3rd quartile). Figure 5 illustrates the distribution of the Malmquist Index, highlighting these variations.

The decomposition of the Malmquist index revealed considerable variation in the technical efficiency of the school units over the analyzed period, as indicated by the Efficiency Change Index, which ranged from 0.863 to 1.147. A median of 1.005 suggests that most schools saw a modest improvement in their technical efficiency, managing to utilize resources more effectively to achieve similar or better outcomes.

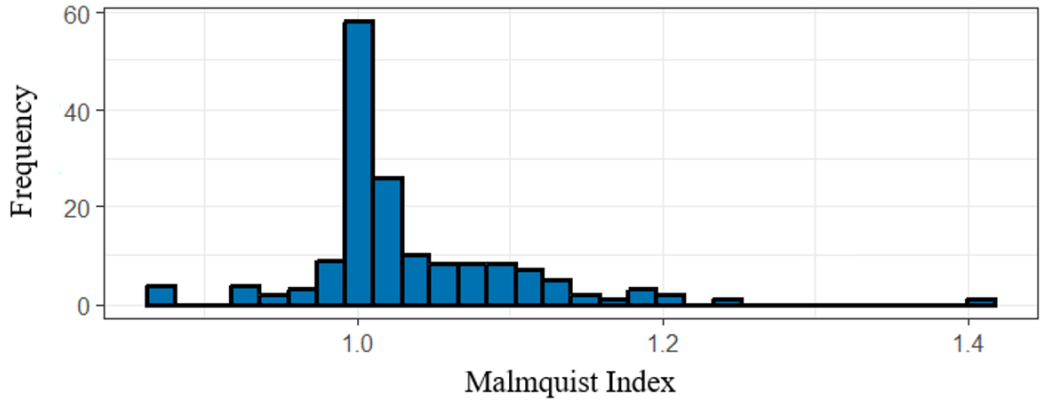

Figure 5: Distribution of the Malmquist Index (own elaboration)

However, the minimum value of 0.863 indicates that some schools experienced a decline in efficiency, likely due to internal challenges or contextual factors they could not address. Meanwhile, with a median of 1, the Technological Change Index points to a general stabilization in the technological production frontier, with half of the units showing no significant technological changes.

Overall, the findings suggest a slight improvement in schools' technical efficiency over time, with some units making noteworthy progress. However, technological progress was uneven, with certain schools advancing more rapidly than others. This indicates that while there is a general trend towards improvement, disparities remain that need to be addressed to ensure more uniform progress across all schools.

DISCUSSION

In this study, we applied the Variable Returns to Scale (VRS) output-oriented Data Envelopment Analysis (DEA) approach to assess the efficiency of 222 high schools administered by the State of Espírito Santo. The Ideb was considered the primary output, while contextual variables such as the age-grade distortion rate, the socioeconomic level of students, the percentage of white students, and teacher effort were used as inputs. The results revealed significant differences between the reference schools and the other units analyzed, providing important insights for educational policy formulation.

The findings indicate that, in 2017, 17 schools were identified as efficient, serving as benchmarks for other units located in similar contexts but with lower performance. In 2019, this number increased to 18, suggesting a slight improvement in the overall efficiency of the schools over time.

The literature has emphasized that efficiency is not only a function of the resources available but also of the management capacity and quality of teaching offered, especially in adverse contexts (Komalasari et al., 2020; Ainscow, 2020; Cheng, 2022; Cox and Mullen, 2023). This aspect is supported by the contextual indicators observed in the reference schools, which, despite higher age-grade distortion rates, lower socioeconomic levels, and a lower percentage of white students, achieve superior results in the Ideb.

This suggests that the effectiveness of educational policies significantly depends on the schools' ability to adapt strategies to their specific realities, as Cox and Mullen (2023) noted. An exemplary case identified in this study is that of EEEM Gomes Cardim, which, as indicated in Table 2, despite having an Ideb below the average of reference schools, exceeds expectations given its highly vulnerable conditions.

It is important to note that many current public policies tend to underestimate the impact of context on school performance, focusing exclusively on performance indicators without considering the conditions under which schools operate. By emphasizing the significance of contextual variables, this study contributes to a deeper understanding of how these factors influence school efficiency. This approach suggests that future research should adopt a more contextualized perspective, as advocated by various scholars in the educational field (Paschoalotto et al., 2020; Creemers et al., 2022; Dias and Zouain, 2023).

Moreover, identifying reference schools and understanding the practices that lead to greater efficiency, even in adverse contexts, provide valuable insights for replicating these strategies in other educational institutions. This may include developing training programs for school managers focused on optimizing the use of limited resources and implementing strategies to engage and motivate teachers, even in challenging environments, as previously indicated by Creemers et al. (2022). In the context of this study, reference schools were identified in 15 of the 78 municipalities in Espírito Santo. Serra, Colatina, and Muniz Freire stand out for hosting two reference schools each. According to the geographical division proposed by the Brazilian Institute of Geography and Statistics (IBGE), three of these schools are located in the North Coast Region, three in the Northwest Region, seven in the South Region, and five in the Central Region of Espírito Santo, with four belonging to the Metropolitan Region of Greater Vitória.

Regarding the Regional Education Superintendencies (SREs), reference schools were identified in 9 of the 11 SREs (81.820%). All mesoregions of the state have at least one reference school, and about 60% of the analyzed schools have at least one partner school managed by the same SRE. This can facilitate the creation of spaces dedicated to sharing experiences, which are essential for driving educational progress. Figure 6 provides a more detailed visualization of the location of these schools.

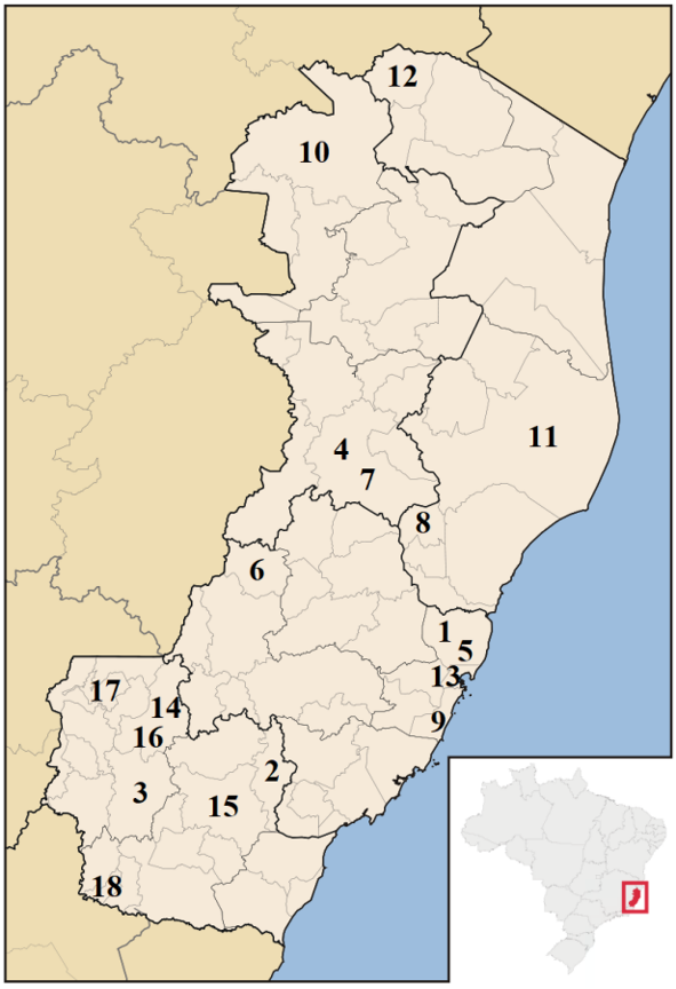

Figure 6: Location of reference schools (own elaboration)

Nonetheless, it is important to acknowledge that DEA assumes all units can learn from and adopt the best practices of reference schools, a premise that may not always be realistic or applicable in practice. Therefore, it is essential to carefully evaluate the feasibility of these best practices and adapt them to each school's unique needs and constraints. This flexible and adaptive approach is critical to ensuring that strategies aimed at improving educational quality are both effective and relevant.

This study also opens avenues for further research. Future investigations could benefit from applying mixed methods and integrating DEA with qualitative approaches such as interviews and case studies to better understand the complexities that influence school performance in challenging environments. Additionally, employing more comprehensive longitudinal data could reveal long-term trends and assess the sustained impact of specific interventions over time.

Limitations of the Analysis

It must be acknowledged that the study has certain limitations. The analysis was based on data from only two cycles of the Ideb, which may not fully capture the long-term dynamics of school performance. Future studies could expand this analysis to include additional Ideb cycles and consider other contextual factors that might influence school efficiency,

such as local education policies and specific government interventions. Furthermore, incorporating qualitative methods to complement the quantitative DEA analysis could provide a deeper understanding of the practices and strategies that make some schools more efficient than others. This type of integrated approach could help formulate more effective policies tailored to the realities of Brazilian schools, contributing to ongoing improvements in teaching quality and educational equity.

CONCLUSIONS

Through the application of Data Envelopment Analysis (DEA) to a group of schools located in the State of Espírito Santo, Brazil, this study aimed to identify those operating in challenging contexts that stand out as reference schools when compared to others in similar conditions. The schools identified, spread across various regions of the state, demonstrate that school efficiency is not solely determined by the availability of resources but also by management capacity and adaptability to local conditions.

This study underscores the need for educational policies that recognize and value regional specificities and suggests the creation of spaces for sharing best practices and dialogue between reference schools and their partner schools. By fostering closer collaboration between these schools, it is possible to not only elevate the level of efficiency throughout the educational system but also to promote greater educational equity. Such initiatives, combined with continuous support tailored to local needs, have the potential to transform school realities and sustainably improve educational outcomes. Thus, this study contributes to the discussion on how more contextualized and collaborative educational policies can play a crucial role in enhancing the quality of education in Brazil.

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A CROSS-SECTIONAL STUDY ANALYZING THE INTEGRATION OF THE MOVING SCHOOL CONCEPT AT SECONDARY SCHOOLS IN GERMANY

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ABSTRACT

Objectives: The increase in physical activity and the reduction of sedentary time can have positive effects on children´s health. The concept of Moving School was developed to reduce students' sitting time and has evolved in a broadly used concept. Method: This study aims to analyse the degree of the implementation of the concept at secondary schools and investigate associated factors with the intention of teachers to implement it in practice. 345 physical education teachers were asked by questionnaire about their knowledge of the concept, their attitude towards it, and their assessment of the current situation in everyday school life. Results: Moving School is well known among physical education teachers. They gain their knowledge mainly through their university studies. Teachers' expectations in terms of effort and performance, social influence, and, in particular, facilitating conditions are positively associated with the intention to use the concept. Conclusion: Teachers are aware of and believe in the effectiveness of the concept. The level of implementation in practice does not reflect this. The framework conditions should be adapted and practical examples of implementation should become better known among the teachers in order to facilitate implementing the concept in schools.

KEYWORDS

Moving school, physical activity, physical education teachers, pupils, secondary schools

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Highlights

- *The Moving School concept is well known among physical education teachers. They gain their knowledge mainly through their university studies.*
- *About half of the teachers participating at the study state that they incorporate elements of Moving School during regular teaching classes and that the infrastructure in the classrooms is poor to very poor.*
- *Teachers' expectations in terms of effort and performance, social influence, and facilitating conditions are positively associated with the intention to use the Moving School concept.*
- *The level of implementation in practice does not reflect teachers' intention to implement the Moving School concept. The framework conditions should be adapted, and practical examples of implementation should become better known among the teachers.*

INTRODUCTION

The World Health Organization (WHO) recommends a minimum amount of moderate to vigorous physical activity of 60 minutes per day on average during a week for three-year-old to seventeen-year-old children and adolescents. Additionally, within these 60 minutes, vigorous-intensity physical activity should be incorporated at least three times per week. Meeting these targets positively impacts the prevention and management of non-communicable diseases such as cardiovascular disease, type 2 diabetes, and breast and colon cancer, for example (Bull et al., 2020). Recent studies indicate that the WHO guidelines are not yet being met in Germany: the second wave of the KiGGS study showed that in Germany, only 22.4% of girls and 29.4% of boys in the 3-17 years age group meet the WHO recommendations. In addition, the prevalence of the recommended level of

physical activity decreases continuously with age, both for girls and boys. For example, among boys aged 14 to 17 years, 16% still meet the WHO guidelines, while among girls, only 7.5% do (Finger et al., 2018).

According to their educational mandate, schools could and should remedy this situation. This could be very effective in increasing physical activity rates because children and young people spend much of their waking time in school (Kohl III and Cook, 2013). However, a current study shows that schools offer few opportunities for physical activity, and children attending all-day schools are, on average, 20 minutes less physically active than half-day school children (Kuritz et al., 2020). Besides inactive screen time in children's and adolescents' leisure time, school is considered an important sedentary factor (Bucksch et al., 2015). On an international average, children sit for about 65% of the school day (van Hecke et al., 2016, van Stralen et al., 2014).

Increased physical activity is associated with health benefits to a certain degree (Rütten and Pfeifer, 2016, Mutz et al., 2021, Carson et al., 2016). In addition, the adverse effects of sedentary behavior are becoming increasingly apparent. As it has been shown that physical activity can compensate for the negative effects of extended sitting (Ekelund et al., 2016), schools should aim to increase periods of physical activity and reduce sitting time in children and adolescents.

So far, there have only been general, non-binding recommendations on physical activity in schools in Germany, e.g., from health insurance companies (Brägger et al., 2017), and there are no specific and binding state guidelines for reducing sitting times at school. Saunders et al. (2022) developed international school-related sedentary behavior recommendations for children and youth and thus provide guidelines such as the necessity to interrupt periods of prolonged sitting, for example, when doing homework, whenever possible. In addition, sedentary learning activities should be replaced by movement-based learning activities whenever possible. Furthermore, for example, the United States and the United Kingdom have their recommendations for physical activity times in schools: at least 30 minutes of the required moderate to high-intensity physical activity should occur during school (Kohl III and Cook, 2013). In addition, Kohl and Cook recommend that pupils participate in at least 30 to 45 minutes of a daily physical education (PE) lesson, with at least half of this time spent being physically active (ibid.). However, it is estimated that only about 50% of schools worldwide can create an environment for sufficient physical activity on school days (Aubert et al., 2018).

Moving School could make an important contribution to the challenge of increasing physical activity and reducing sedentary time in schools. In addition to this health aspect, there are two other arguments to legitimize the concept of Moving School: a developmental or learning theory argument and an educational argument (Thiel et al., 2004). These perspectives each emphasize different approaches and naturally have consequences for an empirical design, particularly the selection of corresponding variables. Developmental and learning theory approaches primarily emphasize the importance of movement for learning processes in other subjects, e.g., by promoting executive functions, motivation, or multisensory access to information that is to be acquired (Aguirre-Loaiza et al., 2019). From an educational science perspective, the focus is primarily on pupils' self-activity in movement-related and cognitive engagement (Wibowo et al., 2021, Wibowo et al., 2023). This article focuses on a health perspective as it was in the original approach, developed by Urs Illi about three decades ago, which aimed to reduce the negative consequences of sitting too long in schools with inappropriate school furniture (Illi, 1998). The concept was well received in German-speaking countries and was popular in sports science research around the turn of the millennium (Thiel et al., 2004).

Nevertheless, suggestions for implementation and concept ideas predominate. However, reports on implementation that take a holistic view of the concept of Moving School, i.e., considering the effect and interaction of several building blocks in everyday school life, are still the exception, especially for secondary schools (Englert et al., 2023). Furthermore, based on a recent study reviewing the information secondary schools publish in their school programs, on their websites, and the information published in the school curriculum, it can be assumed that the Moving School concept has found little implementation in school practice in comparison to recommendations from sports science theory (Englert et al., 2023).

Studies have already investigated the acceptance of individual components in the context of the moving school concept. Neumann and Zimmermann (2020) investigated the acceptance of interruptions to sitting (moving sitting) in lessons. They found that uncertain performance expectations characterize the acceptance process. The teachers surveyed only accepted interruptions to sitting under certain conditions, for example, if the loss of learning time, restlessness, and other disruptions were considered to be as low as possible.

Venkatesh et al. (2003) compared eight prominent models that determined the acceptance of new technologies and their extensions based on empirical data and synthesized them into one single model. This unified model, the Unified Theory of Acceptance and Use of Technology (UTAUT), contains four core determinants of intention and usage and up to four moderators of key relationships. UTAUT was tested using the original data and outperformed the eight individual models (adjusted R^2 of 70%). Nistor et al. tested the UTAUT model using a correlational study characterized by a large sample (N = 2834) and a high diversity of study participants, providing sufficient evidence to validate the model and thereby confirming the fit of the UTAUT model for the intention to use new technologies (Nistor et al., 2012).

The UTAUT model has already been transferred and applied several times, initially in media didactic settings and later in the school education field (Tappe, 2019, Jäger et al., 2014, Pynoo et al., 2011).

Venkatesh's 2003 extensions to the original UTAUT model related primarily to new (information) technologies (e.g., Artificial Intelligence tools) (Venkatesh, 2022). For this reason, the 2003 model was used in all of the above-mentioned transfers since the extensions do not add value to the school's pedagogical context, as the original model was already narrowed down for this purpose.

Furthermore, the key determinants of the intention to use new technologies and the intention itself have been previously shown to differ between women and men and participants of different ages (Morris and Venkatesh, 2000, Venkatesh et al., 2003). When forming an intention to use, social influence and effort expectancy are more salient for women and older people. Also, facilitating conditions are more salient for older people. On the other hand, performance expectancy is more salient for men and younger people (Morris and Venkatesh, 2000; Venkatesh et al., 2000; Miller, 2012; Bem and Allen, 1974).

A unique aspect of this study is that the area analyzed extends to all areas of school and includes the secondary education sector. At the same time, the data is collected on the basis of a broad database. This study aims to provide an overview of the practical implementation of the Moving School concept at secondary schools in Germany, taking into account the effects that the acceptance of the concept and the age and gender of the teachers have on practical implementation. Firstly, we aim to examine the current degree of implementation of the Moving School concept at higher secondary schools in Germany. Secondly, we investigated differences concerning gender and age in PE teachers' knowledge about the Moving School concept and the sources of this knowledge. Thirdly, we investigated the teachers' attitudes towards Moving School and the resulting use or intention to use the concept based on the implications of the UTAUT model. We hypothesized positive associations between performance expectancy, effort expectancy, social influence, facilitating conditions, and intention of use. We also hypothesize that the model will show differences between men and women, analogous to the results of Morris and Venkatesh (see above). Finally, we examined what changes need to be made from the teachers' perspective to better implement Moving School in everyday practice. This study thus provides important information for the planning of Moving School programs that are tailored to the needs of teachers and transferable to other internationally widespread programs that address sub-areas of Moving School, such as Movement Breaks.

METHOD

To report this study, we focused on the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) initiative (Von Elm et al., 2007). We used an analytical cross-sectional study design in which participants were included or excluded based on certain criteria. They were surveyed using a questionnaire, and the data collected was used to describe the current situation and illustrate the influence of various conditions on the implementation of the Moving School concept.

Sampling strategy and participants

The survey was conducted at secondary schools in Germany, focusing on the two most populous federal states, Nordrhein-Westfalen (NRW) and Bayern (Bavaria). A total of 181,100 teachers exist in NRW and 123,098 in Bavaria (Statista, 2023), with only teachers at secondary schools and with a teaching qualification in physical education included in the survey as experts in physical activity. In the German federal state NRW, all secondary schools were contacted by e-mail. Due to differences in school legislation, in the federal state of Bavaria, this was possible for schools in church or private sponsorship. The acquisition of participants at state schools was mainly done through social media. The recruitment period was from August to October 2023. Those participants who refused to publish their details in the questionnaire were excluded, as were teachers who do not teach at secondary schools or do not have a teaching qualification for the subject of sport.

Measurement instrument

To collect the data, a questionnaire was created using the EFS Survey software from Tivian (Tivian XI GmbH. 2023. Enterprise Feedback Suite Survey (Spring, 2023). [Software]), which could be completed online. The questionnaire was evaluated with a pretest. A group of 20 teachers was interviewed and then had the opportunity to add comments to the questionnaire questions. These were incorporated into the final version. The questionnaire consisted of five parts. The first part contained questions about the teachers' personal details (age, professional experience, type of school, federal state, etc.), which ended with a filter question regarding whether the teachers had previously heard of the concept of Moving School and from where they gained their knowledge. For teachers who gave a negative answer (7.2%; $N = 24$), the questionnaire ended after the second part, as parts three to five consisted of content-related questions about Moving School. The second part of the questionnaire dealt with the current implementation status of Moving School at higher secondary schools in Germany. In this part, the teachers were asked on a nine-item scale about the degree to which the seven core building blocks of Moving School, which are Moving Lessons, Sitting in Motion, Moving Physical Education, Movement Break, Physical Activity Offers in Extra-Curricular School Sport, Moving Learning Space and Moving Break (Englert et al., 2023) were implemented at their school on a five-point Likert scale (1-Not at all true, 2-Rather not true, 3-Rather true, 4-Totally true, 5-I don't know). For example, the item "I specifically use movement breaks to rhythmise the lessons" asked about integrating Movement Breaks into lessons. The third part of the questionnaire dealt with the teachers' sources of knowledge about Moving School. The categories "University Education", "Further training", "Self-Study" and "Other sources" were provided for ticking (yes/no response option). In addition, the teachers were offered a free field for entering text using the "other sources" option. This allows gender- and age-related differences in PE teachers' knowledge of the Moving School concept and the sources of this knowledge to be identified. The fourth part of the questionnaire dealt with the teachers' attitudes towards the Moving School concept as a whole (while the second part asks about the use or conditions for using the individual elements) and the resulting use or intention to use based on the UTAUT model. As the model was to be used here to determine user acceptance in a school pedagogical context, an adaptation was necessary as the model does not consider didactic implications (Jäger et al., 2014). The concept of Moving School is not a mandatory element of lesson design in Germany (Englert et al., 2023). It, therefore, has to be assumed

that teachers always integrate elements of the Moving School concept into their lessons voluntarily. The experience was mapped by other parts of the questionnaire (e.g., professional experience and sources of knowledge) (Tappe, 2019). With this section of the questionnaire and the application of the adapted UTAUT model, teachers' attitudes towards Moving School and the resulting voluntary use or intention to use the concept are analyzed. The four determinants of the UTAUT model were recorded with four individual items each and the intention to use two items (see Table 1 in the appendix).

The German translations of the individual subcategories were based on Nistor et al. (2012), where the following reliability values (Cronbach's alpha) for the German version of the questionnaire were given: performance expectancy .817, effort expectancy .838, social influence .793, and facilitating conditions .618. When adapting the model to the Moving School context, care was taken to maintain conformity and thus ensure comparability with the original model (Tappe, 2019). All items of the model were assessed on a four-point Likert scale (1-Not at all true, 2-Rather not true, 3-Rather true, 4-Totally true). The high item correlations within the four determinants, each represented by four items, were confirmed by Venkatesh et al. (2003) using repeated tests. The internal consistency reliability for the four determinants was over .83 in the two repeat tests for Facilitating Conditions and over .91 for the three others (Venkatesh et al., 2003). In the fifth part, teachers are asked what they think would facilitate the integration of the concept into everyday school practice. This shows what changes need to be made from the teachers' point of view in order to better integrate Moving School into everyday school life. Six response categories were provided to tick (e.g., Moving School should be better known among teachers) and three additional free spaces so that respondents could also formulate their suggestions. Multiple answers were possible for this question and the question on sources of knowledge described above.

Statistical analysis

All analyses were performed using IBM SPSS Statistics 29 (IBM Corp (2022), SPSS Statistics for Windows (Version 29.0), Armonk, NY, USA). Participants who did not consent to the further processing of their data or did not complete the questionnaire in full were excluded from the analysis.

Firstly, a descriptive analysis of teachers' statements regarding the current implementation degree of the Moving School concept is presented (mean and standard deviation for continuous variables and relative frequency in percentage for categorical variables).

In a second step, Mann-Whitney-U-Tests were used to identify differences between subgroups in terms of gender (men/women) and age (50 years and older/younger than 50 years) for all ordinal-scaled and metric dependent variables. Mann-Whitney-U-tests were used, as there were two independent samples in each case, and the Likert scales used in the questionnaire were to be assessed as ordinal-scaled. The conditions for T-tests are not met with regard to the normal distribution of the samples (Kolmogorov-Smirnov test). For all dichotomous dependent variables (see 3.3 Source of knowledge about the Moving School concept), χ^2 tests were used to analyze differences in gender and age. Based on the development phases in the teaching profession and the willingness to reform, commitment, and motivation that reaches a plateau around the age of 50, two age groups, under and over 50, were made (Huberman, 1991, Sikes et al., 1985).

Finally, a multiple regression analysis was calculated to assess the influence of the independent variables performance expectancy, effort expectancy, social influence, and facilitating conditions on the intention of use of the components of the Moving School based on the UTAUT model (Venkatesh et al., 2003) as dependent variable. Gender and age were also included as independent variables in the model based on their relevance to the intention of use reported in previous studies (Venkatesh et al., 2000, Morris and Venkatesh, 2000). The level of significance was set at $p < .05$ (two-sided).

RESULTS

Sample Characteristics

A total of 345 teachers participated in the survey. Nine teachers did not consent to their data being used for research purposes, and two teachers were primary school teachers and therefore excluded from further analysis, resulting in a total study sample of 334 teachers (56.9% female), of which 225 teachers came from NRW and 109 teachers from Bavaria. Most teachers were younger than 50 (71.9%) and had heard of the Moving School concept (92.8%).

Implementation degree of the elements of the Moving School concept

According to the teachers, Moving Physical Education is most frequently implemented in practice (Table 1). More than half of the teachers surveyed stated they provided the elements Moving Break, Moving Learning Space, Moving Lessons, and Movement Breaks. Physical Activity Offers in Extra-Curricular School Sport (PAOE), Movement Breaks, and, in particular, Sitting in Motion are implemented to a lower degree. The difference analysis with regard to gender shows that women agree significantly more often (p two-sided = .008) with the statement, "In PE lessons, I make sure that I offer different approaches to exercise (e.g., community experience, self-awareness, self-efficacy, health promotion, etc.)" than men. No significant differences exist when comparing the age groups (≥ 50 years and < 50 years).

Source of knowledge about the Moving School concept

Overall, 54.5% of participants learned about the Moving School concept during their university education (Table 2). There is no significant difference between men and women and between the age groups concerning the proportion of participants who have heard of Moving School. However, the men surveyed stated significantly more frequently that they had acquired knowledge of the Moving School concept by themselves. Differences also existed between the two age groups: the younger teachers acquired knowledge of the Moving School concept significantly more frequently during their university education and less frequently through further training than the older teachers.

Total (*N* = 334)	Totally true	Rather true	Rather not true	Not at all true	I don't know
Moving Physical Education In PE lessons, I make sure that I offer different approaches to exercise (e.g., community experience, self-awareness, self-efficacy, health promotion, etc.).	63.5	32.6	3.0	0.3	0.6
Moving Break Pupils are provided with sports/play equipment during the breaks.	37.2	26.9	19.0	16.3	0.6
Moving Learning Space Our school building and school grounds are designed in such a way that pupils are encouraged to exercise.	18.3	41.1	27.0	13.5	0.0
Moving Lessons I also teach lessons with and through movement.	15.2	38.4	36.9	9.5	0.0
Moving Break During breaks, pupils may use the sports facilities (e.g., sports halls and outdoor sports facilities).	22.5	30.3	20.4	26.4	0.3
Movement Breaks I specifically use movement breaks to rhythmise the lessons.	12.8	36.6	34.8	15.9	0.0
PAOE Alternative non-competitive sports electives are offered (e.g., fitness training, movement arts, etc.).	24.7	24.4	17.2	33.4	0.3
Sitting in Motion The chairs and tables in the classrooms can be individually adjusted.	4.8	8.4	15.9	70.7	0.3
Sitting in Motion The classrooms have various seating options (e.g., seat cushions, beanbags, etc.).	3.0	7.2	24.6	65.0	0.3
Sitting in Motion I allow the pupils to adopt different sitting positions on the chairs during the lesson.	25.5	48.9	18.8	6.7	0.0

Note: *PE = Physical Education*

PAOE = Physical Activity Offers in Extra-Curricular School Sport

Table 1: Degree of implementation (expressed as percentages per category) of the core building blocks of the Moving School concept, 2023

Knowledge about Moving School from:	Total (%) (*N* = 310)	Male (%) (*N* = 133)	Female (%) (*N* = 177)	χ^2-Test P two-sided (Odds ratio)	≥ 50 years (%) (*N* = 90)	< 50 years (%) (*N* = 220)	χ^2-Test *P* two-sided (Odds ratio)
University education	54.5	55.6	53.7	.731 (0.924)	22.2	67.7	**< .001 (7.345)**
Further training	27.7	28.6	27.1	.777 (0.930)	40.0	22.7	**.002 (0.441)**
By themselves	34.2	41.4	28.8	**.021 (0.574)**	41.1	31.4	.101 (0.655)
Other sources	19.7	15.0	23.2	.075 (1.703)	33.3	14.1	**< .001 (0.328)**

Table 2: Differences in gender and age regarding the source of knowledge of the Moving School concept, 2023

Intention to use the Moving School concept among teachers

The mean values of the four variables of the UTAUT model and the intention to use the concept of Moving School are shown in Table 3. The performance expectancy showed the highest mean value of the UTAUT variables. The other variables and the intention of use follow at some distance but also with positive agreement values. The answers of men and women differ significantly in performance expectancy and intention of use, with higher performance expectancy and intention of use in women. The two age groups do not differ significantly in any of the four determinants or the intention of use.

The regression analysis revealed a significant effect in total, $p < .001$, and for each of the four variables of the UTAUT model on the teachers' intention to use the Moving-School-Concept (see Table 4). All four independent variables were positively associated with intention of use. The overall model significantly predicted 45.8% (R^2 corrected) of the variance with regard to the use of the Moving School concept. Neither age nor gender significantly affected the intention of use in the model analyzed.

1 = Not at all true 2 = Rather not true 3 = Rather true 4 = Totally true	Total *M* (*SD*) (*N* = 310)	Male *M* (*SD*) (*N* = 133)	Female *M* (*SD*) (*N* = 177)	Mann-Whitney-U-Test *P* (*r*)	< 50 years *M* (*SD*) (N = 220)	≥ 50 years *M* (*SD*) (*N* = 90)	Mann-Whitney-U-Test *P* (*r*)
Performance expectancy	3.28 (.52)	3.18 (.55)	3.36 (.49)	**.003 (.17)**	3.30 (.59)	3.23 (.58)	.439 (.44)
Effort expectancy	2.66 (.63)	2.58 (.60)	2.71 (.65)	.112 (.09)	2.63 (.70)	2.71 (.69)	.492 (.04)
Social influence	2.37 (.73)	2.36 (.71)	2.38 (.74)	.948 (< .01)	2.38 (.89)	2.35 (.83)	.581 (.03)
Facilitating conditions	2.38 (.57)	2.40 (.53)	2.37 (.60)	.544 (.03)	2.35 (.69)	2.47 (.66)	.126 (.09)
Intention of use	2.49 (.77)	2.38 (.72)	2.57 (.79)	**.023 (.13)**	2.47 (.83)	2.51 (.80)	.599 (.03)

Note: Bold values indicate significant differences.

Table 3: Mean values of the four variables of the UTAUT-Model and the Intention of Use for the total sample and by gender and age group, 2023

	Beta Standardized coefficients	*T*	*p*	95% Confidence interval for *B* Lower Limit	 Upper Limit
Intercept		-1.87	.063	-.98	.03
Performance expectancy	.20	4.12	< .001	.14	.40
Effort expectancy	.20	3.13	.002	.09	.41
Social influence	.20	3.78	< .001	.10	.30
Facilitating conditions	.24	3.49	< .001	.14	.49
Gender	.05	1.04	.298	-.07	.21
Age group	.03	.71	.478	-.09	.20

Table 4: Results of the multiple regression analysis with the dependent variable intention of use, 2023

Facilitators for the implementation of the Moving School concept

When asked what would facilitate the integration of Moving School, 74.9 % of the participants stated that Moving School should be better known among teachers. The second and third most frequently chosen options (73.1% and 72.8% of respondents) were that there should be more practicable examples of implementation and that the workload in everyday working life should be reduced. The least frequent response, from 46.4% of respondents, was that the effectiveness of the concept should be rated higher. In addition to the given options, 14.7% of the participants entered at least one further answer in one of the three free fields. The most frequent answer in the open fields ($N = 11$) was that better equipment would help integrate the concept. The second most frequent answer ($N = 10$) was that the structural design of the school (schoolyards, classrooms, etc.) would have to be changed to better integrate Moving School. Other suggestions included less time pressure, more training, and the development of an App for Moving School.

The difference analysis concerning gender revealed that women stated significantly more frequently (p two-sided = .030) that the workload in everyday working life should be reduced. The group ≤ 50 years stated significantly more frequently that Moving School should be better known among teachers (p two-sided = .019).

DISCUSSION

In this study, we examined the degree of implementation of the Moving School concept at higher secondary schools in Germany. We investigated whether PE teachers know about the concept and whether their attitudes towards Moving School are associated with the use of the concept based on the implications of the UTAUT model (Venkatesh et al., 2003). Finally, we examined what changes need to be made from the teachers' perspective to facilitate implementing Moving School in everyday school practice in the future.

The Moving School concept is known among physical education teachers as 92.8% of the participants state that they are familiar with the term Moving School. Nevertheless, the practical implementation degree of Moving School is much lower. From the teachers' perspective, this is partly due to the lack of adequate equipment in the classroom, such as different seating or individually adjustable desks, which depict the Sitting in Motion element. The degree of implementation of the school buildings or school grounds is rated higher. The teachers' relatively high level of agreement with the items Moving Break corresponds with the fact that the Moving Break is mentioned most frequently in the school programs and on school homepages of all elements of Moving School (Englert et al., 2023) and is also in line with the data from the SPRINT study (2005), the latest large-scale study in this area in Germany: In 2005, 47% of the schools surveyed implemented the Moving Break, whereby elementary schools were also included (Brettschneider et al., 2005). The high degree of practical implementation of the Moving Break element in contrast to other elements of Moving School could also be related to the amount of preparation required since movement options predominate and require a manageable amount of preparation (Thiel et al., 2004). Furthermore, a discrepancy exists in the understanding of PE teachers as physical education

as a subject where they aim to provide students with different approaches to movement while at the same time, only about 50% of these PE teachers incorporate movement breaks during regular lessons in the classroom to make the lesson rhythmic. This gap shows that approximately 50% of PE teachers do not understand or implement movement as part of the lessons in their second teaching subject.

Only about half of the teachers acquired knowledge through university education. The positive change regarding university education is shown in the comparison of the age groups: Among the over 50-year-olds, 22.2% state that they have acquired their knowledge from their studies; among teachers younger than 50 years old, the figure is 67.7%. On the other hand, the group over 50 stated more frequently that they acquired their knowledge through further training, self-study, or other sources. As a result, there is generally no difference between the age groups regarding knowledge about Moving School. The only difference between men and women is that men state more frequently that they have acquired knowledge about Moving School themselves.

Teachers suggested several facilitators for future potential implementation of the Moving School concept. Most teachers (73.1%) stated needing more practicable implementation examples. This number contrasts with the numerous publications in German-speaking countries providing practicable examples of Moving School (Englert et al., 2023, Thiel et al., 2004). It might indicate a lack of connection between research and teachers. More practical implementation examples could also lead to lower effort expectancy. This hypothesis supports that the item 'There should be more practicable implementation examples' shows a significant positive correlation with effort expectancy ($P < .001$; $r = 0.238$). The majority of teachers believe that the general workload would have to be lower to integrate Moving School more. The current stressful situation for teachers is an important starting point for changes that can positively impact the implementation of Moving School. This finding confirms results that highlight time as a crucial factor in the implementation of innovations in the daily practice of PE teachers (Wibowo, 2023) and agrees with studies from other countries that also make this observation. In contrast to the present study, however, this is limited solely to physical activity programs in the classroom (Chorlton et al., 2022, Dinkel et al., 2017, Mullins et al., 2019).

Concerning the four determinants of the UTAUT model, it is striking that the effectiveness of Moving School is rated relatively high. Agreement with the items on effort expectancy is lower. Conversely, this means that teachers consider the effort required to implement the concept in practice relatively high. The answers from men and women differ in the performance expectancy variable and the intention of use. Women rate the impact of Moving School higher than men and intend to use the concept more frequently. The two age groups differ neither in the determinants nor intention of use.

Earlier studies already indicated that teachers seem to be generally accepted for integrating, for example, movement breaks (Neumann and Zimmermann, 2020; Chorlton et al., 2022). The results generated using the UTAUT model confirm these findings and, in contrast to previous studies, also show the teachers' motives in detail, based on a large database. This detailed consideration is also important and complements previous studies, as it has already been found that the attitude of teachers to exercise in the classroom, for example, increases pupils' physical activity (Abi Nader et al., 2018). The regression analysis results show significant positive correlations between the four determinants and the intention of use, and the UTAUT model makes a significant explanatory contribution to the intention to integrate the Moving School concept. The regression coefficient is highest for the determinant facilitating conditions. Therefore, this variable has the strongest effect on the intention of use, and Moving School concepts should focus on practicable implementation, the needs of teachers, and the fit to everyday life in schools. Thus, the disruptive factors established in research that inhibit the integration of sitting breaks into lessons (Neumann and Zimmermann, 2020) should be considered.

Furthermore, facilitating conditions that the school's framework conditions can influence should be established. For example, multipliers at the schools' act as contact persons for the teachers on the topic of physical activity, specifically Moving School. These could publicize the practical examples demanded by teachers in schools, help with problems by providing low-threshold advice to colleagues, and thus act as a link between science and practice. Knowledge about the Moving School concept should be imparted through a wide range of formal and informal learning opportunities and suitable equipment (seats, adjustable desks, etc.) available at schools. Developing suitable, practical training formats for teachers in Moving School is also important, as sustainable professional development can provide teachers with the knowledge and skills to implement such programs in schools (Stylianou et al., 2016).

Some limitations need to be considered when interpreting the data. Firstly, it must be noted that the study does not claim to be representative, and as education in Germany is the responsibility of the federal states, the results cannot be transferred to the whole of Germany without restrictions. In addition, it is possible that, due to voluntary participation, mainly physical activity-interested teachers participated in the study. These teachers might be more open to integrating concepts such as Moving School into their lessons. Not all STROBE criteria were met. In particular, the reasons for non-participation were not recorded.

With regard to the statistical requirements, only those that were relevant to the study design were explained. Furthermore, some of the teachers from Bavaria were recruited via social media, so distortions are also possible. The method of data collection using online questionnaires does not allow an in-depth understanding of the quality of the offers of the Moving School concept. Further studies could, for example, use qualitative data collection to include pupils' motivational aspects or teachers' teaching skills. Nevertheless, this study provides preliminary quantitative data required for the further promotion and implementation of the concept. This alone does allow conclusions to be drawn about the quality of the offers only to a limited extent but is a necessary prerequisite for the development of the positive effects of the concept, as has already been established several times with the use of digital

media in the classroom (Drossel et al., 2019, Tulodziecki et al., 2021). Finally, the development of the questionnaire is based on an adaptation of the UTAUT model to a sports education context. The empirical validity of this adaptation has not yet been tested.

CONCLUSIONS

The study shows that the Moving School concept is well-known among the teachers surveyed. The teachers are also convinced of the effectiveness of the concept. There are major differences in the practical implementation of the individual components of Moving School, and the degree of implementation of the concept does not reflect the level of knowledge of the teachers surveyed. The utilization of the concept depends on the four variables of the UTAUT model. With this information, the study provides an important basis for planning movement integration programs tailored to teachers' needs. According to the teachers, implementation could be improved if they had more knowledge about Moving School and practical implementation examples.

Based on the data, measures that create positive performance expectancies (e.g., through formal and informal learning opportunities) and effort expectancies (e.g., by adapting the infrastructure) appear particularly suitable. Besides facilitating conditions and performance expectancies, responsible persons for Moving School programs might also consider measures to positively influence effort expectancy and social influence to increase the intention of use. They could help to emphasize exercise, games, and sports activities more strongly in the school profile concepts and to strengthen cooperation with sports clubs, especially in all-day schools. On the other hand, the scientific community is challenged to develop easy-to-implement best practice examples for Moving School based on the data created by this study and on the teaching reality at the schools, including the existing obstacles. While the literature focuses on primary school environments, this study shows a clear demand for secondary school environments.

To achieve this, an analysis of the quality of the already existing offers by the teachers could provide profitable insights for the continuation of the research since the present study primarily represents an analysis of the quantitative implementation of the Moving School concept. Based on this, teachers' training and further education, which has been significantly expanded at the universities in Moving Schools in the last decades, can be adapted.

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APPENDIX

Performance Expectancy
I find the concept of Moving School useful for promoting my pupils.
With the help of Moving School, the students' movement can be increased.
By incorporating elements of Moving School, I can increase productivity in the classroom.
By integrating elements of Moving School, I can promote the motivation of my pupils.
Effort Expectancy
I know how to integrate the elements of Moving School into everyday school life.
It is easy for me to familiarize myself with the concept of Moving School and the possibilities of concrete implementation.
I find it easy to integrate Moving School into everyday school life.
I find it easy to learn how elements of Moving School can be applied in practice.
Social Influence
People who influence my behavior think I should integrate Moving School into my lessons.
People who are important to me think I should integrate Moving School into my lessons.
The school management supports the implementation of Moving School.
In general, my school supports the implementation of Moving School.
Facilitating Conditions
I have everything I need to integrate the Moving School into everyday school life.
I have the knowledge necessary to integrate Moving School into everyday school life.
Moving School is not compatible with the forms of learning I usually use.
There is one person I can turn to if I have problems with the practical implementation of elements of Moving School.
Intention of Use
I regularly include elements of Moving School in my lessons.
I intend to integrate elements of Moving School into my lessons in the coming weeks.

Supplementary Table 1: Adapted items of the UTAUT model

Full research paper

FACTORS INFLUENCING THE MENTAL HEALTH OF UNIVERSITY STUDENTS IN THE CZECH REPUBLIC

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ABSTRACT

The importance of mental health care has increased significantly in recent years. It is being used more by both the younger and older generations. This article focuses on the mental health of university students in the Czech Republic based on the annual reports data and data from the EUROSTUDENT 8 survey. The only official data source comes from the annual reports published by individual universities regarding students with special needs. Students with mental health problems belong to Group F, which includes Other Mental Health Problems. The number of registered students with specific needs grew by 16% on average every year between 2016 and 2022. For Group F, the numbers increased by 23% annually. More detailed data from the international EUROSTUDENT survey tracks university students' social and living conditions. The dataset contains over 10,000 observations. This paper uses binary logistic regression to look for factors that influence the mental health of university students. The results show that female students, students in humanities, students with financial difficulties, and students with some form of impairment have higher chances of mental health problems.

KEYWORDS

EUROSTUDENT, logistic regression, mental health, university students

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Highlights

- *The average annual growth rate of registered students with special needs between 2016 and 2022 was 16%. The average annual growth rate for students in Group F (other mental health problems) was 23%.*
- *Female students are 1.6 times more likely than males to report a mental health problem.*
- *Students in the study field of Natural sciences, mathematics, and statistics are 2.4 times more likely to report mental health problems than students in the study field of Services.*

INTRODUCTION

The first point of the preamble of the World Health Organization Constitution defines health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (WHO, 2020). The concept of mental health is explained as "a state of well-being in which the individual realizes his or her abilities, can cope with the normal stresses of life, can work productively and fruitfully, and can make a contribution to his or her community" (WHO, 2004). The definition builds on positivity and productivity. It lacks cultural universality. Galderisi et al. (2015: 231-232) suggest perceiving mental health as "a dynamic state of internal equilibrium which enables individuals to use their abilities in harmony with universal values of society", adding dimensions of managing their own emotion, empathy, and flexibility in facing life demands including those connected with social roles as well as the harmonious interplay between one's body and mind.

Mental health is an essential part of general health and well-being across populations. For university students, it determines not only their quality of life but also their academic success. Numerous studies follow the tight connection between psychological well-being and academic self-efficacy (Tang and Zhu, 2024). The concept of self-efficacy arises from the work of Bandura (1986), which refers to an individual belief in his or her capacity to accomplish various tasks and challenges. Academic self-efficacy is an application of Bandura's classical construct to the educational environment. It manifests itself in setting educational goals and belief in one's capacity to accomplish them (Pajares, 1996) and is positively connected with stress coping (Chýlová and Natovová, 2013). It closely relates to a more recently defined concept of academic buoyancy (Martin and Marsh, 2020) that refers to students' capacity to face challenges and overcome various difficulties and setbacks in the academic environment. Academic buoyancy relates negatively to the ability to deal with academic stress (Putwain

et al., 2024) and to mental health issues in general. It is also negatively predicted by general anxiety and uncertainty stress in students (Hu et al., 2024).

The relationships between students' mental health, well-being, and ability to adaptively manage educational challenges and overcome obstacles are evident. Thus, care for students' mental health is necessary for efficient education (Cornaglia et al., 2015; Mahdavi et al., 2021). However, the reasons for research on the mental health of university students include additional motives, e.g., the occurrence of the first symptoms before the age of 25 in 75% of adults with mental health issues (Pereira et al., 2020). Further, the prevalence of mental health issues among university students increases (Campbell et al., 2022), and faculty staff may feel stressed, anxious, and overwhelmed trying to support them (Ramluggun et al., 2022).

In 2020, 42.3% of university students in the United Kingdom reported severe psychological problems, mostly anxiety disorders and depression, requiring professional help (Pereira et al., 2020). These findings might be explained by the demanding period of the Covid-19 pandemic. The severity of its psychological impact was documented in many studies (de Sousa et al., 2021; Tan et al., 2023). Lee et al. (2021) identified symptoms of moderate to severe stress (including anxieties and depression) in 88% of the respondents recruited from students in a public research university in Kentucky in the early stages of the pandemic. Nevertheless, Kitzrow (2003) already stated an increase in the population of college students with severe mental issues two decades ago.

In the seek for critical factors that increase the risk of mental health issues of students, research revealed the contributing role of financial problems (Bøe et al., 2021). Poverty in childhood increases the probability of anxiety, depression, and suicidal thoughts. On the other hand, students from rich families also reported more frequent suicidal thoughts. Thus, a 'comfortable' level of financial security was identified as optimal (Eisenberg et al., 2007).

Female students are often identified as an 'at-risk' population in mental health research (Pereira et al., 2020; Tan et al., 2023). This finding corresponds to higher vulnerability to stress in the female population in general (Grevenstein et al., 2018; Marsh et al., 2018; Gutiérrez-Hernández et al., 2021) and a stronger tendency to feelings of isolation and over-identification with their emotions compared with males (Krejčová et al., 2023). In contrast, the higher prevalence of mental health issues in the female population was not supported by the research by Campbell et al. (2022). Further, the highest tendency to mental health problems and diagnosis was reported by non-binary students (Pereira et al., 2020).

The student's study field was not proved as an unambiguous factor by meta-analysis of mental health research of students (Tan et al., 2023) but may play a role from the viewpoint of single studies. A higher prevalence was detected for medical students, which is escalated by unsupportive educational climates and stigmatization of mental issues that increase tendencies to seek appropriate help (Medisauskaite et al., 2023). In this context, more studies refer to loneliness as a critical factor in students' mental health (Campbell et al., 2022; Pereira et al., 2020) and the protective influence of self-compassion (Kotera et al., 2019), defined as emotionally positive, caring, and concerning self-attitude (Neff, 2015).

In the Czech Republic, the stigma of people with mental health issues is a serious problem. However, Winkler et al. (2021) detected slight positive changes in correspondence with targeted anti-stigma campaigns. Furthermore, mental health in this region has been affected not only by the COVID-19 pandemic in recent years but also by the war conflict in Ukraine (Koubová and Kimhi, 2024). The interplay of these circumstances stresses the necessity of mental health research in the Czech Republic.

The longitudinal research detected an increase in the severity of stress perception and depressive symptoms during the COVID-19 pandemic in the Czech Republic. During the lockdown, the general level of stress, i.e., the number of respondents who assessed their stress as "moderate" or "high," was 1.4 times higher compared with the state before the lockdown. An increase in depression was even more substantial, with 5.5 times more respondents having depressive symptoms. The prevalence was higher in females but did not vary substantially across respondents' ages (Novotný et al., 2020). Although spending the quarantine alone or with others was not significant regarding the severity of mental health issues, the feeling of loneliness was identified as the biggest risk factor regarding the severity of stress and depression (Novotný et al., 2020).

Rubáš et al. (2022) mapped the destructive impact of the limited opportunity to spend time outside during a lockdown on one's health and well-being. The study of the sample of Czech students from elementary schools to universities confirmed a more serious effect on female respondents than males. "The lack of outdoor stay worsened the mental well-being of 55% of students and the same proportion of young people. Parents noticed their children's health worsening in about a third of cases and an impact on their psyche in 42%" (Rubáš et al., 2022: 113).

In the international comparison, Czech students reported lower scores of perceived stress and depressive symptoms in comparison with their peers in Poland, Slovenia, Ukraine, Russia, Germany, Turkey, Israel, and Colombia. Generally, 61% of respondents reported high perceived stress, but only 30% in the Czech sample. The prevalence of depressive symptoms in Czech respondents was only 21% (compared with 40% in the whole research sample). Nevertheless, the variability among nations was not high, and especially females from all involved countries were evaluated as more at-risk regarding stress, anxiety, and depression (Ochnik et al., 2021). Further, the significance of these results should be assessed in correspondence with the general impact of COVID-19 on selected countries. Novotný et al. (2020) described the impact of COVID-19 in the Czech Republic as relatively mild in terms of the number of infected people and hospitalized, as well as victims. Therefore, the international comparison of Ochnik et al. (2021) should be interpreted with regard to the findings and does not contradict the severity of mental health issues in Czech students.

The mental health of university students in the Czech Republic has not yet been monitored in detail. One reason for this is

the lack of data in the area. This paper aims to start a discussion on the mental health of university students in the Czech Republic based on the available data. Firstly, the paper describes the available data sources. Using logistic regression, it further focuses on finding factors that influence the mental health of university students in the Czech Republic.

MATERIAL AND METHODS

National data source

A single official data source in the Czech Republic captures students with special needs, i.e., the annual reports published by individual universities. A university collects the data based on the Methodological Guideline on Financing the Increased Costs of Students with Specific Needs (hereafter referred to as the Methodological Guideline), an annex to the Rules for the Provision of Contributions and Subsidies to Public Universities by the Ministry of Education, Youth, and Sports (MEYS, 2024b). The Methodological Guideline is updated annually and supports funding the increased costs of educating students with special needs. The Methodological Guideline sets out the conditions and measures that a public higher education institution must meet to benefit from the funding of the subsidy programme (MEYS, 2024b). The Methodological Guideline defines the categories of students with specific needs. It is based on the sub-conditions for studying at the university, and their financial impact is taken into account. According to the Methodological Guideline, students with special needs are divided into the following groups:

- A - students with visual impairment
- B - students with hearing impairment
- C - students with physical impairment
- D - students with specific learning impairment
- E - students with autism spectrum disorder
- F - students with other difficulties

Students with mental problems are classified in Group F. This group is defined as 'A student who is objectively prevented by another psychological disorder or difficulty, including non-autistic neurodevelopmental disorders, i.e., impaired language, speech, and other communication skills, or chronic somatic illness, from fulfilling academic responsibilities in a standard manner' (MEYS, 2024b).

Consensus statistics from annual reports are published by the Association of Providers of Services to Students with Special Needs in Higher Education (hereafter referred to as the Association). The Association brings together higher education institutions in the Czech Republic that aim to fulfil the idea of "higher education for all". The data show an increase in the number of registered students with special needs from less than 900 students in 2012 to more than 4,000 students in 2022 (Figure 1). Data for Group F are available for the first time since 2016, when 335 students were registered in Group F (i.e., 20% of the total number of registered students). In 2022, the group comprised 1,164 students (i.e., 29% of registered students). This is the second most represented category (the first being Group D - students with specific learning impairments). However, it should be noted that this category includes more specific cases. The average annual growth rate between 2016 and 2022 in the total number of registered students is 16%. For Group F, the average annual growth rate reaches 23%. The number of students with other difficulties is growing faster than the total number of registered students with special needs.

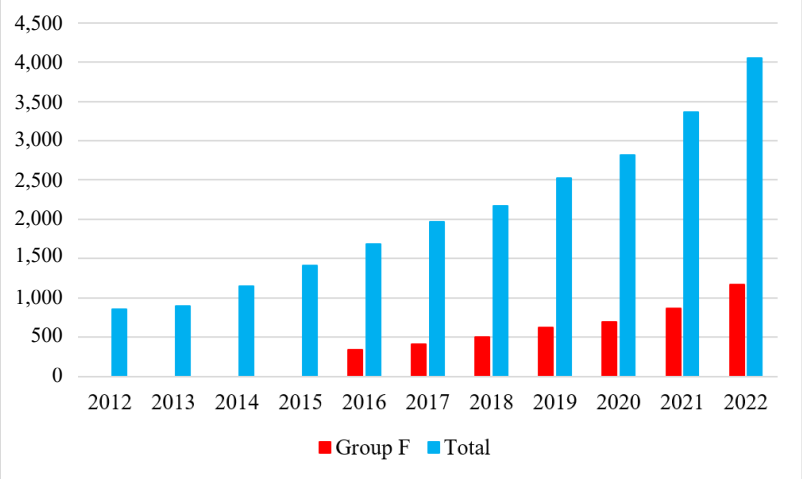
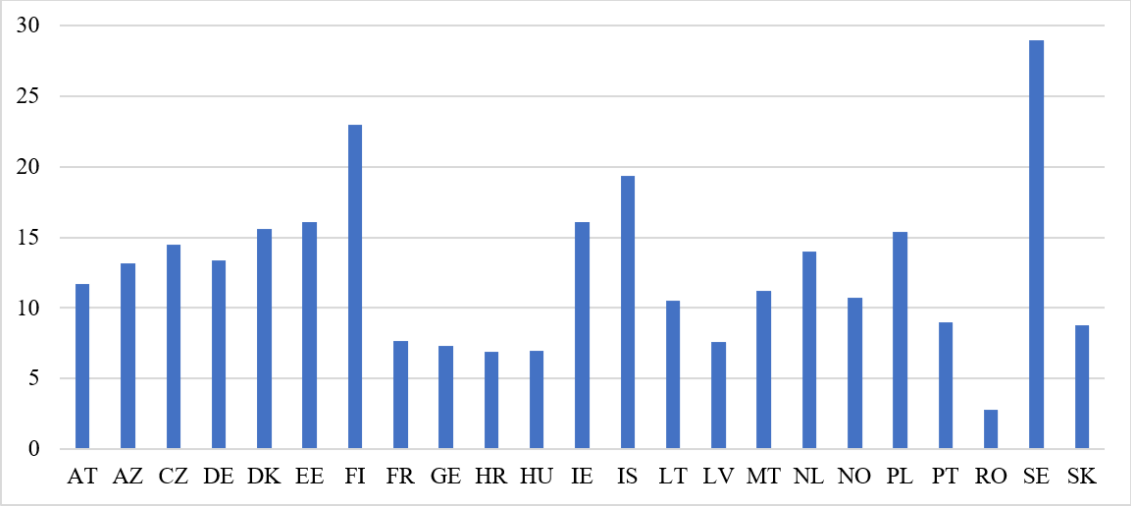


Figure 1: Registered students with special needs and students in Group F, 2012-2022 (source: Association)

International data source

In addition to official data, data from the national part of the international EUROSTUDENT survey on university students' social and living conditions are available. This unique data source covers areas related to study satisfaction, commuting, housing, financial demands of studying, foreign exchange visits, and students' health problems. It is a survey that has been a tradition for several years. Questions on health disadvantages are a regular part of the questionnaire. The Czech Republic has already participated in the initial waves of the survey. Data are available from the fourth wave of the survey, which took place in 2009. In that year, 3% of students detected mental health problems. In the fifth wave of the survey (the year 2013), the volume grew to 4%, with 5% of students in the sixth wave (the year 2016), 7% in the seventh wave (the year 2019), and 15% of students in the most recent eighth wave (the year 2022). The EUROSTUDENT 8 results (Figure 2) of other participating countries show the highest proportion of university students

with mental health problems in Sweden (29%), Finland (23%), and Iceland (19.4%). In contrast, the lowest proportions of students reporting mental health problems are in Croatia (6.9%) and Germany (7.3%). It is not clear whether the differences in the level of mental health problems across countries reflect different levels of prevalence. The most common mental health problems in all countries are depression and anxiety disorder. In contrast, psychosis is the least prevalent (Cuppen et al., 2024). However, this is a subjective assessment of individual students, not a record and information of who is being treated by a professional for their health problems. According to Cuppen et al. (2024), students with an official diagnosis who are being treated for mental health problems make up the largest group of students who have reported having mental health problems in almost all countries. The highest proportion of such students is in Finland (11%) and Sweden (8%). In contrast, the lowest proportion is in Romania (less than 1%). In the Czech Republic, the proportion reaches 6%.



Note: AT – Austria, AZ – Azerbaijan, CZ – Czech Republic, DE – Germany, DK – Denmark, EE – Estonia, FI – Finland, FR – France, GE – Georgia, HR – Croatia, HU – Hungary, IE -Ireland, IS – Iceland, LT – Lithuania, LV – Latvia, MT – Malta, NL – the Netherlands, NO – Norway, PL – Poland, PT – Portugal, RO – Romania, SE – Sweden, SK – Slovakia.

Figure 2: Students with mental health problems, 2022, % (source: EUROSTUDENT 8)

EUROSTUDENT 8 IN THE CZECH REPUBLIC

The latest eighth wave of the survey was conducted between 2021 and 2024. The Ministry of Education, Youth and Sports sponsored the survey, and the Centre for Higher Education Studies was the implementer of the survey. Data collection took place at the end of the summer semester of 2022 (May to July). All public and some private universities participated. Thus, more than 250,000 students at the undergraduate and graduate levels completed the questionnaire (CHES, 2024). The dataset this paper uses for the analysis includes responses from 15 thousand respondents and is weighted to the population of university students in the Czech Republic. This allows for generalized conclusions. The analysis disregarded the age category of 30 years and above as it was not irrelevant for the purpose of the paper. They represent groups that are at the end of their studies or studying a part-time form of study and have a significantly lower proportion of mental health problems, which could affect the analysis. The paper also excluded the middle category of 'middle difficulties' in the financial problems section based on the survey implementer's recommendation. The adjusted dataset contains responses from 10,086 students. Some variables lack observations, so the sum may not add up. Women have the highest representation (54.5%), as well as the age category of 22 to 25 years (41.9%) and undergraduate students (63.4%), see Table 1.

		number of students	in %
Age	up to 21 years	4,080	40.5
	22 to < 25 years	4,224	41.9
	25 to < 30 years	1,782	17.6
Gender	Female	5,496	54.5
	Male	4,590	45.5
Qualification studied for	Bachelor	6,387	63.4
	Master	2,404	23.8
	Long master's degree	1,295	12.8

Table 1: Description of the dataset (source: EUROSTUDENT 8)

Based on previous research, the paper used variables defined by Eurostudent focus groups (Hauschildt et al., 2024) to analyse factors influencing the mental health of university students:

- Field of study: Fields of study based on the international standard classification (ISCED_F 2013).
- Study intensity: Students were grouped into three categories according to their weekly workload in a typical week for study-related activities (taught courses and personal study time). Low-intensity students spend between 0 and 20 hours per week on study-related activities. Medium-intensity students spend more than 20 but no more than 40 hours per week on study-related activities. High-intensity students spend more than 40 hours per week on study-related activities.
- The number of hours students work from time to time or during the whole lecture period, including non-working students (0h): the number of hours students work during the current lecture period.
- Students with/without financial difficulties: Students' self-assessment on whether they are facing financial difficulties on a scale from 1 "very serious" to 5 "none at all"; grouped into two categories. The first one consists of answer options 1+2, "(very) serious", describing those with financial difficulties. The second consists of answer categories 4+5, "no (none at all)," and maps the students without financial difficulties.
- Students with/without impairment limiting them in their studies.
- Form of housing: Students (not) living with parents during the current lecture period (Monday to Friday).
- Students in their first year of higher education.
- Pre-Covid Students: Students who studied/did not study before the COVID-19 pandemic.
- Indication of impairment/disability/health problems (Yes, mental health problem): students with/without disability limiting them in their studies.

Among the fields of study, Business administration and law are the most represented (20.5%), followed by Health and welfare and Engineering, manufacturing, and construction (approximately 13%). The lowest proportion of students is found in Agriculture, forestry, fisheries, and veterinary (3.7%) and Services (4.6%). Regarding study intensity, the medium-intensity group is the least represented (48.9%). Students are mostly working part-time (45.1%). According to the survey results, students generally do not have financial problems (65.3%). Three-quarters of Czech university students have no impairment (75.1%), live without parents (64.1%), and are studying at university for the first time (79%). More than half of university students started before the COVID-19 pandemic (55.1%), see Table 2.

		number of students	in %
Field of study	Education	1,106	11.0
	Arts and humanities	952	9.4
	Social sciences, journalism, and information	961	9.5
	Business, administration, and law	2,067	20.5
	Natural sciences, mathematics, and statistics	707	7.0
	ICTs	848	8.4
	Engineering, manufacturing, and construction	1,294	12.8
	Agriculture, forestry, fisheries and veterinary	375	3.7
	Health and welfare	1,303	12.9
	Services	468	4.6
Study intensity	Low intensity	2,007	20.8
	Medium intensity	4,719	48.9
	High intensity	2,927	30.3
Number of hours students work from time to time OR during the whole lecture period, including non-working students (0h)	0h	3,397	33.9
	1-20h	4,525	45.1
	> 20h	2,106	21.0
Students with/without financial difficulties	Students with financial difficulties	3,497	34.7
	Students without financial difficulties	6,588	65.3
Students with/without impairment limiting them in their studies	Students without impairment	7,458	75.1
	Students with impairment	2,469	24.9
Form of housing	Students living with parents	3,621	35.9
	Students not living with parents	6,464	64.1
Students in their first year of HE	Students in their first year of studying in higher education	2,099	21.0
	Students studying in higher education for longer than 1 year	7,905	79.0
Pre-Covid Student	Enrolled before Covid-19 outbreak	5,554	55.1
	Enrolled after the Covid-19 outbreak	4,531	44.9
Indication of impartment/disability/health problems…Yes, mental health problem	No	8,565	84.9
	Yes	1,521	15.1

Table 2: Description of the dataset (source: EUROSTUDENT 8)

The paper uses binary logistic regression with mental health problems as the dependent variable to search for factors influencing students' mental health, predicting the probability of the occurrence of outcome Y knowing the value of independent variables X_1. In the simplest form, the equation becomes (Field, 2009):

$$P(Y) = \frac{1}{1 + e^{-(b_0 + b_1 X_{1i})}}, \quad (1)$$

where $P(Y)$ refers to the probability of Y occurring, e represents the base of natural logarithms, b_0 refers to the constant, X_{1i} represents predictor variables, and b_1 refers to the predictor. The parameters are estimated using the maximum likelihood method.

RESULTS

Descriptive statistics

First, the dependence of each input variable on the dependent mental health variable was examined. At the 5% level of significance, mental health problems depend on one's age, gender, level of study, field of study, study intensity, and whether the student has financial or health problems.

Table 3 shows that students across age categories suffer from mental health problems similarly (14.3% of students under 21 years of age, 16.1% of students in the age category 25 to 30 years). Women are more likely to suffer from mental health problems (17.3%). The highest proportion of students with mental health problems is at the bachelor's degree level (15.2%). The highest incidence of mental health problems in the field of study is among Arts and humanities (24.9%) and Agriculture, forestry, fisheries, and veterinary (19.9%) students. However, these fields of study contain the lowest numbers of students. Services report the lowest proportions of students with mental health problems (8.2%), followed by Business, administration, and law (10.6%). Students with high study intensity (16.4%) are more likely to suffer from mental health problems than students with low study intensity (12.6%). Students with financial problems are more likely to suffer from mental health problems (21.1%) than students without financial problems (10.8%). Students with

		No	Yes
Age	up to 21 years	85.7	14.3
	22 to < 25 years	84.3	15.7
	25 to < 30 years	83.9	16.1
Gender	Female	82.7	17.3
	Male	89.6	10.4
Qualification studied for	Bachelor	84.8	15.2
	Master	87.7	12.3
	Long master's degree	86.5	13.5
Field of study	Education	84.5	15.5
	Arts and humanities	75.1	24.9
	Social sciences, journalism, and information	83.8	16.2
	Business, administration, and law	89.4	10.6
	Natural sciences, mathematics, and statistics	82.6	17.4
	ICTs	87.9	12.1
	Engineering, manufacturing, and construction	89.0	11.0
	Agriculture, forestry, fisheries and veterinary	80.1	19.9
	Health and welfare	86.2	13.8
	Services	91.8	8.2
Study intensity	Low intensity	87.4	12.6
	Medium intensity	86.2	13.8
	High intensity	83.6	16.4
Students with/without financial difficulties	Students with	78.9	21.1
	Students without	89.2	10.8
Students with/without impairment limiting them in their studies	Students without impairment	97.6	2.4
	Students with impairment	49.3	50.7

Table 3: Occurrence of mental health in university students by differing variables, % (source: Authors' calculation based on the EUROSTUDENT 8 data)

impairment suffer from mental health problems in 50%.

Logistic regression

The significance of the variables for the model using logistic regression was tested before fitting the model. At the 5% level of significance, the presence of mental health problems is independent of age, level of study, study intensity, number of hours worked, form of housing, whether the student is in the first year of study, or whether the student started studying before the COVID-19 pandemic or after the COVID-19 pandemic. The first analysis shows that mental health problems are most likely to be influenced by gender, the field of study, financial problems, and impairment-limiting studies (Table 4). Subsequently, binary logistic regression was used to search

		Exp(B)
Age	Total	
	up to 21 years	0.886
	22 to < 25 years	1.017
Gender	Female	1.580***
Qualification studied for	Total	
	Bachelor	1.064
	Master	0.946
Field of study	Total	
	Education	1.594*
	Arts and humanities	2.573***
	Social sciences, journalism, and information	2.021**
	Business, administration, and law	1.138
	Natural sciences, mathematics, and statistics	2.146**
	ICTs	1.603
	Engineering, manufacturing, and construction	1.186
	Agriculture, forestry, fisheries and veterinary	1.328
	Health and welfare	1.192
Study intensity	Total	
	Low intensity	0.945
	Medium intensity	1.015
Number of working hours	Total	
	0h	0.952
	1-20h	0.843
Financial difficulties	Students with financial difficulties	1.308***
Studies impairment	Students with impairment	39.017***
Form of housing	Students living with parents	0.950
Student's first year of study	Students in their first year of studying in higher education	1.039
Pre-Covid student	Enrolled before Covid-19 outbreak	1.016
	Constant	0.550*

*Note: significance level *0.05, **0.01, ***0.001*

Table 4: Statistical significance of variables in the model (source: Authors' calculation based on the EUROSTUDENT 8 data)

for factors affecting the mental health of university students. The dependent variable was students' mental health problems. Females are 1.6 times more likely to suffer from mental health problems compared to males. Education students are 1.6 times more likely to have mental health problems than students in the study field of Services. Arts and humanities students are 2.6 times more likely to report mental health problems than students in the study field of Services. Natural science, mathematics, and statistics students are 2.1 times more likely to suffer from mental health problems than students in the study field of Services. Social sciences, journalism, and information students are 2 times more likely to report mental health problems than students in the study field Services. Students dealing with financial difficulties are 1.4 times more likely to suffer from mental health problems than students who have no financial difficulties. Students experiencing impairment limiting their studies are 39.6 times more likely to report mental health problems (Table 5).

		B	*S.E.*	Wald	Exp(*B*)
Gender	Female	0.436	0.079	30.458	1.546***
Field of study	Total			68.163	
	Education	0.475	0.217	4.779	1.607*
	Arts and humanities	0.947	0.216	19.244	2.579***
	Social sciences, journalism, and information	0.679	0.222	9.322	1.971**
	Business, administration, and law	0.105	0.210	0.251	1.111
	Natural sciences, mathematics, and statistics	0.725	0.231	9.812	2.065**
	ICTs	0.430	0.233	3.407	1.538
	Engineering, manufacturing, and construction	0.138	0.220	0.397	1.148
	Agriculture, forestry, fisheries and veterinary	0.312	0.255	1.494	1.366
	Health and welfare	0.198	0.214	0.856	1.219
Financial difficulties	Students with financial difficulties	0.298	0.073	16.847	1.347***
Studies impairment	Students with impairment	3.679	0.084	1918.882	39.613***
	Constant	-0.677	0.201	11.364	0.508***

*Note: Exp(B) - Odds ratios; significance level *0.05, **0.01, ***0.001*

Table 5: Binary logistic regression, mental health, 2024 (source: Authors' calculation based on the EUROSTUDENT 8 data)

DISCUSSION

Mental health, in general, is an important topic now. This article attempts to contribute to the debate with its perspective on the mental health of university students in the Czech Republic. Firstly, it analysed the available data sources. Official data on registered students with special needs in the Czech Republic, which include students with mental health problems, are available from the annual reports published by individual universities. Comprehensive data are subsequently published by the Association of Providers of Services to Students with Specific Needs in Higher Education. The published data shows that the average annual growth rate of registered students with specific needs between 2016 and 2022 was 16%. The number of registered students in Group F, which includes students with mental health issues, grew at an average annual rate of 23%. The difference is significant and can also be attributed to (but not limited to) the COVID-19 pandemic. The alternative data source the paper used for the subsequent analysis comes from the national part of the international survey on social and living conditions of university students, EUROSTUDENT 8. This is a unique survey that provides a comprehensive picture of the living situation of students. The data were weighted to the population of students in the Czech Republic, so the conclusions from the analyses allowed generalization.

The results are partly consistent with the findings of similar studies. The data in the Czech Republic also show that mental health depends on gender and students' financial problems. Similar to Pereira et al. (2020) and Tan et al. (2023), this paper found a relationship between mental health problems and gender in the data on Czech university students, with women being at higher risk. This finding is consistent with stronger vulnerability to stress identified in the female population (Grevenstein et al., 2018; Marsh et al., 2018; Gutiérrez-Hernández et al., 2021). Compared with Pereira et al. (2020), the research sample used in this paper did not contain any respondents who identified themselves as non-binary, making it impossible to compare the group with male/female respondents. However, the research by Pereira et al. (2020) indicates that mental health problems of non-binary students should be one of the future well-being-related research topics in the Czech Republic.

The dependence of mental health on financial problems and the high proportion of students with financial problems revealed in our study is fully in line with the findings made by Eisenberg et al. (2007). Students from poorer backgrounds are more likely to have mental health problems than students from richer backgrounds. This fact creates a self-reinforcing effect because the capability to pay for psychological care beyond health insurance makes it available earlier.

In contrast to the analysis by Tan et al. (2023), for example, this paper found a dependence between the field of study and mental problems. Students of Arts and humanities (24.9%) and Agriculture, forestry, fisheries, and veterinary (19.9%) declare mental problems with the highest proportion. On the other hand, students of Services (8.2%) and Business, administration, and law (10.6%) report mental problems with the lowest frequency. Furthermore, students with high study intensity (16.4%) are more likely to suffer from mental health problems. Therefore, some special interventions directed at coping strategies should be targeted at this population.

COVID-19 significantly affected individuals' mental well-being, but unlike the analyses by Rubáš et al. (2022) or Novotný et al. (2020), this paper found no relationship between the period when a student started studying (pre/post-pandemic and mental health problems in the EUROSTUDENT 8 data.

The paper used binary logistic regression to find the odds ratio, which allowed us to conclude that women are 1.6 times more likely than men to report mental health problems. Education students are 1.6 times more likely to suffer from a mental health problem than students in the study field of Services. Arts and humanities students are 2.6 times more likely to report a mental health problem than students in the study field of Services. Natural science, mathematics, and statistics students are 2.1 times more likely to suffer from a mental health problem than students in the study field of Services. Students dealing with financial difficulties are 1.4 times more likely to report a mental health problem than students who experience no financial difficulties. Students having limiting impairments in their studies are 39.6 times more likely to suffer from mental health problems than students without such impairments.

The presented analysis has its limitations. Firstly, the number

of registered students with mental health problems increases along with the increased capacity of specialized centres. However, the number of students who identified their mental health problems in the EUROSTUDENT 8 survey was not affected. The availability of data represents another aspect. The available data from the 2022 survey is the only data source of this magnitude that will allow us to conduct an initial analysis. Moreover, this source contains subjective evaluation by the students, not evidence. Thus, the results are subjective. To find objective results would require psychological testing of students, for which there is no capacity. The authors are aware that the results may be influenced by the level of self-reflective skills but also by the openness in admitting mental health issues that are shaped by the level of stigmatization in the country (Winkler et al., 2021).

The mental health of students was hardly reflected at the national level until recently. The strategic plan of the Ministry of Education, Youth, and Sports (MEYS) for the period from 2021 onwards addresses the topic of student mental health only in one laconic bullet point in the chapter "Other significant themes" (MEYS, 2020: 66), together with the mental health of staff members and the need to prevent the burnout syndrome. The five-year strategic plan is followed by annual implementation plans. In the 2025 Implementation Plan of the Strategic Intent for Higher Education (2024a), the topic is already elaborated in more detail. It represents an explicit part of the priority area as a new item 1. H "Promote the well-being of learners and staff in higher education" (MEYS, 2024a: 5). Thus, it seems that the MEYS is becoming more and more aware of the topic of student mental health and the strategic plans and implementation plans of universities show that universities also become aware of it, compare, e.g., the Masaryk University Strategic Plan Implementation Plan (MU, 2024).

In the context of the analysis results, the authors recommend that the Ministry of Education, Youth, and Sports reopen the issue of insufficient financial aid for students (e.g., Münich and Kořínek, 2021). Beyond the conclusions of Münich and Kořínek (2021), inadequate aid to students exacerbates their mental discomfort, among other consequences. Universities are advised to pay maximum attention to mental health issues and, where appropriate, to consider disciplinary differences, for example, when allocating resources and staff capacity for psychological counselling.

CONCLUSION

The results presented in this paper show that the number of students with mental health problems at universities in the Czech Republic has been increasing in recent years. Mental health problems depend on the gender of the student (women are a more vulnerable group than men), on their financial situation (students with financial problems are more vulnerable), and on the field of study.

For further analysis, it would be appropriate to modify the dataset in the part of the fields of study and narrow down the list so that a prediction model is prepared. This prediction model could subsequently imply whether the person in question, with his or her specific characteristics (gender, age, field of study, etc.), is more likely to suffer from mental health problems. This kind of analysis would enable more targeted interventions but also preventive care that could increase the efficiency of psychological and psychiatric services and, consequently, the mental health of students in the Czech Republic.

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DIGITAL CLASSROOM INNOVATIONS: LEVERAGING SMARTPHONE-BASED APPLICATION TO STIMULATE STUDENTS CREATIVE THINKING SKILLS

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ABSTRACT

Enhancing 21st-century skills, such as creative thinking, is crucial and can be stimulated by integrating Information and Communication Technology (ICT) in the learning process. Therefore, this research aims to evaluate the effectiveness of an Articulate-based mobile application in helping students improve their creative thinking skills. The quantitative research method uses quasi-experimental models and a one-group pre-post-test design. The research involved 60 students as subjects, divided equally into two groups: the experimental and control groups. The research data was collected through tests of creative thinking skills conducted before and after implementing the smartphone-based application. Data analysis is conducted using the t-test technique to compare the test results before and after the intervention and N-Gain to measure the improvement of creative thinking skills. The research results indicate that implementing application media has proven effective and significantly improves students' creative thinking skills. The implications of this research can be used as a reference for the development of technology-integrated education. Moreover, this research contributes to providing elaboration regarding the role of smartphone-based applications as one of the efforts to enhance students' creative thinking skills in the era of digital education.

KEYWORDS

Applications, articulate, creative thinking skills, digital, smartphones

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Highlights

- *Articulate-based learning media significantly enhances students' creative thinking skills in graphic design education.*
- *A positive relationship between the use of mobile learning media and improvements in students' creativity was observed.*
- *The study indicates that Articulate-based media offers an effective approach to fostering creativity in vocational education settings.*
- *The findings support the integration of digital learning tools to improve creative abilities and engagement among vocational school students.*

INTRODUCTION

The Immense development of science and technology in the 21st century has reached almost all sectors, including the economic, socio-cultural, and education fields (Bunyamin, Samsudi and Rohman, 2022). The education field plays a critical role due to its function: preparing Indonesia's future generations (Hussin, 2018). The education sector is crucial as it is responsible for establishing Indonesia's future workforce and leaders (Dunn and Kennedy, 2019). Therefore, optimizing and improving the quality of the educational process is a necessity that must be addressed. The young generations need to get a high-quality education, not only in school but also in the transition process of entering the professional field (Putra et al., 2023). The quality of education is closely related to an effective learning experience. The interaction between teachers and students in the learning process is crucial to achieving the desired learning outcomes (Zainal et al., 2018).

Rapid adaptation has become a necessity amid the rapid developments in technology and information. The ability to access, manage, and utilize information and technology wisely is essential (Yeşilyurt and Vezne, 2023) digital literacy (DL). This requires systematic, logical, and critical thinking skills,

which can be developed by improving education quality. In this context, teachers play a crucial role, particularly in enhancing their teaching methods through the integration of Information and Communication Technology (ICT) tools to create diverse learning materials that address challenges encountered during the learning activities (Misir, 2018; Yılmaz, 2021). With the large variety of learning media availability, the learning process will become more interesting for students. Therefore, improving students' soft skills will accelerate learning goal achievement.

Vocational schools are crucial in equipping students with practical skills and relevant knowledge in the creative industry, particularly in graphic design. This specialized learning at Vocational High Schools (SMK) forms an integral part of the curriculum, ensuring that students are well-prepared for the demands of the industry (Liow, Palilingan and Komansilan, 2022). Throughout this educational experience, students will gain exposure to essential graphic design ideas, which encompass the application of design programs like Adobe Photoshop, Illustrator, and InDesign (Qomariyah, Kuswandi and Praherdhiono, 2019). Students learn about the principles of design, visual composition, typography, image manipulation, and the production of graphic materials. Learning graphic design at vocational schools also often involves practical projects that challenge creativity and problem-solving skills, such as creating posters, brochures, logos, and graphic designs for digital media (Chetty et al., 2019; Giana and Lutfi, 2019). Subsequently, students can enhance their portfolio as they engage in this task, thereby creating a valuable asset for future endeavors in the workforce or further studies in graphic design or related creative fields (Sudana, Apriyani and Nurmasitah, 2019). It is important to understand that by adopting a practical and industry-oriented approach, vocational schools that offer graphic design programs for students should provide not only theoretical understanding but also the practical skills essential for thriving in the professional realm of graphic design (Puruwita, Jamian, and Aziz, 2022). Hence, in the realm of graphic design education, instructors frequently assign projects that require the utilization of creative and interactive learning techniques. By doing so, students can attain the best possible results in their graphic design studies.

During observations in graphic design learning, it was noted that there is limited variation in the use of learning media. Despite implementing inclusive teaching methods and strategies, such as project-based learning, the media tends to be restricted. Most instructional materials are delivered through conventional PowerPoint presentations and other printed media. This can lead to a monotonous and less engaging learning process for some students with diverse learning preferences. However, it is essential to recognize that learning graphic design necessitates creative thinking and ideation to meet user needs effectively. Therefore, concerted efforts should be made to diversify the range of learning materials used. This will give students greater stimuli for creativity and idea generation in graphic design. These observations underscore the importance of integrated and comprehensive media to enhance learning. A thorough understanding of the subject contributes to meaningful learning experiences, and diverse media can catalyze positive learning outcomes (Fletcher et al., 2020).

Regarding the factors contributing to the limited variation in the use of digital learning media, one possible cause could be the preference of some teachers for print-based materials due to fewer distractions during the learning process. This distraction can be mitigated by disabling notifications on unnecessary applications when using technology for learning. Therefore, there is a need for digital learning media that can help students generate creative ideas to fulfill graphic design project assignments. This study aims to assess the effectiveness of digital learning tools in the form of an Articulate-based application that can be used in smartphones to enhance creative thinking skills in graphic design subjects among vocational high school students.

LITERATURE REVIEW

Theoretical Foundations and Concepts of Digital Learning Media

The application of media in learning serves its purpose by facilitating students' comprehension of diverse lesson information that might be challenging to grasp solely through lectures. This phenomenon is undoubtedly intertwined with the development and emergence of both applied research and theoretical models related to educational technology, which have led to significant changes within the educational environment (Kazu and Yalçin, 2022). The creation of learning media necessitates careful consideration of the material's characteristics and the requirements of students and colleagues to ensure its suitability for meeting the student's needs (Budiastuti, Khairuddin and Azman, 2018). An instance of educational technology in progress involves the creation of a learning tool accessible through students' smartphones, utilizing the Articulate Storyline platform. This digital resource integrates textual content, video guides, and real-life examples to deliver information in an organized fashion, enhancing comprehension for students (Viberg, Grönlund and Andersson, 2020). This digital learning tool has been proven to positively impact student academic achievement and has been widely used in various learning contexts (Fletcher et al., 2020; Firdawati, Maison and Nazarudin, 2021). This application will focus on learning graphic design and presenting various materials and tutorials to stimulate students' creative thinking abilities. The primary purpose of using this application is to encourage students to think more creatively in designing graphics for the projects given to them (Triyono, Muhtadi and Widowati, 2022; Pujawan, 2019). For example, a study by Suharno, Selviana, and Sunarno (2022) demonstrated a significant increase in students' creative thinking skills through digital learning media. This was reflected in the data from the pre-test and post-test scores. The average pre-test score was 62, which increased to 84 in the post-test. The N-gain value for creative thinking was calculated at 0.59, indicating a moderate increase in students' creative thinking skills in various aspects such as fluency, flexibility, originality, elaboration, and evaluation. Therefore, the implementation of digital learning media, such as the Articulate Storyline application, not only enriches

the learning experience but also contributes significantly to enhancing students' creative thinking abilities, which is crucial in graphic design education. Integrating technology in learning can yield extensive positive impacts in terms of academic achievement and the development of 21st-century skills such as creativity.

Impact of Digital Learning Media on Student Performance and Motivation

Media-assisted learning can simplify abstract concepts, making them more understandable, accessible, and attainable for learners. Teachers often face challenges in creating high-quality learning materials, but the availability of media enables them to effectively structure and customize diverse learning approaches (Ismail and Al Allaq, 2019). As with several research studies on the effectiveness of digital media conducted by Heliawati, Lidiawati, and Pursitasari (2022), the study evaluated the impact of Gamification-based Articulate Storyline 3 multimedia on students' critical thinking skills and self-regulated learning. It involved 64 students and eight science teachers, focusing on the properties of acidic, alkaline, and neutral solutions. The results showed a significant improvement, with an average score of 81.50 for critical thinking skills and an N-Gain of 72% in the high category. Additionally, students demonstrated strong independent learning, with an average of 86.76% in the good category, indicating the multimedia's effectiveness in enhancing critical thinking and self-regulation. In line with research conducted by Kusuma, Suryani, and Sumaryati (2022), the research indicates that digital learning media accessible via smartphones significantly boosts students' motivation during class participation. The statistical analysis reveals a noteworthy increase in motivation within the experimental group, which achieved an average score of 86.6 compared to the control group's 75.9. This finding underscores the effectiveness of mobile application-based learning media in enhancing student motivation, surpassing traditional, non-digital methods.

Moreover, using digital learning media can also enhance students' vocational skills in vocational schools. This is expressed by Hartanto et al. (2022). Application development that validators have approved is apparently capable of providing vocational school graduates with increased job skills. Additionally, digital learning media integration can be merged with inventive learning methodologies, like case-based learning or problem-based learning (Heliawati, Lidiawati and Pursitasari, 2022; Daryanes et al., 2023). Therefore, teachers do not need to worry if the use of digital media later hinders their implemented learning strategies.

Various formats of digital learning media that can be accessed through smartphones have been identified through an analysis of several research studies. These formats include multimedia, e-modules, applications, and virtual labs. Using digital learning media on smartphones offers many possibilities (Sindu et al., 2020; Nusir et al., 2013; Dewi et al., 2022). Many studies have stated that digital learning media can help students complete assignments and acquire 21st-century skills (Hadiyanti et al., 2021; Damopolii, Lumembang and İlhan, 2021). This study seeks to bridge the literature gap by exploring the use of mobile applications with tutorial learning videos in vocational schools, particularly in graphic design education. While digital learning tools are widely used across various subjects, science materials still dominate the field.

MATERIALS AND METHOD

Research Design and Participants

This research employed a quantitative, pre-experimental design using a One Group Pretest-Posttest (Maisarah, 2019). This design is commonly utilized in preliminary studies where the objective is to observe changes before and after an intervention within the same group. While valuable in exploring potential outcomes, pre-experimental research is often considered a less robust form of experimental research due to the lack of a control group and the possible influence of external variables that may impact the results (Kartowagiran et al., 2017). To mitigate these limitations, careful consideration was given to controlling external factors. For example, the sample was selected using a cluster sampling technique to ensure the accuracy and reliability of the data.

The sample in this research was selected using a cluster sampling technique (Sutrisni et al., 2022). This technique was chosen because it allows for the efficient collection of data from a smaller yet still representative within a larger population. The study's population comprised vocational high school students in Surakarta, Indonesia. The sample included 60 students, with 30 students assigned to the experimental class and 30 to the control class. The age range of the participants was between 16 and 18 years, with both male and female students included, ensuring a balanced gender representation. This sampling technique made data collection more manageable and ensured that the sample accurately reflected the broader student population's characteristics, thereby enhancing the generalizability of the research findings.

Data Collection Instruments and Techniques

The One Group Pretest-Posttest design employed in this study provided a structured method for assessing changes in students' creative thinking skills within a single class (Yaniawati et al., 2023) Design, Develop, Implement, and Evaluate (ADDIE. The process began with administering a pre-test to evaluate the student's initial proficiency in graphic design content, serving as a baseline for comparison. The pre-test scores were then aggregated to determine the average performance of the class, which provided a clear starting point for the intervention.

Following the pre-test, teachers were instructed to deliver the graphic design course using an instructional media application called Articulate, specifically developed for this study. This application was designed to be the primary learning resource for students, featuring embedded probing and prompting questions to stimulate creative thinking. The instructional media was implemented over three sessions, each lasting 45 minutes, totaling six lesson hours. This structured approach ensured consistent exposure to the material across all participants.

After completing the instructional sessions, a post-test was administered to evaluate any improvements in students'

creative thinking skills. The post-test results were compared with the pre-test scores to identify differences in learning outcomes, specifically focusing on creativity skills. This study employed a One Group Pretest-Posttest design to assess the impact of Articulate-based instructional media on students' creative thinking abilities. Initially, students took a pre-test (*O*1) to establish a baseline of their creative thinking skills before being exposed to the Articulate-based media. The instructional media, tailored specifically for the graphic design subject, was then implemented as the treatment (*X*). After completing the learning process using this innovative media, students took a post-test (*O*2) to measure improvements in their creative thinking abilities. This design effectively captures the progression of students' learning, providing a clear and engaging view of how using Articulate-based media can enhance their creative skills.

The data collection method employed in this research involved distributing questionnaires to students (Maisarah, 2019). The questions provided were on a 1 to 5 scale, aiming to gather information about students' creativity. The questionnaire consisted of 20 questions or statements, drawing inspiration from previous studies conducted by Pratomo, Siswandari, and Wardani (2021) and Dewanti (2022) regarding students' creativity as a copy of the questionnaire can be found in Appendix A for reference. Table 1 summarizes the grid used to measure students' creativity levels.

No	Component	Indicator	Item
1.	Fluency	Ability to generate lots of ideas	5
2.	Flexibility	Ability to generate ideas that are different from the common ones	4
3.	Originality	Ability to generate new and original ideas	4
4.	Elaboration	Ability to develop ideas in detail	4
5.	Evaluation	Ability to assess ideas and choose the best	3

Table 1: Instrument Grid for Assessing Creative Thinking Skills (adapt from: Pratomo et al., 2021; Dewanti, 2022)

Data Analysis Technique

The data analysis process in this study involved several essential steps to ensure the validity and reliability of the findings. Initially, data on learning outcomes were gathered through pre-tests and post-tests, administered before and after implementing the instructional media products. To ensure accurate analysis, the collected data underwent prerequisite tests, including tests for normality and homogeneity. The *Shapiro-Wilk* test, particularly suitable for small sample sizes, was used to assess normality, as it provides more precise results in determining whether the data distribution is normal. In this study, data is considered normally distributed if the *Shapiro-Wilk* test yields a *p*-value greater than 0.05 ($p > 0.05$) (Irawati, Huda and Adji, 2022). Additionally, the homogeneity of variance between the pre-test and post-test groups was examined using a homogeneity test, where data is considered homogeneous if the significance value exceeds 0.05. If the significance value is significant ($p < 0.05$), it would indicate that the data variances are not homogeneous (Maharani Zan and Mardian, 2022).

Upon confirming that the data met the prerequisites, further analysis was conducted using the paired sample *t*-test. This statistical method was chosen to determine whether there is a statistically significant difference in learning outcomes before and after using Articulate-based instructional media. Meanwhile, the research hypothesis is as follows:

H_0: There is no difference in learning outcomes before and after using instructional media based on Articulate.

H_1: There is a difference in learning outcomes before and after using instructional media based on Articulate.

To further assess the instructional media's impact or effectiveness, an N-Gain test was conducted. This test measures the magnitude of improvement in learning outcomes by comparing the pre-test and post-test scores, offering a clear quantification of the instructional media's effectiveness. The formula for N-Gain analysis is provided below.

$$\text{N-Gain} = \frac{T_{\text{post}} - T_{\text{pre}}}{T_{\text{max}} - T_{\text{pre}}}$$

Based on the results of the N-Gain analysis, the effectiveness of the instructional media was categorized into three levels: High ($g \geq 0.700$), Moderate ($0.300 < g < 0.700$), and Low ($g < 0.300$) (Nasir and Nirfayanti, 2020). Table 2 illustrates the classification criteria for interpreting the N-Gain scores, providing a clear framework for understanding the impact of the instructional media on student learning outcomes.

N-Gain Score	Category
$g < 0.700$	High
$0.300 \leq g \leq 0.700$	Moderate
$g < 0.300$	Low

Table 2: N-Gain Score Categories for Creative Thinking Skills (adapt from: Nasir and Nirfayanti, 2020)

RESULTS

In evaluating the effectiveness of the Articulate-based learning application, students participated in three face-to-face class meetings focused on graphic design. This application served as a learning tool and resource throughout the process. Before using the application in class, students completed a pre-test questionnaire designed to assess their initial level of creativity. The teacher incorporates this media into the learning activities implemented thus far. Throughout the learning process, the teacher employs project-based learning, wherein students are typically required to submit project assignments related to the material or topics on graphic design during the 4th

meeting. From this, it can be inferred that the utilization of this medium is not immediate during the learning process. Instead, the teacher first studies it to establish connections with the learning strategies employed.

When the learning material had been delivered to students for three meetings, students filled out the questionnaire containing the same post-test questions/statements as the pre-test. This questionnaire also has the same aim: to see whether there is a difference in students' initial and final creative abilities after three meetings using media. Articulate-based learning. The following is a description and analysis of the questionnaire score obtained.

Normality and Homogeneity Test Results

In order to ensure the homogeneity of the data in the one-group pre-/post-test design, statistical evidence must be provided that the variance used in this research is truly homogeneous. Hence, the homogeneity test results presented in Table 3 are one of the prerequisite tests that must be fulfilled.

		Levene Statistic	*df*1	*df*2	*Sig.*
Creativity Skills	Based on Mean	3.211	1	58.000	0.078
	Based on Median	2.772	1	58.000	0.101
	Based on the median and with adjusted df	2.772	1	46.066	0.103
	Based on trimmed mean	2.295	1	58.000	0.135

Table 3: Results of the Homogeneity Test (source: Data processed by SPSS (2024))

Based on the test results output with the help of the SPSS application, the *Sig* value is known. Based on the mean for student creativity ability score is 0.078. Because of the *Sig* value 0.078 > 0.05, it can be concluded that the student data variance is homogeneous. One of the prerequisite tests has been successfully fulfilled. The next is the normality test. Data normality test is applied to see whether the data from research results is normally distributed. This test uses the *Shapiro-Wilks* Normality test technique; the selection of this technique is based on the number of samples which tends to be small (< 150). The results of the data normality test are presented in Table 4.

Group		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	*df*	*Sig.*	Statistic	*df*	*Sig.*
Creativity Skills	Pre Test	0.131	30	0.199	0.973	30	0.638
	Post Test	0.160	30	0.047	0.932	30	0.055

a. Lilliefors Significance Correction

Table 4: Results of the Normality Test (source: Data processed by SPSS (2024))

According to the statistical results obtained using the SPSS application, the *Sig* is evident. value for the pre-test score is 0.638, while the *Sig*. value for the post-test score is 0.055. In both cases, the *Sig*. values are greater than 0.05. Therefore, similar to the decision-making process in the *Shapiro-Wilk* Normality test, it can be inferred that the data for both the pre-test and post-test scores follow a normal distribution. Although the *Sig*. (*p*-value) for the post-test is 0.055, which is close to the significant threshold of 0.05, the data can still be considered to meet the normality assumption based on several considerations. In social and educational research, a p-value near 0.05 is often regarded as "marginally non-significant," implying that although it is close to the threshold, the data is not entirely non-normal. Furthermore, the *Sig.* value for the pre-test (0.638) indicates a normal distribution. Therefore, the overall normality test results can be viewed within a broader context, and the post-test data can still be treated as normal for further analysis, including paired *t*-tests. However, the interpretation of the results should be done with caution. Based on this analysis, the fulfillment of both prerequisite tests suggests that a paired *t*-test can be conducted to assess the impact of media use on enhancing students' creative thinking skills.

Test Results of the Influence of Smartphone-Based Application Media

Testing the impact of Smartphone-Based Application media products on students' creative abilities during learning activities was done using the paired sample *t*-test technique. Table 5 and Figure 1 describe the results of the statistical test analysis, which shows that, on average, the analysis shows a significant difference between pre-test and post-test scores; it was identified that there is a difference in the average score of the pre-test and post-test, where the pre-test score obtained an average of 50.80 and the post-test score obtained an average of 84.83. As illustrated in Figure 1, there is a clear upward trend in the creative thinking scores of students, particularly after the second session of the intervention. This indicates an increase in the average score of students' creative abilities after using Articulate-based media.

		Mean	*N*	Std. Deviation	Std. Error Mean
Pair 1	Pre_Test	50.80	30	3.585	0.655
	Post_Test	84.83	30	3.505	0.640

Table 5: Descriptive Statistics of Pre-Test and Post-Test Scores (source: Data processed by SPSS (2024))

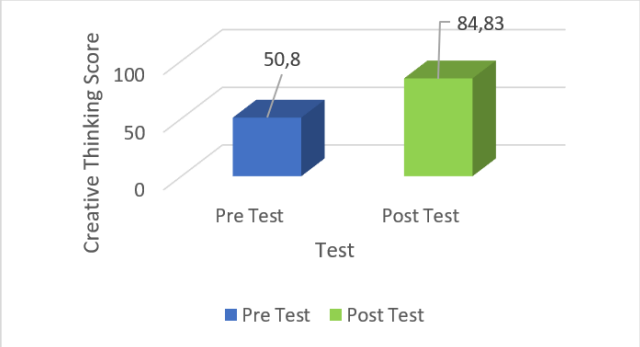

Figure 1: Average Pre-Post Test Score

In the context of conducting significance-level testing through the paired sample t-test, the findings presented in Table 6 indicate that the *Sig*. (2-tailed) value is < .000, less than the predetermined significance level of 0.05. Consequently, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted. Therefore, it can be inferred that there exists a disparity between the average scores of the Creativity Skills pre-test and post-test. This discrepancy suggests that the utilization of articulate-based learning media has a positive impact on enhancing the creative abilities of vocational school students.

	Paired Differences					*t*	*df*	*Sig.* (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre_Test - Post_Test	-34.033	5.798	1.059	-36.198	-31.868	-32.149	29	0.000

Table 6: Paired Sample *T*-Test Results (source: Data processed by SPSS (2024))

The N-Gain test assessed the impact of changes in students' creative skills. Specifically, it was utilized to gauge the effectiveness of Articulate-based learning materials in graphic design education. By comparing students' pre-test and post-test scores, the N-Gain test determines whether there has been a noticeable improvement in their creative abilities following exposure to the instructional media. The tabulated outcomes of the student N-Gain analysis are detailed in Table 7.

Indicator Aspect	Test	
	Pre Test	Post Test
Samples	30	30
Highest Score	56	90
Lowest Score	44	78
Average N-Gain	0.680	

Table 7: N-Gain Scores for Students' Creativity Abilities (source: Data processed by SPSS (2024))

Upon conducting an analysis using N-Gain, the findings from a research study investigating the utilization of Articulate-based media indicate that the average N-Gain Score attained a value of **0.68**, positioning it within the Moderate range (0.3 < **0.68** < 0.7). This outcome signifies that the implementation of this media has a noteworthy influence on enhancing the creative aptitude of students enrolled in Vocational High Schools (SMK). Consequently, it can be inferred that Articulate-based media is efficacious in augmenting the creative capabilities of vocational school students and holds promise as an effective educational tool within the vocational school setting.

DISCUSSIONS

The Influence of Digital Learning Media on Student Creativity

Discussing the methodology elaborated earlier, this research provides empirical evidence demonstrating the positive influence of digital learning media on students' creative abilities. The increase in creativity abilities in the post-test was higher than in the pre-test, which was based on the statistical analysis results of the *Sig*. (2-tailed) is 0.000 < 0.05, so H_0 is rejected and H_1 is accepted. So, there is a difference in the average Creativity Skills pre-test and post-test. The existence of this digital learning media can provide more optimal stimulus and train students to think as creatively as possible in completing tasks in graphic design learning. The choice of Articulate as the instructional media was driven by its flexibility and capacity to engage students through interactive and multimedia-rich content. This corresponds with the growing body of literature that points out the importance of utilizing digital tools that cater to diverse learning styles and foster active learning environments (Marín-Díaz et al., 2020; Lomos et al., 2023).

The findings of this study highlight important implications for educators and policymakers. Moreover, using such applications can foster students' creativity and critical thinking by offering a more interactive and personalized learning

experience. Policymakers should consider supporting initiatives that facilitate wider access to mobile devices and ensure digital literacy training for students and teachers, which is essential for maximizing the benefits of mobile-based learning. The flexibility and accessibility of Articulate-based learning applications on smartphones make them powerful tools for modern education. As mobile learning continues to grow, educators are encouraged to integrate these tools into their teaching strategies to enhance student engagement and improve learning outcomes (Kim and Park, 2019; Molotsi, 2022).

The flexibility of the developed learning application, particularly its smartphone accessibility, underscores its relevance in modern educational contexts. This mobile learning application, as recognized in current literature, represents a significant advancement in how educational content can be delivered, mobile learning itself is generally said to be a form of learning development that is growing rapidly in the current digital era (Triyono et al., 2022; Metruk, 2022). One concrete manifestation of this is the emergence of various learning applications, which are equipped with learning materials in the form of applications (Gede et al., 2022; Melumad and Pham, 2021). This Articulate-based learning application can also provide opportunities for students to work with their friends to complete assignments and study material together (Heliawati et al., 2022; Sindu et al., 2020). The presence of this media will facilitate students' acquisition of knowledge or comprehension of complex concepts. The forthcoming application will explain in diverse formats, including text, video, and case studies (Daryanes et al., 2023; Abdulah, Mustadi and Fitriani, 2021).

The Future of Mobile App-Based Learning: Implications for Vocational Education

The findings of this study offer several practical implications for educators and policymakers. Firstly, the flexibility and accessibility of Articulate-based learning applications on smartphones underscore their potential as powerful tools for modern education. As mobile learning becomes increasingly significant, educators are encouraged to integrate these innovative tools into their teaching strategies to elevate student engagement and optimize learning outcomes (Schmidthaler et al., 2023).

Similar to several previous studies examining how teachers utilize technology and applications in the learning process, research by Aufa et al. (2021) found that digital learning media in electronic modules could be integrated with a problem-based approach. After going through various stages of testing and implementation, the e-module digital learning media has a lot of positive impacts on improving students' abilities. For instance, the Articulate application has apparently been widely applied at various levels of education. Research by Mawaddah, Tati, and Pagarra (2022) at the basic education level showed that the application of this tool has been reported to gradually improve student learning outcomes. In line with this, research findings by Daryanes et al. (2023) demonstrated that educators in high schools are well-acquainted with the use of Articulate-based applications to support instructional practices. This familiarity can be attributed to the fact that, in addition to enhancing academic performance, digital learning tools have been shown to foster the development of essential 21st-century skills, including critical thinking and creativity. Like research conducted by Istiq'faroh, Suhardi, and Mustadi (2020) that the use of digital learning media in comic format can actually improve students' creative thinking abilities, Yaniawati et al. (2021) in their research also succeeded in proving that students who used mobile learning applications during the learning process were able to think more creatively than students who used printed modules during the learning process. Another research study by Rusnawati, Santyasa, and Tegeh (2021) indicates that using electronic module-based learning media during multiple learning sessions can positively impact students' critical thinking skills. Not only does it affect changes in student competence, digital media for learning also affects changes in teacher abilities, as shown by research conducted by Cocca and Cocca (2024), who conducted a 6-month study on the application of digital media in the format of learning videos for physical education teachers reported findings suggesting that video-based reflection interventions can be a significant component of teacher training programs aimed at enhancing educators' ability to evaluate and respond to various classroom situations. Numerous studies have consistently demonstrated that incorporating digital technology, regardless of its form, can enhance academic performance and foster the development of essential soft skills.

A key factor motivating teachers to integrate technology into learning is the belief that it will positively change students' soft and hard skills (Yılmaz, 2021). In addition, teachers need to pay attention to media and message design. The purpose is to accommodate the material being taught so that attractive learning design using digital learning media can foster students' interest in learning and raise students' self-confidence. The previous point will be related to learning effectiveness, especially when it concerns individual students (De Corte, 2019; Guan, Song and Li, 2018).

While the methodology employed in this study is well-aligned with the research objectives, the findings also highlight the need for further exploration to enhance our understanding of the impact of digital learning media. Future studies could greatly benefit from adopting a mixed-methods approach, combining both quantitative and qualitative data to offer a more nuanced perspective on how Articulate-based learning applications influence student outcomes. Additionally, incorporating a longitudinal study design would allow researchers to examine the long-term effects of these digital tools on a broader range of cognitive and non-cognitive skills, including collaboration, communication, and problem-solving. Although this study primarily focuses on creative thinking skills, expanding the scope of future research to encompass other essential 21st-century skills could provide a more holistic view of the benefits of digital learning media in vocational education. By broadening the investigation, researchers could contribute valuable insights into how these innovative tools can be leveraged to support student development across diverse educational contexts.

In conclusion, this study contributes valuable insights into the role of digital learning media in enhancing creativity among vocational students. However, to further elevate the originality and impact of future research, it is recommended to incorporate

more innovative methodologies and explore new theoretical perspectives. Such approaches will not only strengthen the validity of the findings but also contribute to the ongoing discourse on integrating technology into education.

CONCLUSION

Based on the findings of this study, it can be concluded that the learning application developed by Articulate for graphic design has proven effective in improving students' creative thinking skills. Therefore, this Articulate media is worthy of being positioned as a viable learning media option for learning in the digital era. The positive impact observed in students' creative abilities after using this application underlines its potential as a tool that contributes positively and plays a role in stimulating students' thinking abilities. Furthermore, this study highlights the importance of fostering an environment that supports the integration of Information and Communication Technology (ICT) into teaching and learning practices. Thus, through the results and analysis of this study, it is recommended that teachers adopt Articulate software as a valuable resource for developing interesting and innovative digital learning materials. However, it is important to note that the scope of this study is limited to a specific context, which ultimately affects the generalizability of the results. To address this limitation, future research should consider exploring the effectiveness of the Articulate application at various levels of education and with a larger sample size. This will allow for a broader understanding of the impact of implementing the Articulate application as a learning medium on various aspects, such as engagement, motivation, and academic achievement. In addition, further research could examine the long-term effects of using Articulate and similar digital tools and their potential for integration into various subjects and levels of education. By expanding the scope of research, it is hoped that teachers and education practitioners can gain deeper insights into best practices for implementing ICT-based learning through these tools and maximizing their benefits for student learning outcomes.

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APPENDIX

CREATIVITY SKILLS QUESTIONNAIRE

No.	Statement	Response Options				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Component 1: Fluency						
1.	I can easily come up with many ideas when faced with a problem.					
2.	When asked to create something new, I can generate multiple ideas quickly.					
3.	I find it easy to think of several solutions to a single problem.					
4.	I can think of many different ways to solve a design problem.					
5.	When brainstorming, I often come up with several ideas in a short period.					
Component 2: Flexibility						
6.	I can think of ideas that are different from what most people would think.					
7.	I can generate solutions that are unusual and creative.					
8.	My ideas often stand out because they are unique.					
9.	I often come up with unconventional solutions to problems.					
Component 3: Originality						
10.	I can create new and original ideas when solving a problem.					
11.	My ideas are often fresh and innovative.					
12.	I can find novel ways to approach challenges in creative tasks.					
13.	I can come up with ideas that others have not thought of.					
Component 4: Elaboration						
14.	I can elaborate on ideas and provide detailed explanations.					
15.	I am able to expand and improve upon my initial ideas.					
16.	When working on creative tasks, I focus on refining and developing ideas.					
17.	I pay close attention to details when developing creative concepts.					
Component 5: Evaluation						
18.	I can evaluate my own ideas and decide which one is the best.					
19.	I am able to critically assess my ideas and improve them.					
20.	I can prioritize ideas based on their feasibility and potential impact.					

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