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Navigating Academic Educational Frontiers in the 21st Century

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ABSTRACT

As education faces unprecedented challenges in the 21st century, this paper explores the transformative impact of COVID-19, the rise of neurodivergent students, and the integration of generative AI in academic settings. The successful adaptation to online learning during the pandemic, backed by scientific evaluation, underscores the significance of flexibility and advanced technology in creating an efficient and engaging virtual learning environment. The adaptability of the online solution, implemented through Moodle, demonstrated its effectiveness in providing diverse learning materials and maintaining flexibility in teaching approaches. Survey results indicate improved student engagement, satisfaction, and successful achievement of learning objectives. The high acceptance and feasibility of the online platform reflect its sustainability as a long-term educational tool. Addressing the growing population of neurodivergent students requires an accessible learning environment and flexibility in assessments and attendance. Clear communication, supportive structures, and individualized support mechanisms, including dedicated offices, are crucial for ensuring an inclusive educational experience. The paper emphasizes the need for ongoing awareness and training initiatives for educators. Lastly, the integration of generative AI poses challenges for students, ranging from complexity and limited resources to ethical considerations and resistance to change. A comprehensive approach involving standardized training, ethical education, and support for diverse learning styles is necessary to maximize the benefits of generative AI in education. This paper provides insights into navigating these challenges and highlights the importance of adapting teaching practices to meet the evolving landscape of education.

KEYWORDS: Educational Adaptation, 21st Century Learning, COVID-19 Impact, Neurodiversity Inclusion, Generative AI Education

1   INTRODUCTION

As we forge ahead into the 21st century, the landscape of education is encountering unprecedented challenges. For example, the occurrence of Corona in 2020 with the associated lockdown was a huge challenge, as all lessons had to be switched to online operation. For this case, we have already developed a well-functioning solution, which has also been scientifically evaluated. This makes it possible to quickly switch to online teaching in all courses at any time. But other events have occurred recently that require a rethinking and adaptation of teaching and the direction of academic education. For example, the increase in students with neurodivergent needs represents a major challenge in providing everyone with appropriate and supportive education. And the recent emergence of generative AI for the masses requires a rapid transformation of teaching content and learning outcomes. Our presentation aims to shed light on how educators can effectively tackle the impact of COVID-19, accommodate the diverse needs of neurodivergent students, and navigate the transformative influence of Generative AI on teaching practices.

In this paper we want to identify the challenges that will concern us in academic teaching currently and in the coming years.

2   RESULTS GAINED FROM COVID-19

During the pandemic it was necessary to switch teaching to online operation. This turned out to be extremely difficult, but after a long time we managed to do it quite well ([1],[2]).

The successful implementation of our online solution has been substantiated by a thorough scientific evaluation. The switch to online learning, triggered by the challenges given by the COVID-19 pandemic, not only demonstrated our adaptability but also signified a fundamental shift in the way education is delivered. This marked change in approach highlights the effectiveness of our online learning platform, showcasing its ability to meet the evolving needs of education in a rapidly changing world.

The switch to online learning worked well because it was efficient and flexible. One big reason for this success was using advanced technology to smoothly move traditional classroom activities to the digital world. The online platform not only copied the experience of learning in person but also added interactive things to make students more interested. Including videos, tools for working together in real-time, and lessons tailored to each student made the online learning environment interesting and effective.

The results obtained from surveys and assessments conducted during and after the transition period indicated a noteworthy improvement in both student engagement and satisfaction. Students reported a higher level of interaction with course materials, increased participation in online discussions, and a positive perception of the overall online learning experience. The flexibility offered by the online platform allowed students to access educational resources at their own pace, contributing to a more personalized and student-centric approach to learning.

2.1   Adaptability of the Solution

One of the standout features of our online teaching solution was its adaptability. We use Moodle with a specific template, that must be used in any course. The system compiled various learning materials for different subjects and learning styles. Teachers appreciated that the platform was easy to use, allowing them to modify lessons and tests to perfectly suit their classes. This flexibility not only contributed to maintaining education during the pandemic but also made the system a useful and adaptable tool for all future challenges. Feedback from educators further supported the success of the online teaching solution. Teachers appreciated the ease of use, the ability to monitor student progress effectively, and the collaborative features that facilitated communication among both students and educators. The positive reception from the teaching community highlighted the importance of providing educators with tools that empower them to deliver high-quality education in varied circumstances.

2.2   Assessment of Learning Outcomes

The scientific evaluation included a thorough assessment of learning outcomes achieved through the online teaching platform. Quantitative data, such as pre-and post-assessment scores, demonstrated significant improvements in student knowledge retention and application of concepts. Qualitative feedback from educators and students provided additional insights into the effectiveness of the platform in achieving the intended learning objectives.

2.3   Acceptance and Feasibility

Although there is still room for improvement in some areas, one of the most notable results was the high level of acceptance among both teachers and students. The feasibility of the online teaching solution was demonstrated not only in its successful implementation during the challenging times of the pandemic, but also in its sustainability as a long-term educational tool. A sudden change to online operation is only possible at any time and smoothly. The positive results and widespread adoption highlighted the solution's ability to address the urgent need for adaptive and effective education strategies in the face of unforeseen challenges.

In summary, the results of the scientific evaluation demonstrate the success of our online teaching solution in overcoming the challenges posed by the COVID-19 pandemic. The positive outcomes, improved student engagement, adaptability, positive teacher reception, and achievement of learning objectives combine to provide a comprehensive understanding of the effectiveness of the implemented solution. These results show that it is essential to be able to react quickly to new challenges in order to maintain the quality of academic teaching.

3   NEEDS FOR NEURODIVERGENT STUDENTS

In recent years, especially after the pandemic, the number of students with neurodivergent impairments has steadily increased. This increase is not necessarily due to the actual

increase, but the general understanding and acceptance of neurodivergent impairments has definitely increased. That is probably why more people than before are brave enough to address this. Here are some measures that may be necessary in education for neurodivergent students. It is important to note that the needs of neurodivergent individuals can vary widely, and these are general considerations.

At the University of Applied Science Technikum Wien, support is clearly regulated. Neurodivergent students must be supported as much as possible, although a medical certificate from a specialist is required for each individual.

3.1   Accessible Learning Environment

One of the biggest challenges is implementation of an accessible learning environment. Therefore, lots of changes in the current learning platform are necessary. Ideally, it should take the following things into account. To create an inclusive learning environment for neurodivergent students, it's crucial to provide learning materials in various formats. This includes offering content in written, auditory, and visual formats to cater to different learning preferences. Additionally, utilizing accessible technologies and tools for online content access enhances the overall accessibility of the learning materials. This ensures that neurodivergent students can engage with the course content effectively, regardless of their learning style. Incorporating assistive technologies is essential to support neurodivergent students. Allowing the use of tools such as text-to-speech software or specialized learning apps provides personalized assistance. Moreover, providing training and resources for the effective use of these technologies ensures that neurodivergent students can leverage them optimally for their learning needs.

3.2   Flexibility

Recognizing and considering different learning styles is crucial in the assessment process. By ensuring flexible exam formats, neurodivergent students can demonstrate their understanding and knowledge in a way that suits their strengths. This could include considering alternative assessment methods such as oral exams or projects, which may be more suitable for some neurodivergent individuals. A possible extension of the examination time is sometimes taken into account. Using different assessment approaches not only recognizes the unique strengths of neurodivergent students, but also promotes a fair and inclusive assessment process.

Flexibility in attendance requirements could also be crucial to meet the individual needs of neurodivergent students. By allowing different numbers of participants and providing alternatives, such as: Such as recorded lectures or summaries for missed sessions, ensures that neurodivergent students can engage with the course content in a way that suits their individual circumstances. However, there are requirements from our university that do not make everything possible: The group sizes are defined in advance for each teaching method (see [1]) and the attendance requirement is also defined. Individual adaptations are therefore very difficult to implement.

3.3   Clear Communication and Supportive Structure

Providing clear and structured instructions for tasks and course content is essential for neurodivergent students. Clarity in communication aids in better understanding and reduces anxiety. Additionally, maintaining regular communication about course changes or organizational details ensures that neurodivergent students can navigate the academic environment smoothly.

Providing individual support through office hours or consultations is a proactive measure to address the specific needs of neurodivergent students. By creating a space for personalized support, students can seek advice and explanations tailored to their learning needs. There is a dedicated office at our university for this purpose, which is available to provide advice anonymously and away from teaching.

Raising teacher and staff awareness of the needs of neurodivergent students is critical. Raising the educational community's awareness of various forms of neurodivergence promotes understanding and empathy. Integrating training to support neurodivergent students into teacher training ensures that educators are equipped with the knowledge and skills necessary for inclusive teaching practices. After the end of the pandemic, this necessity was recognized and we now offer several training courses involving experts on an ongoing basis.

4   GENERATIVE AI IN EDUCATION

By making ChatGPT available free to the general public, AI and AI tools were also increasingly touted in the media. Of course, students discovered the possibilities of saving time on learning very early on. Research on theoretical topics, for example, can now be carried out with just a little time. The answers to individual questions, especially questions that concern the acquisition of knowledge, can only be solved in a very short time. An AI can even solve more complex content, such as simple programming tasks. Students using generative AI may encounter several challenges that hinder them from achieving expected learning outcomes. Here are some difficulties they might face: Generative AI can provide good support, but the difficulty is being able to evaluate the generated result yourself. At our university, we specifically use generative AI to encourage students to use these tools effectively. Students with less experience are often under the illusion that the solution generated by an AI tool is not the solution to the actual problem.

4.1   Understanding Complexity

Generative AI technologies introduce a level of intricacy that may pose a challenge for students in comprehending the underlying principles. The complexity of these systems can create a barrier, hindering students from fully grasping the intricacies of how generative AI functions. This lack of understanding may impede their ability to effectively apply these tools for educational purposes, potentially impacting the attainment of desired learning outcomes.

4.2   Ethical Dilemmas and Responsibility

Navigating the ethical landscape of generative AI requires a nuanced understanding that may be challenging for students. Issues related to bias, fairness, and privacy in AI applications may surface, posing dilemmas for students in ensuring responsible use. This challenge extends to their ability to make informed and ethical decisions when employing generative AI tools for academic tasks. Addressing these ethical considerations becomes crucial for fostering a responsible and conscientious approach to AI integration in education.

5   CONCLUSION

The impact of COVID-19 on education has prompted a rapid transition to online learning, serving as a direct response to the global health crisis. The implemented online teaching solution emerged as an effective alternative during lockdowns and social distancing measures. Results indicate that the platform's flexibility not only allowed for the continuation of education but also led to improved student engagement and satisfaction, showcasing the resilience of the education system in adapting to unprecedented challenges.

In the realm of neurodiversity inclusion, the adaptability of the online teaching solution takes center stage. Its customization features and diverse learning materials cater to various learning styles, providing crucial support for neurodivergent students with unique educational needs. The positive reception from educators and the observed improvement in learning outcomes underscore the platform's role in creating a more inclusive learning environment, emphasizing its user-friendly nature and collaborative features.

While the primary focus is on the success of the online teaching solution, its evaluation and ongoing adaptability align with the broader theme of Generative AI Education. The platform's adaptability and personalized learning features respond to the transformative influence of generative AI in education. As the educational landscape evolves with the emergence of AI, the positive outcomes from this solution indicate a proactive approach in integrating technology for personalized and adaptive learning experiences.

In conclusion, the implemented online teaching solution not only addresses the immediate challenges posed by the COVID-19 pandemic but also aligns with broader educational themes such as neurodiversity inclusion and the influence of generative AI. Its success lies in its adaptability, positive reception, and improved learning outcomes, positioning it as a model that effectively responds to the multifaceted challenges of the 21st-century educational landscape.

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Culture-Based STEM Education: A Path to Sustainable Inclusive Development, "STEM Education for All"

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The claim that STEM Education is important to national social, cultural, and economic development is widely accepted. The central idea presented is that STEM Education needs to be based on local, regional, and national cultures if it is to serve all who are needed in national development efforts. Consideration of three questions will guide what is presented. Who needs to be served?

STEM Education must first serve and develop a STEM literate population as the foundation for all aspects of development. Second, STEM literate politicians and administrators are essential. Third, scientists, technologists, engineers, and mathematicians are required. As will be discussed, the roles that each cadre must assume are highly interrelated and essential to national development.

What is STEM Education?
Many attempts to define STEM Education have been put forward. No single definition has been widely accepted. However, numerous papers provide characteristics of STEM Education that can be used to formulate a diverse set of culturally relevant perspectives. We present the essential characteristics that can be considered. Formulating and applying different but well-grounded, culturally relevant perspectives on STEM education increases the chances that effective STEM education will be developed and implemented.
How do we develop Culture-Based STEM Education?

We propose that developing Culture-based STEM Education is to base curricula and instruction on local, regional, and national traditions, events, objects, and innovations. STEM subjects can be taught in association with these foci. Questions that can guide developing Culture-Based STEM Education teaching units and examples will be provided.

Key Words: STEM education, national development, scientific literacy

Introduction: The primary goal of STEM education

The claim that STEM Education is important to national social, cultural, and economic development is widely accepted. The usual argument is that innumerable businesses and industries require high-level STEM talent, and that the development of robust national economies depends on such talent. The necessity of having such a talent is undeniable. However, this viewpoint has too often resulted in government and private education programs that make the education of high-level talent the primary, if not one and only, goal. The emphasis on developing high-level talent has another source as well. In the United States and most other countries, educational STEM subjects and programs have been discipline-based and "top-down". The disciplines have been physics, chemistry, biology, mathematics, and, occasionally, Earth science. Within STEM subjects (and probably others as well), colleges and universities are designed to prepare students for graduate school, research, and development careers; high schools aim at preparing students for college and universities, middle/junior high schools are to educate students for high schools, elementary schools are to prepare students for middle/junior high schools, and preschools are to prepare students for elementary schools.* The discipline-based, top-down structure can be seen in interlocking admissions procedures, curricula, instruction, and assessments. Admissions procedures often are based on highly competitive examinations that are designed to meet the curricular demands of the "next level" and for admission to elite STEM schools. Curricula usually represented by national standards are derived from what is taught at the next highest level. Instructional methods often mimic the ways subjects are taught at higher levels as do in-school and external testing programs. Our language around schools is replete with phrases stating we must get children ready for the "next level", special tutorial schools, elite special interest schools, and the next exit or entrance examination". Our language around schools also is replete with reference to many levels of school and government accountability. In many countries, examinations are used to assign students vocational and academic educational tracks. Within academic educational tracks, assessments are used to select students for STEM subjects as we seek to place the best and brightest in STEM subjects.

The above is at the core of planning our STEM education programs. However, there have been challenges and attempts to modify, even replace, this dominant paradigm. Efforts to develop and implement curricula, instruction, and assessments with the goals of functional have been put forward, often vigorously. None have been fully developed or sustained in the face of varying demands for social, political, and economic security. At the present time, concerns about national and global economies competitiveness are most influential and have generated intense demands for educating people for careers in key STEM fields.

Three insidious side effects have resulted from the sustained use of the discipline-based, top-down paradigm. First, the discipline-based aspect of the primary paradigm is that the subjects are taught in terms of the content and methods used within the discipline. The human nature of STEM subjects as an enterprise and the ways in which STEM subjects are related to history, culture, current society, and each other are largely ignored. These omissions limit students' sense of STEM relevance to everyday life and non-academic careers.

Second, the educational process is progressively excluding many students along the way. Assessments are often used to provide the best and brightest to the best educational opportunities in STEM fields. Given that opportunities are limited, this practice is appropriate in that it helps meet one of the goals of STEM Education, identifying those who may go on to the highest-level STEM careers, However, the serious side effect is that the great social value placed rigorous assessment and placement systems and being selected for "special" programs, tells those who are not selected that STEM subjects are only for the elite. Many are discouraged from pursuing STEM subjects and the later development of STEM related interests is diminished.   The effect is to decrease the pool of potential STEM interested students who can serve research, business, industry, and other social needs.

Third, the discipline-based curricula have been presented as being too difficult for all but the most talented. This may be the case because STEM subjects have been extraordinarily successful in enhancing our lives. But perhaps we have overstated its worth in society and attached a bit of arrogance to the positions of STEM subjects. The portrayal if STEM subjects as difficult limits students' sense that they are accessible and for them.

Who needs to be served to enhance national development?

The question "What should be the goals of STEM education?" can be addressed by deciding who needs to be served. The premise of what follows is that STEM Education must develop a STEM literate population as the foundation for all aspects of development. More specifically, development requires a STEM literate population, politicians, and government officials, business and industry leaders and employees, as well as a wide and deep pool of professionals in STEM related fields.

A scientifically literate population is essential so that it decides who to elect; what public programs and research agendas should be supported; the ways in which STEM-based research and innovations should be used; limitations on our use of our innovations; and even whether or not our innovations should be used.

Perhaps most importantly, a STEM literate population is essential to peoples' decisions in their daily lives and work. Should I work my land in a way that is sustainable? What crops should I plant? How can I protect water resources? Should I be vaccinated? Are my home and workplace safe? Should I reuse and recycle? Should I support one politician or political party or another? How do my actions and activities impact climate change? Should I support a building proposal that would improve the local economy? Should I become educated and work in a STEM related field? Should I become politically active or a politician? What should I do in the face of weather and climate changes? What foods and products are safe? What should I eat or not eat? What media reports and advertising should I believe? Answers to all of these questions and many more should be influenced by knowledge of STEM subjects and hopefully improve peoples' lives. The above is not to say that the knowledge of STEM subjects should be the only or even primary consideration in making these decisions. Many other considerations are essential (especially local knowledge and wisdom), but STEM knowledge should often be at least part of the decision making.

We must recognize that the general population is the well-spring for all others in society. It is the place from which all other STEM literate people will be drawn. We cannot

afford to have STEM subjects as being seen as irrelevant, inaccessible, and only for the elite. We cannot afford to leave any potential talent on the sidelines. STEM subjects must be seen as relevant and accessible throughout all students' educational careers.

STEM literate politicians, policy makers and administrators are also essential. Politicians decide what research and development will be funded and what policies will govern that research and development. STEM professionals conduct the research and development that is called for in government programs, influence what businesses and industries develop, produce, market, and inform the media and population.

Many legislative bills and government policies should consider STEM knowledge and methods when they are written, debated, and voted upon. Many government appointments require (or at least should require) STEM knowledge and skill. Policy makers at least need to be aware of when STEM knowledge should be considered in their deliberations and actions. They need to be able to identify issues that are STEM related then develop policies, programs and regulations that address the issues. Finally, they need to be knowledgeable enough to understand and evaluate what their advisors, consultants, and constituents say.

STEM literate business and industry leaders and employes are needed. Almost all business and industries are dependent upon STEM subjects. All use computers and computer-based programs for communication, materials development, product development, manufacturing processes, ways of distributing goods, agricultural planning, and practices just to name a few. The needs of businesses and industries go well beyond the need for high-level professionals and specialists. The work of employees at all levels requires STEM related knowledge and skill. For example, people working on manufacturing paints, operating power plants, running refineries, manufacturing foods, and operating robotics need to be able to recognize problems in the processes they operate, be able to diagnose and solve problems. The problems may be small, but important and need immediate solutions. The effectiveness, efficiency, and profitability of business and industries can be enhanced by all levels of employees who are STEM literate.

Finally, and obviously, the overall population supplies the essential researchers and developers in STEM related fields. Their knowledge, skills, and creativity drive innovation. Innovation drives our economies, protects our environment, enhances our abilities to communicate, changes our social structures, provides national security, provides food security, and enhances our well-being and ways of life. Many of these highly educated individuals are needed in our colleges and universities, government agencies, research institutions, businesses, and industries. The effective identification and education of researchers and developers must be supported by all of the rest of us politically and by our supplying the research and development resources they require, or else development will be limited.

In summary, a STEM literate population is the source of policy makers, business and industry leaders, employees, and STEM professionals; decides who will hold government offices at all levels; decides what issues in their lives need to be addressed by the governments, researchers, and developers; decides what business and industries need to provide; and makes a myriad of personal and work life decisions. Each of the above cadres are interrelated and essential to national development. All are needed for development to occur and be sustained.

What is STEM education?

Before deciding how to approach STEM education, we need an understanding of what is STEM education. Many attempts to define STEM education have been put forward. No single definition has been widely accepted. However, numerous papers provide characteristics of STEM education that can be used to formulate a diverse set of culturally relevant perspectives.

The following is an initial set of characteristics of STEM that has been gleaned from various national and international sources. The set of characteristics was initially developed for Institute for the Promotion of Science Teaching in Thailand (Finley, 2012) and subsequently revised (Sumonta, Finley, and Kittisak, ???). The overall goal is to develop STEM programs that are relevant, accessible, and interesting to students. A major tenet of our approach is to have STEM education be culturally relevant. To emphasis that tenet, we have shown those characteristics that emphasize cultural relevance in *italics*.

We do not claim that this is the only possible set of characteristics but only that they offer a valuable starting point that can be critiqued and improved by experience. We cannot even yet specify some subset or number of characteristics that have to be met to claim a program qualified as being a valid STEM program. We simply propose that the STEM programs can be described in terms of the following characteristics and then validated by professional judgments. STEM education would be valid if it has a substantial number of the following characteristics:

- *Promotes students learning with joy and benefits for their future and present personal, civic, and professional lives.*
- *Provides opportunities to explore many levels and types of possible STEM careers.*
- *Relates directly to real life activities from business and industry, government, NGOs, cultural or community activities in local, regional, national, or international communities.*
- *Engages students in studying critical topics such as health, energy resources, natural resources, environmental quality, natural hazard mitigation, the frontiers of science, technology, engineering, mathematics (PISA 2006), and food resources.*
- Uses at least two of the STEM subjects simultaneously. A preferred option is using three or all four of the subject areas simultaneously, but we have too little experience with STEM to recommend this course at this time.
- Requires knowledge and applications of the domain specific, core and cross cutting and practices of the subjects.
- Provides student-centered instruction.
- *Includes substantial interactions with the local, regional, national, or international communities as part of the instruction. The interactions can be the participation of local people in the schools, students studying in their communities, case studies, community-based projects, service projects, and research projects.*
- *Requires students to do what they will have to do as employees and citizens, that is, produce artifacts that have a counterpart in the real world.*
- *Requires students to communicate the products of their instruction to people from their community, teachers other than their own, or students other than their classmates.*

- Requires and holds students accountable for being able to apply the subject matter rigorously in the planning, description, explanation, and justification of the products that result from their instruction.
- Requires students to provide justified descriptions, explanations, and predictions related to select phenomena though the lenses of multiple relevant disciplines. For example, carbon cycling can be examined in terms of each of the four STEM disciplines plus the environmental sciences, social sciences, and humanities such as the history and economics of our use of fossil fuels.
- Providing opportunities for teaching about the nature of science, technology, engineering and mathematics, and the interactions among those fields and society.
- Instruction that has students working and studying in teams.
- Often using information technologies, communications technologies, and computer - based instrumentation.
- *Providing opportunities to explore many levels and types of possible STEM careers.*

The idea of designing and teaching a variety of different but well-grounded, culturally relevant STEM units of instruction increases the chances that effective STEM education will be developed and implemented. The units often should and will involve ideas from other subjects such as Social Studies, Religion and Culture; Language and Language Arts; Arts; English; Health; and Physical Education. We cannot teach STEM subjects effectively if they are isolated from other areas of culture and society. STEM subjects were developed in the context of and influenced by the cultures within which they were imbedded.

One additional and absolutely essential characteristic is that STEM teaching must meet national curriculum standards and assessment demands. Teachers should not, cannot, and will not teach in ways that do not enhance the likelihood students will do well on national examinations. Furthermore, their schools and national school assessments expect and usually demand that the national standards be employed by teachers.

How do we develop Culture-Based STEM Education?

Consistent with the above characteristics of STEM education, we propose one way of developing Culture-based STEM Education is to base curricula and instruction on local, regional, and national traditions, events, objects, and innovations. STEM subjects can be taught in association with these characteristics. This means that the STEM disciplines are taught to describe and explain the culture-based phenomena that are part of the students' lives. One approach to designing STEM instruction is having teachers answer a series of characteristic based questions that guide their planning. These questions are based on principles of curriculum design and learning theory.

Context Description

A description of the local community, school, and students.

Guiding Questions for Instructional Design.

Q1. What local, regional, and national traditions, events, objects, or innovations will be the focus of the Culture-based STEM Unit.
Q2. What cultural-based project will the students develop or what problem will they solve?
Q3. What STEM Education characteristics will be used?
Q4. What learning outcomes from National Standards will be used? (Science; Computer Science and Technology; Mathematics, Social Studies, Religion and Culture; Thai Language; Arts; English; Health and Physical Education).
Q5. What community connections will be used?
Q6. What schoolteachers and administrators will be involved?
Q7. How will the instruction be done?
Q8. To whom will the students present their work?
Q9. What assessments will be used?
Q10. What local arrangements will be needed?
Q11. What will be the schedule of events for the project?

These questions may be used in any order. One will need to work back and forth among the questions. Some questions might be omitted if they are not applicable. Some might be added. Teachers or preferably teams of teachers must use their professional judgements in these matters.

Practical limitations do not allow the presentation of full Culture-based STEM education units here as we had hoped. Hopefully, what follows at least provides some examples of what has been done previously. These examples are all from Thailand.

- The biology and geology (soil science) of corn planting and the design of objects that can be made from corn stalks and leaves.
- The chemistry of purifying marl (white clay) to make a traditional safe white cosmetic.
- The chemistry of amalgams, specifically brass, and the processes of making brass into locally produced artifacts and souvenirs.
- The geology, risks, and ways preventing landslides on steep hillsides used for growing corn thus limiting the use of slash and burn agriculture, limiting stream degradations from erosion, and preserving land for future farming.
- The hydrology, biology and chemistry of a local stream that is threatened by farm runoff, erosion, and waste pollution along with the creation of a plan to improve the stream quality and sustainable fishing for the future.
- The chemistry, physics, engineering, and mathematics of developing a rice husk furnace that can be used for cooking.
- The biology of commercial duck farming, engineering a way to preserve duck eggs such as salting them along with the chemistry of salt and solutions, and economics of selling the process and eggs in new more distant markets.

Summary

The central idea presented is that STEM education needs to be based on local, regional, and national cultures if it is to serve all who are needed in national development efforts. STEM Education must primarily serve and develop a STEM literate population as the foundation

for all aspects of development. STEM literate politicians and administrators, business and industrial leaders, employees, scientists, technologists, engineers, and mathematicians are required as well. All of these people will emerge from the general population if STEM education must become viewed as interesting, accessible, and relevant.

*Elementary schools have been somewhat less influenced by the top-down, discipline-based paradigm due to its origins in learning social-cultural norms and the basic skills of literacy such as reading, writing and mathematics that are essential to life and studies in other fields.

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Advancing Technology Education in Government: Developing a Data Literacy Framework for Thai Officers.

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ABSTRACT

Data literacy is increasingly recognized as a cornerstone for effective decision-making in the contemporary landscape, particularly for Thai officers engaged in diverse professional domains. This abstract delves into the pivotal role of data literacy in the context of Thai officers and underscores its indispensability in education settings, especially in the program development phase. Officers across various sectors in Thailand grapple with abundant data that demands adept interpretation. Navigating and deriving meaningful insights from this data is a critical competency. Data literacy empowers government officers to make informed decisions, fostering efficiency, transparency, and innovation within their respective roles [1].

Integrating data literacy into educational curricula emerges as a strategic imperative. As the demands of the digital age evolve, education plays a central role in equipping Thai officers with the necessary skills to harness the power of data. Structured courses should be designed to impart technical proficiency and a nuanced understanding of data's implications, ethical considerations, and its role in driving positive organizational outcomes.

The primary goal of this research is to enhance the data skills of government officials in Thailand by synthesizing insights from various frameworks aligned with global standards on digital and data skills. The research identifies effective strategies for developing customized data frameworks for government agencies. The study utilizes a comparative gap study model, incorporating three interviews. The first interview assesses needs and preferences, followed by a second interview where nine experts provide definitions and conduct thorough, in-depth interview assessments.

The resulting framework comprises: 5 skill sets, 25 competencies, and 45 subjects, aligning with the skills required for extensive data utilization within government operations. Through gap analyses, the study identifies practical approaches for crafting a data framework uniquely suited for government agencies. The interviews and experts' opinions gathered uncovered and confirmed the strategies that address the skills needed for comprehensive data utilization within government operations. These efforts aim to formulate a skill development plan that bridges existing gaps and enhances the proficiency of data utilization by government agencies.

KEYWORDS: government agencies, competencies, data literacy, educational curriculum integration, data skills

INTRODUCTION

The fourth industrial revolution hinges on data proficiency. Organizations worldwide understand the mounting value of data literacy, with some estimates predicting that 70% of employees will engage heavily with data by 2025 [2] (a significant increase from 2018). Companies prioritizing data literacy will undoubtedly gain a competitive edge in the rapidly evolving global marketplace.

While educational curricula now often include fundamental digital literacy, specialized data literacy for government work remains lacking. Data literacy encompasses the capacity to read, manipulate, analyze, and present data-driven insights. It includes communicating data effectively and using data strategically to guide decision-making.

Digital competence encompasses using information and communication technologies to locate, assess, create, and disseminate content. Data literacy focuses on collecting, transforming, analyzing, and communicating data findings. These skills form a robust toolkit: digital interfaces generate data, which can be transformed and interpreted to support data-literate actions.

Thailand's Office of the Civil Service Commission (OCSC) recognizes the urgent need for 'Digital Literacy' training to achieve its digital government ambitions. This involves cultivating data fluency alongside the necessary mindset shifts for effective public service. These efforts align with the three pillars of a true digital government: openness, citizen-centricity, and a data-driven culture.

Despite these initiatives, the 2022 Global Data Literacy Benchmark report, surveying over 5,000 employees worldwide, highlighted concerns regarding data fluency among professionals. Responses segmented respondents into 'Coaches', 'Confident', and 'Curious' categories, revealing ongoing obstacles to robust data utilization.

The prior report highlights limited data proficiency across nations, with only 8-19% of individuals feeling equipped to guide others in data usage [3]. Some employees experience significant difficulty when handling data. This lack of fluency translates to an estimated 43 hours of lost productivity per employee, stemming from data-related delays and frustrations.

Interestingly, countries that have adopted data literacy frameworks demonstrate an overall positive impact. These frameworks are often tailored to specific industries. Within government agencies, 49% of surveyed individuals from these countries reported increased confidence in handling data, suggesting the effectiveness of such frameworks.

Figure 1: Classified skills categorized by industry.
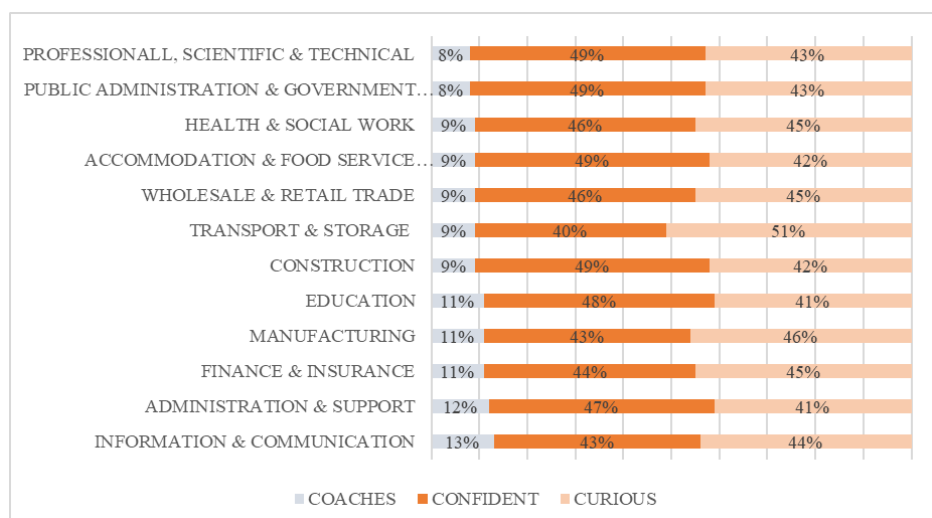
Earlier research indicates that data literacy frameworks boost workers' confidence when handling data. Qlik's study reveals that 85% of data-informed employees report strong work performance, significantly exceeding the 54% found among the general workforces. This highlights a compelling chance for organizations to foster data-driven cultures without facing significant resistance. Companies that prioritize data literacy demonstrate tangible financial benefits, often showing up to 5% greater enterprise value.

Considering this, the researcher seeks to compile survey data and develop a framework to thoroughly identify the core skills needed for effective data literacy initiatives. This includes crafting tailored training programs to upskill the workforce. The project will also compare existing frameworks with Thailand's unique context, ultimately creating standards and a roadmap for systematic skill development within the country.

OBJECTIVES

This study seeks to propel technology education within the Thai government by designing a robust data literacy framework for its officers. Informed by international standards and national digital literacy requirements, the framework will bridge identified competency gaps. In doing so, it will bolster Thailand's governance effectiveness by cultivating a data-savvy workforce equipped for informed decision-making and responsive service delivery.

SCOPE OF WORKS

- Target Audience: The primary focus of this study is the entirety of Thailand's government workforce.
- Research Domain: This study will concentrate on established international frameworks and standards specifically designed for the advancement of data literacy skills within governmental contexts.

LITERATURE REVIEW

Data literacy is the ability to access, understand, and strategically use data to make informed decisions and enhance knowledge. It's essential for both individuals and organizations, supporting data-driven cultures were insights guide operations and growth.

Data Literacy Frameworks and Standards

Numerous frameworks exist to guide data literacy development. Key considerations and recurring themes include:
- International: Various definitions of digital literacy are used globally, often including data skills along with broader competencies like communication, critical thinking, and technology use.
- Data Literacy Body of Knowledge (DLBOK) [4]: Offers a structured framework with five key areas, covering data fundamentals, governance, resource management, provisioning, and analysis.
- Data-Specific Frameworks: Frameworks like the Digital Competence Framework for Citizens and the APS Data Capability Framework provide [5] detailed breakdowns of data-related knowledge, skills, and behaviors.

- DQ Framework [6]: Identifies eight components of digital intelligence quotient, including digital literacy skills.
- DigComp [7]: Defines digital literacy as encompassing information literacy, media literacy, and computer literacy.
- Thailand: While digital skills frameworks exist [8], they lack a strong emphasis on specific data literacy skills and ethical data practices. Call Digital Competence Framework: Highlights information skills, including data usage and analysis.

Related Research

Prior studies highlight key aspects and challenges of data literacy:

- Research-focused: Data literacy programs must adapt to the specific needs of researchers and the processes involved in research data management [9].
- Data Citizenship [10]: Critical thinking about data use is needed in an era of misinformation. Literacy must extend beyond skills to understanding power dynamics, platforms, and the need for citizen participation in the data economy.
- Development Goals: Data literacy is vital for achieving Sustainable Development Goals (SDGs) [11], emphasizing real-world problem-solving through data.
- Healthcare [12]: Medical professionals need literacy not just in handling data, but in understanding its collection and how it shapes decision-making.

By addressing these points, a comprehensive data literacy framework can significantly enhance the abilities of Thai government officers in a data-driven world. Data literacy, beyond mere data access and consumption, empowers individuals to interpret and strategically leverage data for knowledge creation. This review explores the concept, its importance, and existing frameworks to support its development. Data literacy is essential for individuals and organizations to thrive in the data-driven world [13]. By understanding existing frameworks and addressing local gaps, we can empower future generations to make informed decisions and contribute to a data-literate society.

METHODOLOGY

This part shows the methodology which was employed during the study. The methodology adopted in this research is separated into three steps, creating a common understanding phase, creating the Beta version, Data Literacy Framework Output, as shown in Figure.

Figure 2: Research Methodology
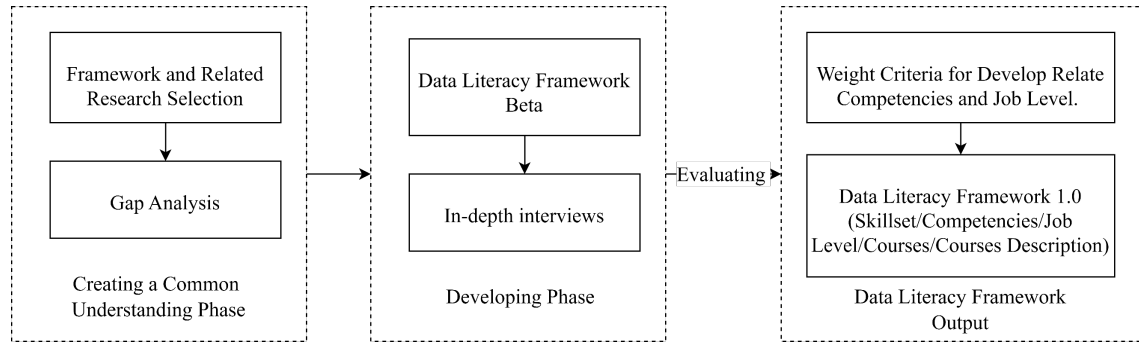
Framework and Related Research Selection

As outlined in the introduction, this research focuses on improving data literacy practices. Recognizing the need for targeted skill development, the following steps have been employed: Research Selection: Relevant research papers on data literacy were carefully analyzed. International Framework Alignment: To establish clear research classifications, types, and assessment methods, internationally recognized frameworks will provide guidance. Standards that ensure consistency across job duties in data-related work will be incorporated, subject to expert review, enabling accurate measurement and alignment with existing data literacy courses.

Gap Analysis

Methodology: To identify discrepancies, several internationally accepted frameworks will be used in the gap analysis process (including APS Data Capability Framework, EU DigComp, Thailand's OCSC Digital Literacy Guidelines, and TPQI for Data Analyst/Data Scientist standards).

Structure: This analysis will inform the creation of a comprehensive Data Literacy Framework with well-defined levels of proficiency.

Assessment Focus: This assessment will center on five core data components: Collection, Management, Governance, Evaluation, and Application.

Table 1: Framework Comparison Analysis

Component/Framework	APS Data Capability Framework	The Data Literacy Body of Knowledge (DLBOK)	EU DigComp	Thailand the Office of the Civil Service Commission (OCSC)	TPQI (Thailand Professional Qualification Institute)
Data Collection	✓	✓	✓	✓	✓
Data Management	✓	✓	✓	✕	✕
Data Governance	✓	✓	✕	✕	✕
Data Evaluation	✓	✓	✓	✓	✓
Data Application	✓	✓	✓	✕	✕

In the table provided, you'll encounter the APS Data Capability Framework with its fundamental elements. The Data Processing Toolbar accommodates up to 26 distinct data workflows, while the EU DigComp Scanner identifies the necessary data workflows to fulfill these requirements. Notably, the Digital Literacy Skill overlooks Data Governance, leaving it unspecified within the skill set. In the context of Thailand, the Office of the Civil Service Commission (OCSC) and TPQI (Thailand Professional Qualification Institute) are deficient in areas such as Data Management, Data Governance, and Data Application due to the unique Thai context. The focus primarily revolves around digital literacy, neglecting crucial aspects of working with and preparing data, such as data organization, manipulation, Governance, culture, and ethics, which are fundamental to data-centric operations.

Data Literacy Framework Beta Version

Continuing from the gap analysis in Gap Analysis section, the researcher proceeds to develop and delineate a process outlining the basic information knowledge that government agencies should possess at an introductory level. Drawing from various established frameworks such as the EU DigComp, APS Data Capability Framework, Thailand's Office of the Civil Service Commission (OCSC) Digital Literacy [8], and TPQI (Data Analyst/Data Scientist [14]), the researcher aims to construct the Beta Version of the Data Literacy Framework.

The Data Literacy Framework Beta Version encompasses defined definitions and skill development levels for officers within the organization, categorized into six initial levels: Executives, Management, Academics, Services, Technologists, and Others. These levels are referenced from the Thailand Office of the Civil Service Commission (OCSC) Digital Literacy Framework, designed for advancing digital government initiatives. The government agencies will subsequently undergo further evaluation based on this framework, as depicted below.

- Executive (E): Stimulate IT awareness, review policies, and drive process changes.
- Management (M): Modify procedures, lead policy implementation, and develop operational plans.
- Academic (A): Analyze data, propose policies, and align with organizational strategy.
- Service (S): Provide IT-enabled services to citizens and other agencies.
- Technologist (T): Develop data technology, manage projects, and enhance inter-agency connectivity.
- Others (O): Utilize government IT resources effectively. the technology. Information for managing assigned tasks appropriately.

Table 2: Data Literacy Framework Beta Version

Components	Competencies	Definitions	Officers Level
Data Collection	Data Discovery and Collection	Identifying and gathering data ethically and responsibly, ensuring compliance with data privacy regulations and best practices.	M, A, S, T and O
	Evaluating and Ensuring Quality of Data	Assessing the accuracy, completeness, and reliability of data sources, implementing methods to improve data	M, A, S, T and O

Components	Competencies	Definitions	Officers Level
	and Sources	quality when necessary.	
Data Management	Data Organization	Structuring raw data by categorizing and grouping it based on relevant criteria, making it easier to find, access, and analyze.	A, S, T and O
	Data Manipulation	Transforming data through processes like cleaning, formatting, and restructuring to enhance its clarity, usability, and suitability for analysis.	A, S, T and O
	Data Conversion (from format to format)	Transforming data from one format (e.g., PDF) to another (e.g., Excel) to ensure compatibility and accessibility.	E, M, A, S, T and O
	Meta Data Creation and Use	Adding information about data (like its source, creation date, and description) to aid understanding and organization.	A, S, T and O
	Data Curation, Security and Reuse	Managing data throughout its lifecycle, ensuring its accuracy, security, and availability for future use and integration with other sources.	S, T and O
	Data Preservation	Taking steps to maintain data integrity and accessibility over time, following best practices and regulations.	S, T and O
Data Governance	Data Governance Basics	Understanding principles and policies to ensure data security, privacy, accuracy, availability, and compliance with legal and ethical requirements.	E, M, A, S, T and O
	Role and Responsibilities Data Governance	Defining and assigning duties within an organization to uphold data governance practices.	E, M, A, S, T and O
	Data Governance Activities	Implementing essential tasks like data classification, access control, and quality assurance to manage data effectively.	M, A, S, T and O
	Data Governance Framework	Following a structured approach to define data governance practices and achieve organizational goals.	E, M, A, S, T and O
Data Evaluation	Data Tools	Utilizing software to manage data pipelines, collect configuration information, and perform other data-related tasks.	A, S, T and O
	Basic Data Analysis	Employing techniques like summarization, statistics, and logical reasoning to understand, describe, and analyze data.	A, S, T and O
	Data Interpretation	Applying various analytical methods to extract meaningful insights and conclusions from data.	M, A, S, T and O
	Identifying	Leveraging data analysis to detect and	A, S, T and O

Components	Competencies	Definitions	Officers Level
	Problems using Data	explain problems within an organization or system.	
	Data Visualizations	Presenting data in visual formats like charts and graphs to enhance understanding and communication.	A, S, T and O
	Presenting Data Verbally	Communicating data insights and findings effectively through spoken language.	A, S, T and O
	Data Driven Decision Making	Utilizing data evidence to inform choices and actions within an organization.	E, M, A, S, T and O
Data Application	Critical Thinking	Analyzing available information, evidence, and observations to form sound conclusions based on data.	A, S, T and O
	Data Culture	Fostering a shared belief and behavior around using data to improve decision-making and organizational outcomes.	M, A, S, T and O
	Data Ethics	Adhering to ethical principles throughout the data lifecycle, including collection, generation, analysis, and dissemination.	A, S, T and O
	Data Citation	Properly referencing data sources to ensure transparency and accountability.	A, S, T and O
	Data Sharing	Making data resources accessible to others within or outside the organization for authorized use.	A, S, T and O
	Evaluating Decision Bases on Data	Using data analysis to assess and compare different options before making crucial choices.	E, M, A, S, T and O

Expert Review

The development of the Data Literacy Framework Beta Version involved the researcher gathering and selecting data experts to provide specific evaluations and opinions. Purposive sampling was employed to select interviewees with expertise in working with data, human resource development, and government sectors. These experts were interviewed using a questionnaire to assess their perspectives on the framework's development and its alignment with the needs of digital government initiatives.

Additionally, the researcher conducted interviews with experts involved in the development of digital government to gather feedback and insights on the preliminary skill levels assessed within the framework. Following this, an assessment was conducted at the preliminary level, accompanied by clarifying the recommendations integrated into the Data Literacy Framework Beta Version. Subsequently, the framework was reviewed by experts through a questionnaire in the next step, allowing the researcher to incorporate the feedback received into the creation of the next version before deployment.

Questionnaires Pattern for Experts

Data literacy – the skills to collect, manage, analyze, interpret, and ethically use data – has become essential for informed decision-making, problem-solving, and improving

services within government agencies. To assess the current state of data literacy among government officers, a comprehensive questionnaire has been designed. This questionnaire covers key areas of data literacy, including data fundamentals, data analysis and use, and the data culture and ethics that underpin responsible data practices, for example.

Data Fundamentals: Collection, quality, organization, manipulation, metadata, security, preservation, governance principles, roles, and appropriate tools.
Data Analysis and Use: Basic analysis techniques, interpretation, problem identification, visualization, presentation, and data-driven decision-making.
Data Culture and Ethics: Critical thinking, cultivating a data-focused organizational culture, ethical use, data citation, and responsible data sharing.

These questions aim to assess whether government officers possess the essential data literacy skills needed to work effectively in a data-driven environment. The questions evaluate knowledge of data collection, organization, and security, along with the ability to analyze, interpret, and visualize data. Additionally, they address ethical considerations, data-informed decision-making, and the understanding of fostering a data-centric culture within government organizations.

Assessment by Stakeholders

The researcher is currently evaluating and selecting stakeholders, including the six identified officer levels (Executives, Managements, Academics, Services, Technologists, and Others), based on expert review of the questionnaire. This ongoing assessment focuses on the operational level of personnel skill development within the organization, specifically involving early-term executives of government agencies.

In this research, the questionnaire format for assessment was tailored to correspond with competencies. The researcher devised a questionnaire utilizing a Rating Scale (Likert, 1961) with three levels: Agree, Moderate, and Disagree.

The provided questions for evaluating data literacy skills among government officers. The goal is to assess their competency in various areas of data management and use.

Assessment Structure

Scoring: A simple agree/disagree scale (1, 0.5, 0) gauges the perceived importance or skill level for each data competency.
Components: The assessment covers data collection, management, governance, evaluation, application, and the ethical considerations inherent in data work.
Sample Questions: Example questions demonstrate how the assessment translates specific competencies into inquiries for government officers.
Focus Areas
The assessment centers on determining whether government officers have the skills to:
- Collect, organize, and secure data.
- Analyze and interpret data effectively.
- Apply data insights to decision-making.
- Create visualizations and presentations.
- Understand data governance principles.
- Use data ethically and responsibly.

Output (Skillset/Competencies/Job Level/Courses/Courses Description)

After receiving additional comment form Assessment by Stakeholders Sections, the researcher will create produce results of the development of Data Literacy skills, courses, Learning Outcome (related on Bloom's taxonomy [21]) and developing into the level of skills for the subjects that should be studied and making definitions and meanings of knowing of data to be clear and there is the same point in defining it correctly.

Table 6: Samples of Skill and Courses related on Data Literacy Competency

Data Literacy Competency	Skills	Course
Basic Data Analysis	Ability to analysis data for report or working with analysis data skill	- Data Analytics for Data understanding and processing - Basic Data Analytics for government sectors.
Data Ethics	Ability to understand, follow the regulations and use the data as much as necessary for working and not infringe the privacy on data subject.	- Introduction to data ethics - Data Laws. - Data Science Ethics.

EXPERIMENTAL RESULTS

In this part we will discuss the conclusions. and summary results from interviews with experts working on data. By receiving comments Suggestions and adjustments are made. Meanings and definitions to be consistent and communicated in the same direction. For experts who agree, including adding There are some substances that experts have said should be added. Knowing the results of the interviews, each expert gave an opinion. The addition is a second version of the knowledge framework. Data Literacy Framework1.0, there will be meanings and definitions from the review as follows.

Data Literacy Framework 1.0

Table 7: The Data Literacy Framework 1.0

Skillset	Competencies	Definitions
Data Collection	Data Discovery and Collection	the process of extracting meaningful patterns from data.
	Evaluating and Ensuring Quality of Data and Sources	A data quality evaluation is a process to determine how well final products meet the original objectives of the statistical activity, in terms of the reliability from an accuracy, timeliness and coherence point of view.
Data Management	Data Organization	the process of sorting raw data into several categories and then arranging them.

Skillset	Competencies	Definitions
	Data Manipulation	the process of organizing or arranging data to make it easier to interpret
	Data Conversion (from format to format)	changing the data in one file format to another format.
	Meta Data Creation and Use	ability to modified, including its deletion
	Data Curation, Security and Reuse	Understand the meaning of data curation and why it is essential to maximize the value of enterprise data.
	Data Preservation	the act of conserving and maintaining both the safety and integrity of data
Data Governance	Data Governance Basics	to ensure data is secure, private, accurate, available, and usable.
	Role and Responsibilities Data Governance	Oversees the implementation of the entire Data Governance program
	Data Governance Activities	Understand activity to relate on Data Governance
	Data Governance Framework	Understand basic Data Governance Framework
Data Evaluation	Data Tools	an ability to use software that helps an organization collect and analyze data.
	Basic Data Analysis	the process of systematically applying statistical and/or logical techniques to describe and illustrate, condense, and recap, and evaluate data.
	Data Interpretation	the process of reviewing data and arriving at relevant conclusions using various analytical research methods
	Identifying Problems using Data	ability to identify problems while working with data
	Data Visualizations	ability to create and understand Data Visualizations
	Presenting Data Verbally	ability to verbally presenting data
	Data Driven Decision Making	can make decisions based on data
Data-Driven Decision Making	Critical Thinking	using data for critical thinking in their jobs
	Data Culture	government officers using data naturally in their work
	Data Ethics	abilities to avoid violating personal data and using data ethically
	Data Citation	ability to use data as a reference in their work?
	Data Sharing	ability to understand the principles of proper data sharing
	Evaluating Decision Bases on Data	ability to use data for work-related purposes effectively

Interview and Assessment Result

In this section, researcher delve into the hierarchical positions of the interviewees, the nature of their business affiliations, a thorough delineation of their duties and responsibilities, and an account of their professional experiences in fields pertinent to data. The purpose is to conduct a comprehensive analysis and elicit opinions that can be utilized for the evaluative process. The specific details are outlined in the table presented below.

Interviewee Background and Experience

The interviewees represent a diverse range of backgrounds and experience levels. Participants hail from private businesses, legal consulting, state enterprises, and government sectors. They hold positions ranging from middle executives and officers to department heads and senior experts. Their collective experience spans 6-15 years, indicating substantial knowledge and expertise within their respective fields. This variety of backgrounds offer valuable insights from multiple perspectives within the context of their work.

After receiving feedback from experts, opinions will be categorized into three levels: Agreement, denoted by a score of 1; Partial agreement, indicated by a score of 0.5; and Disagreement, represented by a score of 0. The determination of these levels is based on the majority consensus, with more than 50% agreement among the expert opinions considered for drawing conclusions and results. This selection criterion is applied due to the nature of the interview involving a sample group with specific recommendations and comments. Instances where agreement falls below 50% imply expert reservations regarding the alignment of job levels and subjects, suggesting potential increased individual workload. only scores surpassing the 50% threshold will be acknowledged and subjected to analysis as indicative of trends in knowledge, skill development, and recommendations for future courses.

Weight Criteria for Develop Relate Competencies and Job Level.

Table 9: Assessment Review by Expert

Skillset	Competencies	Executive Weight Criteria	Officer Weight Criteria
Data Collection	Data Risk Assessment	55.56 ~ 66.67	44.44
	Data Discovery and Collection	44.44 ~ 66.67	77.78 ~ 100.00
	Evaluating and Ensuring Quality of Data and Sources	22.22 ~ 44.44	44.44 ~ 100.00
Data Management	Data Organization	0 ~ 11.11	66.67 ~ 100.00
	Data Manipulation	0 ~ 22.22	11.11 ~ 100.00
	Data Conversion (from format to format)	0	22.22 ~ 100.00
	Meta Data Creation and Use	22.22 ~ 66.67	11.11 ~ 77.78
	Data Security	11.11 ~ 33.33	22.22 ~ 100.00
	Data Curation	22.22 ~ 66.67	22.22 ~ 100.00
	Data Preservation	0 ~ 22.22	22.22 ~ 100.00
Data	Data Governance Basics	88.89 ~ 100.00	88.89 ~ 100.00

Skillset	Competencies	Executive Weight Criteria	Officer Weight Criteria
Governance	Role and Responsibilities Data Governance	100.00	22.22 ~ 100.00
	Data Governance Activities	88.89 ~ 100.00	77.78 ~ 100.00
	Data Governance Framework	100.00	100.00
Data Utilization	Identifying Problems using Data	77.78	77.78 ~ 100.00
	Basic Data Analysis	77.78 ~ 88.89	88.89 ~ 100.00
	Data Software and Tools	44.44 ~ 55.56	66.67 ~ 100.00
	Data Interpretation	55.56 ~ 66.67	66.67 ~ 100.00
	Data Visualizations	55.56 ~ 88.89	77.78 ~ 88.89
	Presenting Data Verbally	77.78	77.78 ~ 100.00
	Data Driven Decision Making	100.00	33.33 ~ 88.89
Data-Driven Decision Making	Critical Thinking	77.78	55.56 ~ 88.89
	Data Culture	88.89	55.56 ~ 100.00
	Data Ethics	88.89	100.00
	Data Citation	22.22	55.56 ~ 100.00
	Data Sharing	33.33 ~ 55.56	44.44 ~100.00

Experts share the same opinion that building skills may require expanding definitions. In-depth details and creating course details that are divided into formats that are appropriate for both administrators Definition and adding skills that should be added in line with the courses Each course will have its suitability assessed to establish the necessity of the course for each position. Subjects studied to build skills The definition of the knowledge framework and results.

Evaluation Results

Assessing Data Literacy components requires a solid understanding of data or data analysis, backed by knowledge, expertise, and hands-on experience in the field. After gathering insights from experts, the next phase entails evaluating and producing additional outcomes, including:

- Formulating Course Codes and Names.
- Determining the Weight of Essential Courses and their relevance to different Job Levels, particularly in areas such as Data Collection, Data Management, Data Governance, Data Evaluation, and Data-Driven Decision-Making Skills and Competencies.
- Developing Course Descriptions.
- Establishing Learning Outcomes for Data Literacy Courses.

Table 10: Competencies and Course Name

Competencies	Course Name
Data Discovery and Collection	Data Acquisition, Risk, and Estimation for Executive
	Data Collection and Analytics for Executives
	Survey Data Collection and Analytics for Officers
Evaluating and Ensuring	Framework for Ensuring Quality of Data and Sources

Competencies	Course Name
Quality of Data and Sources	
Data Organization	Data Organization Essentials for Officers
Data Manipulation	Data Manipulation with Tools
Data Conversion (from format to format)	Data Conversion Essentials for Officers
Meta Data Creation and Use	Metadata Management Fundamentals for Executives
	Metadata Management Essentials for Officers
Data Curation, Security and Reuse	Data Security strategy for organizations management
	Data Curation Understanding for Executives
	Data Curation for General Officers
Data Preservation	Data Preservation Methods & Best Practices for Officers
Data Governance Basics	Data Governance Basics for Management
	Data Governance Basics for Officers
Role and Responsibilities Data Governance	Introduction to Data Governance for Executives
	Introduction to Data Governance
Data Governance Activities	Data Governance Activities for Management
	Data Governance Activities for Officers
Data Governance Framework	Data Governance for Executives
	Data Governance in Practice for Officers
Basic Data Analysis	Data Utilization for Identifying Problems in Management
Identifying Problems using Data	Data Utilization for Identifying Problems
Basic Data Analysis	Data Analytics Essentials for Executives
	Data Analytics for Officers
Data Tools	Data Software and Tools for Management
	Data Software and Tools Essentials
Data Interpretation	Data Analysis and Interpretation Specialization for Management
	Data Analysis and Interpretation Specialization for Officers
Data Visualizations	Data Visualizations for Communication in Management
	Data Visualizations for Officers
Presenting Data Verbally	Data Communications for Management
	Verbal Communications and Presentation with Data
Data Driven Decision Making	Data Driven Decision Making for Manager
	Data Driven Decision Making for Officers
	Critical Thinking for Data Analytics and Management
	Critical Thinking for Data Analytics and Data Work
Data Culture	Introduction to Data Culture for Management

Competencies	Course Name
	Building Data Cultures and Communications
Data Ethics	Data Science Ethics for Management
	Data Science Ethics for Officers
Data Citation	Introduction for Data Citation in Officers
	Data Curation for General Officers
Data Sharing	Data Sharing for Management and Executives
	Data Sharing for Officers and Data Work

In the synthesis of the findings, it is essential to ensure that Data Literacy encompasses meticulously delineated elements. This conceptual framework is intricately tailored to align with the required skill sets at various job levels within government agencies, ensuring suitability for each position. The effectiveness of this framework relies on the clear definition of outcomes and plans, as previously discussed by the researcher. This entails establishing Learning Outcomes, crafting Course Descriptions, and developing a strategic plan that aligns skill development with budgetary constraints. Additionally, careful consideration is given to the structural characteristics of the agency, accommodating its unique needs in line with desired outcomes. This holistic approach guarantees the practical applicability and viability of the proposed framework within government agencies.

CONCLUSION

In conclusion, this study emphasizes the crucial role of data literacy in today's professional landscape, especially within the governmental sector. The proposed data literacy framework is a strategic initiative aimed at empowering government officers in Thailand with the necessary skills to navigate the complexities of the data-driven fourth industrial revolution. This research delves into the critical realm of data literacy within the government sector, recognizing its increasing importance in the era of the fourth industrial revolution. The study reveals a disparity between the emphasis on digital literacy in educational curricula and the insufficient integration of data literacy skills for government officers.

Various definitions of data literacy are explored, emphasizing its role in collecting, transforming, evaluating, and communicating data. Notably, the need for a holistic approach that intertwines digital and data literacy is highlighted, as these skills operate seamlessly and concurrently. The research, centered around the Office of the Civil Service Commission's initiative to upgrade government sector skills, aims to design a comprehensive data literacy framework for government officers in Thailand. The study's objectives include conducting a gap analysis between international data literacy standards and national digital literacy standards to formulate a framework tailored to the unique needs of government officers in Thailand. The methodology involves systematically selecting relevant research papers and developing a comprehensive framework based on international standards and expert assessments. The gap analysis, using established tools such as the APS Data Capability Framework, Digital Competences Framework (DigComp 2.2), The Office of the Civil Service Commission (OCSC) Digital Literacy, and The Data Literacy Body of Knowledge (DLBOK), aims to create a model for a Data Literacy Framework with distinct levels and core components.

This paper aims to contribute to enhancing data literacy among government officers in Thailand, recognizing the transformative potential of a well-designed framework. Bridging the gap between existing digital literacy initiatives and the evolving demands of data-driven governance is crucial for the continued success of government services in the digital age. And future work should focus on practically applying the established framework within the distinct organizational landscape of government offices in Thailand. Evaluating the framework's effectiveness over time, incorporating feedback, and adjusting to advancements in technology are crucial. Potential avenues for future research include

- Practical Application: Implement the framework within diverse government offices in Thailand.
- Evaluation & Adaptation: Assess the framework's effectiveness, gather feedback, and adjust it to reflect technological advancements.
- Collaboration: Explore partnerships with educational institutions and the private sector to develop data literacy training programs.
- Evolving Framework: Maintain adaptability to keep the framework relevant within the ever-changing data landscape.
  Impact Research: Investigate how improved data literacy affects government

  efficiency and decision-making.

  Practical Outcomes: Use the research to design skill-building courses and plan for

  future organizational needs within the Thai government.

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Challenges of the 21st Century: Exploring Teachers' Perspectives on Literacy Resilience

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ABSTRACT

The education systems realized that in order for students to face new challenges, such as the challenges of artificial intelligence, and to be able to adapt to changes in the 21st century, they need cognitive and meta-cognitive skills. Literacy resilience is essential in this context.

Literacy resilience is defined as the ability to deal with literacy challenges through linguistic literacy skills in combination with SRL processes (Amir and Heisman, 2022; Amir, 2024 (under review). The combination between the two fields: linguistic literacy and SRL forms a basis for learning and can enable learners to face the challenges of the 21st century.

This essay examines the challenges of the 21st century through the lens of literacy resilience, with a specific focus on the perspectives of teachers who play a central role in fostering and cultivating the literacy resilience of their students.

409 teachers in Israel from elementary, middle and high schools participated in the study. They answered a dedicated questionnaire that tested the teachers' perceptions of the importance of literacy resilience in dealing with the challenges of the 21st century.

The research findings indicate that teachers place a high value on literacy resilience as it helps learners integrate into society and face the challenges of the 21st century. However, according to the teachers, they do not have enough theoretical and practical knowledge to cultivate reading resilience.

The findings highlight the paramount importance of literacy resilience for students in the 21st century and highlight the need for focused efforts in teacher professional development.

Keywords: 21st century challenges, literacy resilience, linguistic literacy, SRL, professional development of teachers

6   INTRODUCTION

The 21st century is unfolding with unprecedented challenges that require a reassessment of the skills essential for individuals to succeed in this dynamic era. This section examines the challenges of the 21st century with a specific focus on linguistic literacy and Self-regulated learning (SRL) skills. The 21st century poses complex challenges that demand critical thinking and problem-solving skills. Students must develop the ability to analyze situations, think creatively, and formulate innovative solutions to multifaceted problems (Trilling & Fadel, 2012). Cultivating critical thinking skills is essential for students to analyze information critically, question assumptions, and formulate informed opinions. Problem-solving skills enable them to tackle real-world challenges effectively.

6.1   21st-Century Challenges Concerning Linguistic literacy Skills

The OECD defined 14 key skills, categorizing them into three types: Literacy; Core Skills; Personality Characteristics.

Linguistic literacy is the ability to recognize, understand, interpret, produce, and communicate through texts in a variety of contexts. This includes both the ability to understand and evaluate the relevance and quality of spoken and written texts (OECD (2019; 2021).

The challenges of reading comprehension in the 21st century extend beyond traditional texts and encompass a multitude of digital sources. Therefore, reading comprehension skills are central to navigating and extracting meaning from a variety of texts. Readers need not only to understand traditional print materials but also to adapt these skills to diverse digital formats (Snow & Canto, 2018). This challenge requires individuals to cultivate strong linguistic literacy skills to effectively discern, evaluate, and synthesize information. Moreover, as readers navigate the vast digital landscape , the ability to critically engage and understand information from diverse online platforms becomes essential for making informed decisions and participating in modern discourse Anderson & Rainie, 2017; Kiili et al., 2018). The exponential growth of technology requires students to be technologically literate and adaptable. Beyond basic digital skills, they must cultivate a mindset of continuous learning, staying abreast of emerging technologies and acquiring the ability to leverage them for innovation (Weller, 2020).

As people face the challenges of the 21st century, linguistic literacy skills, including writing and text production, are emerging as key ingredients for success.

Writing proficiency remains a foundational linguistic skill. In addition to traditional writing, students must cultivate the ability to communicate effectively in diverse digital contexts, adapting their writing styles to various platforms (Graham, et al., 2017). The challenges of writing in the 21st century extend beyond the traditional realm to encompass a digital landscape where individuals engage in multifaceted text production. Writing is not just about crafting essays or reports but involves creating content for various platforms, including social media, blogs, and websites.(Kiili, et al., 2018).

In the 21st century, the advent of artificial intelligence (AI) introduces new dimensions to writing. Writers now, more than ever, engage in text production using AI platforms that assist not only in generating content but also in refining and editing texts. This shift challenges traditional notions of authorship as writers collaborate with AI tools to enhance the quality and efficiency of their writing.

This evolution in writing practices reflects the dynamic nature of modern communication. Educational systems must adapt to prioritize the development of these linguistic literacy skills, ensuring that individuals are well-equipped to navigate the complexities of the contemporary world effectively.

Linguistic literacy helps learners achieve their goals and develops their critical thinking and critical reading. However, without Self-Regulation Skills and Executive Functions, the learner will not succeed, and it will be more difficult for the learner to face new challenges.

6.2   21st-Century Challenges Concerning SRL Skills

Self-regulated learning (SRL) is a circular, conscious and intentional process by which learners achieve their learning goals. The perception of the learner as active and independent in planning (setting goals, planning time, etc.), executing (monitoring) and evaluating actions is the basis of SRL theories (Pintrich & De Groot, 1990; Pintrich, 2000; Zimmerman, 2000; Zimmerman et al., 2023). Cognition, metacognition, and motivation are interdependent components of SRL (Pintrich, 2000; Zimmerman, 2000).

Self-regulated learning skills play a central role in enabling people to adapt to the rapid pace of technological advancement. The ability to set goals, monitor progress and regulate

cognitive processes becomes necessary for continuous learning and skill acquisition (Zimmerman, 2008). SRL skills empower people to regulate their learning processes, foster adaptability and resilience in the face of evolving challenges (Paris & Winograd, 2019)**.**

Linguistic literacy skills serve as a foundation for literacy resilience. The ability to understand, interpret and communicate through language is essential for navigating the complexities of the modern world. Yet literacy resilience is incomplete without acknowledging the role of self-regulatory skills. SRL involves the ability to set goals, monitor progress, and regulate one's cognitive processes and behaviors to achieve optimal learning outcomes.

6.3   Literacy Resilience

The concept of "literacy resilience" (LR) is grounded in a theoretical framework that interconnects linguistic literacy and self-regulated learning (SRL) skills. , as illustrated in Figure 1. Literacy resilience is defined as the capacity to persist in the face of linguistic challenges and effectively navigate through a blend of linguistic literacy skills and SRL processes.

Figure 1 The Literacy Resilience Model
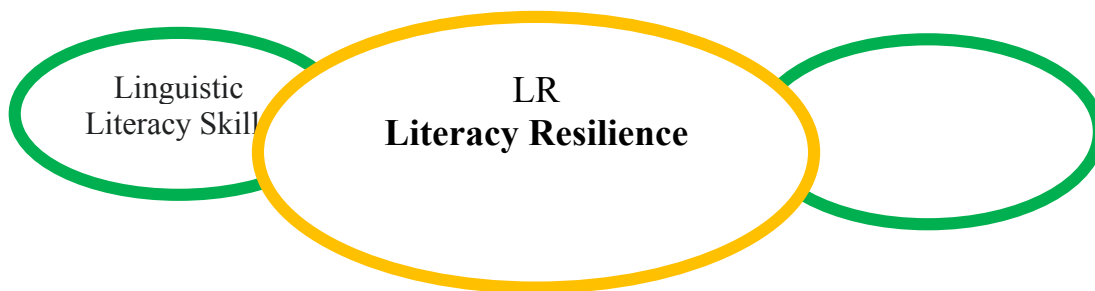
As depicted in the model diagram, literacy resilience finds its foundation in two anchors: literacy skills and SRL skills.

Self-regulated learning constitutes a cyclical process, where the student engages in a sequence of activities. Initially, they plan for a given task, outlining strategies and approaches. Following this, the student actively monitors their performance during the task, paying attention to the efficacy of their chosen methods. The crucial phase of reflection follows, wherein the student contemplates the outcome, identifies strengths, acknowledges areas for improvement, and assesses the overall process. This reflective insight becomes a guiding force for the subsequent phase, as the student utilizes it to adjust their strategies and

adequately prepare for the next task in an ongoing and iterative cycle. (Pintrich, 2000; Pintrich & Zusho, 2002; Zimmerman, 2000; Zimmerman et al., 2023).

Linguistic literacy encompasses the capacity to identify, comprehend, interpret, generate, and communicate through texts across diverse contexts. This proficiency involves not only understanding and assessing the significance and quality of both spoken and written texts but also the ability to produce such texts (Sälzer, 2018; Taylor, 2014). The learner is anticipated to adeptly command a rich linguistic repertoire, navigating seamlessly between various modalities—spoken and written—to convey clear and purposeful meanings. Mastery in linguistic literacy includes the ability to respond logically to both spoken and written texts, as well as the aptitude to organize texts with an appropriate linguistic blend tailored to the context of the discourse (Berman & Ravid, 2008; Lichtinger & Kaplan,2011). Ravid & Tolchinsky, 2002; Tolchinsky, 2022

The synergy between these components forms the basis for constructing literacy resilience. Literacy skills encompass cognitive abilities such as meta-linguistic and meta-textual awareness, while SRL skills encompass executive functions and emotional functions.

In the dynamic landscape of 21st-century challenges, literacy skills and a robust sense of self-efficacy in managing literacy tasks play a crucial role in nurturing resilience among learners. This assumes heightened significance, particularly when students grapple with challenges related to independence and encounter difficulties in executing tasks autonomously. The complexities of contemporary tasks, such as information retrieval, assessing information reliability, navigating multiple sources, integrating and synthesizing diverse information, honing research skills, engaging in critical reading, and producing coherent texts, underscore the need for a heightened level of literacy resilience. The ability to autonomously surmount these literacy challenges, coupled with a strong sense of self-efficacy, forms the bedrock of literacy resilience in the face of 21st-century demands. Importantly, this resilience not only enhances the learner's ability to navigate literacy demands but also significantly contributes to their emotional resilience. In essence, literate resilience is intricately linked to meta-linguistic and meta-textual awareness, executive functions, and emotional functions, empowering learners to effectively confront and overcome the unique challenges posed by the contemporary learning landscape.

According to this conceptualization, literacy resilience refers to a learner's ability to persevere in linguistic challenges by leveraging a combination of linguistic literacy skills and self-regulated learning (SRL) processes. This resilience is evident in the learner's independent

handling of assignments requiring diverse literacy skills, self-directed engagement with oral and written texts, proficient learning management, autonomous planning, and the execution of literacy tasks from initiation to completion. Additionally, it involves the learner's awareness in identifying challenges, selecting appropriate strategies, and engaging in reflective dialogue about their learning.

The development of literacy resilience is a gradual process, resulting from mastery in various skills (speaking, listening, reading, and writing) combined with metacognitive, meta-linguistic, and meta-textual awareness, as well as self-management. These abilities manifest in the learner's behaviors, thoughts, and self-efficacy to effectively tackle literacy-related challenges. Literacy resilience empowers learners to be independent, reducing the reliance on teacher or adult mediation over time.

Informed by the theoretical review, the study seeks to investigate two primary focal points: The significance of Literacy Resilience in tackling the challenges of the 21st century

the degree of use of activities that foster literacy resilience

7   METHOD

7.1   Procedure Instrument and Participants

The study participants consisted of teachers who voluntarily enrolled in a professional development course addressing the challenges of the 21st century. The course was structured into various content clusters, with 20 courses offered in total. Nine of these courses featured a specific cluster, comprising 12 out of the total 30 hours, dedicated to exploring the significance of literacy resilience in confronting 21st-century challenges. The cluster was delivered by instructors who had undergone training conducted by the researcher. The researcher, however, did not actively participate in the courses. The decision to exclude the literacy resilience cluster in some courses was driven by a shortage of instructors trained in this specific area. During the initial session of the literacy resilience , teachers were invited to voluntarily and anonymously complete a questionnaire. Out of the 483 teachers participating in the courses. , 391 teachers opted to fill out the questionnaire. The questionnaire was administered online, allowing participants approximately 15 minutes for completion, with additional time granted to those requiring it Table 1 below provides an overview of the key characteristics of the study population.

Table 1 Study Population - Background Characteristics

Study Population		N	%
Main teaching profession	Hebrew teachers	342	87.5%
	Other	49	12.5%
Education	Senior Teacher	17	4.4%
	BA	190	48.7%
	MA	174	44.6%
	PhD	9	2.3%
Seniority	10 years or less	120	30.8%
	11-20 years	109	27.9%
	More than 20 years	161	41.3%
Total		391	100%

The sample comprises 391 teachers, predominantly focused on language instruction (87.5%), while the remaining educators specialize in diverse subjects such as science and humanities. In terms of academic qualifications, the majority of teachers hold academic degrees, with approximately half (48.7%) possessing a Bachelor of Education (B.Ed.) degree, and a slightly lower proportion (44.6%) holding a Master of Education (M.Ed.) degree. A small percentage have earned a Ph.D. (2.3%), while a minority lack academic education (4.4%). The range of teachers' experience spans from those with no prior experience to individuals with a seniority of 43 years. The average seniority among teachers is 17.95 years, with a median seniority of 18 years (Standard Deviation: 10.64)

7.2   Research Questions

(a) The importance of literacy resilience in dealing with the challenges of the 21st century
(b) The degree of use of activities that foster literacy resilience

8   FINDINGS

The findings reported below relate to the validity and reliability of the questionnaire.
The significance of linguistic literacy in tackling the challenges of the 21st century.

The first domain is The significance of linguistic literacy in tackling the challenges of the 21st century. Accordingly, this domain should widely be seen as the degree to which teachers perceive the contribution of literacy to dealing with the literacy challenges of the 21st century.

For 10 items, as presented in Table 2 below, participants addressed each item according to the following four-level Likert scale : : (1) never (2) sometime, (3) often (4) almost always.

Table 2 The importance of literacy resilience in dealing with the challenges of the 21st century

Items	M	SD	Factor loadings
To address the requirements of the 21st century, it is important to place a strong emphasis on imparting 21st century skills (for example, cultivating critical thinking, cultivating independent learners, and developing linguistic literacy skills to effectively present, explain, or demonstrate information).	3.73	0.57	.811
To address the literacy requirements of the 21st century, it is important to develop learning assignments and other educational content on online platforms.	3.81	0.43	.848
To address the requirements of the 21st century, it is important to use different strategies to promote students' independence in learning (for example, let them deal with their difficulties on their own, encourage them to use different strategies, etc.).	3.86	0.38	.717
To address the requirements of the 21st century, it is important to encourage students to engage in reflective thinking even during and after completing the task. .	3.39	0.78	.764
To address the requirements of the 21st century, it is important to teach the students through a portfolio that includes both processes and reflective thinking.	3.39	0.76	.746
To address the requirements of the 21st century, it is important to cultivate the students' presentation, discussion and collaborative writing skills. .	2.86	1.00	.516
To address the requirements of the 21st century, it is very important to master literacy skills in reading, writing and speaking.	2.36	1.04	.656
To address the requirements of the 21st century, teachers in all fields of knowledge need to integrate literacy skills (for example, knowing how to evaluate information, merge information, write in collaborative platforms, present information, etc.) in their lessons.	2.26	1.12	.547
To address the requirements of the 21st century, teachers in all fields of knowledge need to combine independent learning skills and formulate tasks that they can do on their own.	3.53	0.80	.665
To address the requirements of the 21st century, it is important to foster	2.52	1.15	.588

Items	M	SD	Factor loadings
an environment in the classroom that supports students in developing self-management skills of their learning			
The significance of Literacy Resilience in tackling the challenges of the 21st century	**3.7**	**0.57**	
explained variance percentage			30.8%
Reliability (α)			0.870

Following the completion of the factor analysis on the ten items reflecting the significance of literacy resilience in addressing the challenges of the 21st century, the results revealed a one-factor structure with a variance of 30.8% (refer to Table 2). The Cronbach's alpha for this set of items was calculated to be .870. Participants' average scores amounted to 3.17 (SD=0.57), underscoring the high importance of literacy resilience in confronting the challenges of the 21st century.

The second domain pertains to literacy resilience, encompassing the acquisition of practices and principles that promote both literacy skills and self learning capabilities. Consequently, participants were tasked with assessing eight items, detailed in Table 3 below, utilizing a four-level Likert scale: (1) never (2) sometime, (3) often (4) almost always.

Table 3: Factor analysis on the degree of use of activities that foster literacy resilience

Items	M	SD	Factor loadings
When I conduct classes, I place a strong emphasis on instilling 21st-century skills. This includes fostering critical thinking, nurturing independent learners, and developing linguistic literacy skills for effectively presenting, explaining, or demonstrating information.	2.87	1.04	.513
I need additional guidance and knowledge in the area of literacy skills and creating tasks that encourage students to follow their learning and think about it.	2.97	1.09	.588
I use different strategies to promote students' independence in learning (for example, letting them deal with their own difficulties, encouraging them to search for answers to their questions, encouraging them to use different strategies, etc.)	2.97	0.99	.654
When I give an assignment that requires literacy skills, I promote student autonomy by encouraging them to select a strategy that best aligns to successfully complete the assignment.	2.60	1.12	.619

I develop assignments, including my own online tasks, to promote self-learning among students (at least 2 assignments per year).	1.93	0.91	.433
I explicitly integrate literacy skills into lessons alongside the development of goal-setting, problem-solving, planning, and self-control skills.	1.41	0.72	.479
literacy resilience	2.46	0.63	
explained variance percentage			7.55%
Reliability (α)			.709

After conducting factor analysis on the six items representing literacy resilience, the results indicated a single-factor structure with a variance of 7.55% (Table 3). The Cronbach's alpha for this set of items was determined to be .709. Furthermore, as illustrated in Table 3, the average scores of the participants are 2.46 (SD=0.63), signifying a moderate application of skills that promote literacy resilience.

9   CONCLUSIONS

The findings indicate a noteworthy consensus among participants regarding the significance of literacy resilience in addressing the challenges of the 21st century. Educators widely recognize the importance of fostering 21st-century skills, including critical thinking, cultivating independent learners, and developing linguistic literacy skills. There is a strong agreement on the necessity of creating learning assignments and educational content on online platforms, as well as using diverse strategies to promote students' independence in learning. Encouraging reflective thinking during and after tasks also emerges as a crucial aspect, though opinions show some variability. while there is a general agreement among participants on the importance of encouraging reflective thinking during and after tasks, there are variations in how strongly individuals hold this view. The higher standard deviation associated with this particular aspect of the survey indicates that responses were more spread out or diverse compared to other statements. In practical terms, some participants might strongly emphasize the significance of reflective thinking in the learning process, while others may have a more reserved or diverse perspective. This variability in opinions highlights the nuanced nature of educators' views on this specific aspect of literacy resilience, indicating that it might be an area where perceptions differ more significantly compared to

other surveyed aspects. It emphasizes the need for further exploration and understanding of the factors contributing to this diversity in perspectives.

Additionally, The findings reveal a broad consensus among participants regarding the perceived value of teaching through portfolios and the importance of combining independent learning skills. This alignment signifies a shared recognition among educators on the efficacy of these instructional approaches in fostering literacy resilience. However, the emergence of diverse perspectives becomes particularly evident in areas related to students' presentation, discussion, collaborative writing skills, and the mastery of literacy skills in reading, writing, and speaking. The higher standard deviations associated with these aspects indicate a greater degree of variability in participants' opinions. This variability suggests that while some educators strongly emphasize the significance of cultivating specific skills, others may hold different or more nuanced views.

Regarding the findings on literacy resilience, the data reveals a unifying factor structure with a variance of 7.55%, indicating satisfactory internal consistency. The average score is 2.46, indicating a moderate level of engagement with these activities. The standard deviation of 0.63 suggests some variability in teachers' responses, highlighting that there are differences in the degree to which teachers incorporate activities supporting literacy resilience in their practices.

The moderate average suggests that, on average, teachers are moderately engaged in activities aimed at fostering literacy resilience. However, the standard deviation implies a degree of diversity in teachers' approaches, with some being more proactive in implementing such activities while others may be less involved.

This variability could stem from a range of factors, including differences in teaching styles, perceptions of the importance of literacy resilience, or varying levels of familiarity with effective strategies. To further enhance teachers' implementation of activities supporting literacy resilience, tailored professional development programs could address these diverse needs, providing targeted support to educators aiming to enhance literacy resilience in their classrooms.

Among the findings, an interesting item stands out: "I explicitly combine literacy skills in lessons alongside the development of goal-setting, problem-solving, planning, and self-control skills" received a lower average score of 1.41. This indicates that, in practice, teachers may encounter challenges in seamlessly integrating literacy skills with the broader spectrum of self-regulated learning (SRL) skills (Heaysman, & Kramarski, 2022; Šašić. 2023).

Teachers widely recognize the importance of fostering self-regulated learning (Panadero, 2017) and mastery of linguistic literacy (Tolczynski 2022), which includes skillful movement between spoken and written discourse to represent clear meanings that focus on goals and respond logically to speech or written text (Berman & Ravid, 2008; Tolchinsky 2022). However previous studies show that teachers feel unsure how to promote students' SRL and stimulate SRL to a limited extent (Kistner et al., 2015; Šimić Šašić et al., 2023; Vandevelde et al., 2012).

In the classroom, teachers can benefit from specific interventions that bridge the gap between literacy skills and SRL skills. This may involve adapting teaching techniques, creating tailored learning materials, or designing classroom activities aimed at holistically nurturing both aspects (Kistner, 2015). Collaborative planning and reflection sessions among educators can foster the sharing of successful practices and insights, enhancing the collective understanding of how to effectively integrate literacy and SRL skills.

These findings have implications for the professional development of teachers, emphasizing the need for targeted training programs that specifically address the integration of literacy skills and SRL skills (Avidov-Ungar & Zamir,2024; Avidov-Ungar, 2023; Jansen, 2019). Professional development initiatives should equip educators with practical strategies and methodologies to seamlessly blend these two critical components into their teaching practices. Workshops, collaborative sessions, and accessible resources can guide teachers in creating a cohesive approach to literacy resilience.

In the dynamic landscape of 21st-century challenges, literacy skills and a robust sense of self-efficacy in managing literacy tasks play a crucial role in nurturing resilience among learners. This assumes heightened significance, particularly when students grapple with challenges related to independence and encounter difficulties in executing tasks autonomously. The complexities of contemporary tasks, such as information retrieval, assessing information reliability, navigating multiple sources, integrating and synthesizing diverse information, honing research skills, engaging in critical reading, and producing coherent texts, underscore the need for a heightened level of literacy resilience. The ability to autonomously surmount these literacy challenges, coupled with a strong sense of self-efficacy, forms the bedrock of literacy resilience in the face of 21st-century demands. Importantly, this resilience not only enhances the learner's ability to navigate literacy demands but also significantly contributes to their emotional resilience. In essence, literate resilience is intricately linked to meta-

linguistic and meta-textual awareness, executive functions, and emotional functions, empowering learners to effectively confront and overcome the unique challenges posed by the contemporary learning landscape.

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OPPORTUNITIES, CHALLENGES, AND STRATEGIES FOR APPLYING AI IN EDUCATION IN SOUTHEAST SULAWESI: A LITERATURE REVIEW

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ABSTRACT
The application of artificial intelligence (AI) in education is becoming increasingly popular. Artificial intelligence is developing rapidly and is now used in a variety of educational settings, including adaptive learning, school management, and improving education accessibility. While the potential benefits of AI are alluring, its implementation is fraught with difficulties. The purpose of this study is to explore the development and use of artificial intelligence in education and the barriers associated with its adoption and application. This article conducts a comprehensive literature review to assess the positive impact of artificial intelligence on improving learning efficiency, providing learning experiences tailored to individual needs, and accelerating educational management processes.
Difficulties have been identified in using artificial intelligence in education. These difficulties include concerns about student privacy, a lack of human interaction, and the changing role of teachers in the age of artificial intelligence. Additionally, budgetary and infrastructure barriers may hinder the adoption of AI in public schools. The articles included in this study examine a number of ways in which this problem can be addressed. The study's findings highlight the need to promote the use of AI in education by ensuring supportive legislation, adequate preparation and increasing educators' understanding of its use. Additionally, it is important to create adaptive courses that align with industry trends. By solving these problems, the application of artificial intelligence in education has the potential to transform the way we learn and teach, leading to a more inclusive, efficient and higher-quality education

KEYWORDS: Artificial Intelegence, Strategies, Challenges, Education, Southeast Sulawesi

1   INTRODUCTION

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The use of artificial intelligence (AI) in learning has been a fascinating and rapidly evolving topic in recent years; nevertheless, the use of AI in learning has a long and growing history. At the beginning of the development of artificial intelligence in the 1950s and 1960s, researchers began developing computer programs that could mimic human learning abilities. One example is the Logic Theorist computer software developed by Allen Newell and Herbert A. Simon in 1955 (Anyoha, 2017). This program uses symbolic problem-solving strategies to solve math problems. Advances in computer science, digital technology, and data collection have increased the use of artificial intelligence in learning in the 2010s and beyond.

The focus is on deep neural networks and deep learning methods. AI can identify complex patterns, develop better knowledge, and make accurate predictions using rich data and powerful processing techniques. Using artificial intelligence (AI) in education has significant benefits. However, the controversy surrounding artificial intelligence (AI) in education has become a hot topic in various fields. Here are some examples of debates surrounding the use of artificial intelligence in education:

a. Access Inequality: The utilization of AI in education can lead to disparities in access, particularly in countries with dissimilar technology and infrastructure. Because some students or schools have more access to AI than others, educational disparities can increase.

b. Data Privacy and Security: Concerns regarding data privacy and safety have a significant impact on the implementation of AI in education. Adequate safeguards must be in place to preserve the students' personal information and to prevent any misuse of the data obtained through AI during the collection and utilization of student information.

c. Loss of Humanity: Reviewers often criticize the idea of using AI in education for limiting educators' direct teaching about human values, compassion, and social sensitivity. Technology-based learning experiences may not provide a comprehensive, humanized perspective on education.

d. Bias and Discrimination: If AI systems are not specifically designed and executed, they are susceptible to bias and discrimination. If the computers utilized by AI systems do not take into account diversity and inclusion, their application in education may lead to an increase in existing disparities and gaps.

These debates highlight the importance of creating and implementing ethical, inclusive, and responsible AI in education. A strong AI education should take into account the benefits of technology while still maintaining a critical role for teachers, it should benefit all students without increasing the access or reducing the human component of the learning process. During the pandemic, elementary school teachers in Indonesia have a mixed opinion of online learning. Some teachers perceive the value of online education in preserving educational traditions, while others have problems with the implementation. Limited access to technology, preparation in using online learning platforms, and difficulty maintaining social connections and student participation in distance education are all factors that have an effect on teachers' attitudes (Rasmitadila et al., 2020).

Based on the findings, (Dwivedi et al., 2020) examines the disruptive impact of the pandemic on various elements of education, work and personal life. The authors examine how the epidemic has accelerated the adoption of digital technologies and remote work patterns,

forcing organizations and individuals to adapt to new information management techniques. They analyze emerging challenges and opportunities in areas such as online education, remote collaboration, digital healthcare, and the application of artificial intelligence and data analytics in response to a pandemic. They describe numerous online educational activities, such as the use of digital platforms, interactive media and mobile applications to learn English. Additionally, the essay addresses the obstacles faced by both teachers and students in transitioning to online education, such as: Such as limited internet connection, limited equipment, and difficulties in maintaining direct interaction between teachers and students (Atmojo & Nugroho, 2020).

Compared to previous experiences, Industry 5.0 symbolizes a technological revolution that brings a change in the scale, scope, complexity and transformation of human activities. This revolution is particularly characterized by the use of artificial intelligence (AI) and the replacement of human labor with robots. The difficulties and prospects of Industry 5.0 drive innovation and creativity in vocational training. The government must examine the alignment between vocational training and employment to successfully manage the changes, difficulties and opportunities brought by Industrial Age 5.0. Vocational education should be characterized by an emphasis on individual work performance, a focus on psychomotor, affective and cognitive components, and an adaptation to the changing dynamics of the professional landscape. Based on the information provided above, the following problem statement can be identified:

1. How does the use of artificial intelligence (AI) affect the learning process?
2. What are the debates surrounding the use of AI in education?
3. How does restricted access to and reliance on technology affect the use of artificial intelligence in education in underdeveloped countries?
4. What are educators' opinions and challenges surrounding online learning especially in Southeast Sulawesi?
5. What impact does the 5.0 Industrial Revolution and the usage of artificial intelligence (AI) have on education?

By articulating these challenges, readers can focus more on key issues and better understand the issues surrounding the use of artificial intelligence in education and its implications in different situations. Based on the problem formulation, the following research objectives arise:

1. Explore the impact of artificial intelligence (AI) on learning, both in terms of learning effectiveness, improved learning outcomes, and changes in learning techniques.
2. Examine debates surrounding the use of AI in education, such as: B. Dependence on technology, unequal access, loss of humanity, privacy and security, and bias and discrimination to identify challenges and possible solutions in implementing AI. In education.
3. Investigate the access limitations and technological dependencies that hinder the use of AI in education in developing countries and seek approaches or solutions to these problems.
4. Analyze educators' opinions and barriers to online learning in Indonesia and identify solutions to improve the quality of online learning implementation.

2   RESEARCH METHOD

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A literature review was used as the research method. The literature review research method is used to collect, review and analyze relevant material related to the research topic. This strategy aims to organize and synthesize previously published knowledge. According to Hart (Hart, 2018), a literature review is a systematic process that involves the collection, evaluation and synthesis of information relevant to a specific topic of study. The aim of the literature review is to understand and characterize previous research developments, identify remaining knowledge gaps and create a sound theoretical framework for the research carried out.

The data collection technique used in this study was carried out in several steps, starting with the definition of the topic and problem statement, followed by a literature review using the Scopus and Google Scholar databases with the keywords artificial intelligence, education and Indonesia. The next step is to analyze and interpret the data or literature discovered.

No.	Author	Result
1	Anutariya, C. (2020)	This article provides information on how needs-based curriculum development can be carried out in the area of data science and artificial intelligence. Through case studies in Indonesia, Sri Lanka and Thailand
2	Atmojo (2020)	This article explains how the COVID-19 pandemic has affected English language learning in Indonesia and boost the shift to online learning.
3	Butler, D., Leahy, M., Twining, P., Akcan, S., Brunton, J., Chtouki, Y., … Weis, S. (2018)	The use of ICT in education is strongly linked to the pedagogical orientation of teachers, and research has shown that computer-based interventions are more effective when combined with constructivist approaches to teaching.
4	Celik, I., Dindar, M.,	This article recognizes the increasing interest in teachers
5	Muukkonen, H., & (2022)	Use of AI and highlights the need for further research to better understand teachers' use of AI
6	Chen, Z., Zhang, J., Jiang, X., Hu, Z., Han, X., Xu, M., V, S., & Vivekananda, G.N. (2020)	The review found growing interest in using AI for educational purposes. The author emphasizes that AI has made a significant contribution to improving learning effectiveness, providing personalized learning experiences, and assisting in the development of adaptive curricula.
7	Dwivedi YK, Hughes DL, Coombs C et al	The pandemic has accelerated the adoption of digital technologies and remote work practices, forcing

	(2020)	companies and individuals to adapt to new methods of information management. They analyze new challenges and opportunities in areas such as online education, remote collaboration, digital healthcare, and the use of artificial intelligence and data analytics during pandemics answer.
8	Fauzi, Irviani, R., Muslihudin, M., Satria, F., Huda, M., Kamenez, N. V., & Maseleno, A. (2019)	This article explains that artificial intelligence has brought significant changes in various aspects of life, including in the field of education.
9	Ghufron, G., (2018, September)	One of the unique features of this revolution is the use of artificial intelligence (AI) and the use of robots to replace human labor. The challenges and opportunities of Industry 4.0 drive innovation and creativity in vocational training
10	Halili, S. H. (2019).	The use of technology in education requires a concerted effort from everyone involved. Collaboration between government, educational institutions and the technology industry is important to optimize the use of technology in educational contexts.
11	Jokhan, A., Chand, A. A., Singh, V., & Mamun, K. A. (2022)	Growing reliance on digital resources in higher education, accelerated by technology advances and digitalization of learning material.
12	Kahn, K. (2018)	Children are able to develop understanding and skills in AI programming through the use of Snap.
13	L. Hastini, R. Fahmi, and H. Lukito (2020)	The use of technology in learning can play an important role in improving human literacy in Generation Z in Indonesia.
14	Machmud, M. T. (2021)	This research highlights the role of ICT in strengthening education and teaching, as well as the government's efforts to implement educational technology in their education system.
15	Mangera, E., Supratno, H., & Suyatno. (2023)	The results of this study reveal a close relationship between transhumanism and artificial intelligence in improving the learning process in higher education.
16	Mijwil, M. M., Aggarwal, K., & Mutar, D. S. (2022)	Artificial intelligence can assist teachers in developing their skills, disseminating subject matter to students, communicating with them, and evaluating their performance through a series of exams.

17	Rasmitadila, Rusi Rusmiati Aliyyah, Reza Rachmadtullah, Achmad Samsudin, Ernawulan Syaodih, Muhammad Nurtanto, Anna Riana Suryanti Tambunan. (2020)	Some of the factors that influence teachers' perceptions of online learning include limited access to technology, readiness and competence in using online learning platforms, and challenges in maintaining social interaction and student engagement in distance learning
18	Salam, S., Jianqiu, Z., Pathan, Z. H., & Lei, W. (2017)	Schools face challenges in integrating ICT in schools such as lack of funding, hardware and software costs, outdated curriculum, interruption of electricity supply, internet connection, and lack of ICT-based teacher training.
19	Sartika, F., Ritonga, M., Lahmi, A., Rasyid, A., & Febriani, S. R. (2021)	The conclusion of this study is the need for special attention from various parties, especially in the conditions of the Covid-19 pandemic which requires activities to be carried out online, to pay attention to areas with limited internet access.
	Sudira, P. (2019)	Vocational education curricula can no longer be linear and mono disciplinary. An open, multidisciplinary and trans disciplinary curriculum covering a wide range of skills is required.
	Yusriadi, Y. (2023)	Governments can utilize AI in public services, especially in complex policy making in a changing environment that impacts economic, social and environmental fundamentals.

3   RESULTS AND DISCUSSION

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Artificial intelligence (AI) is a field of computer science concerned with the development of computer systems capable of performing tasks that would normally require human intelligence. McCarthy (McCarthy, 2007), one of the inventors of artificial intelligence, defines artificial intelligence as "the science and engineering of creating intelligent machines, especially intelligent computer programs." Russell and Norvig (Russell and Norvig, 2010) define artificial intelligence as "the branch of computer science concerned with the development of computer systems capable of performing tasks that would require intelligence if performed by humans".

The period known as the "AI winter" in the 1970s and 1980s saw a decrease in both interest and financial backing for research in the field. During this time, researchers grappled with challenges like ambiguity, insufficient knowledge, and the complexities inherent in more realistic tasks.

However, in recent years, artificial neural networks, fuzzy logic, and genetic algorithms have emerged as dominant trends in AI development. This rapid progress is fueled by advancements in computer technology, the abundance of data, and the evolution of machine learning methods. Technologies like artificial neural networks, deep learning, and statistical learning algorithms have yielded impressive results in facial recognition, speech recognition, language translation, and strategy games.

AI has made significant strides in areas like self-driving cars, robotics, natural language processing, and object detection in photos and videos. Its impact is evident across various aspects of our lives. For instance, imagine a scenario where you interact with an intelligent virtual assistant daily. In the morning, you ask for weather and news updates. During your commute, self-driving cars supported by AI ensure safe and efficient travel. At work, AI colleagues analyze vast data sets and provide valuable insights, enhancing collaboration and productivity. When you watch a movie or series on a streaming platform, you will be presented with a series of content recommendations based on your tastes and preferences. All of this is thanks to a recommendation system that uses AI to analyze audience tastes and habits. AI helps doctors diagnose and treat patients in healthcare. Doctors can use AI technology to evaluate patients' medical data, look for trends that humans might miss, and make better treatment recommendations.

Robots with artificial intelligence are employed in the manufacturing industry to perform repetitive jobs with greater accuracy and efficiency. They are more precise than humans in operating machinery, monitoring product quality, and performing other activities. On a more personal level, AI-powered voice recognition and facial recognition applications allow you to unlock your phone or access your accounts quickly and securely. Surveillance cameras capable of detecting suspicious activity or identifying persons' faces are also employed in security. To summarize, AI has brought about huge changes in many facets of our lives. AI has enhanced our experiences with intelligent and adaptable technology, from personal assistants to job automation, object identification to recommendation systems.

Governments can use AI in public services, especially when making complex decisions in an ever-changing environment that impacts economic, social and environmental aspects. The development of chatbots is an example of the application of AI. Chatbots are applications that can absorb knowledge, such as about human nature, so that computers can interpret user discussions. Chatbots can reduce barriers to in-person and telephone services by allowing this implementation of online activities, improving access and participation of communities that would otherwise not be able to use digital channels. Chatbots are used in various areas including education, e-commerce, and business. Chatbots are very useful in the world of education, especially in universities, to answer questions from students and potential students (Yusriadi et al., 2023).

AI Technology in Education
AI has greatly improved education. Picture a school where kids learn using methods tailored to them, teachers pinpoint students' needs better, and assessments are faster. AI has revolutionized learning and teaching, used in managing schools and learning itself. Learning

systems organize lessons, track attendance, and manage student data, freeing up teachers to teach.

AI is also being used to improve the accessibility of education. Students with special needs can benefit from a learning experience tailored to their specific needs thanks to artificial intelligence technology. AI can provide voice or text-based support to students with learning disabilities so they can follow lessons better. In the increasingly advanced world of education, artificial intelligence (AI) has enormous potential to increase the quality and efficiency of the learning process. With the help of AI, the learning experience of students will be more personalized, assessments will be more objective, and administrative processes will be more efficient.AI in education offers the possibility of a more inventive and inclusive educational future. The study by (Mahmud et al., 2021) was conducted through a literature study and comparative analysis of educational technology developments and policies in ASEAN countries. This study selected ASEAN countries for review based on the Information and Communications Technology (ICT) Index, with Singapore at the top, Thailand and Indonesia in the middle, and Myanmar at the bottom. According to the results, most countries are focused on expanding network capacity to enable online learning, and regulations in each country show commonalities in improving technological equity for students. Singapore is demonstrating the use of more advanced technologies, such as expanded use of artificial intelligence (AI) in classroom activities, while Thailand and Indonesia are still in the development phase.

The use of artificial intelligence (AI) in the learning process has positive effects on achieving an effective learning process. Although AI cannot replace teachers, it can support teachers in their work and develop best practices in education (Mangera et al., 2023). Various components of AI implementation support learning, including Intelligent Tutoring System (ITS), Intelligent Virtual Mentor (SMV), Voice Assistant (VA), Automatic Assessment (AA), and Self-Study (H.H). The Intelligent Tutor System (ITS) or Intelligent Virtual Mentor (SMV) allows students to apply their skills in an interactive way through tasks or exercises in specific lessons. SMV is an artificial intelligence technique currently used on various educational technology platforms, especially those available online. The use of artificial intelligence in the learning process has the potential to significantly improve the efficiency and effectiveness of learning. This technology can help teachers prepare and present learning materials, provide feedback to students, and automate a variety of administrative tasks related to the learning process. However, it is important to remember that the role of the teacher in guiding and accompanying students in the learning process remains fundamental.

According to the findings of a case study conducted by (Anutariya, 2020), creating a needs-based curriculum is crucial to produce graduates who are competent and relevant to market needs. Curricula can be developed taking into account a comprehensive understanding of the needs of industry and society, taking into account the skills, abilities and knowledge required in the disciplines of data science and artificial intelligence. This article explains how to design a responsive curriculum in the areas of data science and artificial intelligence. This article provides concrete examples of how curriculum development can be tailored to local and regional needs, using case studies in Indonesia, Sri Lanka and Thailand.

(Kahn et al., 2018) The aim of the research is to examine children's abilities to learn and apply AI programming through the use of a block programming language that is easier to understand and implement. This study was conducted in a developing country where access to technology and education is sometimes limited. The results of this study suggest that by using Snap! Be able to develop understanding and skills in AI programming. You can write rudimentary programs that leverage basic AI ideas like pattern recognition, reasoning, and decision making. This study highlights the possible use of block programming languages in AI education for young people in poor countries. Children can learn and participate in AI programming using approaches that are easier to understand and implement, which can improve their technological skills and give them prospects for a better future.

According to (Hastini et al., 2020), Generation Z is heavily dependent on mobile phones and social media. They prefer to interact online rather than in person. However, Generation Z is less able to evaluate and critically use the knowledge imparted. Your attention span is also limited and only lasts about 8 seconds. Despite advances in technology-enhanced learning approaches such as e-learning, blended learning and online learning, this research shows that the use of technology in learning has not significantly improved human literacy. In Generation Z, they continue to struggle with interpersonal communication and rely heavily on technology. Study (Hajar Halili, 2019) provides an overview of the use of technology in Malaysian higher education, focusing on the use of artificial intelligence, big data and QR codes for educational purposes. One possible conclusion is that the use of technology in education has made great strides. Artificial intelligence, big data and QR codes are being used in educational environments to improve learning processes and efficiency. Furthermore, this paper shows that the use of these technologies has the potential to change the educational paradigm. Artificial intelligence can be used to implement a more personalized and adaptive learning strategy.

The computer science discipline known as artificial intelligence (AI) is concerned with creating computer systems capable of performing tasks that require human intelligence. In the 1970s and 1980s, AI experienced a period of declining interest and funding support, referred to as the "AI winter." In the 1990s, advances in computer technology and algorithms helped revitalize the development of AI. Advances in computer technology, the availability of large amounts of data, and machine learning approach shave led to an explosion in AI development since the 2000s. AI is used in areas such as autonomous vehicles, robotics, natural language processing, and object recognition from images and videos.AI has significantly disrupted learning and teaching. AI is used to improve individual learning, school management and accessibility of education. AI can personalize students' educational experiences, track student attendance, and speed up administrative processes. AI in education opens up possibilities for a more inventive and inclusive educational future. Another study examines education technology adoption policies in ASEAN countries and shows that most countries prioritize developing network capabilities to facilitate online learning. Other publications emphasize the creation of on-demand courses in data science and artificial intelligence disciplines as a means to address industry concerns.

The employment of AI in education benefits not only pupils, but also teachers and educational institutions. In this situation, AI can assist teachers in curriculum planning,

automatically evaluating student performance, and providing pertinent comments. AI can also be used in educational institutions to handle student data, analyze learning trends, and increase administrative efficiency.

However, the use of AI in education is fraught with difficulties. Issues that need to be addressed include concerns about the loss of human interaction and confusion about the role of teachers in the age of AI. Overall, AI has the potential to revolutionize the way we learn and teach. AI can provide a more personalized learning experience, help students reach their full potential, and, when used correctly, increase overall educational effectiveness.

The study essay by (X. Chen et al., 2022) analyzes the use of artificial intelligence (AI) technologies in education over the past two decades. The results of the review indicate a growing interest in implementing AI for educational purposes. The authors emphasize the importance of AI in increasing learning effectiveness, providing personalized learning experiences, and assisting in the development of adaptive curricula.AI has also helped provide more accurate and timely feedback to students and helped teachers make learning more efficient. Overall, this article shows that the application of AI in education has made significant progress over the past two decades and holds promise for improving the quality of learning.

According to (Salam et al., 2017), the biggest obstacle to implementing ICT in public schools is the lack of funds for the education sector. Additionally, expenditure on hardware and software, outdated curricula, disruptions in electricity and internet connectivity, and lack of ICT-based teacher training are major barriers to the integration of ICT in public schools in Pakistan. This paper concludes that Pakistan faces obstacles in integrating ICT into public schools.

According to (Sartika et al., 2021), they show that local governments in areas with low internet connectivity have not effectively planned to facilitate online learning during the pandemic. Implementing online learning at these locations requires a variety of preparations and challenges, such as: B. high costs of online learning, weak Wi-Fi connections and frequent power outages. As a result, students in locations with limited internet connectivity have difficulty finding specific locations with internet access and often have to travel 15 minutes by motorcycle to reach an affordable location with signal coverage. This study concluded that special attention is required from several quarters, especially under the conditions of the Covid-19 pandemic.

(Celik et al., 2022) reviews advances in educators' use of artificial intelligence (AI), identifies gaps, and provides recommendations for future research. This article recognizes the growing interest in teachers' use of AI and emphasizes the need for additional studies to better understand teachers' use of AI. The authors expect that as AI becomes more popular in education, the number of studies on teachers' use of AI in the classroom will also increase. AI-based solutions in education often cannot fully deliver on the promise of multimodal data. This article highlights the importance of researching the use of AI in education.

The integration of ICT into the classroom environment does not lead to immediate changes in educational practice. The use of ICT in education is closely linked to teachers' pedagogical orientation, and research has shown that computer-based interventions are most effective when integrated into constructivist teaching approaches. Butler (Butler et al., 2018) analyzes

the complexity of teaching and learning through the use of ICT (information and communication technologies). This article highlights that the use of ICT in Irish schools is still largely at the level of technical competence, indicating the need to address the pedagogical orientation of teachers. Ireland's digital strategy for schools seeks to encourage teachers to adopt a constructivist pedagogical approach.

Massive changes in the style of work and work systems have occurred in different industrial sectors, including extraction, manufacture, assembly, marketing, distribution, and service, in the era of the Fourth Industrial Revolution. Industrial automation enabled by artificial intelligence (AI), virtual reality (VR), augmented reality (AR), and the Internet of Things (IoT) provides intelligent and humane production and service systems. Revolutionary shifts in the need for job competences and skills is greatly influenced by industrial systems and work processes. In order to respond to the Industrial Revolution 4.0, a significant leap in workforce skill preparation is required to keep up with the industry's revolutionary advances. The vocational education curriculum cannot be linear and monodisciplinary any longer (Sudira, 2019).

As per the findings of Fauzi et al. (2019), artificial intelligence, employing a fuzzy multi-attribute decision-making approach, is utilized to examine the educational revolution, particularly in selecting the optimal vocational secondary school. This research illustrates how artificial intelligence has catalyzed substantial transformations across various domains, including education. In the educational context, artificial intelligence serves to streamline decision-making processes in identifying the most suitable vocational secondary school. The study primarily delves into Education 4.0, which integrates artificial intelligence to evaluate student performance. Leveraging technologies like data analytics and artificial intelligence, Education 4.0 endeavors to comprehend and enhance student performance. The article centers on employing artificial intelligence to scrutinize student performance within this framework. The research methodology involves gathering data on students' academic achievements, attendance records, and engagement in learning activities.

Research conducted by Z. Chen et al. (2020) suggests significant benefits associated with employing artificial intelligence to evaluate student performance. Another study investigated the increasing trend of digital resource consumption within higher education institutions and the potential use of artificial intelligence (AI) in assessing student performance (Jokhan et al., 2022). This research underscores the growing dependence on digital resources in higher education, driven by technological advancements and the digitization of learning materials. Researchers recognize AI as a potential solution to these challenges, emphasizing its importance in collecting and analyzing data on students' digital resource usage. This enables the identification of patterns, trends, and correlations that can inform decision-making regarding student performance.

This article also emphasizes the relevance of teachers' awareness of the applications of artificial intelligence and the use of these technologies, as well as their impact on students. In addition, it is recommended that the government provide teachers with productive technology to support their work, establish standards that serve the e-learning sector, and organize more training and workshops that will help spread the culture of artificial intelligence and... E-

learning is required. and how it contributes to the development of a new generation capable of serving the country now and in the future (Mijwil et al., 2022).

4   CONCLUSION

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This system uses artificial intelligence technology to evaluate student data and provide learning recommendations based on their specific needs. This approach allows students to learn at their own pace and in their own way, increasing learning effectiveness and academic success. Artificial intelligence can also help teachers in teacher development. This system uses artificial intelligence technology to evaluate student data and provide learning recommendations based on their specific needs. This approach allows students to learn at their own pace and in their own way, increasing learning effectiveness and academic success. Artificial intelligence can also help teachers develop their skills, distribute learning materials to students, communicate with them, and evaluate their performance through a series of exams.

Additionally, artificial intelligence helps teachers generate content that meets the needs of their students while ensuring learning. to improve their skills, distribute learning materials to students, communicate with them and evaluate their performance through a series of examinations. Additionally, artificial intelligence helps teachers generate content that meets the needs of their students while ensuring learning.

However, the employment of AI in education in Indonesia is fraught with difficulties. One of them is the region's lack of basic infrastructure, particularly steady and fast internet connectivity. Furthermore, there are also hurdles in incorporating AI into existing education systems, such as teacher training and raising awareness of AI's potential to increase learning. To maximize the application of AI in education However, the use of AI in education in Indonesia is fraught with difficulties. One of them is the lack of basic infrastructure in the region, especially a stable and fast internet connection. There are also barriers to integrating AI into existing education systems, such as teacher training and raising awareness of AI's potential to improve learning. To maximize the use of AI in education in Indonesia, collaboration between the government, educational institutions and technology companies is required. AI-related investments are needed in technological infrastructure and teacher training. Overall, the use of AI in education in Indonesia has the potential to significantly increase the quality of learning and provide a more personalized and effective learning experience. Through continuous efforts to overcome obstacles and ensure proper implementation, the use of AI in education in Indonesia has the potential to create tremendous benefits for students, teachers and the education system as a whole.in Indonesia, collaboration between the government, educational institutions, and technology businesses is required. AI-related investments in technology infrastructure and teacher training are required.

Overall, the use of AI in education in Indonesia has the potential to significantly increase the quality of learning and provide a more personalized and effective learning experience. Through continuous efforts to overcome obstacles and ensure proper implementation, the use of AI in education in Indonesia has the potential to create tremendous benefits for students, teachers   and   the   education   system   as   a   whole.

5   SUGESSTION

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The use of artificial intelligence in education can bring significant benefits. While AI can be used to optimize the learning process, create personalized learning experiences based on student needs, and increase efficiency in school administration, it is crucial to maintain inclusion and equity when building education systems based on AI. Let's consider student privacy issues, the lack of human interaction, and the role of teachers in the future of AI. Ensure that the use of AI in education respects human values and promotes the social interactions necessary for learning.

Further research into instructors' growing interest in employing AI can be conducted. As a result, more research is required to better understand teachers' usage of AI. Focus research on teachers' usage of artificial intelligence in the classroom and the advantages of employing multimodal data in AI systems to better understand teaching and learning processes. In the face of revolutionary changes in industry and labor systems in the Industrial Revolution 4.0 age, the vocational education curriculum must be updated. Ensure that the curriculum is open, interdisciplinary, and transdisciplinary in order to cover many skills that are relevant to the needs of an intelligent and humanistic industry; thus, a responsive curriculum is required.

CONFLICT OF INTEREST
The authors have no actual or apparent conflict of interest with respect to this acquisition process.

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EMPOWERING TOMORROW'S MINDS: A HOLISTIC APPROACH TO EDUCATIONAL DEVELOPMENT IN THE DIGITAL AGE THROUGH LITERATURE REVIEW

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ABSTRACT

This study examines how holistic education can provide a solid foundation for the development of 21st century skills, particularly in the context of the ever-evolving digital age, and examines the impact of holistic education in managing the dynamics of the "digital age". This study used a qualitative approach and literature reviews were conducted using descriptive analysis techniques. The results of this research show that holistic education has proven to be a comprehensive solution to the challenges and dynamics of the digital age. Furthermore, given the rapid changes and complexity of the digital age, holistic education demonstrates its importance by providing an effective foundation for addressing current challenges and supporting students' development to prepare them for the future. This study compares educational innovations in different countries and highlights the role of technology in changing learning paradigms. In addition, the research highlights the rapid progress in mobile learning and the development of artificial intelligence technologies in the educational context. The importance of using technology intelligently and responsibly to provide feedback, as well as the need to adhere to ethical principles and academic integrity, will be taught. Overall, this study highlights the potential of a holistic integration of education and technology as solutions to address the challenges of the digital age. Holistic education not only imparts information, but also contributes to personality development and prepares younger generations to become strong leaders in the future.

KEYWORDS: Digital age, 21st century learning, holistic education, holistic development, innovation

15   INTRODUCTION

The digital age is still evolving and technological change is having a significant impact on various aspects of life, including education. Some of the emerging challenges are related to various factors such as technological advancements, globalization and changing socio-economic dynamics. Therefore, adaptation and innovation are necessary in the world of education to keep up with current developments. Education is very important to train every person to meet the demands of the ever-changing times. This change is inevitable at various levels of society, as tsunami-like scientific and technological advances cannot be controlled by any group. This development does not take into account the social status of the community, be it low, high, underdeveloped or rural, but continues to expand until it reaches the local rural level (Hermansyah et al., 2021).

The world of education needs innovation to evolve and follow the development of other areas. Innovations in education must be measurable and constantly improved to reach better levels. Quality education is linked to knowledge, technology and creative achievement. Educational innovation requires the use of technology. Technology plays an important role in driving innovation in education. There are many things that can use technology in education, such as the learning process. The teaching materials used may rely on technology.

Today, traditional skills are no longer enough as technological developments and the global situation become more complex as the digital age advances. Therefore, it is necessary to adapt to advances in digital technology so that individuals can learn essential 21st century skills such as problem-solving, creativity, digital literacy and collaboration skills to thrive in an environment characterized by the dynamics of the digital age to be and be relevant. This also gives rise to the need for broader and more comprehensive skills than just the imparting of conventional knowledge, which is why today's education should focus not only on imparting information, but also on training individuals with contemporary skills. This issue highlights the need for holistic education as a comprehensive means of providing students not only with knowledge but also with the ability to apply these skills in everyday life. Therefore, a holistic education that focuses not only on academic teachings but also pays attention to social, emotional and spiritual life greatly supports the development of 21st century skills.

Educational technology offers students various opportunities to make meaningful connections to the world. For example, collaboration online courses allow users to collaborate on projects and tasks in real time and from anywhere. At the same time, virtual excursions use virtual reality and video conference to explore remote places. Likewise, live -streaming events allow students to attend lectures, seminars, and other events held in various locations. Finally, online mentoring and internship programs allow students to gain valuable experience and knowledge in their fields of interest from experienced professionals. Information and communication technologies have revolutionized the way people communicate and collaborate inside and outside the classroom. These advancements enable people to work together more effectively while creating new collaborative and educational opportunities. In particular, video conferencing tools such as Skype, Zoom, and Google Meet enable remote users to interact face-to-face over the Internet. Additionally, online collaboration tools like Google Docs, Asana, and Trello encourage teams to edit documents, projects, and other tasks in real time. Digital platforms like Microsoft Teams also facilitate quick communication between team members across different channels around different topics or tasks. Lastly, social media can be used to join forces with others and spread information and opinions quickly. These technological advances have undeniably increased individuals' ability to connect and collaborate effectively.

This is in line with Mardhiyah's (2021) view that learning in the 21st century is not only about the use of knowledge but also about the development of skills. Trilling and Fadel (2009),

citing Fajri and colleagues (2021), stated that key competencies in the 21st century context include the ability to learn and innovate. These include fundamental skills such as problem solving, critical thinking, communication skills, collaboration, and the ability to create and innovate. Today, the focus is on media, information and technology (ICT) skills, including literacy, media literacy and the use of information and technology communication (ICT). The third competency covers life and work and emphasizes the ability to lead a flexible and adaptable life and work, initiative, independence, social and intercultural interaction skills, productivity, responsibility, and leadership and accountability. While basic skills such as reading, writing and numeracy remain important, additional skills such as creativity, critical thinking, effective communication and collaboration will become increasingly important as the challenges of the future grow, become broader and more complex.

Wrahatnolo and Munoto (2018) also found that knowledge is an important resource for young job seekers, but teamwork is actually desirable. Teamwork can be developed at a young age by giving students the opportunity to work in groups. Research shows that modern technology can be a valuable tool for developing critical thinking in students. To achieve this goal, several approaches have been proposed, such as using simulations and online games to encourage players to think analytically and design solutions in virtual situations. The importance of 21st century skills is evident in responding to global changes such as information technology, globalization and others. Although these are important, we emphasize that traditional skills such as reading and mathematics, the so-called basic skills, still form the basis for the development of other skills. This basic knowledge should not be forgotten. In the context of complex changes, particularly technological and organizational ones, complex and specialized skills are required. Developing21st century skills often occur in parallel with these specific skills. Therefore, ignoring any of them can pose a risk. Pedagogical and policy approaches must recognize that individual capabilities include interactions between basic skills, technical skills and 21st century skills. It is important to consider 21st century skills in the context of the underlying key competencies as well as the specific skills associated with them in specific goal-oriented activities.

This study examines how holistic education can provide a solid foundation for developing 21st century skills, particularly in the ever-evolving digital age. To strengthen the link between holistic education and the integration of specific elements, the study examines in more detail how a holistic approach supports the development of 21st century skills in line with digital development. Therefore, this study is expected to provide a detailed insight into the role of holistic education in preparing people for the changes of the digital age and the benefits of technological advancements. By better understanding this concept, we hope that this research also provides a broader perspective for designing educational policies that meet current needs.

16   METHODS

This research used a qualitative approach by studying the literature using descriptive analysis techniques. Literature study is a research approach that involves collecting and analyzing data through reading, note-taking, and research methods of literature (Purna et al., 2023). The data collection technique used is review of different types of literature such as: books and journals published domestically and abroad that are relevant to the issues discussed in this research. In this way, researchers can gather supporting information from various literature sources on the relevance of holistic education for the development of 21st century skills in the digital age.

17   RESULT AND DISCUSSION

17.1   Holistic Education in 21st Century Skills Development

Holistic education plays an important role in managing the dynamics of the current digital age. According to Widyastono (2018), holistic education is an approach in the world of education based on the idea that a person is fundamentally capable of achieving identity, meaning and purpose in the world through their connection with society, the natural environment and spiritual values to find life. In other words, holistic learning involves strengthening all dimensions of students, such as mind, heart and body, with the aim of exploring their own great potential to contribute to the environment around them (Zandroto & Indriani, 2023). In line with this, Miller (2005) said in Widodo (2021) that holistic education refers to education that develops the potential of all students in a balanced and integrated manner. This potential includes intellectual, emotional, physical, social, aesthetic and spiritual aspects in harmony.

In the field of education, the method is holistic education an education that develops the whole and intact person develop all human potential, including socio-emotional potential, intellectual potential, moral potential or character, creativity and spirituality. The aim of a holistic education is the development of the whole person. Meanwhile, a holistic person is a person capable of self-development all the potential that exists within him. Holistic education is a educational methods that develop people as a whole develop all potentials, including socio-emotional potential, intellectual potential, moral potential or character, creativity and spirituality. The potential that exists in humans includes academic potential, physical potential, social potential, creative potential, emotional potential and potential spiritual. People who are able to develop their full potential is a holistic human being, that is, a true human disciple who is always present realizes that he is part of a living system is big, so we always want to make a positive contribution to the environment of his life.

The aim of this holistic training is to optimize the abilities of each individual through a fun, democratic and balanced learning experience (Juliani & Widodo, 2019). Therefore, through experiences in the context of a holistic education, students are expected to be able to explore and explore various aspects of themselves. This means that students are given the psychological freedom to make informed decisions, learn according to individual style, develop social skills and shape their character and emotional aspects (Yogiswari, 2018).

In addition, Liang and Lin (2023) say that holistic education has characteristics including: 1) By emphasizing individual differences and diversity, holistic education recognizes that every student is unique, including different interests, abilities and learning styles. Learn. The main point is to recognize and respect students' individual differences and provide personalized learning support to meet their developmental needs. 2) Emphasize holistic development. Holistic education focuses on the development of various aspects of students, including those who are intellectuals, emotional, social, moral and physical (Hai-ling Guan, 2019). The focus is not only on the development of academic knowledge and skills, but also on the development of character, values, interpersonal relationships and health. Thus, this approach aims to ensure that the values of "diversity" and "unity" can be applied in the educational environment, 3) promoting the development of lifelong learning skills. Holistic education promotes students' skills and awareness of lifelong learning. This approach focuses on students' independent learning, active exploration and critical thinking, while forming sustainable learning skills capable of adapting to change and contributing to sustainable development, 4) paying attention to creativity and communication skills. Student critical thinking, holistic education encourages students to improve their ability to think

independently, problem-solving skills and innovative skills while improving the understanding and analysis of knowledge and information.

In line with this, Rudge in Rahman & Mewengkang (2023) states that there are several principles of holistic education, namely 1) Education is a journey of lifelong learning that involves personal growth and development, 2) Education combines diverse knowledge into a holistic whole, 3) Education involves change and achieving higher levels of progress and aims to achieve balanced health and overall well-being. The holistic education method strategy explained by Kholik (2020) includes several points, including 1) the implementation of transformative learning. Transformative learning emphasizes profound changes in students' understanding, attitudes, and behavior. This is a learning process that allows students to reflect on their own values, beliefs and viewpoints, allowing them to see the world from a different and broader perspective, 2) through flexible learning practices. Flexible learning processes enable adaptation to different situations, individual differences and different learning needs. This includes the use of learning methods and strategies that can be adapted to the preferences and needs of the students, thus offering room for variations in the understanding, processing and application of information, 3) the implementation of problem solving through an interdisciplinary approach. This allows students and educators to view a problem from multiple perspectives rather than focusing on just one viewpoint or area of knowledge. It involves combining ideas, theories and knowledge from different disciplines such as social sciences, natural sciences, humanities, technology etc. and 4) providing a meaningful learning experience. Meaningful learning experiences focus not only on the absorption of information, but also on deep understanding that influences how students see the world, develop skills, and acquire knowledge relevant to their lives.

Holistic education, as Ganeshan and Vethirajan (2023) point out, brings important benefits to students, teachers, schools and society by providing students with the necessary tools to improve their academic performance and develop essential life skills that will help them enable a successful professional career. the future. Additionally, Ganeshan and Vethirajan (2023) explain that holistic education by addressing individual learning styles and creating a supportive learning environment can improve academic outcomes for all students, regardless of their background or circumstances. In a supportive environment that emphasizes academics as well as social and emotional development, students have a greater chance of developing self-awareness, self-confidence and social responsibility. Students who are exposed to solving real-world problems through project activities can develop strong critical thinking skills. These hands-on projects teach skills that will be useful to students in the adult workforce, including data collection, analysis, reporting, and collaboration with colleagues. In addition, a holistic approach to education has been shown to reduce the psychological impact of problems such as violence, abuse or poverty on academic performance by reinforcing the principles of blended learning. Holistic education is not just about imparting academic knowledge, but also takes into account holistic aspects that enable students to develop holistically.

In this digital age, where change is rapid and complexity is increasing, holistic education provides a solid foundation to prepare people to adapt, be creative and develop a deep understanding of the environment around them. Through its principles, holistic education makes a positive contribution to human development that meets the challenges of the times. The 21st century is the digital age, all areas including education have adapted to technological advancements. These changes require that the education system better prepares students to develop 21st century skills to address increasingly complex challenges today and in the future (Muhali, 2019). 21st century skills are a set of skills considered critical to meeting the challenges of the rapidly evolving modern world. The partnership for 21st Century Skills groups 21st century skills into three categories: learning skills (creativity and innovation;

critical thinking and problem solving; communication and collaboration), literacy skills (information literacy, media literacy, online literacy, ICT) and life skills (Flexibility and adaptability; initiative and self-direction; social and intercultural skills; productivity and responsibility; leadership and responsibility) (Van Laar, 2020).

In the educational context, the focus is on the development of 21st century skills aimed at preparing students to cope with the changes in social, economic and technological aspects that are taking place in the information age (Lubis et al., 2023). Therefore, it is very important to prepare students to adapt to any change. In accordance with this, the objectives of national education contained in Article 3 of Law No. 20 of 2003, which states: "National education has the function of developing skills and shaping the character and civilization of a worthy nation, to educate the life of the nation, with the aim of developing the potential of students, "To become people who believe in and are devoted to Almighty God, have a noble character, are healthy, knowledgeable, capable, creative, independent and a democratic and responsible citizen." To achieve this goal, education must continue to adopt approaches that can adapt to technological advances and developments and develop the skills required in the digital age. As reported by Lubis et al. (2023), education focused on 21st century skills aim to produce students who have the ability to be independent, creative, collaborative and adapt to change.

This type of education aims to train people who are capable not only of acquiring academic knowledge but also of skills and attitudes relevant to the needs of the dynamic modern world. The reason for the need to draw students' attention to 21st century skills in the education system is to be able to adapt to changing times. These changes are often related to several factors, including: (1) a shift in the world of work from an industrial production model to a rapidly changing, technology-driven, interconnected global economic growth environment that requires skills appropriate for economic development. and a dynamic, difficult to predict social development; (2) new insights to optimize learning, including the use of technological innovations to deepen and change learning methods; and (3) changes in expectations coming from students themselves, demanding a more connected and relevant education system for their daily lives (Muhali, 2019).

Dewi et. al, (2021) argue that understanding literacy is related not only to language skills but also to the social context and its application. Additionally, the American Association of School Librarians (AASL) says that students must develop four competency components to improve their information literacy, including the ability to research, think critically and acquire knowledge, draw conclusions, make decisions based on accurate information to meet, apply and create. To share knowledge, share knowledge and participate ethically and productively as members of society, because these skills are also considered skills of the 21st century (Cevik, 2019).

Research conducted by Rianawaty et.al (2021) shows that holistic educational practices at SMA Negeri 10 Malang have succeeded in making it a school that is different from other educational institutions. They implement this through extracurricular activities called "Learning to Live" where students have the opportunity to develop their talents, think creatively and learn to socialize through these activities. Furthermore, they said that the 21st century holistic educational model implemented at SMA Negeri 10 Malang is conceptually an education that explores individual potential in a fun, democratic and humanistic learning atmosphere, through the integration of 4H : Head (intellectual), Heart (emotional, social and spiritual), Hand (skills) and Sane (health) through experience and interaction with the environment and The results of this research show that SMA Negeri 10 Malang prepares students not only for academic excellence, but also to become balanced, creative people who make a positive contribution to society, in line with the needs of current developments, especially digital ones era. Especially in the increasingly digital age, this holistic training

proves its relevance in preparing students to use their 21st century skills to meet the demands of constantly changing times. Therefore, the results of this research provide a solid foundation for understanding the positive impact of holistic education in SMA Negeri 10 Malang and its impact on students' development in addressing current challenges.

The concept of character education written by Thomas Lickona emphasizes the importance of education that covers all aspects of student behavior. The basic ideas of moral knowledge, moral feelings and moral behavior proposed by Thomas serve as a guide for character experts. Generally, in character education, teachers are considered role models for students to emulate (Napratilora, Mardiah, and Lisa 2021; Suyudi and Wathon 2020; Ulfa 2019; Wulandari et al. 2020).

17.2   The Relevance of Holistic Education to the Challenges of the Digital Era

Holistic education in the digital age combines traditional educational concepts with modern technology to create a comprehensive learning environment. A holistic approach to education taps into the potential of each individual intellectually, emotionally, socially, physically, artistically, creatively and spiritually. The goal of a holistic approach is to invite students to actively participate in the learning process and instill in them personal and collective responsibility (Ganeshan & Vathirajan, 2023). In the digital age, technology has become a very important tool to support holistic education. 's online learning platforms, mobile applications and other technologies enable broader access to information, interactive learning experiences and approaches that can be tailored to individual needs. Holistic education in the digital age also requires teachers trained to integrate technology into the curriculum and daily learning.

Oktarina et al. (2023) said that the challenges of education in the digital age, especially in Indonesia, are now discussing not only classic issues such as equality and compliance with educational access and infrastructure, but also the quality of graduates who are able to do so with the requirements of current developments compete. Therefore, teachers must be able to adapt to changing times and first master technology to adapt to students. Not only are students expected to be proficient in digital technology, but educators are also expected to be able to use and operate information technology systems. Therefore, an educator is not only a learning facilitator but also a mentor who helps students develop the skills necessary in the digital world, such as digital literacy, critical thinking and the ability to adapt to technological changes. In settlement with this, Sihotang et al. (2019) said that teachers are expected to demonstrate maximum professional competence to prepare students for changing times. Educators are able to design and integrate various, different and interesting teaching patterns and methods according to the needs of the times, so that students can improve the skills, quality and development of teaching materials provided by educators. Educators (Ita, et al., 2022)

Singh (2016) said that there are several issues and challenges to be addressed in the context of advances in the digital age in relation to students and learning, including 1) the problem of required skills and the development of 21st century skills such as a "new form of skills" for students. This involves the development of digital skills and basic knowledge of information and communication technologies (ICT). In addition, skills are required to intelligently access and use digital resources, including search engines, publishing, artificial intelligence and the like. 2) Challenges related to social responsibility, both at the community level, the role of teachers and the responsibility of students, 3) Challenges related to data storage: Large amounts of data are generated every day, creating a need for more data storage space worldwide. Other concerns include the possibility of minor data loss, which may result from accidental deletion, intentional or unintentional corruption, theft, obsolescence, as well as

various types of accidents, disasters, whether natural or as a result of human activities, and various forms of cyber warfare, 4) Access difficulties, situations in which certain data may be well preserved but become unreadable due to loss of interpretation keys, reduced compatibility or other reasons, and 5) Validity of data, it is important for students to be aware of this Your task is to ensure the authenticity, reliability and validity of the retrieved data before it is used.

Another idea is to provide more concrete examples that illustrate the challenges of the digital age. This will help the reader better understand the issue and relate to it personally.   Finally, it may be helpful to provide some practical suggestions or strategies to address the challenges mentioned in the text. This makes the content more action-oriented and allows readers to apply what they have learned in their own lives. The following solutions to these challenges are: 1) Skills challenges require the implementation of a program that prioritizes the development of 21st century skills, including digital skills and core ICT skills (UNESCO, 2019), as part of a holistic educational integration. This shows that students not only understand the topic, but also have the navigation and technology skills required in the digital age; 2) Challenges related to social responsibility require education that promotes social responsibility and involves the community, teachers and students in building responsible values (Miseliunaite, et.all: 2022).

Holistic education emphasizes the importance of character development and moral values as key elements of the educational process. Teachers act not only as information providers but also as guides, helping students understand their role in society and the impact of their actions on the environment. 3) Addressing data storage challenges requires developing effective data management policies and infrastructure, including secure data storage (Joshi, 2021). Holistic education encompasses much more than just academic aspects; Also consider integrating technology and data management into the learning process. For example, you could ask students to understand the urgency of data security and the ethical use of technology so that they not only understand the topic but also become aware of the social and security implications of technology. 4) In order to overcome access difficulties, it is necessary to improve educational technological infrastructures, train teachers and students and develop systems that reduce access barriers (Sachan, 2023), which points to the need for a holistic approach that does not only consider technological aspects , but also ensures that everyone involved has the necessary understanding and skills to use technology for holistic learning purposes; 5) Challenges related to data validity require greater information literacy among students to assess the validity and reliability of digital resources (UNESCO, 2019); This refers to the need to fully align information literacy with the Holistic education focuses not only on the development of academic knowledge but also on the development of critical skills. This includes students' ability to meaningfully filter, evaluate and use information to promote holistic understanding.

Faced with the challenges of the digital age, holistic education offers a comprehensive solution. The main objective is to promote 21st century skills, including digital literacy and basic ICT skills, to equip students with the necessary technological competence. Holistic education emphasizes not only academics but also the cultivation of character and moral values. Promotes social responsibility and seamlessly integrates technology into learning. By combining traditional educational values with modern technology, holistic education aims to develop academically fit, physically and mentally healthy and socially responsible people who are ready to meet the changing challenges of the world.

As images of God, students should be formed in their entirety and not just in part, as is the case in the secular perspective. Christian teachers must be able to see and teach holistically, including planning contextual and appropriate learning content so that students can recognize tolerance and develop their talents. Implementing holistic education in the classroom requires

caring interactions and holistic assessment of students. As a recommendation, the researcher suggests that future research should focus on implementing holistic education in primary schools and identifying the challenges faced by teachers. (Zandroto & Indriani, 2022).

17.3   The Role of Innovation in Education

One of the innovations in the world of education is the use of digital technology. The introduction of new technologies in schools is imperative, but must also be adapted to the specifics of educational students. Ambarwati (2020) said that innovation is important in education to stay current. Teachers must have digital skills and continue to improve the quality of learning. The use of technologies such as online platforms and digital content facilitates access to learning without time and space restrictions. Although technology has both positive and negative impacts, collaboration is required to minimize negative impacts. Educational innovations based on technology must be supported by society. The government must assess the impact of this innovation and promote the improvement of teachers' skills in using technology. All segments of society are expected to support technology-based educational innovations and further evaluation is needed to understand their impact.

In technology acceptance model (Davis, Bagozzi & Warshaw, 1989), perceived usefulness is key predictors of effective technology use. Changes in educational practice depends on the teacher's perspective on teaching and learning. Sensitive to innovations Improved technologies are also an important indicator of the acceptance of innovations. The company responds to current trends in educational innovation in a variety of ways. Number Countries want to implement this technology-based education innovation; while in some other countries have not yet embraced the innovation trend in technology-based learning and others new developments in education in today's developed countries such as: online learning, distance learning and e-learning in the natural sciences university level. The following is the comparison of educational innovation in several countries for Table 1.

Table 1 Educational Innovation in Countries

	Innovation in Education
America and England	America and England continue to promote practical educational innovations through ICT-based platforms (Sheehy dan Ferguson 2008). Since the 1970s, British teachers have viewed technology as a tool that can give students more freedom and control over their learning.
China	Teaching innovations were introduced The Chinese government's goal to build education in the future is the use of technology IT as a tool for developing learning throughout the school e universities in China are developing a vision of Chinese education as education global market leaders of the In 2015, the Chinese government even managed to establish an education system is based on Internet technology and e-learning, which have been subjected to various experiments compares the progress of the British and Chinese school systems. Speech on the topic of academic success China responds to the "shortcomings" of its previous and subsequent education systems In the British education system took over. (Paker, 2000)
Japan	Innovation and educational research Technological development in Japan is a technology-based education system that facilitates the dissemination of intellectual property to the Japanese public through online education learning. Through this system, Japan has built world-class educational institutions which enable the rapid development of science and technology. But carry on In its application, Japanese educational innovation was widely imitated by Asian countries at the time, including Indonesia—for example, the use of robot technology in innovation and future training. (Zen, 2018)
Nigeria	Technological innovation in Nigeria is being held back due to weak intellectual property and copyright laws. This is further compounded by poor practices and non-compliance with ICT policies such as corruption, and lack of acceptance of research databases, which hinder the development of new innovations and negatively affect sustainable development. In order to drive Nigeria's economic growth and social change, it is crucial to raise awareness and provide training to researchers in higher education institutions. This will enable them to better understand and implement technological innovations. (Aguboshim, 2021)
Indonesia	The phenomenon of character transfer in the digital age occurs while learning Islamic religious education still relies on limited face-to-face encounters. Although there are several obstacles, teachers still strive to instill the values of character education. The success of education depends on three main centers: teachers (schools), parents and the environment. Character transfer is done via WhatsApp by sending a video link to YouTube and playing the video in a face-to-face meeting. The biggest challenge is that teachers cannot directly monitor students' character, activity and behavior at home. In addition, students have limited opportunities to use educational media. Therefore, the role of parents in supporting students in the learning process is very important. (Yusuf, 2022)

Interactive learning videos and content tailored to student performance levels ensure personalized and flexible learning. online learning platforms allow students to access learning materials from anywhere in the world, overcoming geographical limitations. Students can study at times that suit their schedule, increasing their flexibility and enabling independent learning. The use of technology in the learning process helps increase student engagement through interactive learning experiences. Another major challenge is the need for reliable

internet access, which remains a barrier in some regions. Student Engagement: Creative approaches are needed to ensure student engagement and active participation in online learning.

The world of education needs innovation to evolve and follow the development of other areas. Innovations in education must be measurable and constantly improved to reach better levels. Quality education is linked to knowledge, technology and creative achievement. Educational innovation requires the use of technology. Technology plays an important role in driving innovation in education. There are many things that can use technology in education, such as the learning process. The teaching materials used may rely on technology.

Likewise, academic research has seen and is likely to continue to see an increasing trend towards international collaboration and competition. In both education and research, we are observing a trend towards reducing North American dominance and increasing European and especially Asian influence. Increasing global competition has led and will continue to lead to a move toward a more market-oriented approach to education and has contributed to the erosion of boundaries between public and private education.

2.4 The Rapid Advancement of Mobile Learning: Latest Concepts and Technology Equations

If we want to define m-learning, we have to cover the pedagogical and technical dimensions of both at the same time, and this is not an easy task, especially when we have to take into account different contexts, situations and environments.

In a study by Ennouamani et.al. (2020) introduced the D-MALCOF (Dynamic Mobile Learning Content and Format) model. In his research, he explains that the model is designed to combine mobile learning and adaptive learning. This model aims to provide learning that adapts to the characteristics of different learners, eliminating unnecessary chapters and ensuring that students study each section of the course to achieve educational goals. Android application development based on this model shows good results in tests and increases the level of knowledge of students.

Although some students were dissatisfied with the adaptation of the format, this study plans to improve this by integrating additional multimedia presentation formats. The project is still in the early stages of development and evaluation. There are plans to develop specific modules for teachers to monitor student progress. It is expected that this application can make a significant contribution to improving the learning outcomes of mobile students in various contexts, and further testing will be carried out involving more students and obtaining input from teachers.

2.5 Development of artificial technology

Advances in artificial intelligence (AI) have transformed the traditional role of a teacher, enabling educators to teach and learn more effectively. Applications of AI, as seen in various forms of education such as MOOCs, blended learning and flipped classrooms, are having a significant impact worldwide. A recent overview summarizes the various applications of AIEd for learner profiling, performance prediction, assessment, personalization and adaptive learning. AI systems can provide instant corrective feedback, perform automated assessments, and assist students in reviewing learning. Intelligent tutoring systems can identify students' strengths and weaknesses, while machine learning can predict at-risk or gifted students. However, the progress of AIEd requires further empirical studies, especially to close the gap between the potential of AIEd and its implementation in education. By

describing practical examples of AIEd applications, it is clear that AI technology can provide real benefits to students and teachers in achieving educational goals (Zhang, 2021).

Alberth (2023) discusses the advantages and disadvantages of using artificial intelligence, particularly ChatGPT, in academic writing. While the article acknowledges the concerns, it suggests that ChatGPT could revolutionize research. However, responsible handling is crucial to maintaining integrity. ChatGPT helps you write efficiently, generate ideas, write articles and interpret data. AI advances, particularly in education (AIEd) and academic writing (ChatGPT), are promising but require more research for optimal use.The synthesis emphasizes ethical consideration of the potential of AI technology in education and writing.

3   CONCLUSION

Holistic education is a comprehensive solution to the challenges of the digital age. It combines 21st century skills, digital literacy and character development to prepare students holistically. By emphasizing individuality, lifelong learning and creativity, it benefits students, teachers and society. In a rapidly changing digital landscape, holistic education remains relevant and provides a solid foundation for current challenges and preparation for the future. Combining traditional training with modern technology creates a comprehensive learning environment. Teachers play a critical role in adapting to these changes, mastering technology, and guiding students toward digital literacy and social responsibility. A holistic education ensures that students not only have technical skills, but are also equipped to deal with the complexities of the digital world.

The existence of artificial intelligence (AI) brings great benefits to human life, making it more productive and efficient. However, there are concerns about the potential threats posed by AI. Several prominent figures, including Geoffrey Hinton and Bill Gates, have expressed concerns about the negative impact of AI. The rapid development of AI raises fears that humans can no longer control their powers. The potential danger is even greater than climate change. In the hands of irresponsible parties, AI can become a callous murder weapon. As part of a global society, it is important for us to take advantage of advances in AI technology while wisely anticipating their impacts. Future generations must be prepared for the challenges of the age of artificial intelligence. The implementation of holistic education, which is required by law, is crucial for raising well-rounded people who are responsible for the entire system of life.

Holistic education emphasizes the importance of balancing human potential in relationships with oneself, the environment, society and God. The goal is not only to create intelligent individuals, but also those who have morals, empathy and good behavior. With a holistic approach, the progress of science and technology should be aimed at humanity. The focus is on the positive development, the good and the well-being of humanity.

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School Social Work in the Digital Age - Increasingly important (not only) in Times of Crisis

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ABSTRACT

The increasing digitalization of everyday life since the 1990s has permanently changed social coexistence. These developments have an enormous influence on the shaping of the lifeworlds of adolescents, which results in new challenges for pedagogical considerations and methods. The "corona crisis" drastically highlighted the growing importance of digital media for social institutions such as schools or social work.

The presentation draws on empirical data in which school social workers were questioned about their experiences with digital media, among other things during the pandemic. The questions of how the interviewed school social workers perceive the increasing digitalization in their professional daily routine in school, which challenges they describe, how they try to deal with them and how digital media are integrated into the professional everyday practice is investigated. It will be illustrated that a critical-reflective approach to digital media by school social workers becomes relevant if they want to reach the realities of adolescents' lives. However, technology-sceptical attitudes and practices can still be reconstructed in crisis situations such as the corona pandemic. Furthermore, it will be illustrated that social pedagogical work in schools is indispensable for a modern understanding of school as a place of learning and living.

KEYWORDS: School Social Work - Digitalization - Professionalism - Corona Crisis

1   INTRODUCTION

Spring 2020 saw a global crisis that confronted large parts of the world's population with a completely new situation: Lockdowns, contact bans and isolation as a result of the defence measures in the context of the COVID-19 pandemic led to massive restrictions, changes and uncertainty in most people's everyday lives. School, as a powerful agent of socialization also had to close its doors during the many pandemic lockdowns. By April 2020, 188 countries had imposed school closures and 91,3% - which is about 1,5 billion students worldwide – were affected (cf. UNESCO 2020 & Huxtable 2022: 16-17).
As a place of learning and living school fulfils important functions: Not only are children and young people taught there, but they also make friends, interact socially and have the chance to experiment in different roles. „Thus, school closures imply a marked disruptions to children's and adolescents lives, during a phase of life when engaging, predictable environments and stable, positive social interactions are crucial for promoting children's and adolescents' socio-emotional development" (cf. Felfe et al. 2023: 1). Questions of how children and adolescents were dealing with this new situation and what effects it had on their emotional and psychological well-being have been addressed by both global studies (see for example International Labour Organization 2020) and national studies limited to Germany (see for example Andresen et al. 2020 & Ravens-Sieberer et al. 2023). Considering the large number of studies, mental health problems and an increase in anxiety of children and adolescents during the pandemic, in addition to reduced educational success, can be identified. The COVID-19 pandemic as an educationally relevant event called upon the education system to deal with these problems and respond to them. Educational institutions such as schools, but also social work, were and still are expected to accompany young people as they deal with their experiences they have made during the pandemic and to offer support.

In order to be able to maintain teaching, „[s]chools attempted to continue the mission of education using numerous creative strategies, largely through distance learning" (Huxtable 2022: 17). Initially, this led to digitally mediated classroom encounters between students and teachers via online formats and subsequently to a debate about the importance of digital media for and in education within and beyond school. The role of school social work, a service of child and youth welfare located directly in schools (cf. Speck 2006: 23), at that time had been discussed little. In recent years, however, there is a growing discussion on digital media in social work in Germany, which is primarily concerned with changes in the living environments of the recipients of social pedagogical services, changes in the services themselves and changes in work processes within social services and institutions (cf. Kutscher et al. 2020). Nevertheless, empirically the role of school social workers in the context of digital media and during the pandemic remains widely unexplored.

The following article addresses this desideratum and uses empirical data from an own research project, that is essentially concerned with digitalization and school social work practice in general. The COVID-19 pandemic plays a prominent role in almost all of the interviews conducted and is highlighted as a significant event for the professional practice of the interviewed school social workers. The focus lies on the described ways in which the interviewees deal with the requirements arising from the pandemic and the attitudes and orientations towards digital media that can be reconstructed from the interview excerpts.

2   BACKGROUND

2.1   School Social Work (in Germany)

According to Fend's structural-functionalist approach, schools primarily have the task of reproducing society as a whole (enculturation, qualification, allocation and integration/legitimation) as well as individual personality development (cultural and political participation, employability, life planning and social identity) (cf. Fend 2008). School social work takes on the important function to establish a link between school on the one hand and the everyday realities of young people on the other hand. Together the different systems contribute their respective expertise to jointly support children and young people in their socialization processes. Marion Huxtable (2022) bookmarks the field of school social work as a growing specialty around the world that is already established in many countries and that "has much to contribute to schools" (Huxtable 2022: 1). Considerations that recognize and incorporate the specific perspectives and working principles of social work mean that education, upbringing and care nowadays are understood as an overall system that is jointly and cooperatively responsible for adolescents. Internationally, school social work is regarded as a service that helps students with school, family and social problems, supports them in acute crises, offers preventative services, promotes cooperation between parents and teachers, and for that purpose works together with parents, teachers, other educational staff in schools and partners outside of schools (cf. International Network for School Social Work). There are various attempts to define school social work in Germany, but this article is based on the following definition: School social work serves to ensure and support the integrability of students from different social and ethnic backgrounds, whose educational conditions it improves by using educational and social pedagogical expertise to help reduce existing disadvantages, promote individual and social development and impart empowerment strategies. It is to be understood as an inter-institutional mediator in the education and support system, acting as an advocacy socialization agent to improve the learning, teaching and living conditions of children and young people in the context of the education system (based on the definition of Spies & Pötter 2011: 91-92). In this context, the profession of school social work is not to be understood as an additional school offer, but as genuine social work practiced in schools. Accordingly, in Germany school social work can be considered to be a field of work in which social pedagogical professionals are continuously working at schools, cooperating with teachers and providing them with supportive advice on educational issues with the overall objective of creating a student-friendly environment (cf. Speck 2018: 358).

Due to the complexity of realities of students' lives and the different types of school forms, it is not possible to clearly define the main working priorities of school social work. Nevertheless, the central offers in general can be broken down as follows:
- Counselling and support for individual students (e.g. individual support and counselling sessions for social, school-related, personal or career-related stress)
- Social pedagogical group work (e.g. social learning, extracurricular projects and group offerings)
- Open dialogue and leisure activities (e.g. school café or activities in the context of all-day-schools)
- Participation in teaching projects and school committee work
- Cooperation and counselling for teachers and parents/legal guardians
- Cooperation and networking with the community (cf. ibid.:358-359)

A concept that has significantly shaped social work in general and school social work in particular in Germany is that of lifeworld orientation that mainly has been developed further by Hans Thiersch (cf. Beck 2017: 1). In this context, the term "lifeworld" refers to the reality experienced by the recipients of social pedagogical services (cf. Grunwald & Thiersch 2018: 906). The reality experienced reflects both the social conditions to which individuals are exposed and their interactions and processing mechanisms within these conditions. The lifeworld reveals the resources available to those affected, the risks to which they are exposed in everyday life as well as the lack of resources to cope with their everyday lives. Lifeworld-orientated social work considers its target groups in all those dimensions and strives to understand and tackle the inner contradictions and challenges that exist in the lifeworlds. Eventually, this should help those affected to cope with their individual problems and to organize their everyday lives (more) successfully (cf. Stange et al. 2023: 305). School social workers also operate in this interrelatedness of subjective experience and lifeworld embeddedness, taking into account the fundamental heterogeneity of lifeworlds. They "treat their clients as a whole" (Beck 2017: 2), consider adolescents in their different life contexts and organize their offers in such a way that they properly regard the aforementioned complexity of lifeworlds and the diversity of social structures in the sense of proximity to everyday life (cf. Stange et al. 2023: 306).

2.2   Digital Media and the Corona Crisis

Digitalization, i.e. the transfer of analogue to digital signals and the resulting possibility of processing information with computers, has a lasting effect on social coexistence. However, the concept of digitalization as a largely technical term has only a limited capacity to describe technological change and the transformation of everyday life, culture and society in their interrelationships. The significance of this technical transformation lies in the associated transformation of the cultural and social sphere (cf. Krotz 2020: 16). This is where Friedrich Krotz's mediatization approach sets in, as it describes above all the fact that more and more social actions are being carried out by more and more actors in media contexts (cf. Schleck & Witzel 2020: 56). Analytically, the approach is helpful to describe „the relation between media change and the change of everyday life and identity, culture and society" (Krotz 2014: 137) in the context of media change. In essence, this emphasizes the temporal, spatial and social permeation of everyday life especially with digital media (cf. Krotz 2012). The mediatization approach understands today's digital transformation, that is digitalization and its consequences, as a current mediatization wave (cf. Krotz 2020: 18).

The developments described have an enormous impact on the shaping and organization of lifeworlds for almost all people around the world, and especially for adolescents. The empirical evidence of their everyday, extensive and natural use of digital media emphasizes the relevance of them for the social activities of children and young people (cf. Schleck und Witzel 2020: 56): communication, interaction, consumption, entertainment, learning and education nowadays take place not only in real spaces, but increasingly (also) in virtual ones. Lifeworlds of children and young people therefore can be described as media worlds.

Beyond that, the importance of digital media for communication and thus for maintaining and nurturing relationships have been highlighted by the COVID-19 pandemic. Digital media made it possible to bridge spatial and, in some cases, social distances. *Social distancing* as a means of controlling the pandemic led to closed schools, contact restrictions, a lack of predictability and ultimately to the erosion of everyday life, especially for children and

adolescents. In this way, the pandemic has caused a further thrust of digitalization in educational institutions, which initially had an impact on the maintenance of lessons and schools and subsequently also affected social pedagogical services, which in some cases had to be provided in unfamiliar digital formats.

However, social functional systems, such as schools and social work, had already been affected by the changes due to digitalization before the pandemic and continue to be so beyond it. Due to the permeation of adolescents' everyday lives by digital media, these systems are required to take a (critical and reflective) look at digitalization and its consequences. Within theory and practice of social work in general, an increasing discussion about various aspects of digitalization has developed in recent years. On the one hand, this discussion concerns the far-reaching changes and the associated problems that go hand in hand with the mediatization of the lifeworlds of recipients (e.g. bullying or internet addiction). On the other hand, it relates to changes in the services offered (e.g. changes in communication channels) and the adaptation of work processes in social organizations and institutions (e.g. digitalized documentation). This leads to new questions regarding data protection and the skills required by professionals (cf. Kutscher et al. 2020).

2.3   Research Aims and Questions

Assuming that all these aspects and considerations with respect to digitalization and the COVID-19 pandemic are relevant to the field of school social work and the professional practice of school social workers, two interviews from the aforementioned study are used and analysed considering the following questions:
  • How was the pandemic experienced and what impact did it have on everyday working life?
  • How are the social pedagogical tasks in school and in the context of the pandemic framed?
  • Which professional attitudes can be reconstructed in the context of digital media and the pandemic?

3   RESEARCH DESIGN

3.1   Data Collection and Sample

This research project and the research questions raised are based on qualitative social research. In stark contrast to quantitative research „[q]ualitative research is a strategy that usually emphasizes words rather than quantification in the collection and analysis of data" (Bryman 2008: 366). The primary interest here is to get as close as possible to the everyday realities by analysing experiences and knowledge of individuals that are related to everyday and professional practices. In order to be able to capture the everyday realities in the words of the people studied, semi-structured interviews have been conducted which, on the one hand, aim to establish comparability and, on the other hand, are designed to be as open as possible so that the interviewees get the chance to tell everything that is relevant and important to them in the context of the research interest. The main objective of such an approach is to develop a detailed understanding of the informants' experiences and perspectives.

As this is a multiple-case study research, it was advisable to develop a structure that enables cross-case comparability. Accordingly, an interview guide was developed to make sure main topics that the researcher would like to cover are addressed. The interview guide, however, is

not to be understood as a structured schedule or protocol. Rather it is flexible regarding the phrasing of questions and the order in which these questions are asked (cf. Taylor et al. 2016: 122-123). The interview situations have been designed in such a way that the interviewees were able to develop their own relevance structures in the context of the issues raised. It is important that the interview questions are formulated in such a way that the focus of the interview remains on eliciting narratives.

In the following, partial excerpts from two interviews conducted in late summer 2022 will be analysed. As part of the research project, which primarily focuses on the connection between digitalization and school social work practice, it was assumed that the COVID-19 pandemic would also become a topic within the interviews. It was therefore decided to also raise a separate question on the professional experience of the pandemic. The question reads approximately as follows:

"How did you experience the Covid-19 pandemic and what impact did it have or does it have on your work?"

3.2   Data Analysis

Since the research interest primarily relates to attitudes and experienced working practice, the documentary method is suitable for analysing the interview material (see for example Bohnsack 2010; Nohl 2010). The documentary method for analysing data material (in this case individual interviews) serves to reconstruct the practical experiences of individuals (or groups), in milieus and organizations, provides information about action-guiding orientations that are documented in the respective practice and thus opens up access to working practice (cf. Nohl 2017: 4). The methodological difference between communicative-generalized (also theoretical) knowledge, which is reflexively available and can therefore be interrogated, and conjunctive (experiential) knowledge, which is understood as practical (also atheoretical) knowledge, is fundamental to this method of analysis. Practically, this distinction is represented in the analytical steps of formulating interpretation on the one hand and reflective interpretation on the other. The formulating interpretation aims at „the decoding and formulation of the topical structure of a text" (Bohnsack 2010: 111) and thus the focus lies on *WHAT* is told by and relevant for the interviewees. In the second step, the reflective interpretation is concerned with the *HOW*: "[H]ow is a topic or the problem presented elaborated on, and in which framework of orientation is it dealt with" (Nohl 2010: 204)? The two interview excerpts have been analysed using both the formulating and reflective interpretation; in addition to presenting the communicated, thematically relevant experiences and perspectives of the interviewees, initial attempts of reconstructing orientations that guide action by comparing and contrasting the two cases will be made.

4   Analysis

An examination of the two interviews used in the following reveals first of all that the COVID-19 pandemic and its consequences are also addressed at other points in the conversations besides the specific question asked by the interviewer. This shows that the pandemic and everything that happened during it had and still has a high significance in the experience of not only professional practices, and that this is taken as an opportunity to reflect on the events. With regard to the question specifically addressing the pandemic, it can be stated that these two school social workers deal with the topic of the pandemic in connection with the (necessary) use and application of digital media in very different ways.

The interviews were conducted in German and translated into English by the interviewer. All individual-related data has been anonymized or pseudonymized so that third parties cannot draw any conclusions about real persons or institutions.

<u>Case A – Lena Drabe:</u> "*ultimately, our work depends on being together, on being present*"

The answer to the question "*How did you experience the Covid-19 pandemic and what impact did it have or does it have on your work?*" Lena Drabe divides into three consecutive sections: The first area is concerned with the general problematization of (school) social pedagogical activities during the pandemic; the second section can be framed as an individually pursued solution to the previously mentioned problematization and the third aspect covers perceived mental health problems among children and young people during and after the pandemic. It is noticeable that the second and third aspects are only described upon request by the interviewer, so that a hierarchization of the aspects in Lena Drabe's experience structure can be assumed.

The most relevant section for Lena Drabe is the impact of the pandemic on her own work.

LD: *It had a serious impact on my work because our clients simply disappeared from one day to another*

Lena Drabe does not take the question as an opportunity to think about the wording of her answer. On the contrary, she seems to have already thought about the question posed and is able to give a clear answer. The phrase "*serious*" implies a momentous and negative effect of the pandemic on her own work, which is explained by the fact that the target group "*simply disappeared*". Physical absence is equated with no longer being existent. The whole thing happens "*from one day to another*", so that it was not possible to being prepared for this situation. The framework of Lena Drabe's experience thus is established and all further narratives and descriptions are rooted in it. She continues:

LD: *there were no more students present on site, and ultimately our work depends on being together, on being present*

According to this, the physical absence of students at school makes social pedagogical work impossible. The described function logic of social work, which is dependent on presence and togetherness leads to the assumption that a real, physically tangible encounter in a physical-material space is constitutive for the performance of (school) social pedagogical activities. In this utterance a perceived powerlessness to act on the part of the social pedagogue due to the pandemic situation and the subsequent measures to contain the virus is documented, and this is ascribed to the entire field of school social work. Accordingly, the pandemic determines whether to be active or inactive. In Lena Drabe's description personal responsibility is therefore rejected. In addition, the meaningfulness of her own work is being questioned in the context of the pandemic:

LD: *if students are not on site, they don't come just to (.) to have a conversation. or the situations don't arise where you as school social worker might um be needed.*

School social work is no longer needed, as the situations that made it necessary for Lena Drabe can no longer arise. Even if the school social worker implicitly makes an appeal to herself in this utterance, namely to become active in order to restore meaningfulness, it

remains a passive experience for the time being. A specifically passive understanding of school social work is also documented: The field does not play an active role in schools but is "*needed*" when called upon. The previous descriptions are concluded in a further condition:

LD: *when the schools were completely closed, the field of school social work was as well*

In this phrase, the maintenance of the field of school social work is once again linked to certain conditions that must be fulfilled in order for social pedagogical work to be possible at all. Furthermore, this condition is generalized to the entire field of work and thus to all those working in it. A statement that is supposedly valid for all persons is added:

LD: *everyone sits at home inside their own (.) four walls and is isolated and, if at all, (.) comes together digitally in um lessons and that's also been very, very slow.*

At this point, at least indirectly, the priority of maintaining teaching is referred to uncritically and a contradiction is implicitly expressed: While lessons and schools can at least continue to work - albeit slowly - and digital media appear to have been identified and used as an opportunity, this has not yet been considered as an alternative to conventional practice in the field of school social work.

LD: *in our sphere of work we weren't geared towards having a digital offer; (.) in terms of counselling or the like.*

However, this statement can be interpreted as a hint that digital alternatives are recognized. It is implied that one could have been prepared and that there is also an awareness of digital offerings. The experienced situation inevitably leads to the need to do something of one's own initiative.

LD   „*that's why we had to get creative*"

It is initially unclear who is meant by "*we*", whether the field of work as a whole or the school social work team on site. In this utterance, however, the passive endurance of the situation is left behind; an independent approach and thus the ability to act is signalled. There is no elaboration on how this creativity looked like, so the interviewer asks how the challenges that have been described so far were met by the school social work team that Lena Drabe is part of.

LD: *(7) Mh::: (2) we tried to find other ways, for example we wrote postcards to the students with our contact details on it and the information that we are still present, sometimes we brought them in person, sometimes we sent them by post*

This time, Lena Drabe has to take her time when answering the question and thinks about her wording. The creativity described consists of finding "*other ways*" to reach the children and young people and to inform them about the continued presence of school social work on site. On the one hand, the favouring of conventional means within her own practice over the use of digital options, which continue to be excluded for her own work, is again documented here. On the other hand, any perceived or assumed needs of the target group are not addressed; although the children and young people are informed about the presence of Lena Drabe and her team, it is them who need to take the next step and approach the school social workers and report any need for help.

When the schools were opened partially, to provide emergency care for certain groups of students, Lena Drabe for the first time mentions something like a (social pedagogical) mandate in the course of the pandemic, which is primarily aimed at providing disadvantaged children with an offer of help:

LD: *We were then involved in the emergency care so that we were able to work with the children who are disadvantaged due to the domestic situation or not being cared for at home*

Disadvantaged students and/or students entitled for emergency care return to school and this leads to a rediscovered sense of meaningfulness of her own work and role in school. This repeats Lena Drabe's previously indirectly expressed understanding of school social work as more of a waiting agency whose services have to be activated by others.

Subsequently, the interviewer asks what current impact the pandemic is having on Lena Drabe's work at the time of the interview. This is followed by a description of an "*overall feeling*", attesting the students' "*psychological stress*" and addressing the problem "*that um many students are affected by anxiety*". Lena Drabe could now take these remarks as an opportunity to describe the tasks that arise for school social work. However, this does not happen and it remains at a perceived status description. This problematizing description also refers to digital media, because:

LD: "*media consumption in general is of course also an issue, that hasn't, of course, become less with the pandemic*"

At this point, a statement is made that is again subjectively considered to be generally valid and that problematizes digital media in the everyday practice of children and young people indicating a risk discourse surrounding digitalization. Using the phrase "*of course*" twice hints at the inevitability of this consequence in the context of the pandemic in Lena Drabe's thinking. This is an addictive behaviour on the part of children and young people that naturally arises from digital media, which in turn was also naturally reinforced by the pandemic situation and the associated isolation. Finally, a dichotomy is repeatedly postulated:

LD: *but I'm also experiencing that young people (.) are interested in signing up for sports clubs again and there is actually a very high need to be active.*

Being active, moving, acting together in presence, i.e. activities that are promoted in sports clubs, are contrasted here with being alone, playing computer games, lack of exercise and, in the worst case, addictive behaviour, i.e. activities that are promoted through the use of digital media. In this section of the interview, Lena Drabe also indicates that she has knowledge about the lifeworlds of her target group and also acknowledges digital media as part of the life realities of children and young people, even if she ultimately attributes negative characteristics to them.

Case B – Matthias Herder: "*I had never done that before (2) I was very sceptical like many colleagues*"

In his answer to the question posed by the interviewer, Matthias Herder describes three distinct and consecutive stages that structure his professional experience of the pandemic:

Initially, he reports a general feeling of uncertainty, which is then used as an opportunity to try out new things and gradually normalizes. He is currently concerned about uncertainty regarding the long-term effects of the pandemic on the emotional world of children and young people. The answer is given coherently without further questions from the interviewer.

At first, Matthias Herder seems to be struggling to find the right wording for his answer:

MH: *Mhm (2) so the um (.) effects at first were the (.) yes, this big question mark was there, as with everyone else; what shall we do now?*

The search for a suitable answer, indicated by pauses in speech and filler particles, points to a reflexive positioning and thus to a distancing from the immediacy of the event. Matthias Herder's generalization of the "*big question mark*", which is specified by the question "*what shall we do now?*", points to an attempt to legitimize the uncertainty of an appropriate approach. It was not only him who had to ask himself this question, but it concerned "*everyone*". The formulation of the "*big*" question reveals that the situation irritates Matthias Herder, unsettles him in his view of (school) social pedagogical work, but that he wants to deal with this uncertainty and is searching for an answer. The question of how to proceed, which he first collectivizes, is then concretized as an assignment to himself:

MH: *how do I organize the work here at the school when no one is present?*

Similar to Lena Drabe, the problem of the absence of people at school and the resulting lack of encounters lead to a situation that was previously unthinkable for his own understanding of school social work. The provision of social work in schools has so far been inextricably linked to the physical location "*here at the school*" and thus to co-presence. Unlike Lena Drabe, however, Matthias Herder takes the situation as an opportunity to rethink his conventional ideas of firstly school and then school social work.

MH: *so we sat down together and thought about how we wanted to tech digitally, but school social work wasn't mentioned.*

This utterance seems somewhat confusing, as it is not actually the job of a school social worker to think about digital teaching options and formats. Here again, he joins a collective, exchanges ideas and tries to use this exchange to create a little more clarity about the task that has been assigned to him. By putting aside his own role clarification in the new and unfamiliar situation as well as helping to think about digital teaching options, Matthias Herder also accepts and even supports the priority given to teaching and school during the pandemic. So while digital media are already accepted as a means in the context of teaching and school, this does not yet seem to be the case for the field of school social work. A restraint and a weighing up of options is documented here, however, without losing sight of his own (social pedagogical) work.

MH: *so that was the first impact, how do I even reach (2) mh the children and young people now? what do they do at home? and how do we get in touch with them?*

Children and young people, their interests and the question of how they can be reached play a pivotal role in these considerations. Yet Matthias Herder doesn't just stop at considerations; after a period of approaching cautiously, the new situation is taken as an opportunity to

become active and to utilize the options that have already been implemented in the classroom also for school social work.

MH: *and those were the first effects of saying I'm going to offer it online somehow*

Matthias Herder is using digital media to continue school social pedagogical offerings even during the pandemic and reach children and young people in this way. Even if this initially takes place in a relatively unspecific "*somehow*" manner, which can be interpreted as uncertainty in the use and application of digital formats, the active engagement with the situation implicates the attempt to make sense of one's own work on the one hand and an active approach to the target group on the other. This initially tentative experimentation with incorporating digital media into his own work is proving its worth as the pandemic progresses.

MH: *and then um (2) with the increase in school closures that came again and again; don't know was it three times or two? it doesn't matter @in any case@ every now and then, um, but it was also quite normal that I could really use online tools*

Within this formulation, the constant normalization and routinization of the use of digital media for the performance of school social pedagogical activities is documented. The number of lockdowns no longer plays a significant role in the final adoption of digital formats in one's own working practice.

MH: *um so I made video calls, offered video counselling; sometimes just chat counselling. that too; I had never done that before (2) I was very sceptical like many colleagues.*

Within this wording, Matthias Herder's specific reflexive examination of his work in the context of new challenges is documented. He takes these as a stimulus to allow himself to be irritated, to take a critical look at his preconceptions, to question them and, if necessary, to change them.

MH: *and the further effects are also a normality, to use these things at all, (2) to use the digital possibilities, the normality among children and young people has also become greater, to also recognize school in this area*

The "*big question mark*" in relation to the challenging new situation and the initial crisis-like experience as well as the resulting demands gradually dissolve. Digital media are becoming the norm in the own work and in school; Matthias Herder believes that students, too, accept them not just as part of their lifeworlds outside school, but also increasingly as part of school.

In the following explanations, the experience after the pandemic becomes relevant, i.e. a period in which it is about returning to school and thus to real experienced collectives.

MH: *the effects afterwards (.) was to get back into it; the effects for me in the area of school social work were also to consider how we could support the children so that they could work well with each other again.*

Here, Matthias Herder frames one of his central tasks as a school social worker, i.e. accompanying and supporting children and young people as they return to the community at

school. This task is labelled explicitly as a school social pedagogical one. His descriptions of the feelings of children and young people remain rather sketchy:

MH: *I can feel the effects (2) yes but (.) I can't really grasp it yet.*

Matthias Herder again takes time to develop an assessment. This repeatedly demonstrates his typical gradual and cautious approach to professional situations leading to a reflective examination. Although he observes "*psychological pressure, performance pressure*", it remains to be seen how this will manifest itself in the long term and what tasks this will entail for school social work.

MH: *"we'll have to wait and see."*

Question marks therefore remain relevant for the shaping of Matthias Herder's own professional practice.

5   COMPARATIVE ANALYSIS AND DISCUSSION

In the following, the two cases are compared and related to each other. Moreover, the research questions are answered by a summarized outline of the analysis results. The differences to be shown point to the maximum contrast between the reconstructed references of school social workers to digital media in their everyday professional practice within this study.

With regard to the professional experience of the pandemic, it can first be stated that both describe a collapse of the previously defined basis of their work. The core characteristics of social pedagogical activities are based on co-presence: Encounter, interactivity, dialogue and co-production are constitutive for the practice of social work (in schools) for both school social workers interviewed. The new situation is thus in sharp contrast to their traditional concepts of school social pedagogical activities. However, Lena Drabe and Matthias Herder deal with this situation in very different ways. Lena Drabe is clearer and more structured in her explanations, which suggests that she has a clear notion of her work - even in new and challenging situations. The initially experienced lack of power and inability to act is partially restored through the use of already proven (conventional) means and media. The crisis experienced is therefore dealt with through the familiar. Matthias Herder, on the other hand, takes the irritation as an opportunity to question his usual assumptions about his own work. The big question marks in and for his work lead to a critical-reflective examination of his work, whereby these examinations seem never to be entirely concluded. Reflecting on his own ideas and approaches is an essential part of Matthias Herder's professional practice.

The two school social workers can also be differentiated from each other in terms of their conception of social pedagogical tasks in general and during the pandemic as well as their understanding of school social work that is reflected within these conceptions. It is important to Lena Drabe to be physically present on site even during the pandemic and to communicate this to the target group. Communication should be maintained by conventional means, but initially this is only done unilaterally by the school social worker. Helping to provide emergency care especially for disadvantaged children and young people while schools have reopened partially is also a described and therefore central task during the lockdown. It is noticeable in her descriptions that the needs of children and young people are not explicitly addressed at any point. Moreover, Lena Drabe addresses the target group in many places as "*students*", giving the institutional integration in school a high degree of defining power over

her own understanding of tasks and role attributions. In general, Lena Drabe maintains a wait-and-see working style; being present and contactable are central to her, As a school social worker, however, she often only becomes active when others report a demand for help and she is "*needed*". Matthias Herder likewise considers maintaining communication with children and young people to be a key task during the pandemic. For this purpose, he is increasingly using digital media, as these not only enable him to maintain his services, but also allow the target group to contact him without having to come to the school location. Overall, his understanding of school social work is expressed in a rather active approach to the target group(s). To his primary target group, he always refers with the terms "*children and young people*"; for him, too, the integration in school is central, but this does not predominantly determine the elaboration of his own tasks or the attribution of roles.

With regard to digital media, both school social workers only see the possibility or the necessity to relate this everyday reality of children and young people to their own work as a result of the pandemic. The examination of digital media in work *with* children and young people and the integration of this into professional practice does not appear to have been present in the field of school social work before the pandemic, even though the examination of digital media *in* the lives of children and young people appears to have been an issue beforehand. For Lena Drabe, digital media do not belong in the field of (school) social pedagogy, even during the crisis. Even if those seem to be recognized as a - sometimes negatively connoted - part of children and young people's living realities, they run counter to (social) pedagogical goals and normative concepts in her own imagination and therefore do not play a major role in her professional practice. Matthias Herder has also been sceptical towards the use of digital media in professional practice. In contrast to Lena Drabe, however, after a critical and reflective examination in the context of the pandemic, he realizes that digital media enable him to maintain work and overcome physical distances even in times of crisis. In this way, digital media become a bridge to the lifeworlds of children and young people, which ultimately leads to the integration of digital media into his professional practice.

6   CONCLUSION AND RECOMMENDATIONS

To conclude and summarize, the research results will be used to draw up some general recommendations for schools and school social work in the context of digitalization.

By establishing the field of school social work, the aim is to ensure that the needs of children and young people are considered from two different perspectives and that they are not addressed exclusively in their role as students. In this way, school social work and school can work together as a community of responsibility and create a place for children and young people that is about more than teaching and learning.

The professional challenge posed by the mediatization of everyday life described above, namely how to deal with the permeation of everyday life with specifically digital media as a result of this process, has become evident for pedagogical considerations at the latest as a consequence of the pandemic. Lifeworld orientation as a professional guiding principle of school social work and thus the consideration and inclusion of children's and young people's experienced reality (cf. Grunwald & Thiersch 2018: 906) also means systematically expanding the focus on young people by including their digital lifeworld experiences and contexts. The primary aim should be to take the individuals seriously in their utilization processes, to integrate their needs and interests and to understand and initiate media

education processes based on the everyday (school) life of adolescents (cf. Schleck & Witzel 2020: 64). Excluding life realities when working with children and young people can lead to dealing with the problem of media addiction, for example, as addressed by Lena Drabe, only in a superficial educational way. The opportunities as well as the risks of using digital media must be explored together with children and young people in an interactive and, above all, action-based way; one pedagogical goal should be enabling young people to recognize, understand and ultimately deal with the contradictions and challenges of digitalization. This requires a productive entanglement of analogue and digital topics and methods, because - as Krotz's mediatization approach illustrates - the real and virtual spheres of everyday life can increasingly no longer be separated from each other.

Creating digital offers in addition to traditional, conventional offers enables school social workers to meet the different preferences of their primary target group. In addition, offering a variety of different settings creates a low-threshold approach. Such an expansion of professional practice also leads to an expansion of the requirement profile for school social work practitioners. It is therefore inevitable that school social workers receive adequate qualification and further training opportunities in the area of media competence as well as time and financial resources in order to be able to utilize and implement the potential in a target group-oriented manner.

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KONASARA E-LEARNING MODELS TO REDUCE STUDENT ACADEMIC STRESS

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ABSTRACT

The aim of this research is to analyze the about causes of academic stress, what types of the causes, and the impact of academic stress using the Perceived Stress Scale and the student academic stress on e-learning systems model. This project employs case study research methods. The results of the studies Based to the study academic stress can have a negative impact on students' physical and mental health. These effects include fatigue, poor concentration, or anxiety. There may cause students to lose confidence in themselves and have problems concentrating. Effects from overthinking on social interactions and learning attendance. Factors that cause academic stress of students participating in e-learning system were identified by several informants, who reported that learning motivation was lost during online learning. They cited various reasons such as laziness, boredom, inability to manage time, loss of concentration and lack of engagement with studies. Several whistleblowers admitted that the environment is not peaceful, which makes it difficult to study. Internet network is very important factor of online learning because without internet network online learning is not easy. From accessing materials, completing coursework, completing assignments, and submitting assignments, almost all online learning activities require Internet access. Based on the results of the data analysis of the Perceived Stress Scale level of academic stress of students Senior High School at Konawe Utara during online learning is placed in the medium category, The researchers also proposed an alternative e-learning model called the Konasara e-learning model.

KEYWORDS: E-Learning, KonasaraModels, Student Stress Academic

18   INTRODUCTION

Using computer-assisted instruction, the university of Illinois at Urbana-champaign developed e-learning in the area of education (Aulia, 2019). In 1990 CBT (computer-based training) was adopted to develop e-learning, and e-learning programs that developed on computer systems or in CD-ROM packaging started appearing. Written content or multimedia (video and audio) in the mov, mpeg-1, or AVI formats (Setiawan, et al, 2020). Online learning causes stress, and students who take online classes experience it, claims (Plessis, 2019). Now that the pressure is higher, many students are turning to social media as a way to relieve their stress. According to his study's conclusions (Rahardjo et al., 2020). Long-term stress management will create social media fatigue due to individual cognitive load and a deterioration in learning quality (Zhang et al., 2016). This is supported by a large number of research, including (Ravindran et al., 2014). One of the things that online learning may have stressed out students is social media fatigue, which eventually harms student performance and learning outcomes (Bright et al. ,2016). Students who claimed that they disagree with online learning did so because their school lacked adequate resources for organizing e-learning lessons, according to early observations made of State High School students in the Kabupaten Konawe Utara. Even if they have a cell phone, it does not enable being used when learning or teaching online, similar to not having a netbook. The discomfort of students with being compelled to learn at home is another factor cited by students as a barrier to the deployment of e-learning. owing to the home environment not supporting the learning process and the lack of direct engagement with other pupils, which is often beneficial when face-to-face instruction is taking place. According to (Kamria and Taridala, 2012). Studies on student dissatisfaction with distance learning, students in Southeast Sulawesi are not satisfied and may even be under the influence of academic stress (Imran and Hasddin, 2021). The researchers have the drive to analyze student academic stress on e-learning Systems at Senior High School Konawe Utara Regency because of the significance of the performance on e-learning system and the overall quality of educational services.

19   RESEARCH METHODS

The Case study is the current research method. As previously indicated (Cresswell, 2017). Data collection methods include observations, interviews, questionnaires, and document studies. And then a qualitative analysis to back it up. Purposive sampling methods were used to choose respondents for this survey, which included up to one hundred and sixty-two students (Sugiyono, 2015). This study's method of analysis takes use of NVIVO 12 plus for windows. The researcher started by coding the outcomes of the literature review (nodes). The second step is to code the interview results (cases). Credibility, transferability, dependability, and confirmability are the elements used to assess trust. This level of confidence is achieved with the assistance of the NVIVO 12 plus program for windows in line with (Bandur, 2019). Technically the flow of case study ilustrated in Figure 1. Which adapted from (Yin, 2009).
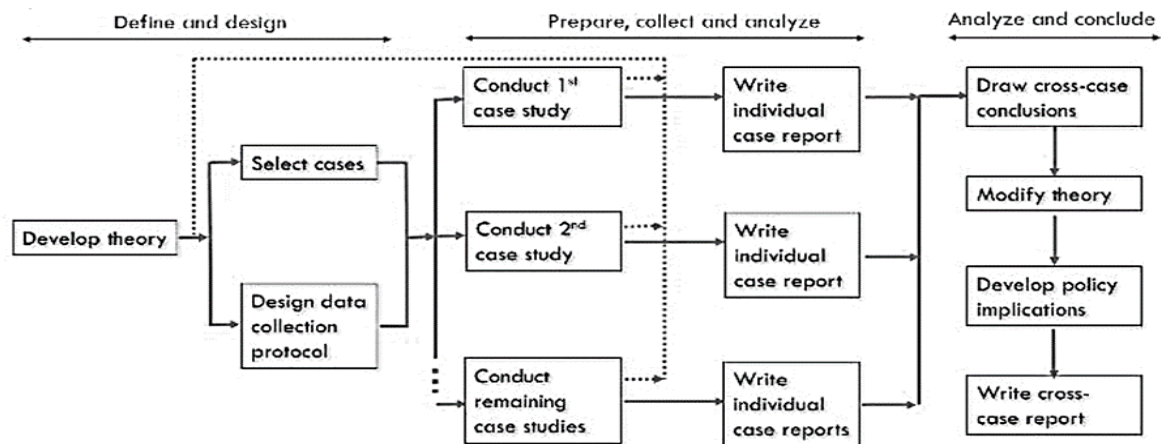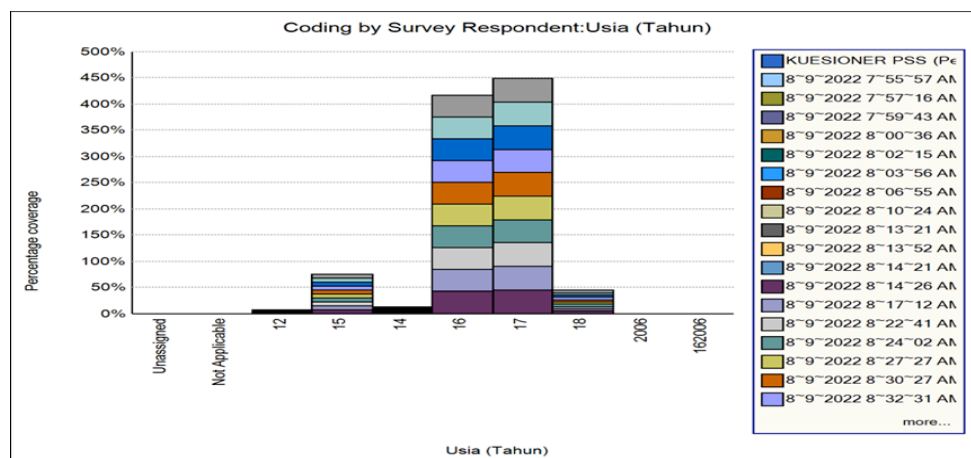
Figure 1. Yin case study procedure (Adapted from ref [13]).

20   RESULTS

This section focuses on the results on student academic stress in e-learning systems, analyzed using the perceived stress scale ; (1) How often students get angry about something unexpected; (2) The extent to which students feel that they cannot control important things in their lives; (3) How often students feel anxious and depressed; (4) How confident are student's ability to solve personal problems (5) How often the student felt that things met the expectations; (6) How often the student feels unable to complete the tasks at hand; (7) How many times did learn the beats in student life (8) To what extent do students think they can solve problems better than others (9) How often do students get upset about things that are beyond your control (10) To what extent do students feel that the problems have accumulated to the point where they can no longer solve them.

In the beginning stage, the researchers distributed questionnaires to gather data about causes of academic stress, what types of the causes, and the impact of academic stress using the perceived stress scale adapted from [14] were being supplied. In this stage, the researchers distributed a paper questionnaire with questions about the academic stress, and e-learning. 162 students between 15 - 18 years old from Senior High School Konawe Utara Regency responded to these questions during the academic year 2023-2024 as shown in Figure 2;

Figure 2. Informants are on average 15 to 18 years old

The following step in case study research is data collection, which includes gathering information from informants through in-depth interviews in order to dive deeper into topics about academic stress and e-learning. Data is gathered by recording and field notes as shown in Figure 3

Figure 3. Word cloud coding interview results

The next step is to print copies of the papers acquired as well as performing analysis and exploring materials related to academic stress and e-learning at Senior High School Konawe Utara Regency. These steps contain documentation linked to e-learning such as learning application or content.

In the final stage, researchers collect data, reduce data, present data, and analyze data from each stage finished, and then design a case study relating to the student academic stress on e-learning systems at Senior High School Konawe Utara Regency. The researchers make contact with the promoter. Both in terms of designing the instruments to be used and discussing how to handle any difficulties that may exist.

21   DISCUSSION

Based to study findings, The level of academic stress of students Senior High School Konawe Utara Regency during online learning is placed in the medium category, because informal answers sometimes have symptoms that cause academic stress that students with difficulty do not cope with online learning and are hindered. During the Covid-19 pandemic.

When the covid-19 pandemic hit Indonesia, the government decided to conduct a bold training to prevent the spread of the virus. Therefore, students should be ready to study independently and face many solvable tasks.
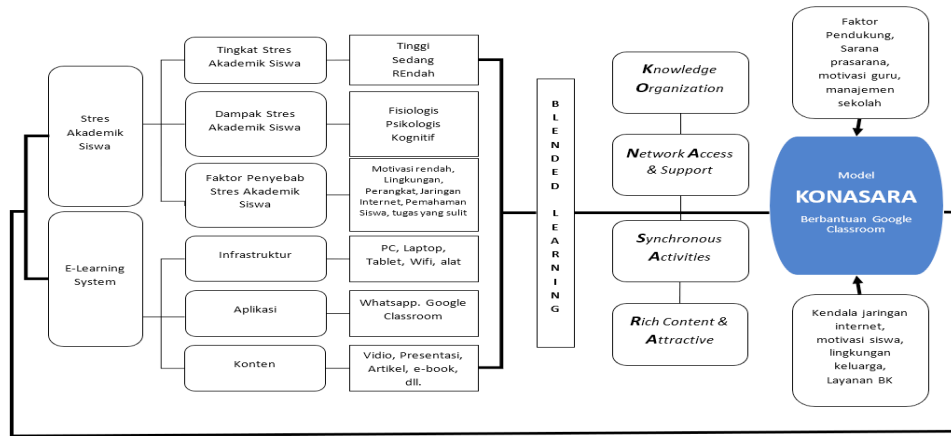
Figure 3. Konasara e-learning models

22   CONCLUSION

A case study on student academic stress on e-learning systems at Senior High School Konawe Utara Regency can be concluded based on the findings of the research and discussion.

Based to the study academic stress can have a negative impact on students' physical and mental health. These effects include fatigue, poor concentration, or anxiety. There may cause students to lose confidence in themselves and have problems concentrating. Effects from overthinking on social interactions and learning attendance.

Factors that cause academic stress of students participating in e-learning system were identified by several informants, who reported that learning motivation was lost during online learning. They cited various reasons such as laziness, boredom, inability to manage time, loss of concentration and lack of engagement with studies.

Several whistleblowers admitted that the environment is not peaceful, which makes it difficult to study. Internet network is very important factor of online learning because without internet network online learning is not easy. From accessing materials, completing coursework, completing assignments, and submitting assignments, almost all online learning activities require Internet access. Based on the results of the data analysis of the Perceived Stress Scale level of academic stress of students Senior High School Konawe Utara Regency during online learning is placed in the medium category.

An e-learning system model with Google Classroom can be used to reduce the academic stress of students in e-learning, which can be combined with: 1) Project-based learning. This model emphasizes project-based learning, which focuses on developing skills and knowledge through projects conducted in groups; 2) Problem-based learning. This model is based on problem-based learning, which focuses on the development of skills and knowledge through solving problems faced by students.

CONFLICT OF INTEREST: "The authors have no competing interests to declare that are relevant to the content of this article"

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