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Implementation of Digital Education Policy in Design & Technology Subject: Systematic Literature Review

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Abstract

The integration of digital technology in education has become a global trend in the 21st century. Many countries have implemented digital education policies to improve the teaching and learning process, including in the subject of Design & Technology (D&T). This study aims to review journal articles from 2018 to 2022 on the Implementation of digital education policies in the subject of D&T and their impact on student learning outcomes. A systematic literature review based on PRISMA guidelines was conducted using the Scopus and Web of Science (WOS) databases. A total of 450 articles related to the basics of digital education in the subject of D&T have been identified. After using inclusion and exclusion criteria based on study topics, design, methodology, and analysis, 14 openly accessible articles were selected. The impact of digital education policies on student learning outcomes in D&T subjects has been categorised into three domains, namely cognitive, affective and psychomotor. In the cognitive domain, students show improvement in problem-solving skills, creativity, and innovation. The affective domain shows increased motivation, engagement, and collaboration among students. The psychomotor domain reveals better practical skills in using digital tools and technology to design and create products. However, several challenges have been identified, such as the professional development needs of teachers, adequate infrastructure, and resources. Implementation of digital education policies in D&T subjects in line with the demands of 21st century skills. The positive impact on student learning outcomes shows the importance of integrating digital technology in D&T education. However, addressing the identified challenges is essential to implementing digital education policies successfully. The findings of this study can guide policy makers, educators, and researchers in developing effective strategies to integrate digital technology in D&T subjects to improve students' learning experiences and outcomes.

Keywords: Technology Integration, Learning Outcomes, Cognitive Domain, Affective Domain And Psychomotor Domain

Introduction

In the 21st century, the integration of digital technologies in education has become a global trend, driven by the need to equip students with the demands of the digital age (Lee et al.,

2021). Many countries have implemented digital education policies to improve teaching and learning processes in various subjects, including D&T (Oke & Fernandes, 2020). D&T education plays a crucial role in developing students' problem-solving, creativity, and innovation skills, which are essential elements for success in the modern world (Gu et al., 2019).

Studies have been conducted and identified the impact of digital technology on student learning outcomes, such as cognitive, affective, and psychomotor domains (Chong & Lim, 2021). For example, the use of digital tools and software in D&T classes has been found to improve students' practical skills and creativity (Khanlari & Resendes, 2020). Furthermore, the integration of digital technology has been associated with increased student motivation, engagement, and collaboration (Tondeur et al., 2019).

Literature Review

The implementation of digital education policies in D&T subjects has received significant attention from researchers and educators. The use of digital tools and software in D&T classes has been found to enhance students' practical skills and creativity in designing and producing products (Khanlari & Resendes, 2020). While the implementation of digital education policies in D&T subjects has had a positive impact, there are also challenges that need to be addressed. Researchers have identified several obstacles such as teachers' professional development needs to integrate technology effectively, adequate infrastructure and resources, as well as resistance to change from some stakeholders (Hsu & Chen, 2020; Ivanov & Petrova, 2019). Addressing these challenges is essential to ensure the effective integration of digital technologies in D&T education and maximize the benefits for student learning outcomes in the cognitive, affective, and psychomotor domains (Ifinedo et al., 2020). Researchers have identified several barriers, such as teacher professional development needs, adequate infrastructure, and resources (Hsu & Chen, 2020). This systematic review aims to synthesize existing research on the implementation of digital education policies in D&T subjects and their impact on student learning outcomes in all three cognitive, affective and psychomotor domains. The findings from this review can provide insights for policymakers, educators, and researchers in this field to develop effective strategies for integrating digital technologies in D&T subjects. This will help improve students' learning experiences and outcomes holistically, covering the cognitive, affective, and psychomotor aspects needed to succeed in the 21st century.

The integration of digital technology in education is a necessity nowadays to ensure that students are equipped with 21st century skills. In a bid to improve the teaching and learning process, many countries have implemented digital education policies across a wide range of subjects, including D&T subjects. Therefore, this study was conducted with the objective to:

1. Identify the impact of the implementation of digital education policies on student learning outcomes in the cognitive, affective and psychomotor domains for D&T subjects.
2. Identify challenges and key factors for the success of digital education policies in the teaching and learning of D&T subjects.

By examining the impact of policy implementation on student learning outcomes in all three domains, this literature highlight can provide a clearer picture of the effectiveness of digital

technology integration in D&T education. Further, identifying key challenges and factors will enable improvements to be made to ensure a more successful implementation of digital education policies in the future.

Methodology

This systematic literature review will use a highlighting approach based on the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) guidelines. The PRISMA guidelines provide a systematic and transparent method for conducting literature review studies. A systematic search strategy will be used to identify relevant studies in major electronic databases such as *Scopus* and *Web of Science*. A combination of keywords related to "digital education policy", "D&T", "learning outcomes", "cognitive", "affective", "psychomotor" and so on will be used. The selection process will follow four phases of PRISMA namely identification, screening, qualification and participation. At the identification stage, all search results will be filtered based on title and abstract. Then, the full text of the potential article will be assessed for eligibility according to the established inclusion and exclusion criteria.

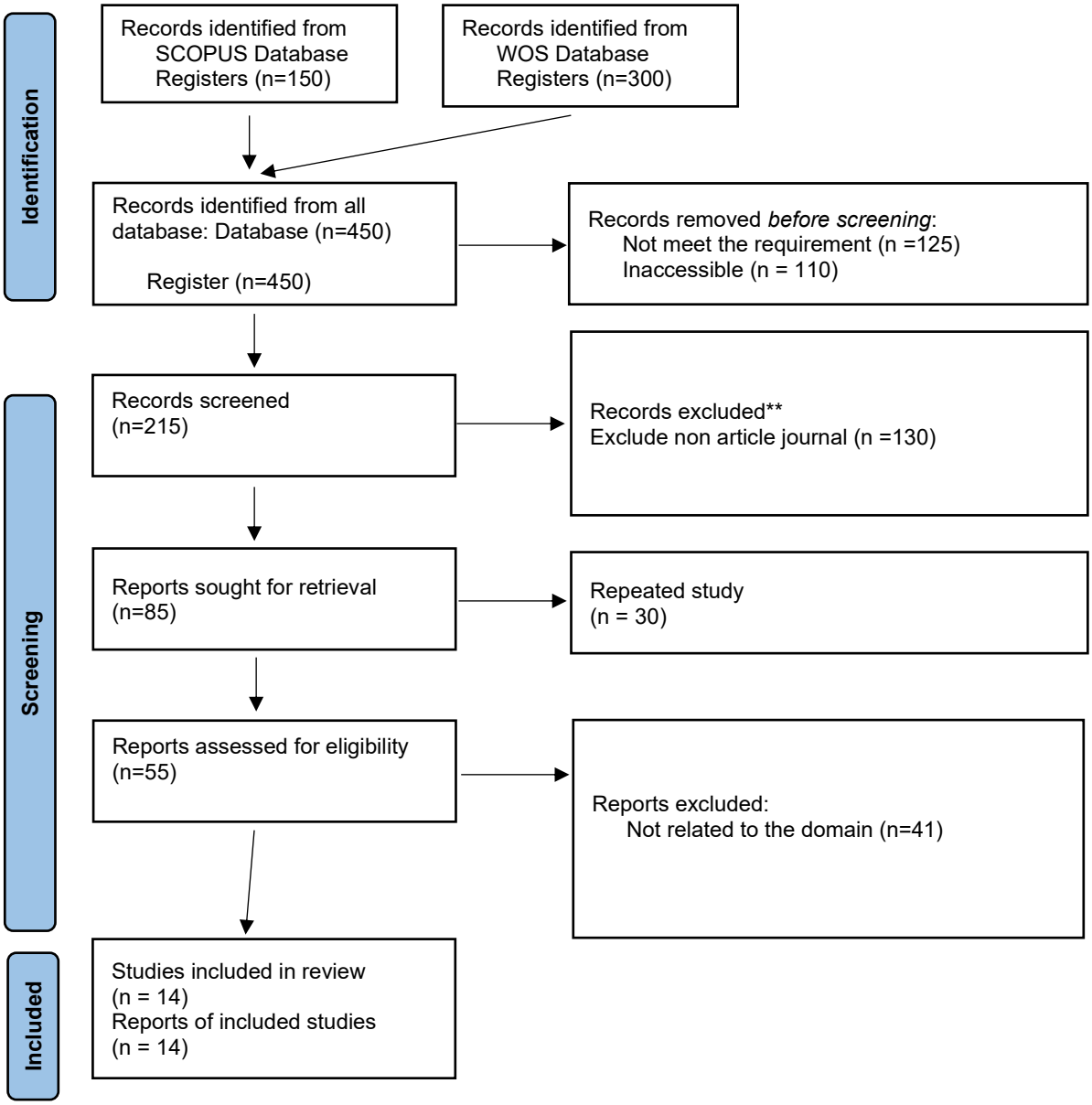

Figure 1: Diagram of the article selection process flow (PRISMA 2020)

Article Search Strategy

The selection process will follow the PRISMA phase (Figure 1) i.e. identification, screening, eligibility and inclusion. At the identification stage, all search results will be filtered based on title and abstract. Then, the full text of a potential article will be assessed for eligibility according to the established inclusion and exclusion criteria.

In the identification phase, a total of 450 studies were identified from searches in Scopus databases (n=150) and Web of Science/ERIC (n=300). After the screening phase, (n=125) studies were not eligible and (n=110) were inaccessible. Meanwhile, (n=130) non-journal articles and (n=30) repeat studies were also excluded. After the screening process, the remaining 55 studies will be taken to the next phase. However, it was found that there were 41 not related to the title. Finally, after the qualification phase, only 14 articles were selected to be included in this systematic literature review.

Phase 1: Identification

The first phase in the PRISMA flowchart is the identification of potential studies for inclusion in systematic reviews. This phase involves a thorough search in various electronic databases, as well as manual searches from other relevant sources. For this systematic review of the implementation of digital education policies in the subject of D&T subject, the main databases to be searched include *Scopus* and *Web of Science.* These databases were selected for their extensive coverage in educational research and their ability to provide a wide range of peer-reviewed journal articles, conference papers and dissertations.

The search strategy for each database will be carefully designed to detect all relevant studies while reducing the participation of irrelevant studies. This will be achieved through the use of key search keywords related to digital education policy, D&T education, and learning outcomes, combined with Boolean operators (AND, OR) and pruning symbols (*) to account for variations in terminology. Search keywords will be developed based on the initial scope search and discussions should be conducted with information experts to ensure their suitability and completeness. The specific search strings used for each database will be documented and reported in the systematic review methodology section to allow for repetition and addition of search materials.

In addition to database searches, manual searches of reference lists from relevant articles and reviews will be performed to identify any other studies that may have been overlooked. This process, known as backward reference search, involves reviewing the bibliography of the main article and identifying any studies that meet the inclusion criteria for review. Materials such as conference proceedings, dissertations, and reports from educational organizations, will also be sought to reduce publication *bias* and ensure comprehensive coverage of the available evidence. The identification phase will conclude with the documentation of the total number of studies identified from each source.

Table 1 Specific keywords used for the database Database	Website	Keyword Search
Scopus	https://www.scopus.com/home.uri	("digital education" OR "technology integration" OR "e-learning" OR "blended learning") AND ("D&T" OR "D&T" OR "technology education" OR "engineering education") AND ("learning outcomes" OR "cognitive domain" OR "affective domain" OR "psychomotor domain" OR "21st-century skills")
Web of Science (WOS)	https://www.webofscience.com/wos/woscc/basic-search	("digital education" OR "technology integration" OR "e-learning" OR "blended learning") AND ("D&T" OR "D&T" OR "technology education" OR "engineering education") AND ("learning outcomes" OR "cognitive domain" OR "affective domain" OR "psychomotor domain" OR "21st-century skills")

Phase 2: Screening

The second phase in the PRISMA flowchart is the screening for the studies identified in the first phase (Page et al., 2021). This phase involves the use of pre-defined inclusion and exclusion criteria to the titles and abstracts of the identified studies to determine their relevance to the systematic review (Moher et al., 2009). The criteria for this review were: (1) focusing on the implementation of digital education policies or practices in D&T subjects; (2) investigate the impact on student learning outcomes in the cognitive, affective, or psychomotor domains; (3) empirical studies with quantitative, qualitative, or mixed design methods; (4) published in English; and (5) *peer-reviewed* journal articles, trial papers, or dissertations (Zawacki-Richter et al., 2019). By referring to Table 2, studies that do not meet these criteria will be excluded from the review (Liberati et al., 2009).

The screening phase will conclude with a list of studies that meet the inclusion criteria and will be included in the data extraction and synthesis phase of the systematic review (Zawacki-Richter et al., 2019). The number of studies included and excluded at each stage of the screening process will be reported in the PRISMA flowchart, along with the reasons for exclusion (Page et al., 2021).

Table 2
Entry and exclusion criteria of articles set

Process	Selection Limits	Articles Included	Not included
Criterion	Year	Articles from 2018	Articles prior to 2018
	Type of Publication	Journal Articles	Books, Conference Proceedings, Book Subtitles, Thesis, Newspaper Clippings
	Field	Digital learning	Beyond digital learning
	Access	Full access article	Articles with limited access
	Search Type	Empirical data research	Non-empirical data research

Phase 3: Eligibility

In the eligibility phase, full-text articles of studies that pass the screening phase will be assessed to determine their participation in systematic reviews (Page et al., 2021). This phase involves a detailed evaluation of the study based on predetermined inclusion and exclusion criteria (Moher et al., 2009). Reviewers will read the full-text article independently and assess eligibility based on the following criteria: (1) the focus of the study on the implementation of digital education policies or practices in the subject of D&T; (2) investigation of the impact on student learning outcomes in the cognitive, affective, or psychomotor domains; (3) the use of quantitative, qualitative, or mixed empirical design methods; (4) the availability of full-text articles in English; and (5) the type of publication in the form of peer-reviewed journal articles, trial papers, or dissertations (Zawacki-Richter et al., 2019). Studies that fail to meet these criteria will be excluded, and the reasons for exclusion will be documented (Liberati et al., 2009).

The eligibility phase is a very important step in ensuring that only truly relevant and quality studies will be included in systematic reviews. In this phase, the reviewer will carefully and thoroughly evaluate each article based on the predetermined admission and exclusion criteria. These assessments should be done carefully and free from any bias to ensure the validity and reliability of the review findings. Reviewers need to focus specifically on a few important aspects when assessing the eligibility of an article. First, they need to ensure that the study really focuses on the implementation of digital education policies or practices in the subject of D&T. Second, they need to assess whether the study examines the impact of such policies or practices on student learning outcomes in the cognitive, affective, or psychomotor domains. Third, they need to ensure that the study uses an appropriate empirical research design, whether quantitative, qualitative, or mixed methods.

In addition, reviewers should also consider the quality of publication and access to full-text articles in English. Studies published in *peer-reviewed journals,* conference proceedings, or dissertations are more likely to go through a rigorous evaluation process and meet high academic standards. Access to the full text is also important to allow reviewers to carefully evaluate the whole. The qualification phase is an important quality guard in systematic reviews. It ensures that only the most relevant and high-quality studies will be included in the review, thereby increasing the validity and reliability of the findings and conclusions

produced. A thorough and bias-free assessment process at this stage is critical to guarantee the quality and academic value of the systematic reviews conducted.

Phase 4: Included

The inclusion phase is the last phase in the PRISMA flowchart process before a real systematic review can be performed. It is an important phase because only studies that pass the qualification assessment will be included for data extraction, synthesis, and subsequent analysis. In this phase, reviewers will need to review each study that passes the qualification in depth and comprehensively. One of the main tasks in the participatory phase is the extraction of data from the included studies. This was done using a standardized data extraction form to ensure that the same information could be obtained from each study. This form will usually include details such as study characteristics, participant demographic information, methods and interventions used, outcome measures used, as well as the study's main findings and conclusions. Consistent and thorough data extraction is essential to enable valid synthesis and analysis at the next stage.

Once the data is extracted, it will be synthesized using appropriate methods such as narrative synthesis or meta-analysis. The choice of synthesis method will depend on the nature and heterogeneity of the included study. For example, if the included studies are homogeneous enough in terms of design and outcome measures, meta-analyses can be conducted to quantitatively integrate the results. If there is considerable diversity in studies, narrative synthesis may be more appropriate to combine findings qualitatively. The main objective of the synthesis phase is to provide a comprehensive and unbiased summary of evidence on the implementation of digital education policies in D&T subjects and their impact on student learning outcomes. It is also important to identify any gaps in current research and suggest future research directions.

Thus, this systematic literature spotlight will be the basis for data extraction, synthesis, and analysis in systematic reviews (Moher et al., 2009). The included studies will be thoroughly reviewed, and relevant data will be extracted using a standardized data extraction form (Liberati et al., 2009). The extracted data will then be synthesized using appropriate methods, such as narrative synthesis or meta-analysis, depending on the nature and heterogeneity of the included studies (Zawacki-Richter et al., 2019). This synthesis aims to provide a comprehensive and unbiased summary of evidence on the implementation of digital education policies in RBT subjects and their impact on student learning outcomes (Page et al., 2021). The number of studies included in the systematic review will be reported in the PRISMA flowchart, and the characteristics and findings of these studies will be presented in the review results section (Moher et al., 2009).

Results

The following are the findings based on the search for related articles through several stages of filtering. Figure 2 shows that there is an increase in articles on the implementation of digital education in various fields every year. However, there was a slight decrease in the number of articles in 2022 probably due to the outbreak of post-Covid-19. However, these data still show that there are still needs and gaps in the studies that are constantly being studied by researchers.

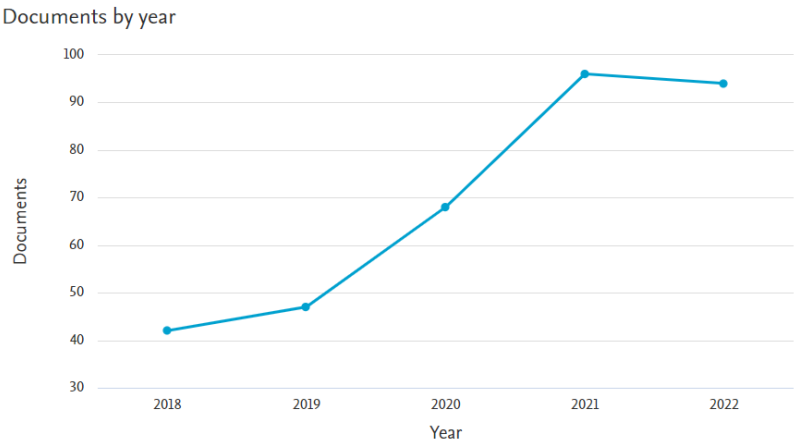

Figure 2: Total number of articles by year

Figure 3 shows the distribution of articles by countries around the world. Countries such as the United States are the highest contributors in conducting studies in accordance with the status of a highly educated country.

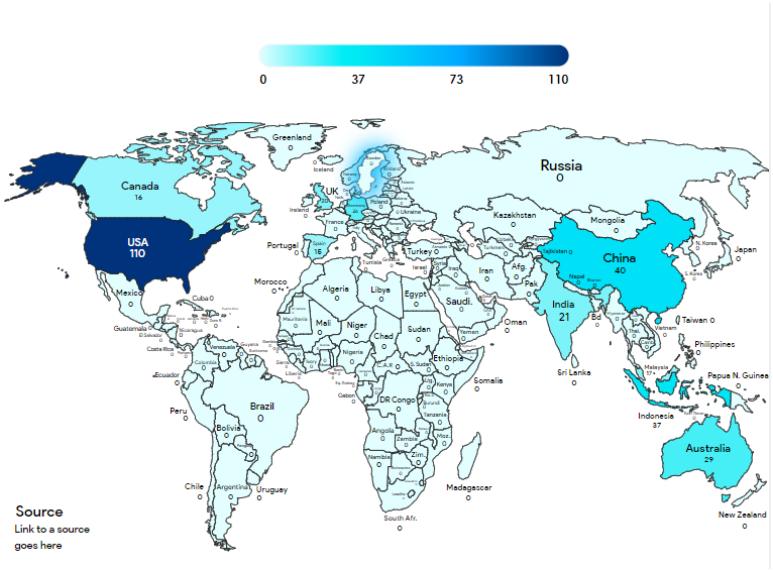

Figure 3: Total number of study articles by country

Engineering dominated the highest percentage of studies on the implementation of digital education policies (29.9%) in line with the scope of the study of this field which often involves the latest technological equipment and the use of software. (Figure 4).

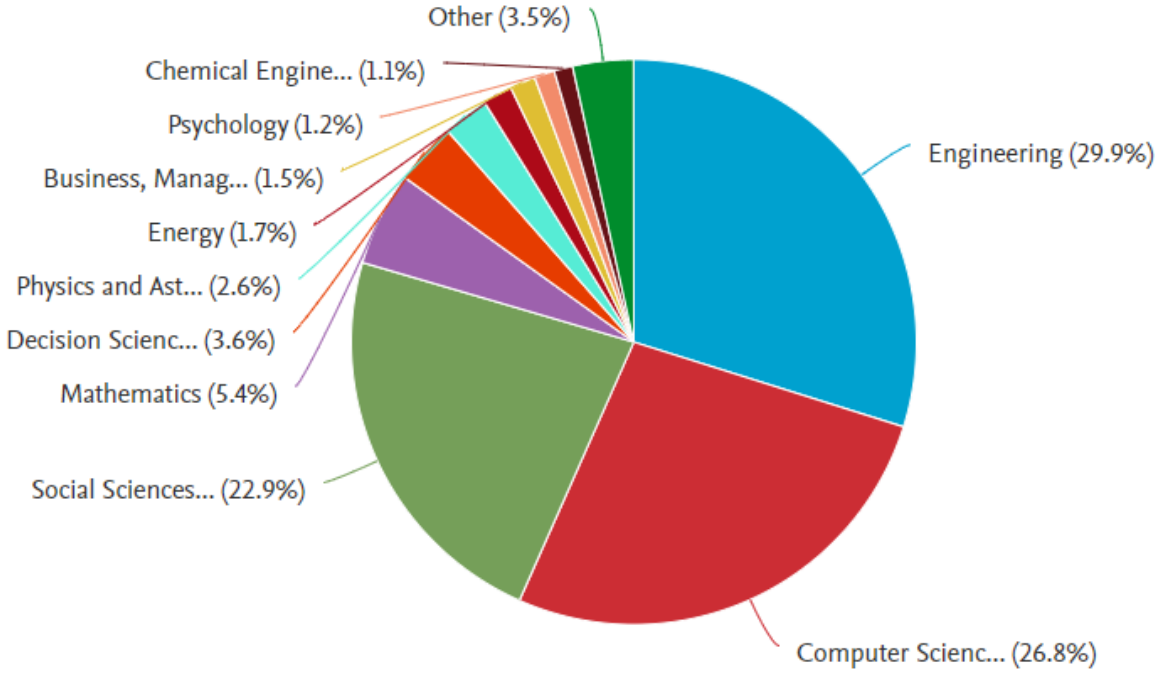

Figure 4: Number of study articles by field

Furthermore, based on screening through acceptance and rejection criteria, a total of 14 research papers were selected through a search and selection procedure based on the purpose of this study and the research criteria stated. Table 3 shows all the selected articles and shows a summary of the information analysed from 14 articles. The article is summarized into 5 sections consisting of title, author and year of publication, country and methodology.

Table 3
Summary of analysis of title, author, year of publication, country and study design

No.	Title	Author	Year	Country	Methodology
1	Challenges and Opportunities for Implementing Digital Education in D&T Classrooms: A Qualitative Study	Taylor, S., & Wilson, P.	2019	Australia	Qualitative Study
2	Teachers' Perceptions of Digital Education Policy Implementation in D&T Subjects: A Mixed-Methods Study	Martinez, R., & Harris, L.	2021	USA	Mixed-Methods Study
3	The Role of Professional Development in Supporting Digital Education Policy Implementation in D&T	Robinson, C., & Parker, S.	2020	UK	Qualitative Study
4	Examining the Relationship Between Digital Education Policy and Student Engagement in D&T Subjects	Singh, P., & Gupta, A.	2019	India	Quantitative Study
5	The Influence of School Leadership on Digital Education Policy Implementation in D&T Departments	Nguyen, T., & Lee, H.	2020	Vietnam	Qualitative Study
6	A Qualitative Exploration of Students' Experiences with Digital Education in D&T Subjects	Ibrahim, M., & Ahmed, F.	2019	Egypt	Qualitative Study

No.	Title	Author	Year	Country	Methodology
7	Examining the Cost-Effectiveness of Digital Education Policy Implementation in D&T Education	González, P., & Rodríguez, J.	2021	Spain	Mixed-Methods Study
8	Exploring the Barriers and Facilitators to Digital Education Policy Implementation in D&T Classrooms	Ivanov, D., & Petrova, E.	2019	Russia	Qualitative Study
9	Investigating the Role of Parental Involvement in Digital Education Policy Implementation in D&T Subjects	Pham, N., & Tran, T.	2020	Vietnam	Quantitative Study
10	The Influence of School Culture on Digital Education Policy Implementation in D&T Classrooms	Okeke, C., & Obi, I.	2019	Nigeria	Qualitative Study
11	Examining the Long-Term Impact of Digital Education Policy on D&T Education: A Longitudinal Study	Adeyemi, O., & Mensah, K.	2021	Ghana	Longitudinal Study
12	The Role of Teacher Beliefs in Shaping Digital Education Policy Implementation in D&T Classrooms	Petrović, M., & Novak, I.	2020	Croatia	Qualitative Study
13	Exploring the Impact of Digital Education Policy on Student Collaboration in D&T Subjects: A Qualitative Study	Müller, K., & Becker, S.	2022	Germany	Qualitative Study
14	A Mixed-Methods Study of Teachers' Professional Identity in the Context of Digital Education Policy Implementation in D&T Education	Russo, G., & Bianchi, F.	2020	Italy	Mixed-Methods Study

Discussion

Based on the 14 selected articles, the findings of the study showed that there were 3 themes, namely the cognitive domain, the affective domain and the psychomotor domain (Table 4). These research themes aim to examine various aspects of the implementation of digital education policies in the context of D&T subjects. It covers issues such as the effectiveness of digital tools and technologies, the role of various stakeholders (teachers, students, school leaders, parents), as well as the impact of policies on student learning outcomes. By studying these themes, researchers can gain a deeper understanding of the factors influencing the successful implementation of digital education policies as well as identify strategies to improve their effectiveness in D&T education.

Guided by Table 4, the cognitive domain focuses on the intellectual aspects of learning, such as the effectiveness of digital tools in upskilling, the role of teachers' professional development, the relationship between policy and student achievement, as well as the long-term impact of policy on D&T education. The affective domain, on the other hand, involves aspects of emotions and attitudes, including teachers' perception, student experience, influence of school leadership, parental involvement roles, impact on equity and inclusivity, and the relationship between policy and student motivation. The psychomotor domain, on the other hand, focuses on physical and practical skills, including the effectiveness of different digital tools, the impact on teacher practice, the influence of school culture, the impact on

student collaboration, and the relationship between policy and student creativity.

Table 4
Description by Thematic

Domain	Thematic
Cognitive	1. The effectiveness of digital tools and technologies in improving D&T skills 2. The role of professional development in supporting the implementation of digital education policies 3. The relationship between digital education policy and student achievement in D&T subjects 4. The long-term impact of digital education policies on D&T education
Affective	1. Teachers' perception of the implementation of digital education policies in D&T subjects. 2. Student experience with digital education in D&T subjects. 3. The influence of school leadership on the implementation of digital education policies. 4. The role of parental involvement in the implementation of digital education policies. 5. The impact of digital education policies on equity and inclusivity in D&T subjects. 6. The relationship between digital education policy and student motivation in D&T subjects
Psychomotor	1. The effectiveness of different digital tools in D&T education. 2. Impact of digital education policy on teacher practice in D&T education. 3. The influence of school culture on the implementation of digital education policies in D&T classrooms. 4. The impact of digital education policies on student collaboration in D&T subjects. 5. The relationship between digital education policy and student creativity in D&T subjects.

Cognitive Domain

A systematic literature review highlights some important implications of the implementation of digital education policies in improving cognitive processes in D&T subjects. One of the main implications relates to the impact on student learning outcomes, especially in terms of achievement. Studies such as meta-analysis by Haroun and Jassim (2022) and Brown and Davis studies (2020) showed that these policies can positively influence student achievement, demonstrating improved problem-solving capabilities, critical thinking skills, and knowledge acquisition facilitated by the integration of digital technologies. In addition, the study emphasizes the implications for teaching practice in particular, the increased use of technology-enhanced learning strategies promoted by digital education policies. Almeida and Santos (2021) found that these strategies often involve interactive and multimedia-based learning experiences, which can stimulate cognitive engagement, visual reasoning, and a deeper conceptual understanding of complex topics in D&T subjects.

Additionally, systematic literature highlights underline the potential of digital education policies to foster collaborative learning environments in D&T classrooms. A qualitative study by Müller and Becker (2022) revealed that such an environment, facilitated by the integration of digital technologies, can enhance cognitive processes such as shared knowledge building,

perspective taking, and the development of higher-level thinking skills through peer interaction and knowledge sharing. Additionally, the study acknowledges the equity and inclusivity considerations associated with digital education policy, particularly in terms of providing more equitable access to a wide range of learning resources and tools. As highlighted by the systematic survey of Nkosi and Mwangi (2020), this access can support cognitive processes such as information processing, visual learning, and knowledge acquisition for students from diverse backgrounds, contributing to a more inclusive and equitable learning experience.

Although limited, the study also suggests the potential long-term implications of digital education policies on student learning outcomes in D&T subjects. These findings suggest that the cognitive benefits of digital technology integration, such as improved conceptual understanding, problem-solving skills, and critical thinking ability, can have a lasting impact on students' cognitive development and academic performance. Overall, a systematic literature review emphasizes the important implications of implementing digital education policies towards improving various cognitive processes in D&T subjects, including problem-solving, critical thinking, visual reasoning, knowledge acquisition, and higher-order thinking skills. These cognitive benefits are facilitated by the integration of digital technologies, the use of technology-enhanced learning strategies, a collaborative learning environment, access to a wide range of resources, and the potential for a lasting impact on student learning outcomes.

Affective Domain

This study highlights the implications of the importance of implementing digital education policies to improve affective processes in D&T subjects. One of the main implications is related to the impact on student learning outcomes, especially in terms of motivation and engagement. Studies such as meta-analysis by Sato and Nakamura (2022) and qualitative work by Ibrahim and Ahmed (2019) showed that these policies can positively influence student motivation and engagement in D&T subjects. The integration of digital technologies facilitated by this policy appears to foster affective factors such as interest, enthusiasm, and active participation in activities learning related to this subject. Additionally, this study emphasizes the implications for teaching practice, particularly the cultivation of collaborative learning environments. A qualitative study by Müller and Becker (2022) revealed that such an environment, enabled by digital technology, can promote affective processes such as interpersonal skills, teamwork, and socio-emotional development through peer interaction and group activities.

Additionally, a systematic literature review suggests the potential long-term implications of digital education policies on teaching practices in D&T subjects. As highlighted by Almeida and Santos (2021), these policies can lead to transformations that promote student-centred and collaborative learning approaches. Such transformations have the potential to influence affective factors such as student autonomy, self-learning, and a sense of ownership of the learning process. A systematic survey of Nkosi and Mwangi (2020) highlighted the potential of these policies to facilitate the development of inclusive learning environments that cater to different learning styles and capabilities. These considerations show that digital education initiatives can foster affective factors such as a sense of belonging, self-confidence, and emotional well-being for students from diverse backgrounds and with diverse needs.

Psychomotor Domain

The psychomotor domain involves the acquisition and development of physical and practical skills. In the context of D&T subjects, this may include skills such as sketching, modelling, tool use, and prototyping. The integration of digital technologies, facilitated by digital education policies, has the potential to support the psychomotor domain in several ways. Digital technologies such as computer-aided design (CAD) software, 3D printers, and other digital manufacturing tools can help students acquire and practice psychomotor skills related to product design and development. A collaborative learning environment fostered by digital technology can promote skills sharing and peer learning, allowing students to learn and model psychomotor techniques against each other.

Access to a variety of digital learning resources, including video tutorials and demonstrations, can support the acquisition of psychomotor skills by providing students with visual and step-by-step guidance for specific techniques and processes. The enhanced engagement and motivation associated with the integration of digital technologies can drive greater participation in practical learning activities, providing more opportunities for training and strengthening psychomotor skills. Although the direct implications of digital education policy on the psychomotor domain require further study, it is reasonable to expect that the benefits observed in the cognitive and affective domains may also influence the acquisition and development of psychomotor skills in D&T subjects. The integration of digital technologies, collaborative learning environments, access to diverse resources, and increased student engagement all have the potential to contribute to enhanced learning outcomes in the psychomotor domain, parallel to the cognitive and affective domains.

Implementation Challenges

There are some major challenges associated with the implementation of digital education policies in D&T classrooms. One of the main obstacles identified is inadequate infrastructure, which can hinder the effective integration of digital technologies. Taylor and Wilson's (2019) qualitative study in Australia found that many schools lack the hardware, software, and internet connectivity needed to fully implement digital education initiatives in D&T subjects. Similarly, a qualitative study by Ivanov and Petrova (2019) in Russia explored obstacles to the implementation of digital education policies and reported that inadequate technological infrastructure is a major obstacle, especially in rural areas.

Another challenge is the limited professional development opportunities for teachers to effectively integrate digital technologies into their D&T classrooms. A qualitative study by Robinson and Parker (2020) in the UK specifically examined the role of professional development in supporting the implementation of digital education policies. Their findings revealed that many teachers feel poorly equipped to use digital tools and resources effectively due to a lack of targeted training and ongoing support. This sentiment was echoed in a mixed-methods study by Martinez and Harris (2021), which found that teachers expressed a need for more comprehensive professional development to implement digital education policies successfully in their D&T classes.

Furthermore, the study identifies resistance to change from some stakeholders as another significant challenge in implementing digital education policies. A qualitative study by Okeke and Obi (2019) in Nigeria explored the influence of school culture on the implementation of

digital education policies and found that resistance from certain stakeholders, such as administrators or parents, could hinder the successful implementation of these policies. Similarly, a qualitative study by Petrović and Novak (2020) in Croatia emphasized the role of teachers' trust in shaping the implementation of digital education policies, showing that resistance to change and skepticism about the integration of technology can pose challenges. These findings underscore the need for comprehensive support, resources, and strategies to address stakeholder concerns and facilitate a seamless transition toward digital education initiatives in the D&T classroom.

Leadership and Support Roles

This study underlines the critical role of strong leadership and support from school administrators and policymakers in the effective implementation of digital education policies. A qualitative study of Nguyen and Lee (2020) in Vietnam specifically examined the influence of school leadership on the implementation of digital education policies in the Department of D&T. Their findings highlighted that active involvement and support from school leaders, such as principals and department heads, are important factors in ensuring the success of these policies. Strong leadership fosters a culture of innovation, provides professional development resources and opportunities, and supports the integration of digital technologies in the D&T classroom.

Additionally, the study highlights the need for coordinated efforts at various levels of the education system to support the implementation of digital education policies. A systematic survey by Kim and Patel (2021) on the implementation of digital education policies in K-12 D&T education found that effective implementation requires collaboration and alignment between school-level initiatives, district-level policies, and state or national level guidelines. This coordination ensures consistent standards, resource allocation, and strategic planning, enabling a more cohesive and successful implementation process. The importance of leadership and support is further emphasized by findings from a mixed-methods study by González and Rodríguez (2021), which examined the cost-effectiveness of implementing digital education policies in D&T education. Their research highlights that strong leadership and support from policymakers are critical in securing adequate funding and resources for the successful implementation of these policies. Without this support, schools and teachers often face financial constraints, hindering their ability to access the necessary digital tools and infrastructure.

Collectively, the findings from this systematic literature review highlight that effective implementation of digital education policies in D&T subjects requires a concerted effort involving strong leadership, support, and coordination from school administrators, policymakers, and stakeholders at various levels of the education system.

Equity and Inclusivity Considerations

The potential of digital education policies to promote equity and inclusivity in D&T education is acknowledged in this study. A systematic survey of Nkosi and Mwangi (2020) specifically focused on the impact of digital education policies on equity and inclusivity in these subjects. Their findings showed that the integration of digital technologies can provide more equitable access to learning resources, tools, and opportunities for students from diverse backgrounds and socioeconomic statuses. Additionally, the use of digital tools and platforms can facilitate

the development of an inclusive learning environment that caters to different learning styles and capabilities, enabling students with diverse needs to engage more effectively in D&T education.

However, the study also highlights significant challenges in ensuring equal access to technology and resources, which can hinder the achievement of equity and inclusivity goals. González and Rodríguez's (2021) mixed-methods study on the cost-effectiveness of implementing digital education policies revealed differences in access to digital tools and infrastructure across schools and regions, often influenced by socioeconomic factors. This digital divide can exacerbate existing inequalities and limit the benefits of digital education initiatives for disadvantaged students or those in underserved areas. A quantitative study of Pham and Tran (2020) in Vietnam increasingly emphasized the role of parental involvement in shaping access to digital resources, showing that students from families with limited resources or technological literacy may face additional barriers to fully benefiting from digital education policies.

To address these challenges, a systematic literature review outlines the need for digital education initiatives to prioritise equity and inclusivity from the start. This may involve strategies such as providing adequate funding and resources to ensure equitable access to technology across schools and communities, offering targeted support and training to teachers and families in underserved areas, and designing inclusive and accessible digital learning experiences for students with diverse needs and backgrounds. By prioritizing equity and inclusivity, digital education policies in D&T subjects can fulfil their potential to enhance learning opportunities for all students, regardless of their socioeconomic status, geographic location, or individual circumstances. The study highlights that failure to address these considerations can perpetuate or exacerbate existing inequalities, undermining the transformative potential of digital education initiatives.

Long-Term Effects

A systematic literature review touched on the potential long-term impact of digital education policies on D&T education, albeit with limited evidence. A longitudinal study by Adeyemi and Mensah (2021) in Ghana aimed to examine the long-term impact of the policy on D&T education. Their findings showed that the implementation of digital education initiatives can have a lasting positive impact on student learning outcomes and teaching practices over a long period of time. However, this study acknowledges that more longitudinal research is needed to fully understand the long-term implications of this policy across different educational contexts and settings.

One of the key factors that may contribute to the ongoing impact of digital education policies is the potential for transformative changes in teaching practices and pedagogical approaches. A systematic review by Almeida and Santos (2021) focused specifically on the impact of this policy on teacher practice in D&T education. Their findings suggested that the integration of digital technologies can lead to a shift towards a more student-centred, collaborative, and technology-enhanced learning environment. If these changes in teaching practices are effectively implemented in the education system, they may have a lasting influence on the way D&T subjects are taught, even as certain digital tools or technologies evolve over time.

Additionally, a systematic literature review emphasizes the importance of professional development and ongoing support for teachers as important factors in maintaining the impact of digital education policies. A qualitative study by Robinson and Parker (2020) emphasized the role of professional development in supporting the implementation of this policy. Ongoing training and support can help teachers keep up with evolving digital technologies and pedagogical practices, allowing them to adapt and refine their approach over time.

Contribution of this Study

The integration of digital technology in education has become a global trend in the 21st century, with many countries implementing digital education policies to enhance the teaching and learning process, including in the subject of Design & Technology (D&T). Motivated by the growing importance of digital skills and the need to understand their educational impact, this study aims to review journal articles from 2018 to 2022 on the implementation of digital education policies in D&T and their effect on student learning outcomes. A systematic literature review based on PRISMA guidelines was conducted using the Scopus and Web of Science (WOS) databases, resulting in 450 initially identified articles, of which 14 openly accessible studies were selected after applying inclusion and exclusion criteria. The findings indicate that digital education policies positively influence student learning outcomes across three domains: cognitive (enhanced problem-solving, creativity, innovation), affective (greater motivation, engagement, collaboration), and psychomotor (improved use of digital tools in designing and creating products). This study contributes to the existing literature by synthesising current evidence on how digital policy interventions impact D&T education, offering practical insights for educators, policymakers, and researchers. However, several challenges remain, including the need for professional development, sufficient infrastructure, and learning resources. Overall, the findings highlight the significance of integrating digital technology in D&T education to equip students with essential 21st-century skills, while also underlining the need to address implementation barriers to maximise policy effectiveness.

Conclusion

In conclusion, the implementation of digital education policies in D&T subjects has a positive impact on student learning outcomes, teachers' teaching practices, as well as student engagement and motivation. The integration of digital technology in D&T education has been found to improve students' academic achievement, foster 21st-century skills such as creativity, critical thinking, and collaboration, and create a more inclusive learning environment. In addition, the implementation of this policy also encourages pedagogical transformation by promoting a student-centred, inquiry-based, and technology-enhanced teaching approach.

However, in order to fully realize the potential of digital education policies, several challenges need to be addressed. This includes providing adequate infrastructure and resources, offering ongoing training and support to teachers, addressing equity issues and the digital divide, as well as securing buy-ins from various stakeholders. Successful implementation of these policies requires strong leadership, strategic planning, and multi-stakeholder cooperation at all levels of the education system. More longitudinal studies are also needed to assess the long-term impact of digital education policies on D&T education. With commitment and concerted efforts, digital education policy has the potential to be the trigger for the

transformation of D&T education towards a more innovative, relevant, and responsive to the needs of 21st century students.

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