Building a digital learning space culture in elementary school

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Abstract: The study aims to investigate the grand design and strategy for building a digital learning space culture, including its impact on learning in elementary schools. Data were gathered by conducting interviews with academics, observing learning processes, and reviewing school records. Throughout the data collection process, data were evaluated using data presentation, data condensation patterns, and conclusion drawing. The study's conclusions were validated using triangulation and data collection methodologies. The study's findings revealed that (1) the grand plan for creating a digital culture was not fully developed, and the provision of digital facilities was tailored to fit limited needs and budgets; (2) the principal implemented a strategy for creating a digital culture for teachers by providing digital facilities and infrastructure, establishing an IT team, and providing professional teacher training; the interaction of the three supported digital culture; and (3) the positive impacts included more engaging learning, increased teacher administration efficiency, and improved students' and instructors' technology skills, whereas the negative effects included a loss in students' fine motor skills and social competence. The implication is that a thorough investigation is required to determine the best formula for employing digital media in learning so that learning effectiveness can be maximized.

Keywords: Digital culture, Digital leadership, Digital learning, ICT media, Teacher digital competency.

1. Introduction

Quality education constitutes one of the seventeen Sustainable Development Goals (SDGs) and represents the 2030 national and global commitment to enhancing societal welfare [1]. Providing quality education may build and guarantee inclusive and equitable quality education that fosters lifelong learning opportunities for everyone. Thus, initiatives to advance education for sustainable development and to incorporate sustainable development into educational frameworks are substantial. To do so, educational institutions should strive to transform themselves into qualitative excellence centres.

The rapid advancement of technology, particularly during the COVID-19 pandemic, has accelerated digitalization throughout nearly all societal aspects, including the digitalization of education. Al Masadeh, et al. [2] reported that the elements of digital transformation substantially influence institutional excellence, with 69.90% of the components contributing to institutional excellence being attributable to digital transformation. The parameters of institutional excellence encompass leadership, knowledge, and human resources; thus, educational institutions must prepare for digital transformation to attain institutional excellence.

Educational institutions must transition from their old approaches to digitalization. Digitalization represents an innovative form that demonstrates tangible proof of enhanced job efficiency and effectiveness. Akhmedov [3] asserts that the acceleration of digital economy growth results in the restructuring of the education system. Educational institutions must digitize their academic, research, internationalization, marketing, financial, and economic operations to sustain a competitive position in the global education services market. The digitalization of education by academic institutions will

transform the work culture of all concerned educational components. Wiśniewska and Grudowski [4] systematic review determined that a culture of excellence comprises seven dimensions: (1) a clear vision, mission, and goals for achieving excellence, (2) excellence-oriented leadership, (3) employee engagement, (4) human resource management, (5) fulfilling and exceeding student and staff expectations, (6) ongoing enhancement process through innovation and best practices, and (7) collaboration and teamwork for improvement.

A study conducted by Leal-Rodríguez, et al. [5] reported that many institutions failed to adapt their culture to the continuous advancement of technology and digitalization despite their potential to transform their organization's resources and capacities. Since many educators cannot fully engage as subjects in their professional activities, educational institutions must address the problem to support the educators' professional skill development. More recently, another study by Li and Kostka [6] demonstrated that many parents and adults encounter obstacles in acquiring and using digital technology, highlighting the essential influence of social support and networks in aiding parents' adaptation to a digital society and lifestyle. Consequently, authorities must proactively offer training to bridge the digital gap.

Børte, et al. [7] found that barriers to students' active learning in the use of technology are caused by (1) a lack of alignment between research and learning practices, (2) a lack of infrastructure support for research and learning activities, and (3) a lack of support for staff development and learning design. The research results of Zinchenko, et al. [8] also noted that there are barriers to the digitalization of education and learning, including poor digital infrastructure, poor internet connection, low information literacy, difficulty selecting and sorting information, and low level of digital competence.

The institutions' educational quality cannot be separated from the institutions' digitalization culture. Kortsch, et al. [9] emphasized that leaders play a crucial role in creating the digitalization of educational institutions; at least, they must study culture globally and focus on developing international human resources. Suryadi, et al. [10] found that digital leadership significantly and positively affects the university performance and convincingly predicts digital innovation. A university's higher digital literacy will increase its digital innovation and performance. Both studies imply the importance of educational institution leaders in facilitating the development of teacher and education personnel resources to enhance skills in operating *Information and Communication Technology* (ICT) to realize the digitalization of education and learning.

Aboobaker and KA [11] reported that at the optimal level of an organizational learning culture, a university's digital learning orientation significantly influences its innovative behavior through higher readiness to change. This is relevant to Mei, et al. [12] finding, which states that teachers are committed to using digital tools to engage, motivate, and facilitate students to learn actively so that teachers reflect more on the implemented learning practices. Furthermore, the results also show that digital learning positively affects teachers' teaching practices and can serve as a tool to improve their performance. Positive teaching practices should also be shared within the learning organization to improve teaching practices at the organizational level.

Within the Indonesian context, low ICT and English language skills are found to hinder the internationalization process of educational institutions significantly [13]. This also has implications for the institution's inability to implement the digitalization of learning since the digitalization process requires English and ICT skills. Moreover, ICT skills are closely related to learning and research performance. When ICT is implemented in the classroom, students feel encouraged to engage in more active, constructive, and interactive activities. Thus, the ICT implementation is positively related to learning outcomes [14].

Evidence that learning using digital media improves learning success is supported by Arlinwibowo, et al. [15] who reported that the learning outcomes of groups that use ICT are better than those that do not. Bygstad, et al. [16] identified three fundamental strengths of the success of the digital learning environment: (1) the technical basis is the alignment between digital education and digital subjects, (2) the digital learning environment has changed the role of teachers as resource facilitators who monitor

student engagement and learning, and (3) the digital learning environment allows educational institutions to surpass physical and institutional boundaries and foster connections with the broader community.

The researchers believed it was crucial to learn from the experiences of two Islamic primary schools in Malang that successfully developed digitalization of learning environments. Both Islamic elementary schools' success was recognized by the Indonesian Ministry of Religious Affairs by designating both schools as digital Islamic elementary schools in 2023. It is a form of the government's recognition of both schools' success in organizing learning through innovative digital education applications.

Both schools' success can serve as a benchmark for other educational institutions in organizing digital-based learning. Moreover, it has become a recent trend that the issue of the importance of digitizing learning and education activities, as well as the demands for expanding the provision of increasingly diverse distance services. Moreover, previous studies have found that an institution's success in building a digital-based work culture can influence its institutional success or excellence. Therefore, this study aims to answer the following questions,

- How is the grand design of developing a digital learning space culture implemented by elementary school?
- What is the principal's strategy in building a digital culture for teachers in implementing the learning process at school?
- What are the positive and negative impacts of efforts to develop a digital learning space culture on the learning process and outcomes in elementary school?

2. Method

2.1. Research Object and Subject

This study examines the utilization of ICT media in educational activities at two Islamic elementary schools in Malang city, Indonesia, to elucidate their program design and strategies for enhancing teacher engagement in learning activities and assess their impacts on achieving the learning objectives. Two public Islamic elementary schools in Malang city were selected as the research sites. Both schools were designated as digital Islamic elementary schools by the Indonesian Ministry of Religious Affairs in 2023, indicating the government's recognition and appreciation of both schools' achievements. Both Islamic primary schools have different characteristics despite being in the same city. The first school is in the city's center, surrounded by *other schools and* universities. The school is easily accessible by various means of transportation. The second primary school is located on the city's outskirts in the middle of a village with a high population density but limited road access.

2.2. Data Collection

To achieve the research objectives, the researchers directly presented at the school to interact with the school principal, teachers, and IT team. The *data were collected through interviews with the principals of the two research sites, including the deputy principals, with 20 teachers representing each class and three IT teams at the school. The data collection process was conducted through focus group discussion (FGD) activities and in-depth interviews when further explanation was needed from the FGD results.* In addition, they observed the utilization of ICT media in the learning process and reviewed strategic plan documents, school operational curriculum documents, and school websites. A qualitative research approach with a case study research type was used to uncover the programs designed, implemented, and evaluated by the schools.

2.3. Data Analysis

The data collected were then analyzed directly during the data collection process using the interactive model pattern of Miles et al. (2014), including data condensation, data display, and conclusions drawn. To ensure the research findings are valid, researchers compared the data obtained from data collection

techniques and sources. Research findings from interviews (individual and group interviews during FGDs) were compared to the data obtained from document analysis and field observations.

3. Results and Discussion

3.1. The Grand Design of Digital Learning Space Development

The research findings show that the development of the digital learning environment to achieve school excellence was driven by the rapid growth of information and communication technology (ICT). Moreover, the findings also show that the school leaders were aware of how to leverage ICT development and carried out their function as agents of change in education and learning services efficiently and effectively. The schools' difference in technological development is minimal: the school located in the city center puts the agenda in the schools' visions, which includes the formulation of technological skills for students, while the school in the suburb puts it in its formulation of the mission, namely, developing digital-based learning to provide technological and literacy skills to students. Both schools acknowledge the importance of developing technological skills to attain learning objectives effectively and efficiently. The presence of a well-formulated school vision and mission encouraged the schools to implement the digitalization program through its goals and achievement strategies.

The finding is relevant to Wahidmurni, et al. [17] who suggested that the educational institutions' values, as outlined in the organization's vision, should become an organizational reference in formulating missions, goals, and strategies to achieve them. The institutional vision provides the educational stakeholders with the reason for the existence of an academic institution. Regarding the digitalization of education, Pettersson [18] study indicates that digitalization in education encompasses ideas that influence the planning (how digitalization is planned) and implementation (how it is enacted) in school organizations. Lomos, et al. [19] found that an explicit vision of establishing ICT as a teaching priority in schools is crucial to ensure the effective implementation of technology-enhanced learning.

The school vision is reflected in the formulation of missions, objectives, and strategies stated in the operational curriculum document. Nonetheless, there grand design document on the development of digital learning spaces is absent, contrasting [20] four stages of digitalization implementation in schools, proposed four stages: (1) provision of digital devices, (2) guaranteeing (remote) access to cloud-based school platforms, (3) providing digital classroom management, and (4) providing content-specific digital devices. During the interview, both schools' principals in this study suggested that they had not understood what stages to implement complete school digitalization. These schools gradually fulfill the requirement of digital facilities according to the needs and available budget and prepare an IT team to maintain the network and train the teachers.

The schools' most pressing need related to digital facilities was the provision of Interactive Boards (iTBoards) for all classes since they previously only prioritized higher grades (grades 6-4). Both schools were committed to fulfilling the iTBoard needs for all classes. The teachers considered iTBoard very important because it can help make learning more attractive, thus improving learning interactions and maintaining student learning motivation. iTBoard differs from prior educational methods utilizing Google Classroom, Classjoji, and LCD projectors. These conditions corroborate [21] study that iTBoard use has significantly influenced the students' scientific higher-order thinking skills (S-HOTS) compared to prior ICT media. However, their findings also show that using ICT in schools may negatively impact S-HOTS significantly the longer the duration of ICT usage is. It is understandable since iTBoard offers a more engaging, interactive, and collaborative learning or presentation experience.

Comparing the current analysis with Lemke, et al. [20] category, the schools were still categorized as carrying out the first stage, namely the provision of digital devices and improvement of teacher skills to utilize these digital ranks in learning activities. Meanwhile, following Pettersson [18] classification, the digitalization program implemented by both schools can be considered to be in stage IIb, characterized by changes and transformations that occur as the implementation of new digital devices is aimed at using new devices to develop innovative digital learning practices. The IT team in both schools

will train the teachers to utilize the new media before they use it in their learning activities whenever new ICT facilities, such as iTBoard or interactive whiteboard, are provided.

The design for the digitalization of learning spaces carried out by the two schools is similar to Lemke, et al. [20] first stage and Pettersson [18] stage IIb. It can be considered appropriate because the design was launched after the end of the COVID-19 pandemic (around mid-2023). Both schools also had a similar focus on establishing adequate ICT infrastructure, building an IT team for network maintenance, and providing training for instructors in their initial design and development stages. These shared similarities may be caused by both schools being under the same Ministry office, the principals joining the same forum, and the rapid turnover of principals transitioning between schools. The school's principal in the suburban area was the former school principal in the city center two years earlier.

3.2. Strategies for Building Teachers' Digital Culture in Learning

The principals issued a policy that supports the utilization of ICT development by establishing an IT Team to enhance the provision of IT facilities and improve teacher competence. The policy positively affects the success of the school's digital learning space development program. The finding is relevant to Spiteri and Chang Rundgren [22] who wrote that leaders' technology proficiency primarily determines the successful integration of technology into learning activities, technicians' robust support, and a supportive school culture. The leader position is critical to drive organizational growth and to achieve the organization's vision, as noted by Wahidmurni, et al. [23].

The study found that the establishment of the school IT team and the provision of IT infrastructure and facilities for learning are the principals' first strategies to promote a digital culture for teachers and students at school. Effective collaboration between the principal, IT team, and teachers in implementing digital learning is the key to successful ICT-based learning. This finding corroborates [19] who reported that leadership and collaboration are essential to support the successful implementation of technology-based learning in schools. The IT team establishment is a follow-up strategy from the learning process using simple online media during COVID-19. This finding strengthens the findings of systematic literature review [24] that the use of hardware, digital content, digital games, and digital competency tests are dominant strategies in implementing learning in the post-COVID-19 pandemic era. The historical cultural realities experienced by the academics (educators and principals) serve as the impetus for establishing and developing a digital culture in the workplace [25]. The IT team establishment is included in Lemke, et al. [20] the first stage is providing digital devices such as interactive whiteboards, set-top boxes, notebooks, tablets, and BYOD in educational settings.

Among the challenges educators encounter in employing new learning media is the necessity for adaptation to enhance their proficiency in using the media. The outcome aligns with Li and Kostka [6] reports on users encountering several problems in adapting to digital technologies. Teacher training was modified by involving external experts, internal IT teams, and teachers with high IT skills to help improve their digital skills. It is relevant to Spiteri and Chang Rundgren [22] systematic literature review, which indicates that school culture—encompassing such as empowering teacher training, collaborative work, reflective activities, and acquisition of new knowledge significantly affect teachers' knowledge, attitudes, and skills, and establishing a reciprocal relationship between these elements. For this reason, policy support for education and professional training is needed.

The finding also corresponds with Nikolopoulou, et al. [26], who reported that teachers' primary barriers to utilizing mobile technology in learning include a lack of resources and support and unfavorable classroom conditions. The implication is that education policy support by school principals for the fulfillment of digital facilities and professional training is needed. The research finding corroborates [27] that the utilization of various ICT modalities can, in turn, facilitate trust building in team task completion bolstered by proficient *e-leaders* utilizing consistent ICT. Thus, ICT-mediated leadership can become significant in management and policy-making.

The schools established classroom teachers' forums to improve their digital competence and skills, facilitating using digital learning spaces. The classroom teachers' forum discusses various problems and solves learning problems. Some of the activities in the teacher forum include transferring ICT utilization skills, creating teaching materials that all teachers can use, helping to solve a teacher's problems, and compiling a work program for subsequent meetings. The forum establishment aligns with Wu, et al. [28] the study found that organizational context, peer support, and information literacy contribute to teachers' innovative behavior in integrating technology into teaching. Other studies also reported that school leaders influence ICT integration in schools by fostering ICT integration in the school community, facilitating ICT utilization, providing financial assistance, providing ICT training, collaboration, strategic planning, and monitoring [22, 29].

Overall, the research findings support [22] who delineated nine elements of school culture that support the effective integration of technology in learning activities: leadership, school strategy, school infrastructure, school support, peer coaching, online learning, collaborative learning, curriculum development, and an open learning environment. This is evidenced by the principal's initiative and facilitation in providing digital resources and support for the IT team and teachers to continually enhance their digital competence in alignment with the current advancement. The rapid development of technology has transformed the manner in which teachers develop their instructional processes, leading to the creation of a different curriculum and learning environment.

3.3. Impacts of Digital Learning Space Development on Learning Processes and Outcomes
3.3.1. Positive Impact of Utilizing Digital Learning Space

The teacher participants saw an enhanced efficiency in learning through the utilization of digital learning spaces, including improved time management, streamlined storage of educational resources, assessments, and archives of other documents. The teachers believed that using ICT may facilitate administrative tasks by enabling the storage of archives related to teacher duties, including teaching modules, instructional materials, and evaluation questions, despite their lack of inclination to revise the question exercises they made before. The finding aligns with Gonfa, et al. [30] who reported the benefits of ICT utilization as an administrative tool for teachers to maintain student records, organize lessons, create handouts, tutorials, and slides, prepare and grade assignments, record results, and conduct statistical analyses on students' grades.

In addition, the teachers also benefit from obtaining modifiable learning resources for creating teaching materials and the freedom to use teaching materials developed by other teachers at school. The accessibility of various educational resources can enhance the school's academic performance [31]. Moreover, this study also found that using various ICT media platforms and applications enriched the choice of learning resources and media, making learning more engaging and students more focused on learning activities designed by the teachers. This finding confirms [5] who reported that the developed ICT media increased students' interest in and motivation for learning.

The current study also reported that students' engagement with various media platforms, applications, and learning resources has enhanced their learning outcomes, as evidenced by test performance. It indicates that learning objectives related to the knowledge studied can be achieved more optimally by utilizing ICT media in learning activities. In addition, students' technological skills can be achieved effectively through learning which utilizes ICT media. The students' use of gadgets to access learning resources surpasses teachers' expectations; even the teachers perceived themselves as lagging behind in the myriad applications that students adeptly navigate when exploring educational materials online. The finding is in line with those of Gonfa, et al. [30] students of all levels benefit from ICT use, as it aids in the information acquisition process and fosters students' creativity, acceleration, enrichment, and depth of technological skills. Moreover, ICT increases students' enthusiasm and engagement in learning, thereby supporting school reform.

3.4. Negative Impacts of Digitizing Learning Spaces

The students' use of ICT media has increased their skills in using technology tools. However, the skill costs the decrease of students' motor skills (handwriting skill) as their penmanship deteriorates. This implies that the dominant use of ICT media by students learning through laptops and cell phones hinders their manual writing skills. This finding pertains to Osman [32] study, which showed that the increasing reliance on technology, such as computers, smartphones, and tablets, has weakened students' handwriting quality and legibility. This decline is particularly concerning, given that handwriting significantly contributes to students' intellectual progress and educational performance. Other studies also reported that digital media hinders other skills. Nguyen, et al. [33] found that students' skills in communication, critical thinking, and exchanging opinions were hindered due to the misuse of ChatGPT and other artificial intelligence (AI) in the learning process, especially in responding to exams or practice questions.

Alongside the deterioration of certain skills, some attitudinal aspects have also decreased due to the excessive use of digital media in educational and non-educational contexts (e.g., playing games or other activities), including increased emotionality and selfishness, as well as reduced physical and social interactions. The finding is pertinent to Aziz, et al. [34] who showed that online learning adversely affects student character, challenging teachers and parents due to limited opportunities to cultivate student character. The schools in the current study have carried out several activities to overcome these problems, including familiarizing group assignments in the curriculum and organizing extracurricular activities.

Another negative side of ICT use is that students access websites inappropriate for their age, as the schools have failed to screen unsuitable content effectively. The accessibility of non-educational websites will greatly disturb students' attention to their studies. This is evidenced by students' conduct in promptly finishing the exercise activities to access other websites during the remaining allowed time. It aligns with Loh and Kanai [35] conclusion that students raised with internet technology tend to perform "shallow" information processing behaviors characterized by frequent distraction and a lack of consideration.

The outcomes of eye screening tests administered by physicians in the school located in the suburbs before and after intensive ICT use revealed increased numbers of students experiencing cylindrical and/or myopic vision. The results of eye health screening before the ICT media utilization revealed eight students with cylindrical and/or myopic conditions. However, following a six-month ICT usage interval, the number of affected pupils escalated to 32. This finding confirms [36] who found that continuous and prolonged use of digital devices without regular periodic breaks has negatively affected students' eye health and visual acuity. In the current study, a lack of regular breaks from digital device usage was correlated with impaired vision at both distant and close ranges.

The average use of digital learning media at both schools averaged 4 hours and increased with the time spent on assignments and non-academic interests, such as gaming and communication. Abusamak, et al. [36] found that the duration of digital device usage was a statistically significant factor associated with increased severity of ocular symptoms. The situation implies the need for a wiser solution to the optimum amount of study time for utilizing digital media.

The study by Kaimara, et al. [37] asserted that the impacts of virtual reality technology and gaming on overall child development remain a subject of scholarly debate. The main research issues pertaining to ethical issues and concerns in students' use of advanced technologies are related to the bioethics of human research and potentially harmful consequences on students' development. Therefore, the teachers at both schools required some assignments to be completed using paper and pencil to reduce students' dependence on digital media and the time spent on their gadgets, as well as to train students' fine handwriting motor ability. Nguyen, et al. [33] asserted that using pen and paper writing (manual writing) provides advantages in accessibility and efficiency, but its implementation necessitates a measured strategy to optimize benefits and mitigate hazards.

4. Conclusion

ICT in education and learning must be used to enhance the quality of educational services in institutions. The ICT utilization in various sectors has demonstrated significant effectiveness and efficiency. However, its utilization in developing digital learning spaces requires meticulous examination, particularly for elementary education. The current study on efforts to build a digital learning space culture in elementary schools shows that the design of digital learning space development had not been meticulously structured as a sequential process in the digitalization of education in schools because of financial issues. Finally, the provision of digital learning facilities was determined by the existing needs and budget constraints. It represents the initial stage of educational digitalization. Moreover, school principals have a vital role in building a school's digital culture. Through his effective leadership, he can contribute to and facilitate the acquisition of digital learning facilities, form an IT Team, train teachers professionally, and facilitate the interaction among these elements to support digital culture in schools.

Furthermore, positive impacts encompass enhanced engagement in learning, improved efficiency in obtaining learning resources and storing learning archives, achieving most of the learning outcomes in cognitive aspects, and increasing students' and teachers' technological skills. On the other hand, the utilization of ICT also has negative impacts, including reduced handwriting motor skills, a decline in students' social interactions and empathy towards peer friends, and a rise in students' ocular health issues. Therefore, the use of digital media in learning in elementary schools needs to be reevaluated, taking into account various supporting and obstructive elements that influence learning efficacy.

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Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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