

Science, Technology, and the Arts-Based School Readiness from an Educational Ecosystem Perspective: Profile of Educators and Learning in Jember Regency

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ABSTRACT

(1) The development of Science, Technology, and the Arts encourages schools to undertake adaptive, innovative, and technology-based learning transformations. However, school readiness for implementing Science, Technology, and the Arts-based learning does not depend solely on the competence of individual educators, but also on support from the entire education ecosystem. (2) This study aims to analyze the readiness of Science, Technology, and the Arts -based schools from the perspective of the education ecosystem by examining the relationship between school institutional factors and educator readiness and its implications for learning practices in Jember Regency. (3) The study used a quantitative approach with a survey. The research sample comprised 178 educators from early childhood education, elementary, junior high, and high schools in Jember Regency. (4) The results of the study indicate that school leadership, innovation climate, availability of technology infrastructure, and support for professional development have a positive and significant effect on the readiness of Science, Technology, and the Arts -based educators. Furthermore, educator readiness has been shown to significantly affect innovative science- and technology-based learning practices. (5) These findings confirm that school readiness is the result of the interaction between structural and individual factors in an education ecosystem. In essence, strengthening Science, Technology, and the Arts -based school readiness necessitates a systemic approach that integrates transformational leadership, a culture of innovation, and ongoing professional development. This research provides an empirical contribution to the development of a school readiness model grounded in Science, Technology, and the Arts within the educational context of the Jember district.

Keywords: Schools' Readiness, Science, Technology, and The Arts, Educational Ecosystem, Teachers' Readiness, Learning Innovation

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INTRODUCTION

The development of Science, Technology, and the Arts has fundamentally changed the educational landscape. Digital transformation is no longer an option but a strategic necessity to improve educational quality and human resource competitiveness. The integration of technology into learning drives a shift from teacher-centered to student-centered learning, one that is collaborative, creative, and problem-solving-based. In this context, schools' readiness in Science, Technology, and the Arts is a crucial indicator for assessing the quality and sustainability of educational transformation. Science- and technology-based schools are a crucial indicator of improving educational quality and preparing students to face the challenges of the 21st century.

The national policy initiated by the Ministry of Education, Culture, Research, and Technology emphasizes the importance of school digitalization, strengthening teachers' digital literacy, and developing innovative technology-based learning. However, the implementation of this policy is heavily influenced by local conditions in each region, including human resource readiness, infrastructure availability, and school organizational culture.

Education statistics in Jember Regency reveal not only the wide distribution of elementary and secondary schools, but also a significant challenge: only about 3.89% of the population has completed higher education. This limited educational attainment poses real obstacles to enhancing educators' professional capacity and schools' ability to embrace science- and technology-based transformation. Addressing this requires a nuanced analysis that accounts for the varied educational backgrounds in Jember. Jember Regency, with heterogeneous geographic and socioeconomic characteristics, exhibits variations in access to and utilization of educational technology, with schools and student numbers spread across the regency. Schools in urban areas tend to have better access to digital infrastructure than schools in outlying or rural areas. This situation has the potential to create gaps in the quality of Science, Technology, and the Arts-based learning if not systematically mapped and addressed.

In this context, educators' profiles are a key factor in determining the success of science- and technology-based educational transformation. Educators with strong digital literacy, an understanding of technology-based pedagogy (TPACK), and the ability to adapt to change will be better able to meaningfully integrate Science, Technology, and the Arts into the learning process. Conversely, limited digital competency and minimal institutional support can hinder the implementation of innovative learning.

Professional educators play a role in developing the next generation of intelligent, virtuous, and ready individuals to face future challenges. Educators are not only tasked with delivering subject matter but also with guiding, inspiring, and shaping students' character (Wijaya, 2023). In the context of modern education, educators' quality must align with 21st-century competencies, such as critical thinking, creativity, digital literacy, and collaboration. Professional educators are required to possess in-depth knowledge of the fields they teach. Furthermore, they must be able to adapt to developments in educational technology, which offers a variety of new methods and approaches to the teaching and learning process (Eliza et al., 2022). By managing classrooms, facilitating interactive learning, and understanding students' individual needs, professional educators can create a conducive and inclusive learning environment. Efforts to improve the quality of professional educators are carried out through education and training programs, professional certification, and the implementation of teacher competency standards (Maryani, 2022; Maulana et al., 2023). This is done to ensure that every educator has the capabilities to achieve national education goals. This is expected to create a generation with character and the ability to compete globally. Teachers must possess qualifications in technology, professional development, and technology-based learning (Putri Husma et al., 2023). The integration of technology into education requires teachers to possess new skills, including the use of digital devices, the utilization of learning applications, and the ability to select and design content tailored to students' needs.

The role of technology in education is significant. By utilizing technology, teachers can access a variety of global educational resources, provide varied content, and adapt learning approaches to individual student abilities (Belva Saskia Permana et al., 2024). Technology also enables more collaborative, participatory, and engaging learning methods for students, such as online classes, learning videos, interactive applications, and virtual simulations. Rapid technological developments have transformed various aspects of life, including education. Technology-based learning is now an effective approach to improving the quality and accessibility of education (Widyawati & Sukadari, 2023). This learning utilizes digital devices, the internet, and various learning applications and platforms to help make the teaching and learning process more interactive, flexible, and enjoyable for students. Technology-based learning enables students to access information and learning resources anytime and anywhere (Sitepu, 2021). With the advent of digital technology, teachers and students can connect for distance learning, utilize e-learning platforms, and access educational resources from around

the world. This competency, in turn, supports the integration of technology into learning and the development of future learning.

The use of technology in education also presents challenges for teachers, including limited access to technology in some regions, gaps in technological skills, and challenges in maintaining student focus and motivation in the digital world. Therefore, it is crucial for teachers to continuously adapt and improve their technological competencies to maximize the potential offered by educational technology. By combining technological mastery and pedagogical expertise, teachers can not only be key drivers in technology-based learning but also prepare the younger generation to face the challenges of the digital world.

In today's era of globalization and digitalization, education must continuously adapt to developments in Science, Technology, and the Arts to produce competent graduates ready to face the challenges of the times. An Science, Technology, and the Arts -based school is an educational concept that integrates technology and innovation into the teaching and learning process to encourage the development of 21st-century skills, such as critical thinking, creativity, collaboration, and digital literacy. Preparation for an Science, Technology, and the Arts -based school goes beyond providing technological devices; it also encompasses infrastructure readiness, human resources, and curriculum adjustments to align with scientific advances and the needs of the modern world.

The transformation to an Science, Technology, and the Arts -based school requires careful planning, encompassing teacher competency enhancement, technological facility upgrades, and curriculum development relevant to the needs of the Science, Technology, and the Arts. Educators need to be trained to utilize technology as a learning medium and integrate Science, Technology, and the Arts -based approaches into their teaching. Furthermore, infrastructure readiness, such as adequate internet access, computer equipment, and access to digital learning resources, is a crucial factor in supporting schools' success in implementing Science, Technology, and the Arts-based models.

While this concept offers numerous benefits in preparing students for the future, challenges remain in implementing Science, Technology, and the Arts -based schools. These challenges include limited access in certain areas, a digital skills gap between students and teachers, and the need to maintain a balance between technology use and direct learning interactions. Therefore, comprehensive preparation is key for schools in creating a dynamic, effective learning environment that aligns with the demands of Science, Technology, and the Arts.

Educator Profile in Educational Units: Educators are a key component in the educational process, playing a strategic role in determining the quality of student learning outcomes (Maullidina et al., 2023; Pramesti et al., 2023; Susilo et al., 2023). Law Number 14 of 2005 concerning Teachers and Lecturers (Government Regulation of the Republic of Indonesia, 2005) states that teachers are professional educators with the main task of educating, teaching, guiding, directing, training, assessing, and evaluating students. The profile of a quality educator is characterized by pedagogical, professional, social, and personality competencies. These competencies serve as the foundation for developing effective, innovative, and contemporary learning processes. 21st-century teachers are required to be adaptable to developments in science, technology, and information (Mardiana et al., 2024; Ofita, 2023). Educators must also be lifelong learners, collaborate, possess strong digital literacy, and integrate academic knowledge, technological skills, and character values into daily learning practices. Learning in Educational Units Effective learning is characterized by active student involvement, the application of a student-centered approach, and the use of relevant media and technology (Adha et al., 2024; Fauziyah & El Yunusi, 2024; Pratama, 2024). Learning in educational units is an interactive process between students, educators, and learning resources within a learning environment. The Independent Curriculum implements contextual, differentiated, and project-based learning (Fauzia & Hadikusuma Ramadan, 2023; Rosa et al., 2024). Educators are required to design learning that facilitates creativity, collaboration, communication, and critical thinking. Teachers are not only conveyors of information, but also facilitators, helping students develop scientific thinking skills, digital ethics, and social sensitivity (Yli-Pietilä et al., 2024). Science, Technology, and the Arts -Based Schools Science,

Technology, and the Arts -based schools are educational units that integrate science, technology, and the arts into all aspects of education, including curriculum, instruction, and school culture (Burhan et al., 2023). Science, Technology, and the Arts-based schools aim to prepare students to face global challenges by mastering technology and developing creative, innovative characters (Teig & Nilsen, 2022). The readiness of Science, Technology, and the Arts-based schools depends not only on technological infrastructure but also on teachers' abilities to manage digital learning and on the school's managerial readiness to integrate Science, Technology, and the Arts into its educational vision and programs. Schools not only deliver traditional academic content, but also build a holistic, creative, and innovative learning ecosystem (Alifah et al., 2025; Fatimah & Winarti, 2022). Students are expected to become scientific thinkers, ethical users of technology, and individuals who appreciate the arts. Science, Technology, and the Arts -based schools emphasize holistic education through the collaboration of science, technology, and the arts, making learning more contextual, interactive, and innovative. Learning focuses not only on academic knowledge but also on practical skills, experimentation, exploration, digital literacy, and art appreciation as part of children's intellectual growth and development—analysis of Science, Technology, and the Arts -Based School Preparation. Analysis of Science, Technology, and the Arts -based school preparation includes identifying the existing conditions of educational units, particularly in terms of human resources (teachers and education personnel), curriculum, facilities and infrastructure, and school management support (Ambarwati et al., 2022; Fadliansyah & Hindun, 2023; Misbahul Arifin et al., 2024; Ulansari et al., 2056).

The transformation to Science, Technology, and the Arts-based schools requires careful planning, including improving teacher competency, updating technological facilities, and developing a curriculum relevant to the needs of Science, Technology, and the Arts (Ni'matussyahara et al., 2023). Educators need to be trained to use technology as a learning medium and to integrate Science, Technology, and the Arts-based approaches into teaching. Furthermore, infrastructure readiness, such as adequate internet access, computer equipment, and access to digital learning resources, is a crucial factor in supporting schools' success in implementing Science, Technology, and the Arts -based models (Arifin et al., 2023).

This study aims to identify the profile of educators in Jember Regency in terms of Science, Technology, and the Arts -based readiness; analyze learning practices that integrate Science, Technology, and the Arts in schools; measure the level of school readiness in implementing Science, Technology, and the Arts -based learning; identify supporting and inhibiting factors in the development of Science, Technology, and the Arts -based schools; and formulate strategic recommendations for strengthening Science, Technology, and the Arts -based schools in Jember Regency.

METHOD

This study employed a quantitative, survey-based approach to address the research objectives, focusing on empirically examining the influence and relationships among variables. A quantitative approach was chosen so that the data obtained could be objectively analyzed through numerical measurements and tested using inferential statistical procedures (Sugiyono, 2013). The survey was deemed relevant for obtaining factual information regarding the perceptions, attitudes, and experiences of a large number of respondents over a broad area. The research location was Jember Regency, East Java, which boasts a diverse range of public and private schools with varying educational ecosystem characteristics. Population data was obtained from the Ministry of Primary and Secondary Education for the odd semester of 2025/2026 (<https://dapo.kemendikdasmen.go.id/guru/1/050000>). The sample was selected using a purposive sampling technique based on a sample frame compiled from a list of active teachers throughout the study area. All participants who were willing to complete the research instrument honestly and in full were included in this study. Specifically, all participants who had completed the instrument were then mapped according to specific criteria (Table 1).

Table 1. participants' criteria

active teaching in an educational institution	Minimum five years
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teaching experience	
most recent educational background	Education Bachelor's Degree
possession of a teaching certificate	At least 1 year
history of participating in training related to science, technology, and information technology (ICT)	

Purposive sampling is widely used in educational research because it ensures that respondents align with the research objectives (Etikan et al., 2016). This selection process yielded 178 respondents who met the criteria, comprising 132 classroom teachers and 46 subject teachers. The respondents reflected a diverse profile, providing a fairly representative picture of the conditions of educators in the research area.

The research instrument was developed as a structured questionnaire containing indicators of Science, Technology, and the Arts-based educator competencies, Science, Technology, and the Arts-based learning readiness, and school support facilities for Science, Technology, and the Arts (Table 2). Each construct was elaborated into several items based on theory and previous research findings, and the items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) (Likert, 1932). Prior to use, the instrument was tested through a series of validity and reliability tests. Validity testing was conducted using the Corrected Item-Total Correlation technique, in which an item is considered valid if its correlation coefficient is at least 0.30 (Hair et al., 2019). The test results showed that all items met this criterion. To ensure the suitability of the theoretical constructs, exploratory factor analysis (EFA) was also conducted. The KMO value was 0.87 (>0.60), and Bartlett's Test of Sphericity was significant ($p < 0.001$), indicating that the data merit further analysis (Kaiser, 1974). All items had factor loadings >0.50 and eigenvalues >1 , confirming the validity of each construct. The instrument's reliability was assessed using Cronbach's Alpha, with values of 0.84 for work environment, 0.88 for work motivation, and 0.91 for pedagogical competence. All values exceeded the 0.70 threshold, indicating that the instrument was reliable both overall and per subscale (Nunnally & Bernstein, 1994).

Table 2. Indicator of the research instrument

Science, Technology, and the Arts -based educator competencies	3 items
Science, Technology, and the Arts -based learning readiness	3 items
school support facilities for Science, Technology, and the Arts	3 items

Data collection was conducted via an online questionnaire in Google Forms, sent to teachers who were difficult to reach face-to-face. Respondents were given 2 weeks to complete the questionnaire, and researchers provided periodic reminders to encourage participation and complete responses. This strategy was chosen to reach respondents more effectively and minimize missing data (Cohen et al., 2018).

RESULT AND DISCUSSION

Profile of Educators in Jember Regency

This study had 178 respondents from 33 sub-districts in Jember. However, some sub-districts responded to the survey, while others received only one response. This was due to limited collaboration between researchers and schools in the sub-districts

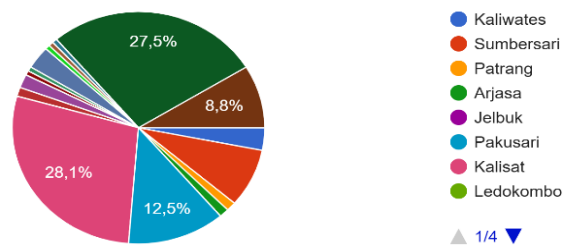


Figure 1: Teacher Respondents in this study

The teachers who responded to this study were classroom teachers and subject teachers. Classroom teachers refer to kindergarten and elementary school teachers, while subject teachers refer to teachers at the junior high/high school/equivalent level. The following describes respondents by teacher type.

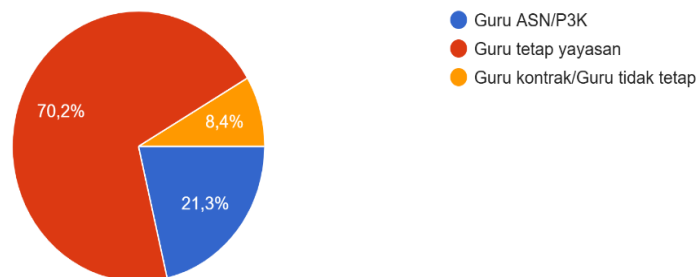


Figure 4. Employment status of Jember teachers

Of the 178 respondents, 74% already hold a professional educator certificate, while the remaining 26% are still working toward a competency certificate.

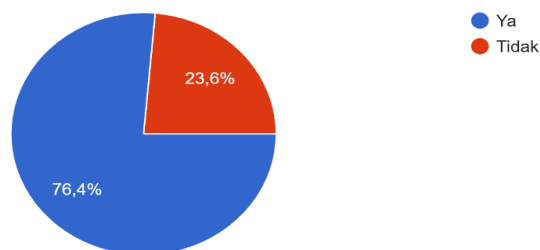


Figure 5: Ownership of a professional educator competency certificate

There is a relationship between ownership of a professional educator competency certificate and ownership of an ICT training certificate in learning.

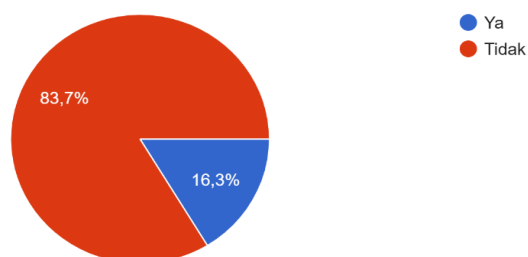


Figure 6: ICT certificate ownership

Based on Figure 6 above, 83.7% of teachers in Jember have ICT certification, while 16.3% do not. The number of ICT certifications correlates with the number of teachers with professional educator certifications and with the number of schools in Jember that own laptops/computers (71%). The remainder still do not have laptops/computers or have limited access to them.

The impact of digital device ownership is on teachers' ability to integrate ICT into the development of learning materials. 73.1% of teachers have used ICT in developing materials. This result aligns with their ownership of digital resources. The remaining 20.2% are categorized as rarely using them, and 6.7% do not use them at all.

Saya menggunakan teknologi dalam penyusunan perangkat pembelajaran (RPP, LKPD, bahan ajar).
178 jawaban

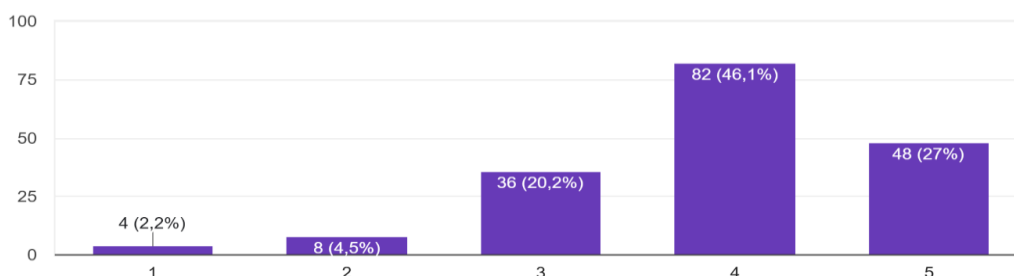


Figure 9: Ability to use ICT in preparing learning devices

The above data illustrate the school's readiness to become an educational institution that can keep pace with technological developments. Adequate digital facilities will provide a foundation and teacher readiness to implement appropriate learning. However, teachers in Jember can improvise by using existing digital devices, such as mobile phones. This is evidenced by survey data showing that teachers are familiarizing students with digital learning resources. Currently, many students, especially in junior high schools, have mobile phones. Some schools allow students to bring mobile phones to school. This provides a foundation for students' development of learning resources. Based on the survey data, 55.2% of students have become accustomed to using digital learning resources, 33.7% still occasionally use them, and 10.1% do not use any learning resources. This data indicates that schools do not yet have digital learning resources available in every classroom. Therefore, implementation depends on school policy and educators' readiness.

Educator collaboration and exploration skills

The second key factor in Science, Technology, and the Arts -based school readiness is educator collaboration. 19.7% of teachers are very accustomed to discussing developments in Science, Technology, and the Arts, 43.3% are accustomed to discussing them, 29.8% are somewhat experienced, and 7.3% are somewhat unmotivated. This data indicates that school support for community-based professional development remains quite good.

Saya berdiskusi tentang inovasi pembelajaran berbasis teknologi dengan sesama pendidik

178 jawaban

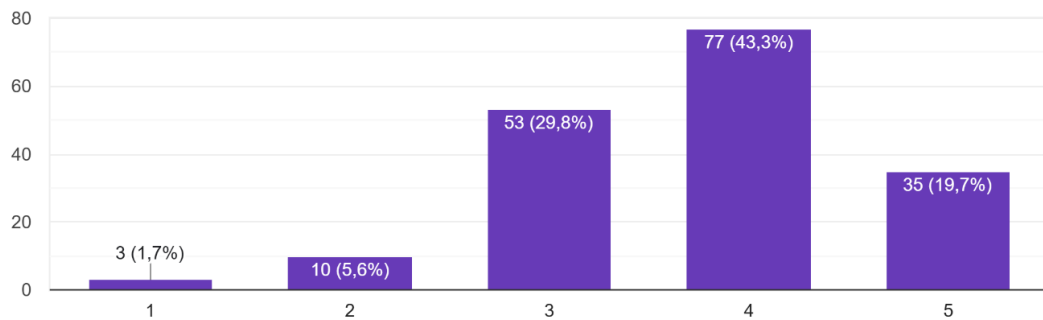


Figure 12: Teacher collaboration skills

Teachers' collaborative skills using social media align with their discussion skills. The results showed that 19.7% were very familiar with social media discussions, 51.1% were average, 24.2% were moderate, and 5% were not familiar. These results did not differ significantly from the data on teachers' collaboration skills. This data may indicate that teachers collaborate to improve competency in specific events or areas

Saya menggunakan media sosial untuk pengembangan kompetensi profesi

178 jawaban

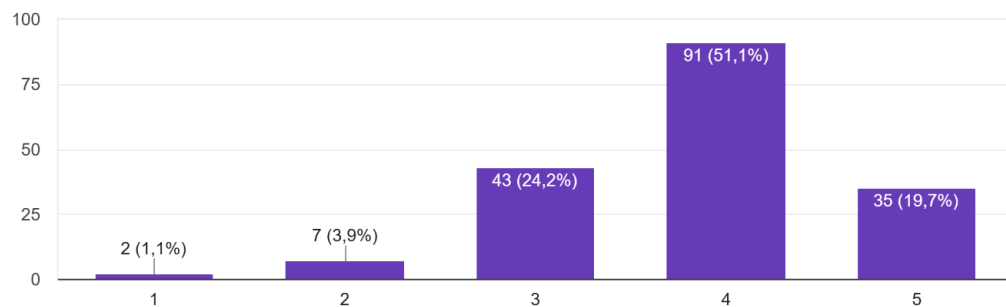


Figure 13 Collaboration capabilities on social media

Sekolah menyediakan perangkat TIK yang memadai untuk pembelajaran

178 jawaban

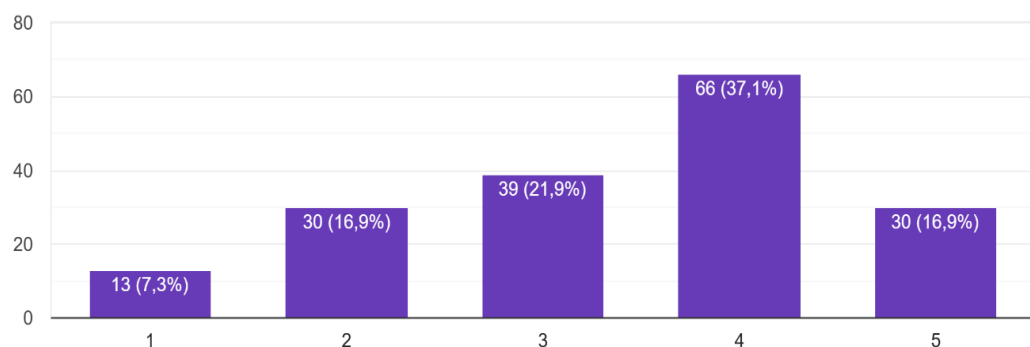


Figure 14: Availability of ICT facilities and infrastructure in schools

The primary support for utilizing existing ICT facilities requires adequate internet access. Based on the data, 66.9% of schools have adequate internet facilities, 18% have inadequate internet facilities, and 15.2% have inadequate internet facilities. This data aligns with the ownership of ICT facilities and infrastructure. Schools with ICT facilities are supported by adequate internet access, thereby optimizing the use of these facilities and infrastructure for learning activities.

Akses internet di sekolah mendukung penggunaan platform pembelajaran digital
178 jawaban

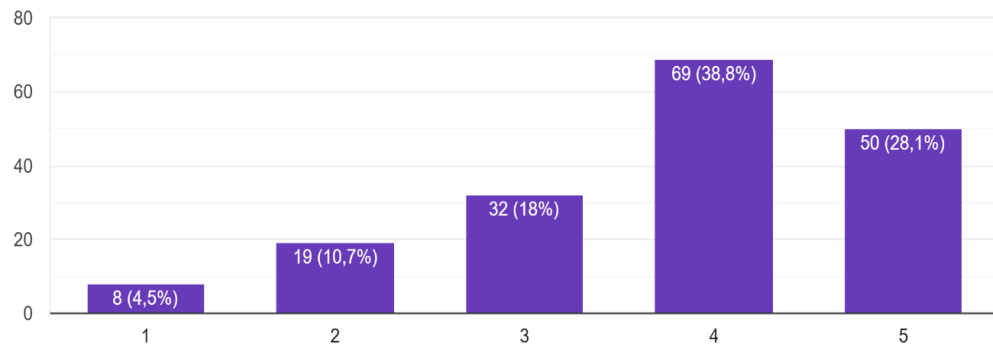


Figure 15: Availability of internet facilities at school

Based on the data presented above, the readiness of Science, Technology, and the Arts-based schools in Jember is categorized as quite adequate. This can be seen in the teachers' abilities to prepare lessons, implement them, and conduct activities.

DISCUSSION

This finding also points to what is new here: readiness for Science, Technology, and the Arts based schools in Jember Regency is not simply a matter of individual teacher competence, but emerges from the interaction between school leadership, innovation climate, technological infrastructure, profesional development support, and teacher own readiness.

This is broadly consistent with recent studies. (Muhaimin et al., 2020) similarly found high digital readiness and TPACK competence among indonesian teachers, while (Firrizkiyah et al., 2026) and (Handayani et al., 2025) reported that transformational leadership drives teacher's readiness to adopt innovative, technology based learning. However, (Muhaimin et al., 2020) and (Lestari et al., 2024) showed that facility ownership alone does not guarantee effective digital integration in rural schools, which mirrors this study's finding that infrastructure without adequate leadership support tends to produce suboptimal practice. This is also in line with the discussion of educational innovation already cited earlier in this article (Ambarwati et al., 2022). The similarities likely reflect shared national policies on teacher certification and school digitalization, while the differences, particularly the weaker role of infrastucture on its own, may be explained by Jember's more heterogeneous geographic and socioeconomic conditions compared with the more homogeneous samples used in some of the studies above. The contribution of this study is to bring institutional and individual readiness factors together within a single ecosystem framework, rather than examining teachers competence or principal leadership (Firrizkiyah et al., 2026), (Handayani et al., 2025) separately, as most prior studies have done.

In practicem this suggests that technology investment in Jember schools needs to be paired with leadership development rather than as a stand-alone solution. Further research using a longitudinal design and direct classroom observation is recommended to better capture how school readiness translates into sustained learning transformation.

School Readiness Contributes to the Implementation of Science, Technology, and the Arts - Based Learning

This pattern described earlier is also visible in the data below. Schools with stronger institutional support tend to show more consistent implementation of Science, Technology and the Arts based learning, while weaker support tends to produce gaps between schools rather than only between individual teachers. Science, Technology, and the Arts -based school readiness supports the implementation of Science, Technology, and the Arts -based learning. At the educator level, Science, Technology, and the Arts -based readiness is reflected in cognitive readiness, technological skills, and attitudes toward change. Teachers with high readiness tend to implement a wider range of and more contextually relevant learning strategies. However, there is variation between schools, indicating differences in readiness levels based on each school's institutional conditions. In practice, the results of this study imply that strengthening Science, Technology, and the Arts-based school readiness in Jember Regency requires a comprehensive approach. Quality improvement programs should not only focus on technical teacher training but also on strengthening school leadership and fostering a climate of sustainable innovation. Collaborative approaches between schools can also be a strategy to reduce the readiness gap.

This study still has limitations in its use of snapshot data and some perception-based instruments. Therefore, further research is recommended using a longitudinal approach and direct observation of learning practices to obtain a more comprehensive picture of Science, Technology, and the Arts -based transformation.

Science, Technology, and the Arts -based Transformational Leaders support School Readiness.

The comparison with the previous studies above also helps explain the results in this section. Leadership appears to be the main factor connecting institutional support to teacher readiness, which is consistent with several studies on transformational leadership in Indonesian schools (Firrizkiyah et al., 2026), (Handayani et al., 2025). This may also explain why the availability of facilities alone does not automatically improve learning quality if it is not supported by strong leadership. This research shows that the readiness of Science, Technology, and the Arts -based schools in Jember Regency is not only determined by the competency of individual educators but is also influenced by institutional factors. Principal leadership, a climate of innovation, the availability of technological infrastructure, and support for professional development have been shown to contribute to educators' readiness to implement Science, Technology, and the Arts-based learning.

These findings reinforce the view that Science, Technology, and the Arts -based educational transformation is systemic. Schools with leadership that supports innovation tend to have teachers who are better prepared to integrate technology and project-based or problem-solving learning approaches. This aligns with studies that suggest that leadership and school organizational culture play a crucial role in driving pedagogical change. Furthermore, a collaborative school climate also strengthens teacher readiness. Teachers in work environments open to learning, experimentation, and collaborative reflection demonstrate higher levels of readiness than teachers in schools with a less supportive work culture. Thus, Science, Technology, and the Arts -based readiness is not simply a matter of technical ability but is also influenced by social and structural support within the school environment. While technological infrastructure plays a crucial role, the results of this study indicate that the availability of facilities does not necessarily correlate with the quality of Science, Technology, and the Arts -based learning. Schools with adequate facilities but lacking leadership support and professional development demonstrate suboptimal learning practices. This confirms that technology is a supporting tool that needs to be integrated into an innovative school policy and culture framework.

CONCLUSION

This study concludes that Science, Technology, and the Arts -based school readiness in Jember Regency is a systemic phenomenon and is not solely determined by the competency of individual educators. This readiness is shaped by interactions among school leadership, a culture of innovation, the availability of technological infrastructure, and support for ongoing professional development. These institutional factors have been shown to contribute to

increasing educators' readiness to implement Science, Technology, and the Arts-based learning. At the individual level, high levels of educator readiness correlate with more innovative, contextually oriented learning practices and those oriented toward the pedagogical use of Science, Technology, and the Arts. However, technological infrastructure alone is insufficient to drive learning transformation without the support of visionary leadership and a collaborative school culture. Conceptually, this study confirms the relevance of the educational ecosystem approach in explaining Science, Technology, and the Arts -based school readiness. Educational transformation cannot be understood as a purely individual process, but rather as the result of synergy between organizational structures and educational agents. These findings provide an empirical contribution to strengthening the Science, Technology, and the Arts -based school readiness model in the regional context. The results of this study recommend that efforts to improve the quality of education in Jember Regency be carried out through a comprehensive approach that encompasses strengthening school leadership, fostering a culture of innovation, and ongoing professional development for educators. Policies that focus solely on providing technological resources without considering the ecosystem dimension may be less effective at driving learning transformation. Future research is recommended to employ a longitudinal design and expand the scope of the study to obtain a more comprehensive picture of the dynamics of Science, Technology, and the Arts -based school readiness across various educational contexts.

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