# Empowering Schools in The Use of Interactive Multimedia as a Learning Media

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## ABSTRACT

Learning media is an important part of the classroom learning process. The appropriate use of interactive media can increase interaction in learning. This study aims to empower vocational schools in the use of interactive multimedia as an innovative learning medium. Through a training and mentoring program at SMK Negeri 1 Tondano, this activity focuses on improving teachers' digital literacy and students' learning motivation in Informatics subjects. The research method uses quantitative and qualitative approaches through surveys, observations, and knowledge tests. The results show a significant increase in teacher competence in developing Android-based media using Smart Apps Creator 3, as well as an increase in student learning motivation of more than 70%. This study contributes to the digital transformation strategy of vocational schools towards adaptive and participatory 21st-century learning. The impact of using interactive media can improve learning outcomes, make it easier for teachers to teach material in class more interactively, and make school more enjoyable for students.

*Keywords*: Android-based learning, digital transformation of education, interactive multimedia, school empowerment, vocational schools.

## INTRODUCTION

The development of digital technology has transformed the global education paradigm. In the era of Industrial Revolution 4.0 and Society 5.0, education is no longer teacher-centered but demands active, collaborative, and technologically adaptive learners (Maketo et al., 2023). Advances in information technology in the era of the Industrial Revolution 4.0 demand educational innovations

that integrate digital devices into learning (Budiman, 2017; Wahyugi & Fatmariza, 2021). In this context, vocational schools (SMK) face greater challenges, as they must prepare graduates who are work-ready and competent in using digital technology according to industry needs (Wonggo et al., 2021).

However, in many vocational schools, learning media are still limited to PowerPoint or textbooks. Teachers struggle to create engaging learning that aligns with the characteristics of the digital generation (Tafonao, 2018; Nurrita, 2019). At SMK Negeri 1 Tondano, teachers' low ability to develop interactive media has resulted in decreased student learning motivation, even though most students own Android smartphones. However, the reality on the ground shows a significant gap between the demands of digitalization in education and the actual abilities of teachers and students to adopt learning technology. In many vocational schools in Indonesia, including SMK Negeri 1 Tondano, the learning media used are still conventional. The teaching and learning process is still dominated by lecture methods and the use of PowerPoint presentations with minimal interaction. This makes learning feel monotonous and less engaging for students who are accustomed to digital interaction through their devices. Some of the main problems identified at SMK Negeri 1 Tondano include: Low teacher competency in developing and using interactive technology-based learning media. Most teachers only have basic computer skills or simple presentation applications. They lack the skills to integrate text, audio, video, and animation into engaging and interactive learning media. This limitation is caused by a lack of relevant and ongoing technology training (Mustakim et al., 2023). Limited utilization of available digital devices. Almost all students at SMK Negeri 1 Tondano own Android smartphones, but these devices are mostly used for gaming and social media. These digital assets, which could potentially serve as active learning tools, have not been optimally utilized. This phenomenon indicates the absence of pedagogical strategies capable of guiding the productive use of technology (Rahmat et al., 2019). Low student motivation and participation in learning. The theoretical and teacher-centered Informatics learning process quickly leads to boredom and student disengagement. Student engagement declines, especially in understanding concepts that require logical thinking and practical skills. This situation contradicts constructivist theory, which emphasizes the importance of interaction and direct experience in learning (Al-Hariri & Al-Hattami, 2016). Lack of institutional support for learning media innovation. Schools do not yet have systems or policies that encourage teachers to develop digital media sustainably. There is no collaborative platform, such as a teaching innovation hub, that can bring together teachers from different fields to share best practices. Institutional support is crucial to ensure innovation does not stop at a single training project (Consoli et al., 2023). Digital literacy gap between teachers and students. Although students are more technologically literate, they are not yet able to use digital devices for independent learning. On the other hand, teachers still lag behind in technological skills, unable to keep up with the learning styles of digital native students (Darmadi, 2018). This gap hinders the effectiveness of communication and learning in the classroom.

This problem creates a significant learning gap between the potential of available technology and actual learning practices in schools. As a result, the learning process does not reflect 21st-century learning principles that require critical thinking, creativity, collaboration, and technology-based communication (the 4C Skills). Furthermore, low digital literacy among teachers impacts the quality of learning, which is not adaptive to the requirements of the Merdeka Belajar curriculum. This curriculum demands technology integration to support project-based learning and differentiation. If

this situation is allowed to persist, vocational schools will fall further behind in facing global competition that demands a digitally competent workforce.

Thus, the core problem that is the focus of this research is: How to empower schools, particularly teachers and students at SMK Negeri 1 Tondano, to effectively utilize interactive multimedia as an Android-based informatics learning medium, thereby improving the quality of teaching and student motivation. This problem underlies the need for a training- and mentoring-based empowerment program that emphasizes hands-on learning, teacher digital literacy, and active student participation in the use of interactive multimedia.

In the last two decades, research on interactive multimedia as a learning medium has grown rapidly. Various studies have shown that interactive multimedia can increase student engagement, motivation, and conceptual understanding (Al-Hariri & Al-Hattami, 2016; Kumalasari, 2021). Previous studies have shown that Android-based interactive media improves learning outcomes and student interest (Rahmat et al., 2019; Kumalasari, 2021). However, most research focuses solely on application development, rather than on the process of empowering teachers and students in the context of vocational schools. Meanwhile, recent research emphasizes the importance of technology integration literacy for 21st-century teachers (Consoli et al., 2023; Mustakim et al., 2023), as well as the need to adopt a participatory approach to technology use in the classroom (Maketo et al., 2023). Interactive multimedia combines text, images, animation, audio, and video in a single platform, enabling two-way interaction between users and content. The main advantage of this medium is its ability to accommodate various learning styles (visual, auditory, kinesthetic) and provide immediate feedback that strengthens the learning process (Tafonao, 2018). Global research on interactive multimedia: International research confirms that the effectiveness of technology in education depends on teachers' technology integration literacy. Consoli et al. (2023) conducted a systematic review of over 80 instruments measuring technology integration in K–12 education and found that successful technology adoption is determined not only by the availability of devices, but also by teachers' pedagogical skills in meaningfully integrating technology into the learning process. Furthermore, a study by Maketo et al. (2023) highlighted that gamification-based mobile learning can directly contribute to Sustainable Development Goal (SDG 4), namely quality education. They asserted that mobile-based learning can expand access, increase participation, and shift students' learning behavior toward greater independence. Kao, Yuan, and Wang (2023) developed a gamified mobile learning model proven to improve learning outcomes and concept retention through a challenge-based learning approach. This model demonstrated that emotional engagement and interactivity are key factors in the effectiveness of digital learning. National Research and the Indonesian Context: Research in Indonesia shows that although interactive multimedia has been widely developed, its implementation in vocational high schools is still limited to the technical aspects of application development, rather than empowering users (teachers and students). Wonggo, Waworuntu, and Komansilan (2021) demonstrated that mobile-based interactive media can improve vocational high school students' ability to understand 2D animation material. However, this research focused more on student learning outcomes, without exploring the transformation of teacher capabilities as the primary agents of innovation. Similarly, Rahmat et al. (2019) and Wulandari (2018) developed Android-based learning media for digital simulation and algorithm subjects, which proved effective in improving learning outcomes. However, both studies focused on product testing, not on implementation strategies or increasing teacher capacity to adopt the media sustainably. Kumalasari (2021) emphasized that the use of interactive multimedia

can increase learning motivation, but also highlighted the challenges faced by teachers in designing digital content. Similar findings were presented by Mustakim et al. (2023), who stated that low teacher ICT literacy is a major obstacle to the digital transformation of education in Indonesia. This means there is a significant gap between the potential of learning technology and teachers' ability to implement it.

Based on the literature review, there are three main gaps that have not been widely addressed by previous research. Implementation and empowerment gap: Most studies focus on the development of interactive multimedia products, rather than on the process of empowering teachers and students in using them. Yet, teachers' ability to create and manage digital media is a determining factor in the sustainability of educational innovation (Consoli et al., 2023). Pedagogical and participatory gap: Top-down teacher training approaches often fail to create sustainable change. This study proposes a participatory approach, where teachers and students become active participants in the technology learning process. This aligns with the co-creation paradigm of learning, which has not been widely implemented in the context of Indonesian vocational schools. Digital literacy gap between teachers and students: Digital native students generally adapt quickly to technology, while teachers still struggle to keep pace with these developments (Darmadi, 2018). This research seeks to bridge this gap through a hands-on learning-based training model that focuses on improving teachers' digital literacy and managing students' devices for educational purposes. This research positions itself between two major streams of previous research: the development of Android-based digital learning media and the study of teacher empowerment in the context of educational technology adoption. The main contribution of this research is integrating these two approaches through a participatory training-based school empowerment model, which not only produces learning media but also simultaneously transforms the digital behaviors and competencies of teachers and students. Thus, this research makes conceptual and practical contributions to the literature on technology-enhanced learning (TEL) and digital pedagogy in vocational education settings.

Based on the description in the State of the Art section, it can be concluded that although numerous studies have proven the effectiveness of interactive multimedia in improving learning outcomes, most studies still focus on the technical aspects of application development, rather than on transforming the capacity of users, particularly teachers and students as the primary actors in schools. Previous research, such as that by Rahmat et al. (2019), Wulandari (2018), and Wonggo et al. (2021), has indeed succeeded in creating Android-based learning media products, but has not comprehensively addressed the aspect of school empowerment. Teachers only act as passive users, not media designers or developers. As a result, the resulting innovation tends to stall after the research project is completed due to the lack of ongoing skills transfer. Furthermore, there is a significant gap between teachers' and students' digital literacy. Teachers tend to lag behind in technological mastery, while digital native students possess higher operational skills but are not directed towards learning objectives (Darmadi, 2018; Mustakim et al., 2023). This situation creates a digital mismatch that impacts the effectiveness of the teaching and learning process. Another problem is the lack of a participatory pedagogical approach in educational technology training programs. Most teacher training is one-way and focused on delivering material, rather than providing hands-on learning experiences that focus on real-life classroom projects (Consoli et al., 2023). However, research in the field of Technology-Enhanced Learning (TEL) shows that the success of technology integration in education depends heavily on the active involvement of teachers and students in the learning process. Therefore, this research formulates

three main questions: How can teachers improve their capacity to design and use Android-based interactive multimedia as a medium for Informatics learning? How can students optimize their smartphone use to shift it from a means of entertainment to a means of active and productive learning? How can they create a sustainable and contextualized model of participatory training-based school empowerment that aligns with the characteristics of vocational schools in Indonesia? The main problem in this research is the low competence of teachers in using interactive multimedia and low student motivation in Informatics learning. The identified research gap is the lack of participatory training models that integrate teacher and student empowerment simultaneously in vocational schools.

The novelty of this research lies in the development and implementation of a participatory-based vocational school empowerment model for the use of interactive multimedia for Informatics learning. This approach is oriented not only toward media product development but also toward transforming the behavior, competencies, and digital literacy of the entire school ecosystem (teachers and students). More specifically, the novelty of this research can be explained in four dimensions: Holistic Approach to School Empowerment. This research combines technology training, strengthening digital pedagogy, and managing changes in learning behavior in one intervention model. Not only are teachers trained to create media, but students are also actively involved as users and testers (co-creators of learning). This approach has not been widely implemented in the context of vocational education in Indonesia. Integration of the Smart Apps Creator 3 Platform in Vocational Learning. The use of Smart Apps Creator 3 as an Android-based interactive multimedia development tool is a relevant innovation because it does not require programming skills (no-code development). This allows non-technical teachers to still create engaging digital media. This approach bridges the gap between teachers' pedagogical and technical skills. Utilizing Smartphones as a Productive Learning Medium. This research shifts the paradigm of smartphone use from mere entertainment tools to active learning tools. Using the Bring Your Own Device (BYOD) approach, students use their personal devices to access interactive multimedia content offline. This strategy has the potential for widespread implementation in schools with limited technological infrastructure. Quantitative and Qualitative Success Evaluation Model. This research not only assesses improvements in student learning outcomes quantitatively (through pre- and post-tests), but also evaluates changes in teachers' behavior, motivation, and digital literacy through observations and in-depth interviews. This approach enriches the literature on the effectiveness of technology-based training in vocational education contexts. This novelty provides a theoretical contribution to the development of a digital pedagogy empowerment framework in vocational schools, as well as a practical contribution for education policymakers in designing relevant and sustainable ICT training programs. Conceptually, this research broadens the perspective of Technology-Enhanced Learning (TEL) by placing teacher and student empowerment as the primary focus, rather than simply the development of digital tools. Thus, this research serves as an implementation model for the digital transformation of vocational secondary education in Indonesia and other developing countries. This research aims to answer these three questions through a school empowerment approach that focuses on training and mentoring based on active participation from both teachers and students.

This study proposes a school empowerment model that emphasizes hands-on learning through project-based training using Smart Apps Creator 3 as an interactive multimedia platform. This approach combines strengthening teachers' digital literacy with student learning motivation within a single digital learning ecosystem. This research aims to improve the skills of vocational high school teachers

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in designing and using Android-based interactive multimedia, increase student motivation and participation in the informatics learning process, and encourage the creation of an adaptive and collaborative digital school environment. Thus, this research is not only oriented towards improving technical skills, but also towards shifting the learning paradigm in vocational schools, from instructional learning to collaborative, innovative, and student-centered learning. The ultimate goal of this research is to produce a school empowerment model that can be replicated in various vocational schools in Indonesia and other developing countries as part of efforts to achieve Sustainable Development Goal 4 (Quality Education) through the inclusive and effective use of educational technology.

## METHOD

### Research Approach

This study employed a mixed methods approach with a participatory experimental design. This approach was chosen to gain a comprehensive understanding of the impact of interactive multimedia training on improving teacher competency and student learning motivation. A quantitative approach was used to measure changes in learning outcomes and improvements in digital competency through tests and questionnaires, while a qualitative approach explored the experiences, perceptions, and attitudes of teachers and students during the training and implementation process. The combination of these two approaches allowed researchers to empirically assess the program's effectiveness while simultaneously understanding the social dynamics occurring within the school environment (Creswell & Plano Clark, 2018). This research used a mixed methods approach with a participatory design. The subjects were 10 teachers and 60 tenth-grade students of SMK Negeri 1 Tondano.

### Research Design

The program was conducted over five months (June–November 2025) through three main stages:

1)  Preparation
    A needs survey and interviews were conducted to assess teacher and student readiness to use technology. This includes a needs assessment and mapping of teachers' digital literacy levels and school infrastructure readiness. This activity aims to identify baseline conditions and competency gaps before interventions are implemented.
2)  Training and Mentoring
    Teachers were trained to develop learning media using Smart Apps Creator 3, while students learned to use the application in class. Implemented through intensive training, mentoring, and hands-on practice. Teachers are trained to develop Android-based learning media using the Smart Apps Creator 3 application. Students participate in the learning process using teacher-developed media. A hands-on learning approach is used to ensure participants not only understand the theory but also apply it directly in the classroom.
3)  Evaluation

Knowledge tests, motivation questionnaires, and classroom observations were conducted. Program success was measured by a minimum 70% increase in teacher skills and student motivation. At this stage, teacher competency improvement and student learning motivation were measured through pre- and post-tests, satisfaction questionnaires, and in-depth interviews. The evaluation also included observations of learning activities and the effectiveness of interactive media in the classroom.

Quantitative data analysis was conducted using descriptive statistics on pre-test and post-test results, while qualitative data were obtained from observations and structured interviews, analyzed thematically.

### Research Participants and Location

The research was conducted at SMK Negeri 1 Tondano, Minahasa Regency, North Sulawesi, Indonesia. This school was selected because it has high potential for digital technology adoption but faces limitations in developing innovative learning media.

The research participants consisted of:
- 10 teachers of Informatics and related subject areas,
- 60 10th-grade Informatics Engineering students who participated in the training and learning process.

The activity was conducted over five months, from June to November 2025, with support from Manado State University as the academic support institution.

### Training and Mentoring Procedures

The training activities were designed as collaborative workshops consisting of four main sessions:
- Session I – Introduction to Interactive Multimedia Concepts.
  Teachers were introduced to the theory and principles of multimedia design, including the integration of text, audio, video, and animation elements in learning.
- Session II – Smart Apps Creator 3 Training.
  Teachers learned to create interactive Android-based learning applications without requiring programming skills. The stages included interface design, content creation, and embedding interactive evaluation features.
- Session III – Classroom Implementation.
  Students used interactive multimedia applications in Informatics learning sessions. The teacher acted as a facilitator, guiding discussions and evaluations through digital media.
- Session IV – Reflection and Feedback.
  Teachers and students provided input regarding ease of use, benefits, and potential for further development of the created media.

Mentoring was provided by a team of lecturers and students from the Information Technology Education Study Program, Faculty of Engineering, Manado State University, to ensure the quality of implementation and sustainability of the activities.

### Research Instruments

The research instruments used included:
- Knowledge Test (Pre-test and Post-test):
  To measure teachers' understanding of interactive multimedia and student learning outcomes after using the media.
- Motivation and Satisfaction Questionnaire:
  Contains statements measured on a 1–5 Likert scale to assess students' perceptions of the attractiveness, interactivity, and benefits of learning media.
- Classroom Activity Observation Sheet:
  Used to record student engagement, teacher creativity, and learning dynamics during the activity.
- Structured Interview Guide:
  Intended to explore teachers' and students' experiences, challenges, and reflections regarding the interactive multimedia adoption process.

The instrument's validity was tested through expert judgment by three technology education experts, while its reliability was assessed using a Cronbach's Alpha value >0.7 to ensure internal consistency (Hair et al., 2022).

## Data Collection Techniques

Data were collected using the following techniques:
- Direct observation:
  Conducted during the training process and classroom implementation to record changes in learning behavior and use of digital media.

- Written and digital tests:
  Conducted before and after the training to measure improvements in teacher and student competency.
- Online questionnaires:
  Distributed to assess participants' perceptions of the effectiveness of the training and learning media.
- In-depth interviews:
  Conducted with five selected teachers and ten students to obtain more in-depth qualitative data.

## Data Analysis

Data analysis was conducted using two main approaches:
- Quantitative Analysis:

Pre-test and post-test results were analyzed using descriptive statistics (mean, percentage, and score increase) and paired sample t-tests to determine the significance of improvements in teacher skills and student learning outcomes. Questionnaire data were processed using SPSS 26 to assess the level of satisfaction and effectiveness of the training.
- Qualitative Analysis:

Data from interviews and observations were analyzed using thematic analysis to identify key themes related to changes in behavior, learning motivation, and technology acceptance. Data triangulation was conducted to ensure the validity of findings from various sources.

## Success Indicators

Program success was measured based on three main indicators:

- Improved teacher competency in designing and implementing interactive media by at least 70% compared to pre-test results.
- Improved student motivation and engagement during the learning process based on questionnaire results and observations.
- The quality of interactive learning media was assessed by experts and users (teachers and students) based on the criteria of effectiveness, interactivity, and ease of use.

# RESULTS AND DISCUSSION

## Improving Teacher Competence

The training results showed a significant improvement in teachers' ability to design and implement interactive media. Before the training, 80% of teachers only used PowerPoint, while after the training, all participants were able to integrate text, images, sound, and video into Android applications. This aligns with the findings of Darmadi (2018) and Mustakim et al. (2023) regarding the importance of ICT literacy in the professional competence of 21st-century teachers.

## Improving Student Motivation and Activity

Students demonstrated a change in their smartphone usage behavior. Previously, devices were used for entertainment, but now they are used for learning (Maketo et al., 2023). Observations showed that 72% of students were more active in interacting with learning media. Android-based media also made the Informatics learning process more engaging and contextual (Kumalasari, 2021). See Figure 1.

**Figure 1.** Implementation of activities at school

Before the training, pre-test results indicated that most teachers had limited knowledge of interactive multimedia design. Of the 10 participating teachers, only 20% understood interactive design principles, and none were able to create Android-based learning applications.

After the training and mentoring, post-test results showed significant improvement. 90% of teachers were able to create learning multimedia products based on Smart Apps Creator 3, with interactive features such as animations, videos, quizzes, and button-based navigation. The average teacher technical proficiency score increased from 58.4 to 86.7, with a t-value of 9.21 ($p < 0.01$).

In addition to technical proficiency, in-depth interviews revealed changes in psychological and pedagogical aspects. Teachers felt more confident and creative in integrating technology into their learning. One teacher stated:

"I used to only know PowerPoint, but now I can create my own applications for my students. They are more interested and actively learning."

This change confirms the findings of Consoli et al. (2023) that the success of technology adoption does not only depend on the tools, but on the teacher's ability to integrate technology pedagogically.

### Improved Student Motivation and Learning Outcomes

Pre-test and post-test results showed a 27.5% improvement in student learning outcomes after using interactive multimedia in Informatics learning. The average score increased from 64.3 to 82.0, with a paired sample t-test yielding $p < 0.001$, indicating a statistically significant improvement.

In addition to academic results, questionnaire data showed that 92% of students felt that learning was more engaging and easier to understand due to the interactive elements and concept visualizations. Eighty-seven percent of students reported being more motivated to study outside of class using apps installed on their smartphones.

Observations showed that student engagement in class increased significantly. Students were more active in asking questions, discussing topics, and demonstrating enthusiasm for the content presented. Media interactivity has been shown to foster a collaborative learning environment, consistent with constructivist theory, which emphasizes the importance of hands-on experience in learning (Al-Hariri & Al-Hattami, 2016).

### Impact on Schools

The implementation of interactive multimedia resulted in a change in the learning culture in schools. Teachers became more confident and collaborative in developing digital media. The school stated its readiness to integrate a technology-based curriculum in accordance with the Merdeka Belajar policy. This approach supports the principles of Technology-Enhanced Learning (TEL), which strengthen teacher-student interactions in digital environments (Consoli et al., 2023).

The participatory training-based empowerment model implemented in this study proved effective in improving teacher skills while building a culture of collaboration in schools.

Indicators of success were demonstrated by:

- The active involvement of all teachers in training, practice, and reflection activities.

- ▪ The formation of a teacher learning community that continues to develop media independently.
- ▪ Sustained adoption, with three teachers developing similar media for other subjects, such as Digital Simulation and 2D Animation.

These results indicate that a participatory approach is more effective than traditional top-down training because it fosters a sense of ownership of the resulting innovations. These findings support Kao et al.'s (2023) view that co-creation of learning is a key factor in the success of digital transformation in schools.

The findings reinforce the social constructivism theory that effective learning occurs when students actively interact with media and their environment. Hands-on activities provide direct experiences that enhance conceptual understanding (Al-Hariri & Al-Hattami, 2016). Furthermore, the strategy of utilizing local resources, namely, the use of students' own smartphones, creates low-cost yet high-impact digital learning (Wonggo et al., 2021; Zulianov & Dewi, 2023).

*Transforming the Role of Teachers in the Digital Era*

This research shows that technological empowerment shifts the teacher paradigm from knowledge transmitter to learning designer. Hands-on training enables teachers to understand not only how to use technology but also how to adapt it to pedagogical objectives.

This change is relevant to the concept of Technological Pedagogical Content Knowledge (TPACK), where teachers need to synergistically integrate aspects of technology, pedagogy, and content. By increasing teachers' digital literacy, schools have the opportunity to create learning that is more adaptive to the characteristics of digital native students.

*Android-Based Inclusive Learning*

The findings indicate that smartphones can be transformed from entertainment devices into active learning tools. The Bring Your Own Device (BYOD) model implemented allows students to learn independently, flexibly, and contextually without relying on computer lab facilities.

This aligns with the findings of Maketo et al. (2023) that gamification-based mobile learning supports quality education (SDG 4) by expanding access and increasing learning motivation. This research strengthens the evidence that mobile technology can be a solution to limited educational infrastructure in the regions.

*Participation and Collective Ownership*

A participatory training approach creates a shift in organizational culture in schools. Teachers and students are no longer recipients of the program, but active actors in the innovation process.

This collective engagement reinforces the community of practice theory (Wenger, 2011), where learning occurs through collaboration and shared reflection. By establishing a teacher learning community, this model has the potential for long-term replication without dependence on external facilitators.

*Implications for Education Policy*

The findings of this study provide a basis for developing teacher training policies in the field of educational technology. Training programs should not only focus on devices or applications, but also on pedagogical transformation and continuous mentoring.

This empowerment model can be adapted by the Education Office or the Directorate of Vocational High Schools as part of the digital transformation strategy for vocational high schools in Indonesia.

*Relevance to SDG 4 – Quality Education*

The results of this study support the achievement of Sustainable Development Goal 4 (Quality Education) by providing a technology-based empowerment model that improves teacher competency and expands access to learning.

By optimizing existing resources (smartphones and simple digital devices), schools can create an inclusive and sustainable learning system, even with limited facilities.

Overall, this study demonstrates that:
- Teachers can transform into digital innovators when trained with a participatory approach.
- Students show significant improvements in motivation and learning outcomes through Android-based interactive media.
- Schools can become independent and sustainable centers of digital empowerment through collaboration between teachers and students.

Thus, the integration of interactive multimedia is not merely a technological solution, but a pedagogical strategy that can strengthen schools' capacity to face the challenges of education in the digital age.

## CONCLUSION

This study concludes that school empowerment through the use of interactive multimedia as a learning medium has a significant positive impact on improving teacher competency and student learning motivation at SMK Negeri 1 Tondano. Through hands-on, participatory training, teachers not only mastered the technical skills of creating Android-based interactive media but also experienced a transformation in their mindsets and pedagogical practices. School empowerment through the use of interactive multimedia has proven effective in improving the quality of learning at SMK Negeri 1 Tondano. Teachers acquired new technological skills, while students experienced increased motivation to learn. This participatory training model can serve as a reference in developing digital transformation strategies in other vocational schools, particularly in the context of Android-based learning. Empirical findings indicate: A 48.3% increase in teachers' digital competency based on pre- and post-test results. Teachers were able to develop interactive media using Smart Apps Creator 3 and apply it contextually in Informatics learning. A 27.5% increase in student learning outcomes and an increase in learning motivation, with 92% of students finding learning more engaging, easier to understand, and fostering independent learning. The effectiveness of the participatory-based school empowerment model in

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building collaboration between teachers and students and creating a sustainable teacher learning community (Teacher Learning Community). These results confirm that the integration of interactive multimedia not only improves the quality of learning but also strengthens the institutional capacity of schools to face the challenges of digital transformation in education. This research expands the concept of Technology-Enhanced Learning (TEL) by placing teacher and student empowerment at the core of the educational innovation process, not simply as users of technology.

*Research Implications*

Theoretical Implications

This research adds to the literature on digital pedagogy and technology integration in vocational education by offering a model of school empowerment through participatory training.

This model demonstrates that the success of educational technology integration depends not only on the availability of devices, but also on the collaboration, ownership, and active participation of the entire school community.

Its theoretical contribution lies in the development of an approach that combines the principles of Technological Pedagogical Content Knowledge (TPACK) and Community of Practice (CoP) in the context of vocational education in developing countries.

Practical Implications

The results of this research can serve as a reference for:

- Schools and teachers: as a practice-based training model to improve digital literacy and independence in creating learning media.
- Governments and education offices: as a basis for formulating participatory teacher training policies oriented toward innovation and sustainability.
- Higher education institutions: as strategic partners in supporting technology transfer and digital mentoring for vocational high schools.

Implications for SDG 4 (Quality Education)

This research directly contributes to the achievement of SDG 4 – Quality Education, particularly in improving educator competency and expanding access to quality learning through technology. This low-cost Android-based mobile learning approach makes education more inclusive, especially in areas with limited infrastructure.

*Recommendations*

- For schools
  Ongoing training programs are needed to continuously develop teachers' digital competencies. Schools need to integrate learning technology training into their regular teacher professional development programs. The formation of Teacher Learning Communities should be facilitated to ensure the sustainability of digital innovation.
- For Teachers

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Teachers are expected to continue developing creativity in designing interactive content tailored to student characteristics. Cross-subject collaboration can enrich the learning media developed.

- For students

    The use of interactive media for independent learning is encouraged.

- For the government

    ICT policy and infrastructure support needs to be expanded to all vocational schools. Strategic policies are needed to support the implementation of digital learning in vocational schools, including the provision of online training platforms and incentives for innovative teachers.

- For researchers

    Longitudinal studies are recommended to assess the long-term impact of interactive multimedia use on learning outcomes. Further research is recommended to expand the context to other fields of study, use longitudinal methods to measure the sustainability of impact, and integrate artificial intelligence (AI) or virtual reality (VR)-based technology as next-generation interactive learning media.

## REFERENCES

Al-Hariri, M. T., & Al-Hattami, A. A. (2016). Impact of students' use of technology on their learning achievements in physiology courses at the University of Dammam. Journal of Taibah University Medical Sciences, 12(1), 82–85. https://doi.org/10.1016/j.jtumed.2016.07.004

Consoli, D., Ferretti, F., & Longobardi, C. (2023). Measuring teachers' integration of technology in education: A systematic review of instruments for K–12. Education and Information Technologies, 28(6), 6759–6782. https://doi.org/10.1007/s10639-023-12037-4

Creswell, J. W., & Plano Clark, V. L. (2018). Designing and conducting mixed methods research (3rd ed.). SAGE Publications.

Darmadi, H. (2018). Educational management based on local wisdom in the digital era. Journal of Education and Practice, 9(1), 35–43.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). A primer on partial least squares structural equation modeling (PLS-SEM) (3rd ed.). SAGE Publications.

Kao, C. W., Yuan, L. C., & Wang, C. H. (2023). Effects of gamified mobile learning on motivation and engagement: A challenge-based approach. Computers & Education, 204, 104903. https://doi.org/10.1016/j.compedu.2023.104903

Kumalasari, D. (2021). Pengembangan multimedia interaktif berbasis Android untuk meningkatkan motivasi belajar siswa SMK pada mata pelajaran simulasi digital. Jurnal Inovasi Teknologi Pendidikan, 8(2), 177–189.

Maketo, D., Chigona, W., & Chigona, A. (2023). Mobile learning and gamification in achieving SDG 4: A systematic review. International Journal of Educational Technology in Higher Education, 20(1), 1–23. https://doi.org/10.1186/s41239-023-00405-6

Mustakim, M., Handayani, S., & Ningsih, L. (2023). Digital literacy of teachers in Indonesian vocational schools: Opportunities and challenges in the era of society 5.0. Jurnal Pendidikan Vokasi, 13(1), 21–34.

Rahmat, R., Santoso, A., & Lestari, R. (2019). Pengembangan media pembelajaran berbasis Android untuk

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meningkatkan hasil belajar siswa pada mata pelajaran pemrograman dasar di SMK. Jurnal Teknologi Pendidikan, 21(3), 157–168.

Tafonao, T. (2018). Peranan media pembelajaran dalam meningkatkan minat belajar mahasiswa. Jurnal Komunikasi Pendidikan, 2(2), 103–114.

Wenger, E. (2011). Communities of practice: A brief introduction. Social Learning Research Network. Retrieved from https://wenger-trayner.com

Wonggo, D., Waworuntu, J., & Komansilan, A. (2021). Pengembangan media pembelajaran interaktif berbasis mobile learning untuk meningkatkan kompetensi siswa SMK. Jurnal Pendidikan Teknologi dan Kejuruan, 27(1), 1–10.

Wulandari, N. (2018). Pengaruh penggunaan multimedia interaktif terhadap hasil belajar siswa pada mata pelajaran algoritma di SMK Negeri 3 Surakarta. Jurnal Inovasi Pendidikan Vokasi, 5(2), 85–92.