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New Design of TV Sekolah Prototype as Innovative Learning Media for Early Childhood Education

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ABSTRACT

The COVID-19 pandemic disrupted traditional education systems, highlighting the need for digital learning solutions, especially in Early Childhood Education (ECE). **This study** introduces TV Sekolah, a hybrid learning platform designed to address the unique challenges of ECE by integrating synchronous virtual interaction, multimedia content, gamification, and cultural education. Existing digital platforms often lack features tailored for young children, and TV Sekolah bridges this gap with four key components: School Stage, Digital Library, Virtual Classroom, and TV Sekolah Festival, creating a comprehensive learning environment. **The research** uses the Successive Approximation Model (SAM) for prototype development, allowing iterative design, evaluation, and refinement with feedback from teachers, students, and stakeholders. The platform scalable technology efficiently manages video content and interactive learning, catering to diverse user needs and overcoming connectivity limitations. Preliminary feedback indicates improved learner engagement and educational outcomes. However, challenges such as limited device access and internet connectivity, especially for low income families, remain. **To address** these, the platform partnered with local governments to provide affordable devices and telecom companies for discounted internet packages. The education ministry also introduced training programs for teachers. **This study** offers solutions to these barriers and contributes to advancing hybrid learning by providing an inclusive, adaptable, and practical platform for early learners in diverse socio economic settings.

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1. INTRODUCTION

The COVID-19 pandemic has accelerated the need for digital transformation in education across all levels worldwide, including Indonesia [1]. Traditional face toface learning models faced unprecedented disruptions, especially in ECE, where interactive and engaging methods are crucial. Existing digital platforms often focus on either asynchronous content delivery or limited synchronous interaction, which may not fully address the diverse needs of young learners and educators [2, 3].

TV Sekolah is an innovative hybrid learning platform uniquely integrating four learning quadrants School Stage (video streaming), Digital Library, Virtual Classroom, and gamified TV Sekolah Festival to provide comprehensive, engaging, and culturally relevant learning experiences [4, 5]. TV Sekolah stands out in its hybrid approach by integrating various media formats such as digital libraries, gamification (TV Sekolah Festi-

val), and video based streaming, unlike other digital platforms like Google Classroom or Zoom, which mainly focus on video conferencing and content sharing. The unique feature of TV Sekolah lies in its combination of interactive and gamified learning experiences, designed specifically for ECE [6].

The rapid digital transformation in education, accelerated by the COVID-19 pandemic, has underscored the need for accessible and inclusive learning solutions, particularly for ECE. The TV Sekolah platform is an innovative hybrid learning solution designed to address this challenge, aligning with SDG 4: Quality Education, which emphasizes the provision of inclusive and equitable education for all. By integrating synchronous virtual interaction, multimedia content, and gamification, TV Sekolah ensures that young learners, especially from low income backgrounds, can access quality educational experiences. Furthermore, through strategic partnerships with governments and telecom companies, the platform also addresses SDG 10: Reduced Inequality by offering affordable devices and discounted internet packages, bridging the digital divide and enhancing educational participation in underserved communities. This research highlights the role of technology in achieving these SDGs and demonstrates how hybrid learning models can contribute to sustainable educational practices in the digital age [7, 8].

By leveraging a modular and scalable technical architecture, TV Sekolah supports content creators (teachers and students) with easy to use tools while managing extensive video data efficiently. This platform aims to bridge digital gaps by addressing the challenges faced by educators, students, and parents, especially those in low resource settings, thereby contributing to inclusive education during and beyond the pandemic [9, 10].

2. LITERATURE REVIEW

The insights gathered from previous studies highlight the critical role of hybrid learning models, interactive media, and gamification in enhancing educational outcomes, particularly in early childhood settings [11]. Building upon these foundations, the development of the TV Sekolah platform seeks to address existing gaps by integrating these elements into a cohesive, scalable solution tailored to the challenges faced in developing regions. The following sections describe the design, implementation, and evaluation of the TV Sekolah prototype, emphasizing its unique features and practical contributions to hybrid learning [12, 13].

2.1. Hybrid Learning in Early Childhood Education

Hybrid learning, which integrates face to face and online instructional methods, has emerged as a critical educational approach in response to the disruptions caused by the COVID-19 pandemic [14, 15]. This model offers the flexibility to combine synchronous and asynchronous learning, enabling educators to tailor instruction based on learners needs and contexts. Hybrid learning enhances personalized education by blending independent study, collaborative activities, and virtual interaction, which collectively improve learner motivation and engagement [16]. Such flexibility is particularly vital in ECE, where diverse developmental needs and attention spans require adaptive learning formats.

Moreover, the incorporation of microlearning short, focused learning modules has demonstrated significant benefits for young learners. Microlearning strategies facilitate knowledge retention and make learning more manageable by breaking complex content into digestible segments [10, 17]. These techniques complement hybrid learning models by offering accessible, targeted content that supports continual cognitive development. Together, hybrid learning frameworks and microlearning approaches form a robust foundation for platforms like TV Sekolah, which aims to deliver effective, engaging education to children in varied socio economic settings [18].

2.2. Educational Technology and Interactive Media

The rapid advancement of educational technology has transformed traditional teaching methods by incorporating multimedia and interactive tools that foster active learning. Interactive media, such as comics and animations, significantly boost students motivation and improve both cognitive and affective learning outcomes [19]. Video based platforms and gamification techniques have become popular tools in engaging learners by making education more enjoyable and relatable. highlights that gamification increases student participation and motivation, which are crucial factors for sustained learning [20, 21]. The role of social media and interactive technologies in enhancing communication and collaboration within educational environments.

Incorporating these technologies in platforms like TV Sekolah not only enriches the learning experience but also addresses diverse learner needs by offering multiple modes of content delivery [22, 23]. By

integrating video streaming, interactive virtual classrooms, and gamified activities, educational platforms can engage students more holistically, particularly in Early Childhood Education where engagement and interactivity play critical roles. The ability to customize learning paths and foster collaboration through technology aligns well with the pedagogical goals of personalized and inclusive education [24, 25].

2.3. Challenges of Digital Education in Developing Countries

Despite the promising benefits of digital education, many developing countries face significant barriers that hinder equitable access to technology enhanced learning. Limited access to digital devices and stable internet connectivity as critical challenges that disproportionately affect children from low income families, exacerbating educational inequalities [26, 27]. Furthermore, the successful implementation of digital learning also depends heavily on teacher preparedness and parental involvement, both of which require adequate training and support [28]. Without addressing these socio economic and infrastructural challenges, the full potential of digital education cannot be realized.

The use of iterative prototyping models like the SAM offers a practical approach to developing educational technologies that are responsive to these challenges. SAM cyclical design and evaluation process allows developers to refine systems based on real user feedback, ensuring solutions are contextually appropriate and user friendly [29, 30]. By involving educators, students, and other stakeholders throughout the development cycle, platforms such as TV Sekolah can better meet the nuanced needs of their target populations and provide scalable, sustainable digital learning environments [31].

2.4. Gamification in Learning

Gamification has gained considerable attention as a strategy to enhance learning by incorporating game design elements into educational contexts. Gamified learning environments increase learner engagement, motivation, and enjoyment, thereby promoting deeper cognitive involvement and better learning outcomes [32, 33]. The use of rewards, challenges, and interactive competitions can stimulate intrinsic motivation and create positive social dynamics among learners. further illustrates that gamification fosters collaboration and healthy competition, which are particularly effective in motivating young learners in settings such as Early Childhood Education [34, 35].

The TV Sekolah Festival feature exemplifies this approach by providing students with opportunities to showcase creativity and talents through gamified activities and competitions at various levels. This not only enhances student engagement but also helps build self confidence and social skills. Gamification role in making learning fun and meaningful aligns with contemporary educational paradigms that emphasize learner centered approaches and holistic development [36, 37].

3. METHODS

The development of the TV Sekolah platform followed a systematic and iterative process designed to ensure alignment with user needs and educational goals. Leveraging the SAM, the project engaged key stakeholders including instructional designers, teachers, and media experts throughout the prototype design and refinement phases [38, 39]. This collaborative approach allowed for continuous feedback and adjustment, resulting in a robust and user centered hybrid learning solution tailored for early childhood education.

3.1. Prototype Development Approach

The development of the TV Sekolah platform employed a prototype based design methodology to iteratively create and refine the system according to user requirements. This approach emphasizes close collaboration between system developers and end users such as teachers and students to ensure the platform meets educational needs effectively. Drawing from established prototyping principles, the design process included stages of requirement gathering, prototype creation, evaluation, and revision. This cyclical process allowed the team to identify potential usability issues and functional gaps early, enabling timely improvements [40]. The platform was developed using a combination of web based technologies such as HTML5, CSS3, and JavaScript for front end development. The backend was built using Python and Django for managing user data and video streaming. The platform media content is hosted on cloud servers with redundancy features to ensure continuous availability. The integration of gamification was implemented using the Unity game engine to create the TV Sekolah Festival.

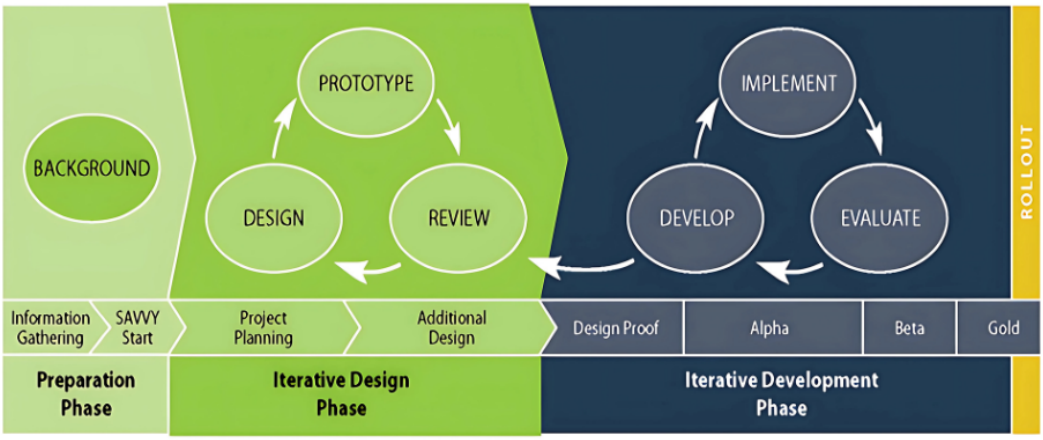

Figure 1. The phases of Successive Approximation Model (SAM).

Moreover, the project utilized the Successive Approximation Model (SAM), an agile instructional design framework that supports rapid development and flexibility. SAM iterative phases of preparation, iterative design, and iterative development facilitated continuous engagement with stakeholders, ensuring that feedback was incorporated into each version of the prototype [41]. This model was particularly suited for the dynamic nature of educational technology development, where evolving user needs and technological capabilities require adaptive and responsive design strategies. The phases of the SAM model are illustrated in Figure 1.

3.2. Technical Architecture and Implementation

The technical backbone of TV Sekolah was designed to support scalability, reliability, and accessibility. The platform architecture consisted of modular components integrating video streaming, content management, virtual classrooms, and gamification modules. The backend leveraged cloud based services for storage and streaming, allowing efficient handling of large volumes of multimedia content with adaptive bitrate streaming to accommodate varying internet speeds [42, 43].

Security and content moderation were integral to the platform design, ensuring a safe learning environment free from inappropriate content. Additionally, RESTful API facilitated seamless communication among components and enabled integration with external educational tools. The development team also implemented offline access features to mitigate connectivity issues common in low resource settings, ensuring learners could access critical content even with intermittent internet availability. Teacher training and support systems were incorporated to enhance digital literacy and platform adoption [44].

3.3. Preparation Phase

The preparation phase involved comprehensive information gathering and stakeholder analysis to define the needs and characteristics of the primary users teachers and students in Early Childhood Education. Key participants included instructional designers, facilitators, program managers, and media experts who collaborated to establish clear objectives for the TV Sekolah platform. Initial brainstorming sessions generated foundational ideas and design drafts, which were subsequently reviewed and validated by experts to ensure alignment with curriculum standards and pedagogical goals [45].

This phase also emphasized understanding contextual challenges such as limited technology access, varying digital literacy levels, and socio economic factors impacting learners and educators. By incorporating these insights early in the development process, the team could tailor design choices to address real world constraints, thereby enhancing the platform relevance and usability for diverse user groups [46, 47].

3.4. Iterative Design Phase

The iterative design phase comprised repeated cycles of designing, prototyping, and reviewing the platform features and interfaces. This approach allowed the team to test concepts and functionalities incrementally, gathering continuous feedback from stakeholders to refine usability and effectiveness [48, 49]. Detailed assessments were conducted focusing on critical factors such as development time, budget constraints, risk mitigation, and scope management, ensuring that the project remained feasible and on schedule.

User experience considerations were central during this phase, with usability testing sessions conducted with teachers and students to identify interface issues and improve navigation flows. The iterative cycle fostered collaboration among developers, educators, and content creators, enabling adjustments that enhanced the platform adaptability to different learning contexts and technical environments. This phase laid the groundwork for a robust, user centered solution that could be reliably implemented and scaled [50, 51].

4. RESULT AND DISCUSSION

This study innovated TV Sekolah learning media which provided an interactive session for both teachers and students and presented safe, creative, interesting, fun, effective, and efficient content that actualized children talents from an early age through the features developed on the TV Sekolah. Feedback from teachers, students, and parents indicates that TV Sekolah has been highly effective in enhancing the learning experience. Teachers reported a significant improvement in student engagement, as the interactive nature of the platform kept students focused and motivated. Students found the learning experience enjoyable, especially with the gamified elements of the TV Sekolah Festival. Parents noted that the digital library content was helpful for reinforcing learning at home, though some expressed concerns about the availability of digital devices and internet connectivity, particularly in low income households.

4.1. School Stage

Figure 2. School stage on TV Sekolah channel program

This was online video based streaming on a Youtube channel developed by the respective schools in accordance with the designed learning program and the teaching curriculum. Teachers interacted with students by recording and uploading videos and teaching materials, followed by learners with the help of the parents. Identified online videos on the Youtube channel to be very effective in learning. For instance, the "Visit Melbourne" channel, which introduces the city branding and "Award Winning Wines in Melbourne" gave an attractive impression to viewers". For this reason, apart from being a learning medium, TV Sekolah Programs are used as promotional media for institutions. Additionally, the aired programs are planned and arranged by the teachers as the main moderators to maintain the security of the shows consumed by the students. This ensures that the content is safe and does not display any pornographic videos, episodes of violence that would negatively influence the children in their learning. Since the teachers manage the programs, they continuously produce educative materials that motivate the children in doing tasks without coercion, and were free to express themselves on TV Sekolah Channel programs, as shown in Fig. 2.

4.2. Digital library

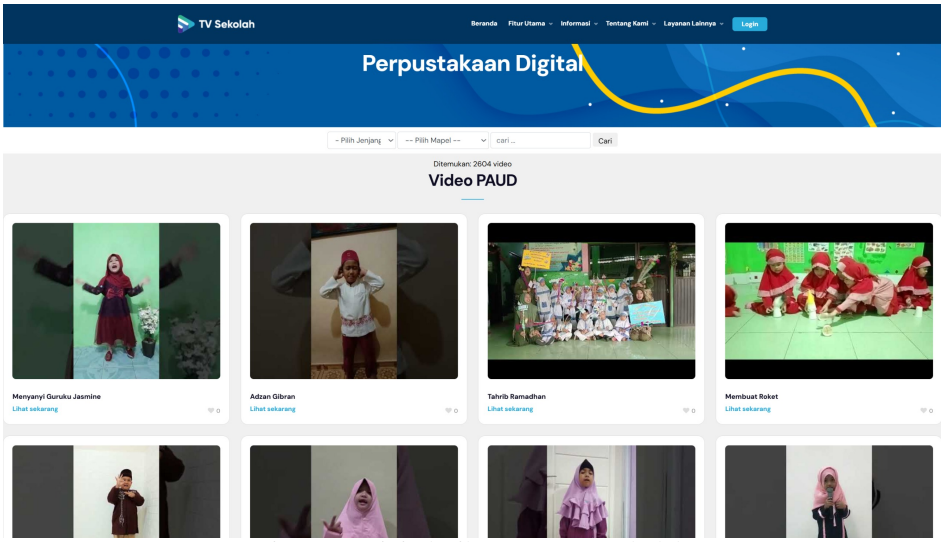

Figure 3. Digital Library on TV Sekolah

The term digital library was often used interchangeably with electronic libraries (e-library) and virtual libraries. The TV Sekolah Digital Library was a collection of videos by teachers and students produced with accuracy to avoid SARA (ethnicity, religion, and race issues), sensitivity, pornography, violence, hate speech, and hoaxes. The teachers are expected to create instructional video contents according to the projected topics, themes, and competencies in achieving curriculum goals. The teachers take the role of coordinating, organizing, motivating, and evaluating the digital based learning platform in a unique, interesting, innovative, and creative manner. TV Sekolah acted as a digital library through uploading videos of regional cultural performances, shows a variety of traditional foods, the uniqueness of the natural environment, which were meant to expand knowledge, provide a deeper insight of information for students, teachers, and accompanying parents. It is also a medium for developing children talents such as singing, dancing, giving speeches, or expressing their ideologies. Furthermore, it increases students self confidence because children are able to actualize themselves on a TV. This has become authentic since the documents or student portfolios are stored in the TV Sekolah data cloud. Some of the videos presented are displayed in Fig.3.

4.3. Virtual class

TV Sekolah virtual classrooms (Fig. 4) provided microlearning videos for students, making learning more effective by relating the videos with the learned content. Microlearning granted learners access to the newest information in the format that they required. The use of micro learning techniques, enabled efficiency and competence by improving the teaching mechanisms to make the knowledge acquired memorable. The classes were then designed to implement a hybrid learning according to government recommendations and the principle of independent learning, which was a comparison of 4 learning quadrant methods, including face to face learning, Independent Learning, Collaborative Learning, and Virtual Face to Face Learning. A hybrid compression technique incorporated excellent properties of each group. Finally, the students learned according to their interests and needs leading to improved cognitive development. The hybrid learning strategies employed in TV Sekolah combine face to face, independent, and collaborative learning. For instance, in Independent Learning, students can access microlearning videos through the virtual classroom, allowing them to learn at their own pace. Collaborative Learning occurs through discussion forums and group projects facilitated by teachers. The Virtual Learning component involves live streaming sessions and recorded lessons, where students interact with teachers and classmates in realtime, further enhancing engagement. That the hybrid learning system was highly recommended with the following strategies as illustrated in Table 1.

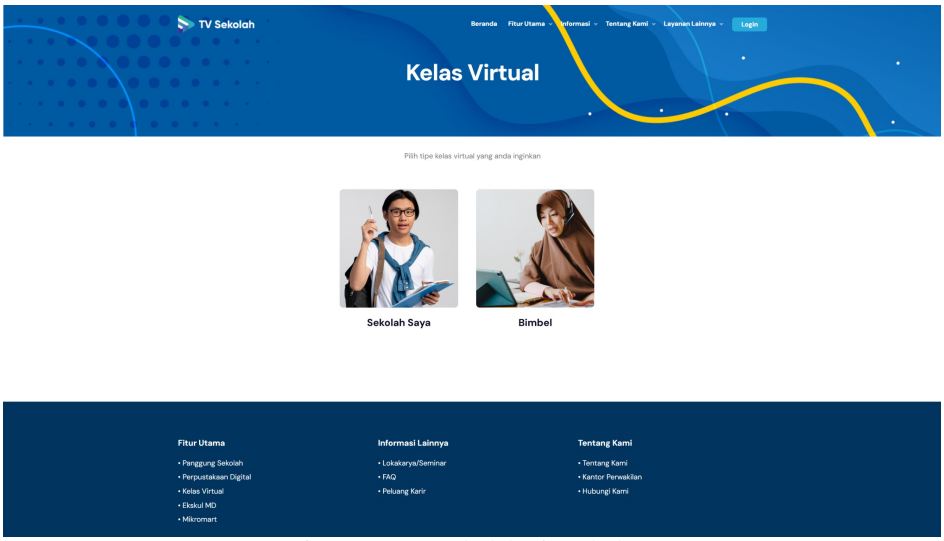

Figure 4. TV Sekolah virtual class

Besides learning from their teachers, students have the privilege to interact with other learners from different schools and teachers. This gives them a platform to add valuable information, insights according to their needs and interests. The technique offers comparisons in improving the content and quality based on various information from other schools. The comparison is positively steered to provide comprehensive learning, exchange of information, mutual synergy, and collaboration. Furthermore, the platform gives teachers a leeway to do individual learning and consultation, especially for students who need special coaching on different themes, competencies, discussions on developing special talents, different interests with both learners and parents. Virtual classes also provide complete modules according to student needs, along with questions, essays, assignments, and work procedures in relation to the course, adjusted to learners development and needs.

Learners group	**Teaching strategy suggested**	**Learning object media**
Visual	Simulation, Presentation, Read Text	Forum, Wiki, Animation, Graphic, Picture, Simulation, Video
Verbal	Discussion group, brainstorming, questions, and answers, solve the problem	Audio Recording, Podcast
Sequential	Presentation, Questions, and answers	e-book, audio
Global	Roles games, brainstorming, case study	Weblog, wiki, chat, e-mail, MCQ

Table 1. The recommended hybrid learning system

The division into Lite, Regular, and Premium Virtual Classes ensures that students from varying backgrounds can access the content. The Lite Virtual Class, which is free to access, provides MOOCs (Massive Open Online Courses) to students with limited access to technology, while the Premium Virtual Class offers a more personalized learning experience with video conferencing and one on one tutoring. This tiered approach helps bridge the digital divide by providing free content while offering more advanced learning experiences for those who can afford additional services. In cases where the teacher developed a private tutoring platform, there was a cost implication to cater for the extra time and other services for instance internet charges. The Virtual Premium class had a similar operating technique as the Regular Virtual Class, the difference was the system of facilities, and the learning materials were accompanied by comfortable video conferencing to enable students, teachers, and parents or companions to interact freely. The pedagogies used have been available in institutions that offered distance learning, but in this scenario, the implementation was meant to meet the expectations of many people in taking the course at no cost, which initially was based on peer and social e-learning models. However, the subsequent models (XMOOC modeled learning management) were founded on online courses,

including video based lectures, assessment, and messaging. In this premium virtual class, teachers got more income through guiding private learners according to their various needs and interests.

4.4. Extracurricular MD

Figure 5. Extracurricular MD

The Extracurricular MD feature introduces a gamified approach to education, replacing the TV Sekolah Festival in the TV Sekolah platform. Extracurricular MD offers students opportunities to engage in extracurricular activities such as music, dance, drama, and other artistic performances through structured, online competitions. This feature not only enhances student engagement but also promotes creativity and talent development in a fun, competitive environment. By integrating these activities into the learning process, Extracurricular MD encourages students to participate in non academic pursuits, fostering both personal growth and a sense of community see Figure 5 for an example of an Extracurricular MD activity.

The impact of Extracurricular MD on student motivation has been highly positive. Students expressed excitement and increased participation in these activities, as they provided a welcome break from traditional lessons and allowed them to express their talents in an interactive way. Teachers observed a boost in overall engagement, with students eager to participate in activities aligned with their interests. The platform ability to offer creative freedom through extracurriculars has helped make learning more dynamic and enjoyable for students, which is critical in maintaining attention and enthusiasm in early childhood education.

However, similar to the previous festival model, Extracurricular MD faced challenges related to access. Students from low income backgrounds experienced difficulties with limited access to recording equipment and the necessary technology to participate fully. Additionally, internet connectivity issues in some areas posed barriers to the seamless participation in these activities. Teachers also faced the challenge of integrating these extracurricular activities alongside the academic curriculum, which required additional planning and time. Despite these hurdles, Extracurricular MD has proven to be a valuable tool for enhancing the educational experience, and with further improvements to access and support, it holds significant potential for fostering well rounded student development.

5. MANAGERIAL IMPLICATION

The successful implementation and sustainability of the TV Sekolah hybrid learning platform require strategic actions in several areas. Educational institutions must prioritize investing in technology infrastructure to address issues like limited internet access and device availability. Collaborating with governments and private partners can provide affordable devices and internet packages for low income families. Ongoing teacher training is necessary to improve digital literacy and teaching skills, while peer support networks can help share best practices. Parental involvement, especially in early childhood education, is crucial, and schools should create programs to educate parents on supporting digital learning. Flexible learning models, such as offline resources and mobile friendly versions, should accommodate varying technological capabilities. To reach a wider audience, the platform must be customizable for different regions, offering modular content, local language support, and AI driven personalization. Long term sustainability depends on a mix of funding sources,

including public private partnerships, grants, and cost effective solutions for infrastructure and content development. Additionally, data analytics should be used to monitor platform effectiveness and refine features based on feedback. By addressing these areas, TV Sekolah can provide quality education, especially to underserved communities.

6. CONCLUSION

The development and implementation of the TV Sekolah hybrid learning platform have demonstrated significant potential in enhancing early childhood education (ECE) through innovative digital learning methods. By integrating interactive features like video streaming, digital libraries, virtual classrooms, and gamification, TV Sekolah creates an engaging and accessible learning environment for young students. This platform addresses the challenges posed by the COVID-19 pandemic, ensuring that learning continues despite the closure of schools and physical distancing measures. Through the use of these diverse media forms, TV Sekolah provides an effective solution for promoting educational continuity and fostering an interactive, engaging experience for early learners.

However, the success of the platform is not without its challenges. Key issues such as limited access to digital devices, inconsistent internet connectivity, and the lack of teacher readiness in using digital tools remain significant barriers to full implementation. The findings from this study underscore the need for ongoing support in teacher training, improved access to technology for students, and greater involvement from parents in the learning process. Additionally, the scalability of the platform requires continuous investment in infrastructure and content development to ensure its effectiveness across various educational contexts.

Looking forward, the TV Sekolah platform holds great promise for the future of hybrid learning in Indonesia and beyond. To maximize its impact, it is crucial for educational leaders, policymakers, and stakeholders to collaborate in addressing the challenges related to digital equity, teacher training, and content customization. With sustained investment, strategic planning, and the inclusion of diverse learning strategies, TV Sekolah can serve as a model for innovative, inclusive, and accessible education that supports the development of young learners, particularly in the face of ongoing global challenges.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: SW; Methodology: SW; Software: SW; Validation: SW; Formal Analysis: SW; Investigation: SW; Resources: SW; Data Curation: SW; Writing Original Draft Preparation: SW; Writing Review and Editing: SW; Visualization: SW; All authors, SW have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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The authors received no financial support for the research, authorship, and/or publication of this article.

7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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