



## SOCIOTECH LEARNING ECOSYSTEM: STRENGTHENING STUDENTS' SOCIO-ECONOMIC RESILIENCE THROUGH COMMUNITY-BASED DIGITAL PLATFORM INNOVATION IN TOLITOLI

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**ABSTRACT.** The socio-economic resilience of students in 3T regions such as Tolitoli Regency still faces significant challenges, particularly in utilizing technology as a learning tool. This study aims to develop a Sociotech Learning Ecosystem, a community-based digital learning platform designed to strengthen students' learning skills, digital literacy, and socio-economic support. The method used is a combination of the Borg and Gall Research and Development (R&D) model modified with a Community-Based Participatory Research (CBPR) approach. The research subjects include junior high school/high school students, teachers, school principals, parents/guardians, and community partners in Tolitoli Regency. Data was collected through participatory observation, in-depth interviews, and Focus Group Discussions (FGDs), then analyzed thematically. The research findings indicate that despite the availability of digital devices and internet access, challenges such as unstable connections, low digital literacy, and limited community engagement remain major issues. The developed model successfully integrates technology, contextual learning content, and active community involvement, thereby creating an adaptive and inclusive learning ecosystem. In conclusion, the Sociotech Learning Ecosystem offers a holistic solution that can be replicated in other regions facing similar challenges, while also supporting the equitable distribution of national education quality.

**Keywords:** Sociotech Learning Ecosystem; Socio-Economic Resilience; Digital Literacy; Community-Based; Tolitoli Regency

### INTRODUCTION

Education in Indonesia's remote areas, including Tolitoli Regency, faces complex and multidimensional structural challenges. Limited educational infrastructure, lack of access to information technology, and low community involvement in the learning process are the main obstacles to educational progress in this region (Margaretha & Simanjuntak, 2020; Yoku et al., 2023). Although the government has launched various school digitization programs, the reality is that many students in remote, outer, and underdeveloped (3T) areas are still unable to fully utilize technology to support their learning. This challenge is increasingly relevant in the era of digital disruption, which demands high levels of

technological literacy from both students and educators to compete equally within the national education system (Anwar, 2022).

The gap between ideal conditions and reality in the field becomes increasingly apparent when comparing the government's vision for digital education with the results of observations and interviews at SMPN 2 Dondo, one of the schools in Tolitoli District. Ideally, technology-based learning is expected to provide equal access to learning resources, facilitate independent learning, and increase student participation in the educational process (Safar et al., 2023; Mayasari et al., 2022). However, field findings reveal that limited access to stable internet, insufficient devices, and low digital literacy pose significant barriers (Laheng et al., 2022;

Permatasari & Nawangsari, 2022). Although some students have personal devices such as smartphones or laptops, technical challenges and low digital skills prevent the full potential of educational technology from being realized (Ferizaldi & Fazlina, 2020).

From the perspective of educators, efforts to integrate technology have actually been made through the use of Google Classroom, Quizizz, and the Merdeka Mengajar Platform. However, its effectiveness depends on the readiness of students and teachers to utilize the available features (Hanifatulazimah et al., 2023; Siregar et al., 2021). Some teachers complain that although digital assessments simplify the evaluation process, some students answer questions carelessly without paying attention to the quality of their answers. This phenomenon indicates that the implementation of technology in education is not merely a matter of device or network availability, but also relates to learning motivation, pedagogical strategies, and the cultivation of a positive learning culture among students (Islami et al., 2024; Gustino & Suprapti, 2024).

Community involvement in education in Tolitoli has so far been incidental and not systematically structured. Schools do establish partnerships with agencies such as the Health Office, Police, and Prosecutor's Office to provide thematic counseling, but these contributions have not directly integrated the local community into technology-based learning processes (Adnan et al., 2023). However, various studies indicate that active community participation in the learning ecosystem can enhance the relevance of educational content, reinforce local values, and support the sustainability of learning programs (Nursifa, 2023). The gap between the community's potential and its actual role in digital education is one of the gaps that need to be bridged.

Previous research indicates that a top-down approach to digital platform development often fails to address the needs of 3T regions due to a lack of adaptation to the local context (Hanifatulazimah et al., 2023; Soleha, 2021). Conversely, a bottom-up approach that involves local actors from the design stage can produce a more adaptive and sustainable learning model (Nurwahyuliningsih, 2021). However, research integrating this approach with community-based learning technology remains limited, particularly those focused on strengthening students' socio-economic resilience (Darmawati et al., 2022). Therefore, an innovative learning model that synergistically combines technology and community strength is needed.

The innovation offered in this research is the development of the Sociotech Learning Ecosystem,

a community-based digital learning platform designed participatively using the Community-Based Participatory Research (CBPR) approach. This concept combines the principles of sociotechnological design with community empowerment, resulting in a learning model that not only relies on technology but also strengthens social interaction and local cultural values (Insari et al., 2022; Gustino & Suprapti, 2024). This model is expected to address the specific needs of students in Tolitoli, who face challenges related to limited resources while also requiring social support to enhance resilience in the field of education.

The novelty value of this research lies in the integration of contextual technology with community participation as the main actor in all stages of development, from needs identification to evaluation of results. Unlike conventional digital learning models that often position students as passive users, the Sociotech Learning Ecosystem encourages students, teachers, parents, and the community to actively participate in creating, managing, and developing learning materials. This approach emphasizes the importance of building a sustainable educational ecosystem through inclusive and collaborative innovation.

Based on the background and research gaps described above, this study aims to design and develop an effective community-based Sociotech Learning Ecosystem model to strengthen the socio-economic resilience of students in Tolitoli Regency. This model is expected not only to address technological and human resource limitations in 3T areas but also to serve as a best practice example that can be replicated in other regions with similar characteristics. Thus, this study contributes both scientifically and practically to the development of technology- and community-based educational innovations in Indonesia.

## METHOD

This study uses a modified Borg and Gall Research and Development (R&D) model approach, combined with Community-Based Participatory Research (CBPR). The selection of this combination of methods aims to produce learning innovations in the form of a Sociotech Learning Ecosystem designed in accordance with the needs and potential of Tolitoli Regency, Central Sulawesi Province, while ensuring active community involvement from the initial design stage to the final evaluation. The R&D approach allows for the development of a tested product through a series of trials, while CBPR emphasizes the full participation of all stakeholders in the research process.

The research subjects include junior high and high school students in Tolitoli Regency as the main users of the platform, teachers and school principals as learning facilitators, and parents or guardians as supporters of education at home. Additionally, this research also involves community leaders and community partners such as the Health Department, Police, and Prosecutor's Office, who play a role in community-based outreach and educational activities. The selection of subjects was conducted using purposive sampling, considering the representation of each party involved in the local learning ecosystem.

The research process was conducted in six sequential stages. The first stage involved identifying needs and mapping the local context through participatory observation, in-depth interviews, and Focus Group Discussions (FGDs) to explore the obstacles, potential, and expectations related to technology-based learning in Tolitoli Regency. The second stage is the initial design of the platform model, which includes interface design, collaboration features, and integration of local values. The third stage is the development of contextual learning content that combines academic material with local content and is developed together with teachers and students. Next, the fourth stage is the implementation of a limited pilot test at partner schools, monitoring the use of the platform in teaching and learning activities and recording user interactions. The fifth stage is the evaluation of effectiveness and community reflection conducted through interviews, questionnaires, and focus group discussions to assess the platform's impact on student learning participation and socio-economic resilience. The final stage is the refinement and finalization of the model based on the evaluation results, accompanied by implementation guidelines and publication manuscripts.

The research instruments used consisted of interview guidelines, observation guidelines, simple questionnaires, and field notes. Interviews were conducted with representatives of each subject group, including students such as Rehanri Saputra and Afifa Nuraisa, school principal Mohammad Amin, teachers, parents or guardians such as Fitriani, and representatives of community partners in Tolitoli Regency. Observations were conducted in school and community settings to monitor the learning process, technology use, and interactions between students, teachers, and the community. Meanwhile, FGDs were used to gather input in a focused discussion forum involving participants from different backgrounds.

Data collection was conducted using triangulation, combining direct observation, in-depth interviews, and FGDs to obtain a comprehensive picture. Data analysis used thematic analysis techniques through the stages of data reduction, data presentation, and conclusion drawing (Najmah, 2023). Data validity was maintained through member checking with key informants and peer debriefing among researchers (Sugiyono, 2020). This process ensures that the research results are accurate, accountable, and replicable in other areas with similar characteristics.

## RESULT AND DISCUSSION

The results of this study describe the actual conditions of technology-based learning in Tolitoli Regency, which were analyzed through four main aspects: (1) access and learning habits, (2) digital literacy and interest, (3) community involvement, and (4) students' socio-economic resilience. The analysis was conducted by combining field data from interviews, observations, and focus group discussions (FGDs), which were then interpreted using theoretical frameworks and findings from previous research.

### *Access and Learning Habits*

The data collection results show that the majority of junior high and high school students in Tolitoli Regency already have digital devices such as mobile phones and laptops. These devices are their main means of accessing digital learning resources, both at school and at home (Rosyid et al., 2024). However, the availability of devices does not necessarily guarantee a smooth learning process. The main obstacle is the quality of the internet connection, which is often unstable, especially in rural areas far from the city center (Azubuike et al., 2021; Kulal et al., 2024). This condition directly affects the smooth running of online learning, especially when material is delivered via video or online conferences that require high bandwidth (Gu & Sok, 2021).

At school, the learning patterns observed show that students find it easier to understand the material when teachers combine verbal explanations with hands-on practice. This approach is considered effective because it provides an applied learning experience, in line with the principles of experiential learning (Zhou, 2021). At home, students tend to review the material they have learned at school to reinforce their understanding, though some choose to rely on searching for new information online (Muharom et al., 2021). This indicates that independent learning habits are beginning to form, though they are still influenced by external factors such as family support and the availability of

learning resources (Qaribilla et al., 2024; Kaharuddin et al., 2022).

Environmental factors also influence students' learning habits. Some students admit that they have to share devices with other family members, limiting their access to digital materials (Méndez-Domínguez et al., 2023). This situation reinforces the idea that limited access to devices and digital infrastructure can widen the gap in learning quality between students. This challenge indicates that technological interventions must consider flexibility in learning time and alternative access methods, such as offline modes or lightweight materials.

Learning habits formed from a combination of face-to-face learning at school and independent learning at home show opportunities to develop hybrid learning models that are appropriate for local conditions. Through the Sociotech Learning Ecosystem, these habits can be guided in a more structured way so that students are not just passive consumers of technology, but also users who are able to manage their learning strategies independently and collaboratively (Sarier & Uysal, 2022).

### ***Digital Literacy and Interest***

Students in Tolitoli utilize various popular applications such as Ruangguru, YouTube, and Google to support their learning (Fanani et al., 2021). These platforms were chosen because of their ease of access and the completeness of the materials available (N. W. E. Sari et al., 2022). However, their use has not been fully integrated with the school curriculum or the needs of context-based learning (Prastyo, 2022). Students in non-urban areas often choose digital learning resources based on availability and familiarity, rather than academic relevance.

Limited digital literacy is one of the most notable barriers. Many students are unable to distinguish credible sources of information from those that are not, resulting in a high risk of information misuse (Wardani et al., 2023). Teachers report that although technology-based assessments such as Quizizz and Wordwall facilitate the evaluation process, some students complete the questions carelessly without paying attention to the substance of their answers (Falloon, 2020). This highlights the need for learning strategies that focus not only on mastering the material but also on developing critical and evaluative thinking skills (Herianingtyas et al., 2023).

Students' interest in digital technology is quite high, but it tends to be focused on entertainment content or social media rather than educational content (Hartabela et al., 2024). Among teenagers,

digital interest is often used more for entertainment than for self-development, unless it is guided by teachers or special programs (Fanani et al., 2021). This situation is one of the reasons why the Sociotech Learning Ecosystem needs to be equipped with interactive features that can combine entertainment and learning elements in a balanced way (Eriani et al., 2023).

By providing digital literacy modules integrated into the platform, it is hoped that students can develop skills in selecting, verifying, and utilizing information productively (Supriyadi et al., 2023). These modules can also serve as a means for teachers to provide more structured guidance on digital ethics, cyber security, and technology-based collaborative skills (Prastyo, 2022).

### ***Community Involvement***

Community involvement in education in Tolitoli Regency, particularly at SMPN 2 Dondo, has been established in the form of cooperation with external agencies such as the Health Office, Police, and Prosecutor's Office. The programs implemented include thematic awareness campaigns on topics such as the dangers of drugs, traffic rules, and legal understanding (Aqilla & Rahmasari, 2024). However, these contributions have not yet been fully integrated into technology-based learning. This indicates that there is untapped potential to enrich digital learning materials (Purnasari & Sadewo, 2020).

In the context of the Sociotech Learning Ecosystem, community involvement has a broader meaning than just participating in incidental activities. Local communities can act as providers of content based on local wisdom, mentors for students in practical skills, and facilitators in connecting students with the world of work or entrepreneurship (Kusumastuti et al., 2020). This model is in line with the concept of community-based learning, which emphasizes the importance of active community involvement in supporting the educational process.

The interview results show that some teachers see great potential in community collaboration, especially in terms of building the relevance of learning materials to students' daily lives (Nurhidayat et al., 2022). With community support, learning can become more contextual, participatory, and sustainable. These findings are consistent with the view that integrating social actors into the educational technology ecosystem can enhance the sustainability of innovation.

Going forward, community involvement in the Sociotech Learning Ecosystem can be formalized through cooperation agreements, joint training, and

the development of technology-based local curricula (Rahma et al., 2021). This approach is expected to create a sense of ownership among the community towards the platform, so that the sustainability of the program does not depend entirely on external support (Hardiyanti, 2021).

**Socio-Economic Resilience of Students**

The socio-economic resilience of students in Tolitoli Regency is influenced by various factors, ranging from family economic conditions to social support from the surrounding environment (Supit & Gosal, 2023). Field data shows that some students face limitations in paying school fees, purchasing learning materials, or even meeting basic daily needs. This situation is exacerbated by parents' seasonal or irregular employment, such as farming or gardening.

For some students, helping with household chores is a routine before studying. Although this can reduce study time, some students actually feel more focused after completing household chores because their minds are less burdened (L. P. Sari & Ain, 2023). This phenomenon shows that non-academic factors play an important role in determining the quality of student engagement in learning (Kurnia & Fauziah, 2023). Educational resilience in vulnerable areas requires adequate socio-economic support.

In terms of external support, parents and guardians generally support the use of community-based digital platforms, provided that the content is positive and beneficial. Concerns that arise include the risk of gadget addiction and exposure to age-inappropriate content (Hakim & Azis, 2021). Therefore, online security features and parental supervision are important components that must be included in the Sociotech Learning Ecosystem.

By integrating adaptive learning features, social support from the community, and online safety protections, the Sociotech Learning Ecosystem can serve as a learning tool that not only enhances academic competencies but also strengthens the socio-economic resilience of students in resource-limited areas (Rizyana & Alkafi, 2023).

Based on the findings from the four aspects described above, a summary of the research results can be compiled, containing the field conditions and their implications for the development of the Sociotech Learning Ecosystem model. This summary is designed to provide a comprehensive overview of the relationship between empirical findings and the direction of community-based digital learning model development in Tolitoli Regency.

Table 1. Summary of Field Findings and Implications of the Sociotech Learning Ecosystem Model

Aspect	Research Findings	Implications for the Model
Access and Learning Habits	Devices are available, but internet connections are often unstable.	The model needs to have offline mode features and lightweight content for limited networks.
Digital Literacy and Interest	Popular applications are used, but digital literacy is limited.	Need for integrated digital literacy modules in the platform.
Community Involvement	External partners exist, but are not yet involved in digital learning.	The community needs to be involved in content creation and mentoring.
Socio-Economic Resilience	High economic vulnerability, varying family support.	The platform should facilitate collaboration for non-academic support.

Source: Research Data (2025)

The summary in Table 1 shows that the problems of digital learning in Tolitoli Regency are not only technical aspects such as the availability of devices and internet access, but also social, economic, and cultural dimensions that affect the success of technology adoption. Therefore, the following integrative discussion will elaborate on the relationship between these findings and the theoretical framework and previous research, while also explaining how the Sociotech Learning Ecosystem can serve as a relevant and sustainable solution.

First, the results of this study confirm that the availability of digital devices alone is not sufficient to improve the quality of learning in 3T areas. Stable internet connections, software support, and relevant learning strategies are determining factors for success (Ananda & Suranto, 2024). Conditions in Tolitoli show that without adequate technical support, the use of technology will remain limited (Nisyak, 2023).

Second, digital literacy is an essential component in maximizing the use of learning technology. Students' low ability to filter relevant information indicates the need for special intervention in the form of digital literacy training integrated into the curriculum (Fahrurrozi et al., 2022). The digital literacy module developed in the Sociotech Learning Ecosystem can serve as a practical guide for students and teachers to use technology critically, safely, and productively (Sukmana et al., 2024).

Third, community involvement in digital education in Tolitoli is still partial. In fact, the community has great potential to provide learning resources, mentors, and socio-economic support (Susanto et al., 2024). Integrating the community into the platform can strengthen the sustainability of the program and ensure that the learning materials are relevant to the students' real lives (Sapioper et al., 2022).

Fourth, the socio-economic resilience of students cannot be ignored. The proposed learning model must be able to provide solutions to the economic barriers faced by students, both directly through scholarship support and learning resources, and indirectly through the strengthening of life skills and economic opportunities (Widyastuti & Mukti, 2022).

Fifth, the Sociotech Learning Ecosystem as an innovation offers a holistic solution that combines technological, social, and economic aspects. This approach not only addresses the digital divide but also strengthens local social capital, encourages community involvement, and creates an adaptive and sustainable learning ecosystem (Fahlevi & Yusnaldi, 2020). This model has the potential to be replicated in other regions with similar characteristics, with adjustments according to local needs (Laapo, 2021).

## CONCLUSION

This study produced a community-based Sociotech Learning Ecosystem model designed to strengthen the socio-economic resilience of students in Tolitoli Regency through the integration of learning technology with the active involvement of the local community. The findings indicate that while digital devices and internet access are available in most schools and students' homes, major challenges such as unstable connections, low digital literacy, and limited community involvement in technology-based learning remain significant barriers.

Through a Community-Based Participatory Research (CBPR) approach and a modified R&D design, this model is able to accommodate local needs by involving students, teachers, parents, and community partners from the design stage to the evaluation stage. The integration of digital literacy, contextual learning content, and socio-economic support in one ecosystem enables the learning process to be more adaptive, inclusive, and relevant to the realities of students' lives.

These findings confirm that the success of educational transformation in 3T areas does not only depend on the availability of technology, but also on the strengthening of social capital, community participation, and the provision of sustainable support for students. The Sociotech Learning

Ecosystem model offers a holistic solution that can be replicated in other regions with similar characteristics, with adjustments to each local context.

Looking ahead, the prospects for developing this model include improving digital security features, integrating technology-based financial literacy and life skills programs, and strengthening cross-sector collaboration networks to support program sustainability. Further implementation can also be directed toward testing at various levels of education and in regions with different geographical challenges, so that its contribution to the equitable distribution of national education quality becomes more tangible and measurable.

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