







Optimizing the Role of *English Sensor* in Improving Students' English Vocabulary Mastery through Digital Learning at MGMP SMAN 6 Makassar

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Abstract

Background: Students' English vocabulary proficiency at SMAN 6 Makassar remains relatively low, with average scores ranging from 65 to 75. This issue is partly attributed to the suboptimal integration of digital technology in classroom instruction, despite the availability of adequate technological infrastructure.

Aims: This community service program aimed to optimize the use of the *English Sensor* platform for vocabulary learning, enhance the digital competence of MGMP English teachers, and strengthen students' vocabulary mastery through the *Word by Word Adventure* model based on scaffolding and gamification.

Methods: The population consisted of English teachers in the MGMP forum and tenth-grade students at SMAN 6 Makassar. A total of 15 students were selected using purposive sampling, representing different proficiency levels based on teacher recommendations. The program was implemented through five stages: (1) socialization, (2) workshops implementing the *Word by Word Adventure* approach, (3) digital content development training, (4) classroom-based integration of *English Sensor*, and (5) monitoring and evaluation using pretest-posttest assessments, classroom observations, and participant feedback.

Results: Preliminary findings indicated that teachers began to adapt to technology-assisted instruction, while students demonstrated increased learning motivation. Pilot implementation showed a 27% improvement in students' vocabulary mastery compared with pretest scores, indicating the effectiveness of *English Sensor* in supporting digital-based vocabulary learning.

Conclusion: The optimization of *English Sensor* contributed positively to improve students' vocabulary mastery and strengthen teachers' digital integration skills. The program also supported the achievement of SDG 4 (Quality Education), SDG 10 (Reduced Inequalities), and Higher Education Key Performance Indicators (IKU).

A. Introduction

English Sensor is a school-based digital learning platform designed to support English language instruction through interactive vocabulary exercises, multimedia content, and real-time learning analytics. The

platform enables teachers to create structured learning tasks and allows students to practice vocabulary through self-paced, feedback-rich activities accessible via school-provided digital devices. In this study, *English Sensor* is positioned not merely as a technological tool but as a pedagogical medium that can potentially respond to long-standing challenges in vocabulary learning.

In this context, English is an essential competency for senior high school students in meeting academic demands and responding to global developments. Vocabulary mastery serves as the primary foundation for reading, writing, speaking, and listening skills, and limited vocabulary has been shown to hinder overall language development. When students fail to build a strong lexical foundation, their overall communicative competence is significantly constrained, making vocabulary development a central priority in English language instruction. However, despite this recognized importance, vocabulary instruction often remains under-optimized in everyday classroom practice.

This gap between pedagogical importance and classroom reality becomes particularly visible in the learning context of SMAN 6 Makassar. Initial mapping indicates that students' vocabulary achievement remains in the range of 65–75 on the school assessment scale, accompanied by low retention and learning motivation. MGMP teachers also reported that students tend to lose focus when learning is still dominated by repetitive conventional methods. This condition highlights the need for a more interactive and adaptive learning approach aligned with the characteristics of digital natives. Thus, instructional innovation becomes an urgent requirement rather than an optional enhancement.

Responding to this instructional need, the integration of digital technology emerges as a promising solution for creating more engaging and effective vocabulary learning environments. Technology-mediated learning environments allow students to interact with language through multimedia, real-time feedback, and flexible learning pathways, which are difficult to achieve through traditional classroom methods alone. At the same time, such integration does not merely modernize instruction, but also aligns learning practices with students' everyday digital experiences.

Empirical evidence strongly supports this direction. Previous studies have emphasized the importance of integrating digital technology into language learning. Digital literacy has been shown to contribute significantly to English communication competence (Ekaningsih & Kurnia, 2022), and Indonesian educators have demonstrated positive attitudes toward the use of technology in the post-pandemic era (Paramahita et al., 2023). Educational technology offers effectiveness through multimedia integration, self-paced practice, and automated feedback (Golonka et al., 2014; Kohnke, 2020).

Mobile-assisted learning consistently improves retention, motivation, and academic performance (Metruk, 2024; Stockwell, 2010; Sung et al., 2016; Zhang & Zou, 2022). In the context of vocabulary learning, exposure through digital media and mobile applications provides flexibility and opportunities for continuous learning. More specifically, beyond general technology integration, game-based digital learning provides a focused pedagogical strategy for strengthening vocabulary acquisition. Game-based environments create meaningful repetition, immediate feedback, and motivational learning cycles that are well suited to vocabulary development. These environments are particularly relevant for senior high school learners who require both cognitive challenge and sustained engagement.

Consistent with this, digital game-based learning has been proven to significantly enhance vocabulary performance. Wang and Feng (2025) demonstrated that learning experiences through digital games can improve focus, motivation, and vocabulary learning outcomes. The effectiveness of gamification is explained through the use of elements such as points, levels, and incremental challenges that foster students' intrinsic motivation (Deterding et al., 2011; Sailer et al., 2017), while digital games in language learning support a more interactive vocabulary acquisition process (Godwin-Jones, 2014). The experience of flow in digital environments also contributes to increased concentration and learning satisfaction (Lai & Tai, 2021). Accordingly, digital learning can enhance student motivation and promote self-directed learning (Lai & Morrison, 2013).

In parallel with student-centred innovation, teacher readiness is also a crucial factor in the successful integration of technology. Technology acceptance models such as UTAUT emphasize that perceived usefulness and perceived ease of use strongly influence users' decisions to adopt technology (Venkatesh et al., 2023). In the educational context, teachers' intention to use technology is shaped by positive attitudes, perceived ease of use, and social norms (Teo, 2015). Teachers' digital literacy capacity likewise determines the quality of digital pedagogical implementation (Garcia et al., 2021), making it an important component in the success of community service programs.

Nevertheless, despite the growing body of evidence supporting digital learning, a clear implementation gap remains in school-level practices. Many schools already possess digital infrastructure, yet these resources are often underutilized for specific instructional purposes, particularly for structured vocabulary development. Thus, this gap is not rooted in the absence of technology, but in the lack of systematic pedagogical integration.

In line with this problem, although empirical evidence shows that digital technology is effective in improving language learning, no community service program has specifically integrated school-provided digital technologies into vocabulary instruction in a systematic way. Previous initiatives have focused more on promoting general digital literacy, training teachers to use new media, or developing new learning applications, without optimizing the technological resources already available in schools. To date, no community service report has been found that utilizes *English Sensor* as a structured vocabulary learning platform in public senior high schools in Makassar.

These conditions reveal a clear service gap: (1) schools possess digital devices that are not yet optimally used for vocabulary learning; (2) teachers have not received pedagogical training specific to the use of *English Sensor*; (3) students as digital natives have not yet experienced interactive and multimodal learning; and (4) no community service program has addressed this gap through the integration of school-owned technology into vocabulary instruction.

Based on this service gap, this program carries programmatic novelty in the form of integrating an existing school digital platform, *English Sensor*, into structured vocabulary learning through teacher training, strengthening digital pedagogy, and technology-based classroom implementation.

Therefore, based on the background above, this community service program aims to optimize the use of the *English Sensor* platform for vocabulary learning, enhance the digital competence of MGMP English teachers, and strengthen students' vocabulary mastery through the *Word by Word Adventure* model based on scaffolding and gamification.

B. Methods

This community service program employed a participatory empowerment approach by involving English teachers from the MGMP forum and students of SMAN 6 Makassar as key partners. A mixed-methods design was used, combining quantitative and qualitative data to obtain a comprehensive picture of program effectiveness (Creswell, 2014). The pretest–posttest design was used to objectively assess changes in students' vocabulary achievement, in accordance with recommendations from educational experimental studies that emphasize the importance of measuring change across two time points (Sardianti et al., 2025). Qualitative analysis was obtained through classroom observations and teacher–student reflections, consistent with the principles of triangulation in technology-enhanced learning evaluation (Teddlie & Tashakkori, 2012).

1. Population and Sampling

The population consisted of English teachers in the MGMP forum and tenth-grade students with low average scores in English at SMAN 6 Makassar. A total of 15 students were selected using purposive sampling, representing different proficiency levels based on teacher recommendations. Five MGMP English teachers participated as trainees in digital pedagogy and content development. This sampling technique ensured that the participants were directly involved in English language learning activities and could contribute relevant data to evaluate the effectiveness of English Sensor.

2. Instrumentation

Three instruments were used to collect data: a vocabulary pretest–posttest, observation sheets, and questionnaires.

a. Vocabulary Pretest–Posttest

The test consisted of 30 multiple-choice items assessing word meaning, synonym recognition, and contextual usage.

Example Items:

1. Choose the correct synonym for “assist”:
a) Ignore b) Help c) Delay d) Remove

2. *Choose the best word to complete the sentence:*
“The students were highly ___ when using the digital learning game.”
a) bored b) confused c) excited d) passive

Validity and Reliability:

Content validity was verified through expert judgments by two MGMP English teachers and one university lecturer. Cronbach’s Alpha reliability index was 0.81, indicating high internal consistency.

b. Observation Sheets

Used to monitor student engagement, task completion, and teacher facilitation during the classroom integration of English Sensor.

c. Questionnaires

A 4-point Likert-scale questionnaire captured participants’ perceptions regarding usability, motivation, and learning experience.

3. Procedures

The implementation of the program consisted of five main stages.

a. Socialization

In the initial stage, the English Sensor platform was introduced along with its potential applications in English language learning. This activity was supported by a presentation of the material and a discussion session involving both teachers and students (see Figure 1).



Figure 1. English Sensor Socialization Activity at SMAN 6 Makassar

b. Workshop

This stage focused on applying the *Word by Word Adventure* strategy through gamification and scaffolding approaches. MGMP teachers participated in hands-on practice sessions, while students explored the game features (see Figures 2 and 3).



Figure 2. MGMP Teachers’ Workshop on Implementing the Word by Word Adventure Strategy

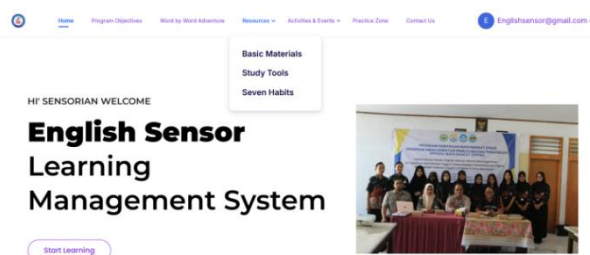


Figure 3. English Sensor Application Interface for Vocabulary Learning

c. Digital Content Training

Teachers were trained to design interactive instructional materials on the English Sensor platform. This activity included developing vocabulary questions, creating game-based exercises, and integrating multimedia elements.

d. Classroom Integration

English Sensor was implemented directly in the teaching–learning process. Teachers facilitated students in accessing and engaging with the digital content (see Figure 4).

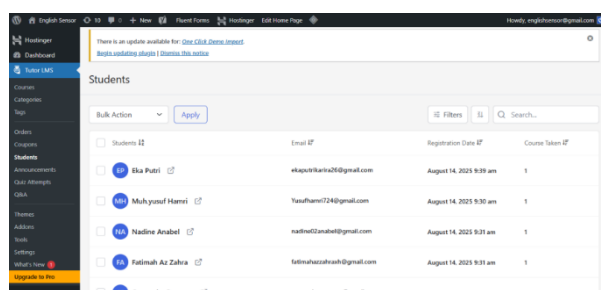


Figure 4. Students using English Sensor in vocabulary learning

e. Monitoring and Evaluation

Evaluation was carried out through the administration of pretests and posttests, as well as the collection of feedback from teachers and students to assess the effectiveness of the program. The measurement results are presented in a comparative table of initial and final scores (see Table 1).

4. Data Analysis

A mixed-methods analytical approach was used.

Quantitative Analysis:

Pretest and posttest scores were compared using descriptive statistics to measure vocabulary gains. Students' average scores increased from 66 to 84, indicating an 18-point improvement (27%).

Qualitative Analysis:

Observation and questionnaire data were analyzed through reduction, coding, categorization, and interpretation. Themes focused on motivation, engagement, responsiveness, and challenges experienced during digital learning. This process aligns with triangulation principles in technology-enhanced learning (Teddlie & Tashakkori, 2012).

C. Results and Discussion

1. Results

The results of this community service program are reported according to the five stages of implementation (1) socialization, (2) workshop, (3) digital content training, (4) classroom integration, and (5) monitoring and evaluation to explicitly demonstrate the outcomes achieved at each step, as requested by the editor. This structure highlights both process indicators (participation, competence development, and implementation fidelity) and outcome indicators (engagement and learning gains) derived from the use of the English Sensor platform.

1.1 Socialization Stage

The socialization stage resulted in increased awareness and acceptance of digitally assisted vocabulary learning among MGMP English teachers and students at SMAN 6 Makassar. Teachers demonstrated positive perceptions regarding the relevance of English Sensor to curriculum objectives and classroom needs, as evidenced by active participation in discussions and classroom-related questions. Students showed high initial interest, curiosity, and willingness to explore platform features during the introduction session. This stage successfully aligned participants' understanding of program objectives, expected learning outcomes, and the role of digital platforms in supporting vocabulary instruction, thereby establishing readiness for subsequent stages.

1.2 Workshop Stage

The workshop stage produced measurable gains in teachers' pedagogical understanding of the Word by Word Adventure model. Teachers were able to translate theoretical principles of gamification and scaffolding into concrete lesson designs, as reflected in the completion of sample vocabulary activities incorporating levels, points, and feedback mechanisms. Collaborative task design and peer discussion indicated strengthened professional interaction within the MGMP forum. Teachers also reported clearer distinctions between pedagogically driven gamification and superficial motivational use, indicating improved instructional decision-making.

1.3 Digital Content Training Stage

The digital content training stage aimed to strengthen teachers' competencies in developing interactive instructional materials using the English Sensor platform. The results showed that teachers were able to create structured vocabulary exercises, design game-based tasks, and integrate multimedia elements into their instructional content. Teachers demonstrated increased technical proficiency in managing digital content and organizing vocabulary materials according to difficulty levels.

This stage contributed to the development of teachers' digital pedagogical skills, particularly in aligning technology use with instructional goals. By the end of the training, teachers were capable of independently designing digital learning materials that could be directly implemented in classroom settings.

1.4 Classroom Integration Stage

During classroom integration, English Sensor was implemented directly in vocabulary learning activities. Observational data revealed higher levels of student engagement, participation, and task persistence compared to conventional instruction. Students actively interacted with platform features such as hints, levels, and instant feedback, which supported self-regulated learning behaviors. Students frequently revisited challenging vocabulary items and monitored their own progress using the platform's tracking tools, indicating increased learning autonomy and sustained attention during learning sessions.

1.5 Monitoring and Evaluation Stage

The monitoring and evaluation stage yielded both quantitative and qualitative evidence of program effectiveness. Quantitative analysis showed an increase in the mean vocabulary score from 66 (pretest) to 84 (posttest), representing an 18-point gain or approximately a 27% improvement. The distribution of individual student scores is presented in Table 1, while the summary of mean scores and percentage improvement is shown in Table 2.

Qualitative findings from classroom observations and student questionnaires corroborated the quantitative results. Teachers reported improved efficiency in monitoring student progress through automated feedback and progress-tracking features, while students expressed higher confidence and positive learning experiences in learning English vocabulary. Collectively, these findings demonstrate that the English Sensor platform effectively enhanced vocabulary mastery and improved the overall quality of the teaching-learning process.

Table 1. Students' Vocabulary Pretest and Posttest Results

Students	Pretest	Posttest	Improvement
S1	65	82	+17
S2	66	83	+17
S3	64	81	+17
S4	67	85	+18
S5	68	86	+18

Students	Pretest	Posttest	Improvement
S6	66	84	+18
S7	65	83	+18
S8	64	82	+18
S9	67	85	+18
S10	66	84	+18
S11	65	83	+18
S12	68	86	+18
S13	67	85	+18
S14	66	84	+18
S15	65	83	+18
Mean	66	84	+18

Processed from the findings of the community service program (2025)

Table 2. Mean Score

Measure	Pretest	Posttest	Gain	Percentage Improvement
Mean Vocabulary Score (M)	66	84	+18	27%

Processed from the findings of the community service program (2025)

Based on Tables 1 and 2, students showed higher engagement during learning, particularly through gamified features such as levels, points, hints, and instant feedback. Teachers also demonstrated increased competence in designing digital learning materials following the digital content training. They reported that features such as progress tracking and automated feedback supported more accurate monitoring of student performance. Observation data also confirmed that students were more independent, often rechecking unfamiliar vocabulary using the platform's hint and review modes.

2. Discussion

An increase of 17–18 points in students' vocabulary scores indicates that the effectiveness of *English Sensor* is not solely attributable to technology use, but to the alignment of its instructional design with principles of learning psychology and educational technology. Classroom observations revealed more stable student engagement, higher task persistence, and improved on-task behavior compared to conventional instruction. The platform encouraged repeated exposure, retrieval practice, and contextualized learning, which supported both short-term performance and longer-term vocabulary retention.

From the perspective of Self-Determination Theory (Deci & Ryan, 2000), *English Sensor* supported students' autonomy, competence, and relatedness through flexible learning paths, leveled challenges, and collaborative classroom use, thereby strengthening intrinsic motivation, as reflected in posttest performance. From a Human–Computer Interaction (HCI) standpoint, the high usability of the platform minimized interaction costs, reduced navigation friction, and allowed learners to allocate cognitive resources more efficiently to vocabulary processing. This supported established principles of effective digital interface design and contributed to smoother learning flows during classroom implementation.

Cognitive Load Theory (Sweller, 1994) further explains the program's effectiveness, as vocabulary content was presented in manageable units and supported by adaptive exercises that reduced extraneous cognitive load while maintaining germane load for schema construction. The sequential structure of *Word by Word Adventure* functioned as digital scaffolding (Viriyanpanyanont, 2021), enabling more systematic and cumulative vocabulary acquisition. In line with Multimedia Learning Theory (Mayer, 2003), the integration of text, images, and audio supported dual-channel processing and strengthened both comprehension and retention outcomes.

Gamification elements, such as points, levels, badges, and incremental challenges, created structured progress loops that improved focus, time-on-task, and retrieval practice, consistent with findings on flow and engagement in digital learning environments (Wang & Feng, 2025). Students reported higher enjoyment, reduced learning anxiety, and greater confidence in attempting new vocabulary, indicating positive affective outcomes beyond cognitive gains.

In terms of social impact, the program contributed to more equitable access to quality English learning opportunities. Students from diverse socio-economic backgrounds were able to engage with high-quality digital learning resources using school-provided facilities, which helped reduce disparities in access to private courses or commercial learning applications. Increased confidence in English vocabulary use also

supported students' participation in classroom discussions, peer collaboration, and school-level academic activities, fostering a more inclusive and interactive learning climate.

At the school level, the program strengthened institutional capacity in several ways. First, it encouraged the more efficient utilization of existing digital infrastructure that had previously been underused. Second, it promoted a shift in school culture toward more innovation-oriented and data-informed teaching practices, as teachers began to use platform analytics to monitor student progress and adjust instruction. Third, the program contributed to the school's readiness to implement broader digital learning initiatives, aligning with national digital transformation agendas and strengthening the school's profile as a technology-responsive institution.

The development of teacher capacity emerged as a central outcome alongside student gains. Through structured training and mentoring, teachers enhanced their competencies in designing interactive digital learning materials, aligning technology use with curriculum objectives, and integrating formative digital assessment into daily practice. Increased perceived usefulness and reduced effort expectancy, as explained by the Technology Acceptance Model (TAM) and UTAUT (Paramahita et al., 2023), strengthened teachers' intention to sustain digital tool use beyond the program period. Teachers also developed greater confidence in classroom management within technology-rich environments and in facilitating collaborative, student-centered learning.

These improvements in teacher competence functioned as a key mechanism supporting student outcomes. More systematic lesson planning, clearer learning pathways, and more timely feedback contributed directly to higher vocabulary scores and stronger learning motivation, indicating that improved instructional quality mediated the effectiveness of the technology. Furthermore, the creation of a professional learning community among MGMP teachers fostered peer support, knowledge sharing, and a sustainable model of continuous professional development.

From a digital engagement perspective, students demonstrated higher cognitive, behavioral, and affective engagement when using *English Sensor* compared to conventional tasks, in line with the digital engagement literature (Henrie et al., 2015). Overall, improvements in vocabulary performance and motivation are best understood as the results of a dynamic interaction among platform usability, motivational design, cognitive load management, strengthened teacher pedagogy, and institutional support, rather than the adoption of technology alone. This confirms that sustainable digital learning requires both effective tools and the continuous development of teacher and school capacity.

2.1 Implications

2.1.1 Theoretical Implications

The findings of this program contribute to the broader application of modern learning theories within technology-enhanced educational services. First, the improvement in students' vocabulary supports the concept of competence support in Self-Determination Theory by demonstrating that level structures and adaptive feedback can mediate motivation and learning outcomes. Second, the effectiveness of the English Sensor interface reinforces the Human-Computer Interaction literature, which emphasizes the importance of low interaction cost in digital learning systems. Third, the results are consistent with Cognitive Load Theory, indicating that presenting vocabulary in small units accompanied by gradual practice constitutes an effective instructional strategy. Fourth, this program validates the application of gamification theory in vocabulary acquisition, particularly regarding mechanisms of flow and incremental challenge. Thus, this study enriches theoretical understandings of how gamification and scaffolding can be integrated into mobile-based language learning.

2.1.2 Practical Implications

This program demonstrates that digital platforms can enhance student performance when integrated with appropriate pedagogical strategies. For teachers, the digital content training effectively improved their technological pedagogical skills, making it a replicable training model for other schools. The implementation of the *Word by Word Adventure* strategy provides a clear practical framework for vocabulary instruction through leveled activities, rapid feedback, and multimodal interaction. For students, the use of English Sensor enables continuous learning beyond the classroom, supporting higher cognitive and affective engagement. This program can serve as a reference for schools aiming to optimize existing digital platforms that have not yet been systematically utilized.

2.1.3 Policy Implications

These findings indicate the need for policies that support the systematic integration of educational technology into the secondary school curriculum. Developing teachers' capacity in digital literacy and content design should be implemented as an ongoing program rather than an incidental intervention. Schools that already have digital platforms such as English Sensor are encouraged to establish standard operational procedures for their utilization so that implementation does not depend solely on individual teacher initiative. Moreover, the results reinforce the importance of investing in digital infrastructure and structured training to ensure the sustainable transformation of technology-enhanced learning.

2.2. Research Contribution

This community service program contributes by:

1. Demonstrating a structured model for integrating school-owned digital platforms into vocabulary instruction.
2. Providing empirical evidence for gamification and scaffolding in Indonesian high schools.
3. Showing that mixed-methods evaluation can effectively assess community service-based learning innovation.
4. Expanding insights into teacher readiness and digital pedagogy development.

2.3 Limitations

This program has several limitations:

1. The sample size ($n = 15$) limits generalizability.
2. Short implementation duration prevents evaluating long-term retention.
3. The focus was limited to vocabulary mastery; other skills were not assessed.
4. Program success depended on available digital infrastructure, which may vary across schools.

2.4 Suggestions

Further implementations should extend the duration of intervention to measure long-term retention. Teachers should receive additional training to diversify digital content. A larger-scale pilot across multiple schools is recommended to test the consistency of the program's effectiveness. English Sensor features should also be expanded to accommodate broader aspects of English learning.

D. Conclusion

This community service program demonstrated that optimizing the English Sensor platform effectively enhanced students' vocabulary mastery, with an average score improvement of 17–18 points (approximately 27%). The integration of the Word by Word Adventure model, combining gamification, scaffolding, and multimodal learning, successfully increased student motivation and engagement. The program also strengthened MGMP teachers' skills in digital content development and classroom technology integration.

These findings indicate that the success of digital learning depends on the alignment between instructional design, interface usability, learner motivation, and teacher readiness, rather than the technology alone. The program offers a replicable model for schools that possess digital facilities but have not yet utilized them optimally. Overall, this initiative contributes to improving the quality of English language learning and reinforces the relevance of technology-supported instruction in secondary education.

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F. Author Contribution Statement

RI conceptualized and designed the program and conducted digital content training. AMAS developed the English Sensor application. AH prepared and wrote the manuscript. AF assisted in field implementation. All authors contributed to the overall design and revision of the program.

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