Augmented Reality in Green Promotion: Community College Students' Attitudes and Interest

M. A. Ismail[1*], M. A. Norazman[1] and N. Mohd Yusof[1]

[1*]Kolej Komuniti Bagan Datuk,
36400 Hutan Melintang, Perak, Malaysia.

*Corresponding Author's Email: azlin@kkbgd.edu.my

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Abstract

In today's digital landscape, augmented reality (AR) applications are increasingly used as promotional tools. This study investigates the perceptions of students at Kolej Komuniti Bagan Datuk (KKBgD) regarding the Smart Promotion and Learning Kit (SPLK) application. It compares the views of students in the Computer Systems and Networking Certificate (SSK) program with those in the Motorcycle Maintenance Certificate (SVM) program and explores whether the SPLK application influences student interest. Using a mixed-methods research design, the study involved 74 KKBgD students, employing questionnaires and semi-structured interviews for data collection. Quantitative data were analyzed through descriptive statistics and t-tests using SPSS version 26, while qualitative data were examined thematically. The results indicate that KKBgD students have positive perceptions of the SPLK application, particularly in terms of User Interface (UI), User Experience (UX), Accessibility, and Perceived Effectiveness. While no significant differences were found between SSK and SVM students regarding UI, UX, and Accessibility, a significant difference was noted in Perceived Effectiveness. Interview findings corroborate these results, highlighting that the SPLK application enhances students' understanding and interest compared to traditional promotional methods. Overall, KKBgD students view the SPLK application favorably, recognizing its effectiveness in improving comprehension and engagement. This study offers valuable insights for enhancing the SPLK application's development as a promotional tool at KKBgD and provides guidance for utilizing AR in marketing strategies within educational institutions.

Keywords: Augmented Reality (AR); Influences; Perception; Promotional; SPLK.

1.0 Introduction

The environmental crisis is one of the most urgent challenges we're facing, with wide-reaching impacts on ecosystems, public health, and economic stability. The United Nations Environment Program (UNEP) identified a "triple planetary crisis" in 2020—climate change, biodiversity loss, and pollution—that highlights the need for a global shift toward sustainable practices (UNEP, 2020). Addressing this crisis requires not only scientific innovation and policy changes but also a fundamental shift in public awareness and behavior. Educational institutions play a crucial role in this transformation, equipping students with the knowledge, skills, and motivation needed to drive sustainable change. Despite growing awareness, traditional educational methods—such as lectures, brochures, and posters—often fall short of effectively engaging students in sustainability topics (Xue & Lu, 2020). This is where Augmented Reality (AR) offers transformative potential.

AR overlays digital information onto the physical world, creating interactive and immersive experiences that make environmental education more engaging and relatable. For example, AR can overlay data on climate impact or pollution levels onto real-world settings, helping users visualize and understand complex environmental challenges in a more immediate and impactful way (Gualtieri & Gualtieri, 2019). This interactive approach not only enhances understanding but also has the potential to inspire behavior change toward more sustainable practices (Ding et al., 2019). The role of AR in green promotion is expanding, with recent studies showing its effectiveness in diverse sustainability efforts. For instance, AR has been used to improve waste management by guiding users on how to recycle materials accurately (Green City Times, 2024), and in virtual prototyping for product development to reduce resource consumption and waste (FXMedia, 2024). These applications show that AR can support eco-friendly practices while fostering innovative approaches in green technology. However, there is still a need to explore how AR can be effectively integrated into educational and promotional settings to maximize its impact on sustainability initiatives. Research suggests that organizations using AR for sustainability can significantly reduce their carbon footprint and enhance operational efficiency through optimized resource management (Sherwen, 2024).

A recent study by Shakirova, Berechikidze, and Gafiyatullina (2024) evaluated the impact of using AR technology to develop environmental literacy, motivation, and cognitive load among high school students. The findings show that the immersive application-based course had a positive effect on students' environmental literacy and motivation and helped reduce cognitive load slightly more than average. This evidence provides essential insights for improving programs and courses using technology for environmental and nature conservation education. The objectives of this study are:

i. To align this study with a focus on green promotion and sustainability education, the research objectives are as follows:
ii. To assess user satisfaction with the SPLK application's visual design, focusing on how it promotes environmental themes.
iii. To evaluate the level of user engagement with the SPLK application as a tool for green promotion and awareness.
iv. To determine the SPLK application's accessibility and ease of use in promoting sustainable behaviors among students.

This study addresses the following research questions to better understand the application's impact on sustainability awareness:

i. What are the perceptions of KKBgD students regarding the SPLK application as a green promotion tool?
ii. Are there differences in perceptions of the SPLK application's green promotion between students from the Computer and Network Systems Certificate (SSK) program and the Motorcycle Maintenance Certificate (SVM) program?
iii. To what extent does the SPLK application increase students' understanding, interest, and behavioral inclination toward environmental sustainability?

Imagine a world where learning about our environment is as exciting as playing games. That's what Augmented Reality (AR) brings to the table. Over the past few years, AR has revolutionized the way we understand and promote environmental awareness. Early studies demonstrate the prowess of AR in creating interactive experiences that not only capture our attention but also leave a lasting impression, reinforce brand messages and extend the reach of promotions (Rauschnabel, Kammerlander, & Ivens, 2016). The magic of AR lies in its ability to transform abstract concepts into tangible experiences, making sustainability education more relevant.

When it comes to promoting green practices, AR has proven to be a game changer. Unlike traditional brochures, which often end up as waste, AR offers a cost-effective and resource-friendly alternative. Mulyana and Arifianto (2020) highlight how AR has evolved from the days of clunky Quick Response code (QR codes) to a sleek markerless system, making it easier for everyone to use. This evolution has paved the way for a wider application of AR in environmental education, making it more accessible and impactful.

Recent studies have added more weight to the educational benefits of AR. Yildiz, Ozcelik, and Ozkan (2021) found that using AR to teach biodiversity significantly increased student knowledge and engagement. Similarly, Liu, Li, and Li (2022) found that AR not only increases environmental awareness among university students but also promotes pro-environmental behavior. Akçayır and Özkan (2023) summed it up perfectly: AR has the potential to make learning about the environment an immersive and interesting experience.

But the potential of AR doesn't stop at individual learning. It's also a powerful tool to promote green technology. AR can make invisible environmental impacts visible, helping people make more informed and sustainable choices. Imagine an app that shows the environmental footprint of the products you buy or guides you on how to recycle properly (Green City Times, 2024). Companies are also jumping on the AR bandwagon. Virtual prototyping through AR helps reduce waste by allowing designs to be tested digitally before physical production begins (FXMedia, 2024). In energy management, AR can monitor and optimize energy use remotely, making it an important tool for sustainability (Sherwen, 2024).

The SPLK application is an excellent example of how AR can be used to promote sustainability. The platform offers a range of AR-integrated products—from digital brochures to interactive social media content—that make learning about sustainability fun and engaging. By adding AR to these products, SPLK not only enhances their visual appeal but also strengthens consumer commitment to sustainable practices (Rauschnabel, Kammerlander, & Ivens, 2016). Research shows that AR can significantly increase brand loyalty, user recall and engagement with sustainability content (Chen et al., 2021; Kim et al., 2020).

In order to understand the impact of SPLK, this study will analyze how it affects student engagement, information retention and satisfaction with environmental messaging. By aligning with current research on the

effectiveness of AR in sustainability promotion, this study aims to provide valuable insights for future AR applications in education and promotion.

At the heart of this study is a framework that looks into how the SPLK application affects students' views and behaviors toward environmental sustainability. The framework sees SPLK app usage as the main factor, with user satisfaction, engagement, and the usability of the AR experience as intermediate factors. It ultimately examines how these elements influence students' perceptions and actions related to sustainability.

Figure 1, illustrates the SPLK Conceptual Framework for AR-Integrated Learning and Environmental Sustainability. It shows the relationship between using the SPLK application and its effects on user satisfaction, engagement, and usability, which in turn shape students' perceptions and behaviors toward sustainability. This framework is significant as it provides insights into how educational technology can encourage sustainable behaviors among students.

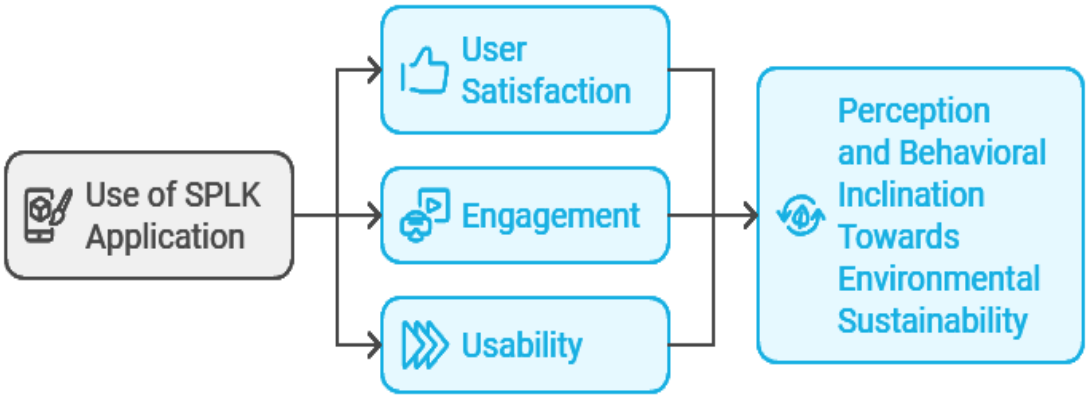

Figure 1: Illustration of SPLK Conceptual Framework for AR-Integrated Learning and Environmental Sustainability

2.0 Methodology

This chapter outlines the mixed-methods research design utilized in this study to explore how students at Kolej Komuniti Bagan Datuk (KKBgD) perceive the Smart Promotion and Learning Kit (SPLK) application as a tool for promoting sustainability. By blending quantitative and qualitative approaches, the research aimed to gain a well-rounded understanding of the application's impact on user engagement, satisfaction, accessibility, and overall effectiveness.

The mixed-methods approach provided a rich perspective by employing surveys for quantitative data and semi-structured interviews for qualitative insights. The survey was structured to assess user perceptions across five key areas: demographics, user interface (UI), user experience (UX), accessibility, and perceived effectiveness. Meanwhile, the qualitative interviews offered an opportunity to delve deeper into user motivations and personal experiences with the SPLK application. This combination allowed for a comprehensive analysis of trends in student perceptions while also capturing nuanced insights that quantitative data alone might miss. The significance of using both quantitative and qualitative methods in this study cannot be overstated.

The quantitative analysis provided statistical measures such as means, standard deviations, and t-tests to identify differences in perceptions among various student groups. In contrast, the qualitative interviews added depth by contextualizing these findings, allowing for a more nuanced interpretation of student experiences and motivations regarding the SPLK application. This methodological blend enhances the validity of the findings by balancing broad trends with detailed individual perspectives. For the quantitative phase, 74 students were surveyed from a total population of 88 at KKBgD. A simple random sampling method was used to ensure that each student had an equal chance of being selected, which minimized bias and helped reflect the general attitudes of the student body toward the SPLK application. To enrich the qualitative data, six students were purposefully chosen for semi-structured interviews, representing varying levels of engagement across different study programs. This approach ensured that diverse experiences were captured, providing a well-rounded view of how students interact with and perceive the application. Refer figure 2.

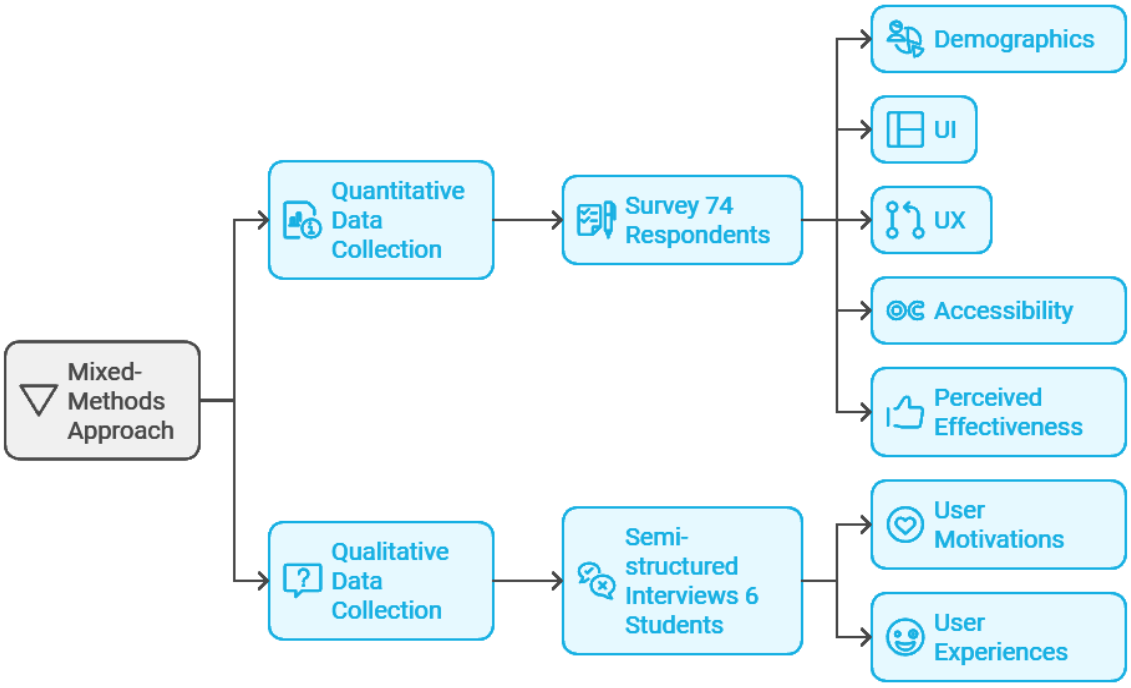

Figure 2: Illustration of SPLK Data Collection Method and Analysis Process

The data analysis process involved several steps. For the quantitative survey data, descriptive statistics were calculated to provide an overview of ratings for each section of the SPLK application. Key indicators such as mean scores and standard deviations were used to gauge overall satisfaction levels among students. T-tests were then conducted to identify any significant differences in perceptions based on different study programs.

Qualitative data from the semi-structured interviews were analyzed thematically. Responses were coded and categorized into key themes that reinforced and contextualized the quantitative findings. This approach not only provided additional insights into how effective students found the SPLK application in promoting sustainability but also highlighted areas for improvement based on user feedback.

To ensure that both quantitative and qualitative data were reliable and valid, several measures were implemented. For quantitative data, content validity was established through expert review of survey questions to ensure relevance and clarity. Construct validity was confirmed by aligning survey sections with established theories in user experience and educational technology. Reliability testing included a pilot test with a small group of students prior to the main survey to assess internal consistency.

For qualitative data, triangulation was used to cross-reference findings with quantitative results, enriching the overall understanding of student perceptions. Member checking allowed participants to review their responses for accuracy, ensuring that their views were authentically represented. Peer review of thematic codes helped maintain rigor in qualitative analysis.

Ethical considerations were paramount throughout this research process. Informed consent was obtained from all participants, who were briefed on the study's purpose and assured of their confidentiality. Student identities were anonymized in both survey responses and interview transcripts to protect their privacy. Participants also retained the right to withdraw from the study at any time without any repercussions.

The methodology employed in this research is significant as it combines both breadth and depth to understand how the SPLK application functions as a green promotional tool within an educational context. By utilizing mixed methods, this study captures broad trends while also highlighting individual experiences, enhancing both generalizability and contextual richness in its findings. The rigorous validity and reliability measures further ensure that research outcomes are credible, providing valuable insights into how augmented reality can be effectively applied in promoting sustainability in educational settings.Through its systematic approach and comprehensive analysis, this methodology lays a solid foundation for future studies exploring innovative technological solutions for environmental education and sustainable behavior promotion within academic institutions.

3.0 Result and Discussion

For the quantitative data, there were four variables measured in this study: User Interface (UI), User Experience (UX), Accessibility, and Perceived Effectiveness. Based on Table 1, the mean for UI is 4.2889 with a standard deviation of 0.55861. This high mean value indicates that, on average, respondents considered the UI of the SPLK application to be good. This finding is consistent with previous studies that emphasized the importance of well-designed and intuitive user interfaces in enhancing user satisfaction (Smith et al., 2018; Nielsen, 2012).

The mean for UX is 4.2247 with a standard deviation of 0.62790. This high mean value indicates that respondents gave a positive assessment of their experience using the SPLK application. This finding is consistent with the research of Hassenzahl (2010) and Forlizzi and Battarbee (2004), which highlighted the importance of positive user experiences in fostering user

engagement and satisfaction.The mean for User Accessibility is 4.1233, a relatively high value, with a standard deviation of 0.70847. This indicates that the level of user accessibility to the SPLK application is high.

The Perceived Effectiveness aspect also showed a high mean of 4.2529 with a standard deviation of 0.58139. This high mean value indicates that respondents viewed the use of the SPLK application as a promotional tool positively and believed it to be effective. The moderate standard deviation also suggests a small variation in respondent assessments. Previous research by Sherwen (2024), Shakirova et al. (2024), and Jha & Verma (2023) highlight the importance of perceived user effectiveness in determining user satisfaction and continued use of a system or product. Additionally, a study by Roberts & Huang (2021) emphasizes how contemporary applications' usability directly impacts user retention and satisfaction.

Therefore, the findings from this analysis indicate that respondents have a positive perception across all variables studied: User Interface (UI), User Experience (UX), Accessibility, and Perceived Effectiveness. These findings are also consistent with previous research as stated. Therefore, the first research question "What is the perception of Kolej Komuniti Bagan Datuk students towards the use of the SPLK application as a promotional tool?" has been successfully answered.

Generally, there was no significant difference in the mean values of the three variables assessed in the study, namely UI, UX, and Accessibility, based on the two types of programs offered at Kolej Komuniti Bagan Datuk. However, there was a significant difference in the mean values for the variable of Perceived Effectiveness. Table 1 presents the descriptive analysis for each variable:

Table 1: Descriptive Analysis of Variables

Variables Measured	**Mean**	**Standard Deviation**
User Interface (UI)	4.2889	.55861
User Experience (UX)	4.2247	.62790
User Accessibility	4.1233	.70847
Perceived User Effectiveness	4.2529	.58139

Table 2 presents a descriptive analysis of the variable Perceived Effectiveness. The analysis of perceived effectiveness of the ARPromo application shows that students in the Computer and Network Systems Certificate (SSK) program have a higher and more consistent perception (mean: 4.3947, SD: 0.49868) compared to those in the Motorcycle Maintenance Certificate (SVM) program (mean: 4.1032, SD: 0.63025). This indicates that SSK students find the application more effective, while SVM students exhibit greater variability in their perceptions. These insights suggest the need for tailored improvements to the ARPromo content to better meet the needs of SVM students.

Table 2: Group Statistical Analysis

	Program	*N*	*Mean*	*Std Deviation*	*Std Error Mean*
Perceived Effectiveness	Computer and Network Systems Certificate (SSK)	38	4.3947	.49868	.08090
	Motorcycle Maintenance Certificate (SVM)	36	4.1032	.63025	.10504

Table 3: Independent Samples t-test for Perceived Effectiveness by Program

		F	Sig	t	df	p Sig (2-tailed)	Mean Difference	Sd Difference
Perceived Effectiveness	Equal variances assumed	.078	.781	2.213	72	.030	.2915	.1317
	Equal variances not assumed			2.199	66.65	.031	.2915	.1325

Levene's test in Table 3 shows F > 0.05, indicating homogeneous variances between the two groups. Therefore, the t-test analysis results are taken from the equal variances assumed section. The t-test analysis shows a significant mean difference between Computer and Network Systems Certificate (SSK) students (M = 4.3947, SD = 0.49868) and Motorcycle Maintenance Certificate (SVM) students (M = 4.1032, SD = 0.63025) with t(72) = 2.213, p = 0.030. Since the p-value of 0.030 < 0.05, the null hypothesis is rejected.This t-test result indicates a significant difference in perceived effectiveness of the SPLK application as a promotional tool between SSK and SVM students. Thus, the second research question, "Is there a difference in perception between SSK and SVM students?" is answered.

Table 3: Independent Samples t-test for Perceived Effectiveness by Program

		F	Sig	t	df	p Sig (2-tailed)	Mean Difference	Sd Difference
Perceived Effectiveness	Equal variances assumed	.078	.781	2.213	72	.030	.2915	.1317
	Equal variances not assumed			2.199	66.65	.031	.2915	.1325

Based on the qualitative data analyzed from semi-structured interview transcripts, it was found that the SPLK application can significantly enhance users' understanding of KKBgD through visual and virtual elements. R1 and R4 emphasized that the visual elements in the SPLK application greatly facilitated their understanding of the structure of the KKBgD building. R1, an SVM student, stated, "Using the SPLK application, I can see all the rooms and buildings in KKBgD. There are some labs that I didn't even know existed." This was also supported by R6, an SSK student, who said, "This is the first time I know about the workshops in KKBgD and what's inside those workshops."

Furthermore, R5 opined, "The SPLK application provides an exciting experience for me. I enjoy being able to see all the facilities available at KKBgD just on the screen." This was supported by R2, R4, and R6 who emphasized the enjoyment of using the SPLK application where they only needed to move their smartphones without moving from their position. R4 also stated, "The SPLK application makes reading more interactive and easy. I enjoy reading and getting to know KKBgD." These findings prove that the SPLK application can increase user motivation in using the application. The interactive features of SPLK make the user experience more enjoyable and personalized, aligned with the benefits of AR as stated in previous research findings.

Overall, all respondents R1, R2, R3, R4, R5, and R6 agreed that the SPLK application is very suitable to be used as promotional material for friends and can facilitate users, especially prospective students, to make decisions to enroll at KKBgD due to the interactive and visual features of the SPLK application which are enjoyable and make it easier for users to understand KKBgD more closely. Therefore, the third research question, "To what extent can the SPLK application increase students' understanding and interest?" has been answered.

4.0 Conclusion

In conclusion, the use of the SPLK application as a promotional tool for KKBgD has received a positive perception from students. Quantitative data analysis indicates that students have a favorable perception of the UI, UX, Accessibility, and Perceived Effectiveness of the SPLK application. The study results also highlighted a significant difference in perceived effectiveness between SSK and SVM students. Furthermore, qualitative findings suggest that the SPLK application can increase users' understanding and interest in learning about KKBgD. These findings underscore the potential of AR technology as a useful tool in raising awareness of environmental issues.

Beyond the numbers, students shared that SPLK, especially with its augmented reality (AR) features, deepened their understanding and made learning more enjoyable. Many students described the AR as making abstract concepts more tangible, which in turn boosted their engagement and interest. This highlights the potential of AR to create immersive and interactive learning experiences that go beyond traditional methods.

Looking forward, future studies could explore SPLK's impact in broader settings by comparing it with similar applications at other institutions. Bringing in insights from AR and education technology experts could further refine SPLK's design to make it even more effective. Long-term studies would also help to understand how AR impacts learning retention, cost-efficiency, and accessibility over time.

Finally, AR's benefits could extend beyond learning—there's real potential to use it for promoting environmental awareness and sustainable practices among students. By focusing on these areas, educational institutions can harness the power of tools like SPLK to support both education and environmental responsibility, creating a richer learning experience that also encourages students to be more mindful about the world around them. Overall, the positive reception of the SPLK application at KKBgD demonstrates its potential as a powerful tool for both educational promotion and environmental sustainability.

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Author Contributions
M. A. Ismail: Supervision, Study Design And Methodology, Reviewed And Editing; **N. Mohd Yusof:** Data Curation, Validation and Designed The Study, Collected And Analyzed The Data, Writing of the manuscript; **M. A. Norazman:** Data Analysis, Review, Interpretation Of The Results.

Conflicts of Interest
The manuscript has not been published anywhere else and is not being considered by any other journals. All authors have authorized the review, agree with the submission, and state that they have no conflicts of interest in the work..

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