

PAPER

A Hybrid Approach to Raising Digital Literacy among Adolescents in KSA Using a Mobile Application

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ABSTRACT

As digital technologies and the Internet evolve, digital issues are becoming more prevalent and are a serious concern due to their increased level of integration in our daily lives. Many users lack the necessary digital literacy to protect themselves and their communities from such issues. Background research reveals that adolescents in Saudi Arabia are particularly vulnerable to these issues, also supported by the studies pre-test for students (15.8%). This highlights a gap regarding preventative measures that researchers aim to fill. This study investigates the effectiveness of integrating a dedicated mobile application focused on raising awareness regarding digital issues such as cyberbullying within a hybrid teaching framework amongst primary and middle school students in Saudi Arabia. The application's features, including but not limited to pre-tests, post-tests, lecture material, and progress monitoring, along with its ease of use, are designed to efficiently achieve digital issue learning outcomes. To assess this hybrid approach toward raising awareness of digital issues, this study gathers 30 participants and splits them into three groups: group one (hybrid), group two (traditional), and group three (online only). The results, which were analysed via one-way analysis of variance (ANOVA) and Tukey's honest significant difference (HSD) post-hoc test, demonstrate a significant advantage in the increased level of awareness of students from the first group. This indicates that our mobile application in hybrid settings is significantly more effective in enhancing knowledge retention amongst students and raising their level of awareness of digital issues.

KEYWORDS

education, digital issue, learning, mobile application

1 INTRODUCTION

In this era of technological advancements and innovation, the use of digital technologies is continuously growing, particularly in the educational sector, which is constantly evolving as new technology becomes available [1], [2]. Consequently, the rise in digital issues such as cyberbullying, phishing, online fraud, hacking, identity theft,

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and so on, which is correlated with increased time spent on technological platforms [3], [4], presents a new and ongoing problem that must be addressed, as the persistence of these issues can lead to serious threats such as security breaches, financial losses, mental health issues, and even suicide [5]. Adolescents are also vulnerable to digital issues and their consequences across various platforms, such as social media and gaming environments [3], [6]. Therefore, digital literacy and raising awareness regarding these topics is integral to ensuring the safety of users across the globe [7].

1.1 Digital issues in KSA and the gap in research

The Kingdom of Saudi Arabia and its adolescents are no exception when it comes to these digital issues, as studies have shown that a staggering 31.5% of students in Riyadh [8] and 42.8% of adolescents in the Jazan region experienced cyberbullying, with direct links to consequences including but not limited to decreased academic performance, increased stress, and, in severe cases, thoughts of self-harm [9]. Furthermore, studies have shown that the majority of users (41%) who fall victim to phishing attacks and cyberattacks in KSA are students [10]. Consequently, schools and institutions must be proactive in educating students and raising awareness to avoid such issues [11]. The government has taken steps to tackle these issues by strengthening cybersecurity via a robust IT infrastructure and awareness campaigns through national eLearning centres aimed at safeguarding users by providing digital literacy as part of the VISION 2030. The accelerated shift towards e-learning in Saudi Arabia due to COVID-19 has undoubtedly increased the rates of digital literacy as a means of recognising and eliminating these threats, thus ensuring safety and security online [12]. Nevertheless, a unified program addressing digital issues targeting students of primary and middle schools in KSA does not yet exist. Teachers and parents cannot assess the level of digital literacy and awareness of digital issues amongst their students and children, respectively. Students of this age who are young and particularly susceptible to these attacks due to their lack of awareness, reduced understanding, and limited experience regarding online security, yet who spend increased time on digital devices, must receive adequate education and awareness to help them avoid these breaches [13], [14], along with attentive monitoring and assessment of their understanding of such issues.

1.2 Research proposal

This study proposes the use of a dedicated mobile application within a hybrid framework utilizing teacher guidance and lessons to educate primary and middle school students across Saudi Arabia on digital issues and to raise their awareness regarding the harms and consequences of such digital issues, thus improving digital literacy. Young people are the target audience of this study since they are the most vulnerable age group due to their increased usage of digital devices yet limited knowledge of digital issues. Research shows that cybercrime is growing amongst young people in Saudi Arabia, which makes them more prone to cyberattacks [15]. Consequently, there is a critical need for enhanced cybersecurity education and training programs in KSA [16]. Our research proposes a comprehensive learning experience through features within the application, such as pre- and post-tests, video and written lecture materials, progress monitoring by all parties, and so on. The contents of the application are in Arabic, to be consistent with the main learning medium in KSA. By employing a unified resource of information through a mobile

application, such as what this study recommends, along with receiving the guidance of educators, students can fully engage with the material, thereby enhancing their understanding of digital issues. On the other hand, educators can assess pre-test results and address specific areas of concern for students rather than approaching lessons with no targeted student knowledge planning beforehand. Thus, they can fulfil learning outcomes more effectively. Each student can receive a personalized learning experience based on feedback from their tests, thereby enjoying optimal results, as opposed to traditional learning environments. With increased awareness of digital issues, students will be better equipped to safely navigate the digital world, recognizing and avoiding digital dangers. The proposal of a hybrid teaching approach offers a modern approach to teaching and education regarding modern-day issues. This approach not only modernizes education but also provides students with critical life and work skills, thus preparing them for jobs requiring a high level of digital literacy [17]. The methodology section explores in further depth the reasons behind proposing a mobile application and the accompanying features for integrating it with teaching and learning curriculums regarding digital issues.

2 LITERATURE REVIEW

Digital issues are becoming more significant because their associated challenges and threats are becoming increasingly dangerous. These issues affect not only individuals and their privacy concerns but also societies and communities at large and people of all demographics, particularly adolescents. Therefore, it is crucial to incorporate digital issue awareness programs into school curricula and to find ways to measure students' awareness of these threats and potential intervention strategies. Unfortunately, schools lack the means to accurately assess students' understanding of digital risks and how to avoid them. This highlights the need for schools to take a more active role in spreading awareness of digital issues at an early age. On a broader scale, various platforms—such as the Cyberbullying Research Centre, which focuses on cyberbullying—aim to raise awareness and prevent digital issues. However, there is no platform that focuses on raising awareness or preventing digital issues in general. Nevertheless, during the last decade, many studies have covered digital issues such as sexual assault, cyberbullying, the dark web, phishing, fraud, identity theft, and digital privacy.

Perhaps one of the most important digital issues that cause various harms to society and individuals alike is sexual violence over the internet and its serious effects on adolescents and children in particular [18]. The diverse behaviours associated with online sexual violence present another challenge within the broader realm of digital issues, demanding significant efforts to fully understand its scope due to its complexity and various aspects. Some researchers [19] have divided it into five factors that can be summarized as follows: online sexual harassment, harassment based on gender and sexuality, electronic stalking, sexual exploitation based on images, and the use of digital technologies to facilitate sexual coercion or unwanted sexual experiences [20]. However, most studies focus on adults and sexual violence directed against them. The gap in the literature addressing the dimensions of this problem among adolescents and children highlights the importance of our research. This importance is reinforced by the fact that research has concluded that there is an urgent and increasing need to develop policies for, and spread public education among, adolescents and children, especially given that societal customs and cultures play a role in facilitating abuse and harassment via the internet [20]. Furthermore, digital photographs and explicit media are technology-facilitated sexual violence

(TFSV) tools that are being used in the digital world to control, harm, and threaten victims. The distortion and non-consensual sharing of these images provide an avenue for perpetrators to blackmail victims.

Another profitable scam in the digital world is phishing, which remains a problem for many people due to the evolving methods that its practitioners implement. There is no agreed-upon definition for phishing. However, [21] defines it as “a fraudulent activity that involves the creation of a replica of an existing web page to fool a user into submitting personal, financial, or password data.” Despite increased public awareness and advancements in browser security, phishing attacks remain prevalent and difficult for users to identify [22], [23].

Among the most extensively studied digital issues is cyberbullying, which has attracted the attention of researchers from technical, social, and psychological perspectives [24]. Numerous studies [25, 26, 48, 49, 50] have examined the impact of cyberbullying on adolescents and children, both inside and outside schools. [27] explored the relationship between involvement in cyberbullying and self-harm among adolescents. The study concluded that cyberbullying behaviour is complex, necessitating the development of an integrated strategy to prevent it, particularly during early adolescence. It emphasizes the importance of incorporating cyberbullying prevention into school mental health programs and educating adolescents on the safe use of social media.

One of the most powerful and untraceable mediums adopted by cybercriminals, terrorists, and state-sponsored actors is the dark web [28]. Its unpredictable nature, combined with its vast size and anonymity, makes it an appealing medium for criminals of all kinds. For the purpose of tackling cybercrimes, the dark web, a major barrier, must be thoroughly examined to uncover and eliminate the anonymity that attracts criminals. [29] investigates the link between the dark web and how it has boosted online anonymity and privacy. The study found that the dark web uses tools such as TOR and Onion Routing to create an anonymous identity that is not easily traceable. Limitations exist, but these tools remain the most effective way to hide a user’s identity. This makes the dark web a playground for illegal activities and a means for governments to undertake illicit activities unnoticed. Thus, there is a clear need for tight vigilance and up-to-date security measures, as tools are constantly being upgraded.

With the increased reliance on technology, society is pivoting towards a more digital lifestyle. The need for digital privacy is becoming crystal clear as cyber threats increase exponentially at an alarming rate. Studies have revealed the need for stronger privacy, security, and regulatory measures to ensure user safety in educational environments in order to raise awareness of privacy concerns among students and elementary school educators. Some studies [30], [31] have provided solutions to digital issues, such as cyberbullying, by emphasizing the importance of automated classification systems that detect cyberbullying on social media networks. These studies also focus on improving detection methods by enhancing data collection models and developing systems that account for the contextual and multimedia nature of online interactions. Additionally, they emphasize the significance of automated detection systems in mitigating the harmful effects of cyberbullying.

The authors [32] discuss the need for additional research in areas related to social justice that lack sufficient established research, particularly in the area of education. This study suggests concentrating on intellectual growth rather than a traditional literature review.

This study [33] discusses the utilization of bibliometric and science mapping techniques to analyse digital addictions and how they have evolved. The study mentions the main components and trends identified from 2018 to 2022, with a particular growing interest in respect to smartphone use and its relationship with education.

The research lacks meta-analysis and systematic reviews, which would provide extensive findings.

3 METHODOLOGY

The study implemented a qualitative and quantitative approach in two separate stages. The first stage focused on a qualitative approach by creating a mobile application to educate primary and middle school students on digital issues such as cyberbullying, identity theft, fraud, and so on, based on previous literature. The second part evaluated the effectiveness of the implementation of this application in a hybrid setting in raising awareness of digital issues amongst primary and middle school students through a quantitative approach, with the use of statistical tools such as one-way analysis of variance (ANOVA).

3.1 Mobile application

This study proposes using a mobile application along with traditional educational methods to raise awareness of digital issues within a hybrid framework due to its established positive influence on achieving learning outcomes [34] as well as the global gradual shift to digital learning since COVID-19 [35]. Furthermore, with a unified source of information, students can easily access and study topics. This will encourage them to use the application regularly and motivate them to complete the tasks on digital issues seamlessly. In addition, educators can monitor and identify areas of strength and areas of weakness in which students require additional support, both before and after class. This provides a flexible learning experience whereby each student can focus on their weak points at their own pace—a situation beneficial for addressing specific gaps in understanding digital issues, unlike in traditional classrooms, where teachers must balance the needs of all students. This flexibility, along with ease of use, increases engagement time and students' motivation to use the app for educational purposes [36].

The aim of this study is to provide a modern and relevant educational experience through the mobile application, utilizing the most recent technological methods in education to provide students with the necessary resources to improve their awareness of digital issues. Studies [37], [38] indicate that mobile learning can lead to positive educational outcomes, particularly in supporting short-term courses such as digital issues and providing students with the ability to review lecture materials at their convenience. The ability to revisit and replay important parts of lectures reinforces learning and ensures better retention of information, thus giving students more control and an active role in their learning and leading to improved learning outcomes [39], [40].

Although literature reviews show positive learning outcomes from the use of mobile apps [34], [41], there is still a gap in their use, often driven by individual motivation rather than institutional guidance. Therefore, this application aims to provide students with a guided approach and to assign tasks, thus optimizing students' use of the mobile application and helping them attain their maximum potential in understanding digital issues. Online learning is a subject of continuous research and development to achieve optimal results. Relative to in-person learning, online learning has been proven to be more effective in supporting students in attaining higher results and levels of satisfaction [42]. This is partly due to the organization and ease of access to the material stored in the system, as well as the speeding up of this development due to COVID-19.

3.2 Pre- and post-test

The proposed format involves providing a pre-test to assess students' level of awareness of digital issues before they read about the topic, as well as a post-test to determine their progress at the end. Receiving detailed feedback on the results of the students' pre-test is integral to providing a positive learning outcome [43] in digital issues and to increasing students' levels of engagement such that they interact more deeply with the material [44]. Feedback on these tests is essential for long-term retention because it allows students to identify their shortcomings and further educate themselves on the sub-sections by setting clear and defined benchmarks and because it provides teachers with the tools to tailor their educational methods based on students' knowledge gaps [45]. The positive outcomes of post-testing on learning outcomes are more prominent than those of pre-testing, though the presence of both has positive outcomes on students' overall performance on final exams [46], [47] as opposed to post-testing alone.

3.3 Research experiment

This study requested the participation of a middle school teacher in Saudi Arabia. The teacher was asked to gather 30 ninth-grade students to participate in the study. Participant and school details will not be disclosed for privacy reasons. The students were split equally into three groups to assess the effectiveness of implementing our mobile application in educational settings. Each group underwent a different type of teaching method with the aim of exploring the effectiveness of our proposed application integration in raising awareness of digital issues amongst students. To encourage voluntary participation, we offered a prize incentive. However, the true purpose of this class was not disclosed. This ensured that the experiment provided reliable results unaltered by participants' awareness of the study's true objectives. Because schools in KSA are segregated, the participants of this study, including the teacher, were male. The researchers decided that no more than one teacher should participate to ensure that it remained a dependent variable. This enabled the accurate measurement of the teaching method and ensured a more reliable set of results. Furthermore, while digital issues cover a wide range of topics, this study focused on cyberbullying due to its growing prevalence in KSA.

The first group experiment involves our proposed concept: Before the lesson, students access the mobile application to take a pre-test that assesses their awareness of digital issues. The educator addresses areas of weakness, allowing him to plan and educate students accordingly. Students then complete a post-test on the application that assesses their knowledge retention. Ultimately, this method integrates digital methods of teaching with offline traditional teaching, which this study believes is the optimal method for future learning and education in raising awareness of digital issues.

The second group follows a strictly traditional method of teaching whereby students complete a hard-copy pre-test and are then educated on the topic of cyberbullying. After class, they complete a post-test on paper. The purpose is to compare the results and determine if this method is the most effective one in raising students' awareness of digital issues.

The third and final group learns in an online-only education setting. Students take a pre-test on the application and then study the contents of the lesson through lecture materials—such as lecture videos, notes, etc.—provided on the application. This group then takes a post-test to determine their level of understanding of digital issues.

Each student from groups one and three is asked to bring a personal device to complete the course. The teacher provides students with a brief explanation of

the procedure of the upcoming class, which will educate them on cyberbullying, with the aim of raising their awareness of this digital issue. Students from groups one and three are provided with a basic overview of the use of the applications, as well as their respective usernames and passwords. Any issues with logging in to the application are addressed before the beginning of this timed experiment.

Each group is allocated 40 minutes for education, excluding the time for the pre- and post-test, which are ten minutes each, with 15 questions. This structure ensures that the experiment's total duration is one hour across all groups, thus maintaining timing consistency and avoiding bias related to time allocation. The results are a fair test and reliable findings. Although the pre- and post-tests contain the same 15 questions, they are randomized for each student. Each attempt to prevent recall bias, therefore, ensures that the results reflect the students' true understanding of the topic rather than their ability to recall questions and answers. The teacher is responsible for ensuring that the tests are taken under exam conditions, with no discussions or sharing of answers. The entirety of this experiment is conducted in a normal classroom setting. This studied experiment planning is intended to make the experiment as fair as possible and to ensure the reliability of the results.

3.4 Statistical analysis

To evaluate students' understanding of cyberbullying, the study gathers their pre-test and post-test results, out of 15, and analyses them. This study uses SPSS, a quantitative data analysis software, to perform statistical analysis via one-way ANOVA and Tukey's honest significant difference post-hoc test. This helps us identify if our mobile application in the proposed setting has the most significant effect on raising awareness of digital issues. Group one represents students involved in the hybrid teaching method, group two represents students involved in the traditional teaching method, and group three represents students involved in the independent online learning method. The findings of this analysis will be discussed in the results and discussion (Section 4.2).

3.5 One-way analysis of variance (ANOVA)

This study performs ANOVA testing to compare the significant difference between groups. Once the test values of all three groups are inserted into one column, and their respective group numbers are inserted into the second column, SPSS analyses the data. The software first provides the researcher with the sum of squares between groups (SSBG) and the sum of squares within groups (SSWG). A high SSBG score indicates that the dependent variable, which in our case is the teaching method, has a significant effect on outcomes. In contrast, a low score means that the teaching methods do not have a significant effect on outcomes. On the other hand, the SSWG assesses the performances of students amongst each other within each group, as opposed to comparing groups collectively. The higher the score, the greater the difference between the performance of these students. Overall, if the SSBG is greater than the SSWG, then the teaching method (dependent variable) plays a significant role in the outcomes of the post-test results. Meanwhile, if the opposite is true, then other factors affect the outcome of the post-test results. These factors would require further testing to identify. The mean square between groups (MSBG) and within groups (MSWG) provide us with the average difference between the group means per degree of freedom. In addition, the F value determines if there is a significant difference between group means, with a value greater than one indicating a significant

difference in group means and, therefore, a difference in the teaching methods' effect on the learning outcomes. Finally, the significant difference (p) value determines the likelihood that the F value occurred randomly. A value less than 0.05 is considered significant, therefore supporting the findings of the F value that teaching methods play a significant role in learning outcomes.

3.6 Post-hoc test

This study uses Tukey's HSD post-hoc test to compare each group and demonstrate, through the significance difference, which group causes the significant difference that the first step identified. It does this by comparing each group individually, as opposed to collectively, as in a one-way ANOVA. Therefore, it pinpoints the teaching method that has a significant difference in post-test results. Furthermore, it ensures that the findings are not victims of type I errors, known as false positives, thereby ensuring further reliability of our findings and controlling the rate of error.

This post-hoc test provides us with the mean difference, which represents the difference between the average of the post-tests of each group, thus, participants' understanding of cyberbullying as a digital issue. The lower the value of the standard error relative to the mean difference, the more reliable the findings are. The significant difference in this test will help us identify the teaching method that has the most positive impact on learning outcomes. Figure 1 displays the methodology of the research experiment.

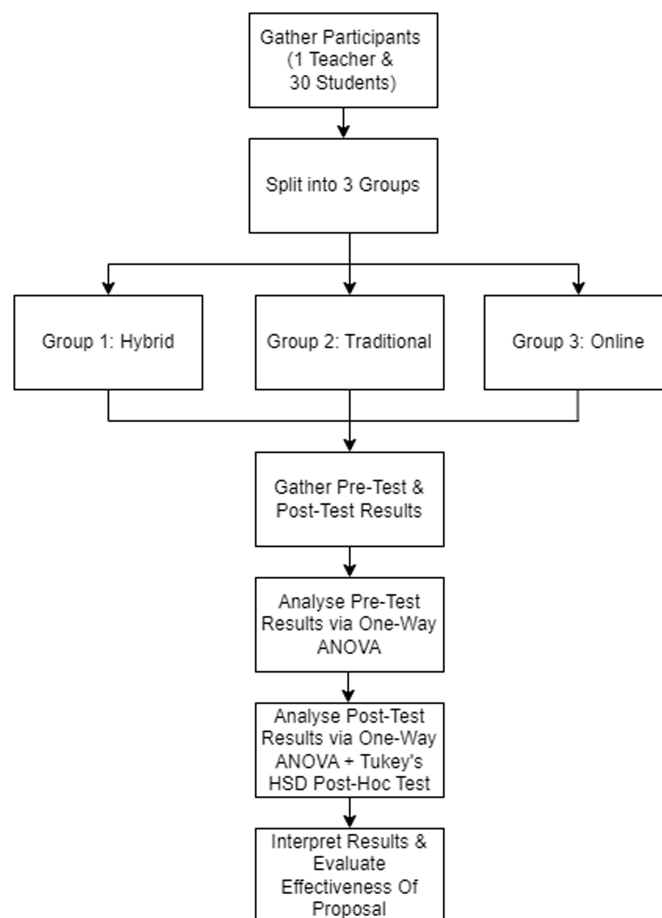


Fig. 1. Research experiment methodology

4 RESULTS AND DISCUSSION

4.1 Application

This study sought to create an Arabic mobile application for use in a hybrid teaching setting to educate and raise students' awareness of digital issues as a unified source of information. The research focused on including elements that would prove integral, including a pre-test, a post-test, lecture videos and notes, test reviews, and so on. The pre- and post-tests used to measure students' awareness of the studied topic related to digital issues are integral to short-term and long-term lesson planning and assessment of students' level of awareness of digital issues. Moreover, these results are compiled into a single application, which makes it valuable data for research purposes and can be utilized by education leaders such as ministers to further investigate and address challenges related to digital literacy. Furthermore, given the long-term benefits of progress monitoring, institutes and schools can understand which topics students at different stages have faced difficulties in understanding over the years. This will allow for modifying their approach to teaching or allocating more time to prepare for lessons. In addition, educators can assign tailored tasks on the mobile application to students who are not at the required level. This will help raise students' level of understanding of this topic. Without our mobile application, educators will find it difficult to track students' progress on digital issues through various topics and years. The incorporation of lecture materials, concise topic notes, and other relevant material into this mobile application allows students to revisit and retain essential information on digital issues at any time, even after the completion of their course. This approach ensures that students maintain and develop their knowledge of digital issues, which are continuously evolving and require ongoing review. By providing a unified source of information, this mobile application delivers all the necessary tools to educate students and raise their awareness of various digital issues. It also offers tools that educators and relevant parties can use to ensure the fulfilment of this goal while utilizing the results of student progression tests in understanding digital issues for long-term development and growth in this area.

The various stages on the mobile application regarding the pre-test include firstly taking the test, which consists of 15 questions. The student can then see their score, with the option to review the test, provide personal feedback, or advance to the next section, which would be the topic content. Our proposal states that after the pre-test, the teacher will assess student scores and areas of knowledge to efficiently plan lessons. During and before the lesson, students can refer to the course content to boost their understanding and revise key points. After the lesson, students complete the post-test on the application to demonstrate their level of knowledge retention. Once again, the user can review their test or provide feedback on the topic. Furthermore, teachers are also able to directly monitor each student and their relative progress on each of their tests. This can also be viewed by students and parents, as it displays the pre- and post-test results, review, and any written feedback that the user has provided.

Ultimately, this study focused on providing a user-friendly interface for its comprehensive digital learning platform and ensured that the platform would be easy to use whilst not overloading pages with unnecessary options and information. This design method facilitates easy access for users and motivates them to use the application for educational purposes. Furthermore, the chronological format of the lessons

ensures that students follow a certain pathway that guides their learning, ensuring that students achieve their learning outcomes effectively, thus boosting their understanding of digital issues. The application reinforces our hybrid model, as students are encouraged to engage with it before and after class, providing flexibility as it is supported in various environments. This approach supports research findings that emphasize the importance of hybrid learning to enhance engagement and knowledge retention. In addition, it involves a teacher-instructed learning approach via the integration of its various elements in lesson planning and approach. The initiation of an Arabic application, as opposed to an English application, is a key means of attaining optimal results in student learning outcomes, unimpeded by a language barrier that can easily be overcome.

4.2 Experiment

Our study proposed the integration of traditional and modern learning techniques to study and raise awareness of digital issues. To discover the effectiveness of this proposal, we evaluated this method of study against two other methods: traditional learning and online learning. We sought to determine if our approach via the use of the mobile application is most effective in achieving the desired results, i.e., raising awareness of digital issues amongst students. Thirty students were equally split into three groups. Each student completed a pre- and a post-test before and after their learning experiences, respectively. The purpose behind gathering the results of the pre-test and analysing it from an experimental perspective was to ensure that all students were on equal footing and that the results of the post-test were not built upon prior knowledge rather than knowledge gained during the learning experience. Furthermore, the pre-test served multiple practical purposes. In addition to providing students with an idea of what to expect in their upcoming class, it provided the teacher with students' areas of strength and weakness. Thus, the teacher could plan classes in a manner that enabled the easy achievement of learning outcomes based on raising awareness of digital issues.

First, the study analysed the pre-test results via a one-way ANOVA test on SPSS to determine if there was a significant difference between the group results before students began their assigned learning experiences. The results showed a p-value of 0.874, which is considerably more than 0.05, indicating no significant difference between students' scores. As a result, the groups were on the same level of knowledge before they began the second step of the experiment. This demonstrates that the post-test results would not be affected by a knowledge gap between students prior to the experiment. Importantly, the pre-test results representing the level of awareness of digital issues amongst these students before the experiment support previous research indicating that adolescents in KSA suffer from digital issues more than any other age group. Their awareness is notably low, as demonstrated by the group's average score (15.8%), which falls well below the desired standard. This reinforces the contribution of this study to raising awareness of digital issues amongst primary and middle school students in Saudi Arabia through a mobile application. The results of the pre-test and post-test are displayed in Table 1, which reveals a more significant increase in awareness of digital issues amongst participants of group one. This reinforces our mobile application and data to support its role in significantly raising students' awareness of digital issues.

Table 1. Pre- and post-test results

Group 1		Group 2		Group 3	
Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
3	13	3	11	1	10
3	13	4	13	5	13
5	14	1	8	4	11
4	14	2	8	1	8
1	14	2	11	1	10
3	12	3	10	2	10
1	12	2	9	3	11
2	12	1	8	0	9
1	12	3	9	2	8
2	14	3	8	3	12
2.5	13.0	2.4	9.5	2.2	10.2

The post-test results serve experimental purposes; the measurement and comparison of the level of awareness of digital issues after the lesson between each group helps clarify the effectiveness of our mobile application relative to the other two groups. In practice, post-test results indicating students' awareness of digital issues provide educators with insight into students' performance, thereby allowing for the implementation of additional support techniques that ensure students are at the required level of awareness regarding their studied digital issues topic.

Post-test results representing students' awareness of digital issues were also inserted into SPSS separately and analysed via one-way ANOVA. The results (refer to Table 2) show that the SSBG (68.60) is greater than the SSWG (58.10), indicating that the independent factor (teaching method) is what causes the difference in the groups' results. This is also supported by a p-value of 0.000, which indicates a clear significant difference between the post-test results of the groups, and by a high F-value (15.94). These results show that the difference in teaching methods, with or without the use of the mobile application between the groups, caused the difference in levels of awareness of digital issues and influenced student learning outcomes based on the post-test results. To further identify the details of this difference, the study performs Tukey's HSD post-hoc test.

Table 2. One-way ANOVA post-test results

	Sum of Squares	Degrees of Freedom	Mean Square	F	Significant Difference (p)
Between Groups	68.60	2	34.30	15.94	0.000
Within Groups	58.10	27	2.15		

The results of Tukey's HSD post-hoc test (refer to Table 3) compare each group together. The mean difference between groups one and two is 3.50, which is the largest mean difference between any two groups. The mean difference between groups one and three is 2.80, while the mean difference between groups two and three is -0.70, indicating that the mean score of groups three is greater than that of group two by 0.70. These results clearly indicate that students in group one attained higher scores

than students in the other groups. This demonstrates the superiority of our mobile application in a hybrid setting when it comes to raising awareness of digital issues due to the higher information retention that these students attained, as displayed by the post-test results. Furthermore, the p-value scores between group one and groups two and three are 0.000 and 0.001, respectively. Thus, there is a significant difference between these groups. The p-value between groups two and three is 0.542, indicating no significant difference. These scores suggest that the teaching method that this study proposes, undergone by group one, is the most beneficial, as a significant difference was found in the awareness of digital issues amongst group one students after the class, while no significant difference (0.542) was found between the levels of awareness of digital issues amongst group two and group three students. This is further supported by the confidence intervals between group one and groups two and three, which were between 1.863 and 5.127 and between 1.173 and 4.427, respectively. These findings indicate that the integration of our mobile application with traditional methods is the best way of raising awareness of digital issues amongst students, as relying on traditional methods alone or online methods alone will not yield optimal results. These findings are consistent with the previous literature, which found that a hybrid teaching method integrating traditional and modern means of learning yields the best results and leads to more effective achievement of learning outcomes.

Table 3. Tukey HSD post-hoc test for post-test results

Group		Mean Difference	Standard Error	Significant Difference (p)	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	3.50	0.656	0.000	1.873	5.127
	3	2.80		0.001	1.173	4.427
2	3	-0.70		0.542	-2.327	0.927

5 CONCLUSION

Against the background of previous studies, this study proposes an Arabic mobile application for primary and middle school students in Saudi Arabia to educate them and raise their awareness of digital issues while involving the teacher in face-to-face teaching. This study believes that, through the integration of traditional and modern learning techniques, students can much more efficiently achieve learning outcomes related to digital issues. The addition of pre-tests allows teachers to determine students' level of awareness of digital issues before classes begin, thus facilitating a planned learning scheme for the lesson whilst also serving as a data set with which to assess the general level of awareness of digital issues amongst different age groups over the years. Furthermore, the inclusion of post-tests allows all parties to monitor and assess students' progress during the digital issues course. The application provides lecture videos and material to support students and gives them the option of recapping on their own time, without having to rely on their class notes, which might be incomplete or missing vital information, thus limiting their progress in digital literacy. The purpose of using a mobile application as a unified source of information for raising awareness of digital issues is its established positive effect on learning outcomes, flexibility, ease of use, accessibility, and so on.

This study aims to investigate the effectiveness of this mobile application in its proposed learning environment in comparison to traditional learning and online

learning by forming three groups of ten students who will learn about a common digital issue (cyberbullying) under the supervision of one teacher. The comparison is based on the post-test results, which reflect students' understanding and level of awareness of digital issues after the topic is taught. The findings are analysed via one-way ANOVA testing, as well as Tukey's post-hoc test, to identify where the significant difference lies. Our post-test findings show that students involved in our proposed method retained more information effectively and achieved higher levels of awareness of digital issues than those of the other two groups. The use of this approach to educate and raise awareness regarding digital issues and filling the gap in digital literacy will yield satisfying results. It will protect young citizens of KSA from digital issues and tackle threats before they arise, as well as help students adapt to the ongoing transition of this world into a digital one, making them more qualified for future jobs.

The results of this study and this application were tailored to raise awareness of digital issues amongst primary and middle school students. Its findings cannot be measured across different areas of teaching, such as math or physics, without further research. Furthermore, pre-tests could be assigned before students arrive at the lesson. Thus, teachers will have time to analyse the pre-test results and plan their lessons based on students' areas of strength and weakness. Teachers can then dedicate the saved time to educating these students, thereby promoting efficiency. Teachers and students, as well as guardians, can monitor students' progress on this application. Given the mobile application's flexibility, ease of use, and accessibility, this study proposes it as a hybrid method to raise awareness of digital issues.

Ultimately, this study recommends that the proposed mobile application, as well as its proposed method of use through hybrid learning, be used across KSA in all primary and middle schools to educate students on digital issues and threats. Our research highlights how digital tools can be integrated into educational settings to raise awareness of digital issues. Thus, it provides a roadmap for future initiatives in similar contexts. However, this study is open to suggestions regarding the development of this teaching method through its application or through teacher and student guidance to extract the highest benefits.

6 FUTURE RESEARCH AND LIMITATIONS

The participants of this study are all male. Therefore, the results are not representative of the entire population. Females and students from different age groups and schools should also be tested to cement the findings of this study. In addition, different subjects of study should be researched to identify if these findings extend to all areas of teaching. This study was short-term and, thus, unable to explore the long-term effects of this study method. This study focuses on KSA, and further research needs to be done in other countries and regions to enhance the applicability of the results.

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