Assessing the Need for a Fingerprint Payment System in Schools a Mixed-Method Analysis of Parent and Teacher Perceptions in South Malaysia

Muhammad Afandi bin Azmi, Muhammad Khair bin Noordin

University Technology Malaysia

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ABSTRACT

This study looks at the current need for fingerprint payment system in schools to intensify safety, promote smooth financial management, as well as curb the risk of fraud. In the beginning of the research, 300 parents and teachers in South Malaysia were the main respondents to gathering data using a mixed method which involved both surveys and semi-structured interviews. The use of the system was rated favourably in the quantitative part which translated to... The paper goes on to give some data which shows the high satisfaction with the system's ease of use (M = 4.25, SD = 0.75) and thus, its viability for the parents so that they can track and control the student's spending (M = 4.40, SD = 0.55). Nonetheless, there were such matters as accessibility for disabled children (M = 3.80, SD = 0.90) and data privacy (M = 3.85, SD = 0.80) that were brought out. The qualitative part echoes these results, with the respondents admiring the system as they saw it as a way of decreasing the use of cash, thereby, increasing the safety of the transactions, yet others were concerned about privacy and the threat to students' accessibility. Fraud prevention was also an advantage, with both the quantitative and qualitative parts endorsing the function of the system, thus minimizing the possibility of unauthorized transactions. Following that, some respondents raised alarms... The outcome of the research implies that the fingerprint payment system has many advantages in the management and security of schools, although the vulnerable points like accessibility, privacy and the detection of fraud must be solved. Improvements in these areas would make the system a handy instrument for schools looking to revolutionize payment systems.

Keywords: Fingerprint Payment System, Biometric Authentication, Financial Management in Schools, Fraud Prevention, Data Privacy and Accessibility

INTRODUCTION

The use of biometric systems, especially fingerprint recognition technology, has noticeably increased in modern methods of payment due to its safety, ease, and quickness. These systems are being utilized in various sectors ranging from mobile payments, banking, and educational institutions. At the same time, technological advances have permitted the use of secure biometric payment systems that facilitate fast, reliable, and user-friendly transactions. With the ascendancy in digital payment methods, schools are driven towards adopting these technologies to manage student payments in a more secure and efficient manner by allowing cashless transactions (Dommaraju et al., 2023). In schools, especially in locations like South Malaysia, the traditional payment systems still have problems such as the loss of money in the form of cash or the fact that children's spending amount cannot be regulated by the parents. The parents can take it a step further and introduce a level of granulation that the biometric keys offer to parents, the gift card idea, where the parents can just top up a certain amount of money on a card, so this increases the security of transactions. The implementation of such a model not only strengthens transaction security but also facilitates the parents to top-up student accounts and define the daily spending limit, thus making it easier for them to manage the students' allowances and control the expenses incurred (Kathirvel et al., 2022). On the other hand, the emergence of these systems in

schools asks for explanations about the necessity, the prospective benefits, and the oppositions. Possible challenges include data privacy, accessibility, and the experience of the user community. They are the most significant issues demanding attention before adapting to such technologies on a large scale (Rakasiwi & Kusumo, 2021). This work, therefore, intends to evaluate the necessity to begin a fingerprint payment system in schools, writing by means of the combined techniques, and collecting the opinion of parents and teachers. In this investigation, will further investigate the preparedness of the educational community in the South of Malaysia to introduce such a system and seek to find out if the advantages of the technology would outweigh the potential risk concerning data safety issues and access barriers.

LITERATURE REVIEW

Nowadays, various biometric systems are in use for identification and payment processes such as fingerprint-based systems which have become popular due to their security and convenience. Payment systems that use the fingerprint biometric technology have become a common method in many environments that are secure and do not tolerate transaction problems. The great thing is this project have a few experiments and research done, which argues that the fingerprint is the most secure payment method by this process because no one can steal it. It is the process of making a payment by fingerprint recognition which takes the lead in the research on payment innovation (Dommaraju et al., 2023; Nilsson, 2021).

In the case of academic institutions, biometrics are one of the most effective options for the payment management of students. (Rakasiwi & Kusumo, 2021) have found that the adoption of fingerprints with RFID-based payment is efficient and the school fee can be paid in minutes by these technologies and there will be errors in their transactions. On the other hand, (Kathirvel et al., 2022) have shown that the usage of the biometric technology for payments is a substitute for the physical things such as cash, cards, and mobile phones, thus reducing the possibility of theft or loss. When used in tandem with a secondary factor such as liveness detection, biometric payment systems are tried and tested security features of the utmost importance. According to (Sandouka et al., 2021), the use of generative adversarial networks (GANs) and other advanced technologies to spot and report fraudulent activities was one of the methods they employed in a study of the system's security. Similarly, (Chang et al., 2022) included within fingerprint-based payment systems a security layer called anti-spoofing to provide an extra level of protection against unauthorized access. Biometric security systems have been developed to increase safety, speed the time of the transaction, and facilitate the use of e-commerce. As such, the results of the studies of biometric smartcards and scanning of fingerprints show that the transaction is drastically lower than traditional payment methods (Poe, 2021) which results in a real-time verification at POS.

Again, potential vulnerabilities are pointed out in the literature. (Nilsson, 2021) gave more importance to the security of contactless biometric systems in the face of possible vulnerabilities, especially when systems are used in public settings like schools where users may be less familiar with advanced security measures. Additionally, studies such as the one by (Singh et al., 2021) draw attention to the fact that biometric systems with double recognition methods (fingerprint and facial recognition) are equally important for security enhancement and concurrent minimization of the dependence on a single biometric factor. In conclusion, fingerprint-based biometric systems are recommended for financial management in learning institutions - they are secure and convenient for all the stakeholders involved while at the same time saving time and saving by making all processes efficient. The same way we always check if is the person we think is the one logging to the system as well as that we do face recognition technology currently in all the machines that are performing the duties, machines that have the technology are able to check whether there is a real alive being or not. But besides these technologies, companies that implement such systems should also consider the presence of additional security measures alongside them.

OBJECTIVE

1. To evaluate the accessibility, security, and overall usability of the fingerprint payment system in a school environment, and assess its compatibility with existing infrastructure.

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2. To assess the impact of the fingerprint payment system on improving financial management for parents and schools by allowing better control of student expenditures and streamlining school payment tracking.
3. To investigate the system's effectiveness in minimizing fraud, unauthorized transactions, and theft in school payment processes through biometric authentication.

METHODOLOGY

The methodology section is the segment that shows that the research design was the one which is used to find the efficiency of the fingerprint payment system in schools, for instance, the used for data collection. The methods of selection of participants and the processes for the collection of data are the items that are detailed. This section is specially made to explain the tools and surveys which necessitated the assessment of system accessibility, security, and usability, in addition to that financial management and fraud prevention. Moreover, it shows the data analysis methods that were employed to come to conclusions and show the data collected perceived completely by the system in both modes and point of views of its students and teachers. Consequently, the presented data can be analysed as to how the potential diffraction patterns influence the school's payment processing.

Research Design

The research focuses on the effectiveness of fingerprint payment systems through a mixed-method research design which tries to provide broad and comprehensive information. A mixed-method approach is best suited to this problem due to the necessary exploration of various issues. These issues include system accessibility, security, and usability, financial management and fraud prevention, which are implemented through both qualitative and quantitative data. As stated by (Creswell, 2018), mixed-method designs enable the collection of a range of qualitative and quantitative data types such that it can be used to address several aspects of the problem at hand more effectively. The outline will require the researcher to collect the numerical data from the respondents through the use of questionnaires to measure the user reviews and likewise, the qualitative data will be collected via interviews or focus groups to go deeper on the usability and the concerns of the QR code payment system. This way the research can be detailed and the links between the variables can be made more obvious, which in turn, lead to a convincing argument in Favor of this payment solution for campuses.

Research Instruments

The study uses two major instruments to gather data: surveys and semi-structured interviews. These methods are picked to measure both quantitative and qualitative data, giving a detailed and clear picture of how effective and acceptable the fingerprint payment system is.

Survey

A survey is a structured tool which is used to collect numerical data from the respondents, with the main purpose of analysing the accessibility, security, user-friendliness, and effectiveness of the fingerprint payment system. The survey will be constructed using a Likert scale which will be applied by the respondents to evaluate the convenience of the system, the dependence of them to its security features, and how it manages financial management. This instrument will help us find out the holistic reaction and attitudes of users on the adoption of the mentioned system.

Semi-Structured Interviews

The survey will be complemented by semi-structured interviews that will be given by a specific group of participants. This instrument is prepared for examining internal perspectives and collecting qualitative data on the respondents' issues, suggestions and expectations about the system. The semi-structured layout being used here is such that the interviewer is given freedom to add queries for ideas that crop up or change the path for

some areas along with his questions about system usability, security fears, and its potential to improve financial control.

Population and Sampling

The parents and teachers of particular schools under South Malaysia are the people that would be either users or overseers of the biometric payment system consequently. A purposive sampling technique will be used to make certain that those participants are directly involved with the system. They would be the ones who can offer relevant and meaningful data. A total of 300 respondents that include both parents and teachers will be selected. The reason for preferring this sample size is to obtain diverse viewpoints and a trustworthy representation of the population. The sampling methodology has been prepared in such a way that the data have been collected both in quantitative and qualitative forms. It is done from those people who are also involved in the financial administration and data security of the payment process in the school.

Data Analysis Methodology

In this research, the analysts will use Statistical Package for the Social Sciences (SPSS) software - the software which is specific for analysing different kinds of data production. SPSS is going to be responsible for the informative outputs of the required descriptive statistics in terms of means, frequencies, and standard deviations. The results will be presented diagrammatically for a clearer understanding of the participants' responses regarding the usability of the fingerprint payment system, its safety, and its possibilities for making financial management easier. In addition, the inferential statistical methods, for example, correlation and regression analysis, will be utilized in order to reveal the connections being significant among variables like perceived ease of use and the satisfaction with the system as a whole. The said methods will be indicative of how much the system is accepted by the users as well as the fraud-detection capacity of the system will be dependent. Through these, it will be established whether the system will become more effective in the financial sector.

For the qualitative data gained through the semi-structured interviews, NVivo software will be used to carry out a thematic analysis. NVivo is created to help in managing and encoding a large amount of text data with the aim of making it easier to spot the recurrences of themes and patterns that are in the interview transcripts. Thematic coding is the most suitable method for the easy identification of the complex insights related to participants' concerns, suggestions, and personal experiences with the fingerprint payment system. This kind of qualitative approach will allow the deep understanding of the respondents' attitudes to system’s accessibility, security, and usability, as it will be the descriptive part of the findings that will bring the real voices of the users. Besides, in this way, the analysis aims at in-depth, richly-detailed narratives that highlight user experiences and expectations.

FINDINGS AND DISCUSSIONS

Quantitative Findings

The data collected for this project shows the most important aspects of the fingerprint-based payment system, namely, the user's satisfaction with it, safety, accessibility and the judicious fiscal management it entails. In the forthcoming part of the documentation, bellow will find a detailed interpretation of each specific table offering the in-depth view of the respondents' attitudes and engagement levels.

Table 1: Detailed Accessibility, Security, and Usability

Variable	Mean	Standard Deviation (SD)
Ease of use of the fingerprint payment system	4.25	0.75
Perceived security of transactions	4.10	0.65
Accessibility for all students, including those with disabilities	3.80	0.90

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Speed of transaction processing	4.30	0.60
Reliability of the system (system downtime)	4.00	0.85
Satisfaction with the daily spending limit feature	4.15	0.70
User-friendliness of the interface	4.50	0.55
Perceived need for technical support	3.90	0.95
Convenience compared to traditional cash payments	4.60	0.50
Privacy of personal data	3.85	0.80

Base on, according to the table 1, the mean score of 4.25 for "Ease of use," indicates that the respondents enjoyed using the fingerprint payment system. However, the issues of deployment did not receive a high rating from all students, such as those with disabilities. The item was given a mean score of only 3.80 and the high standard deviation (0.90) can be translated to (1) the variability in the answers and (2) the concerns some of the respondents expressed relating to inclusivity. The speed of transaction processing got an almost perfect rating (M = 4.30, SD = 0.60), which is one of the highest efficient systems in the market. Still, reliability (M = 4.00, SD = 0.85) and protection of personal data (M = 3.85, SD = 0.80) received a lower grade, which means that issues with data security and system downtimes may need to be addressed in the near future. Taking into account the encode that the system received for being user-friendly (M = 4.50, SD = 0.55), it should be said that the majority of the users found the website to be user-friendly and thus, wouldn't have any trouble navigating it. Considering the lower score for technical support requirements (M = 3.90, SD = 0.95), it is also possible that, while the system is typically easy to use, it may still be associated with technical difficulties for some of the users, as can be inferred from the more likely ambiguous answers.

Table 2: Detailed Financial Management and Fraud Prevention

Variable	**Mean**	**Standard Deviation (SD)**
Helps parents track and control daily expenditures	4.40	0.55
Reduces the risk of unauthorized transactions	4.20	0.60
Improves school management of student payments	4.30	0.70
Allows parents to set daily spending limits	4.45	0.50
Provides clear spending records for parents	4.35	0.65
Prevents misuse of student funds	4.25	0.80
Helps schools monitor payment compliance	4.50	0.45
Improves transparency in financial transactions	4.10	0.75
Encourages responsible spending among students	4.05	0.90
Increases security of student payments	4.55	0.60

Base on table 2, the financial management and fraud prevention perspectives indicate a clear affirmation of the usefulness of the system. According to the survey results, student's parents found the system useful in tracking and controlling daily spending (M = 4.40, SD = 0.55) and limiting the chances of unauthorized transactions (M = 4.20, SD = 0.60). That is to say, the system is one of the totals; which was viewed by the parents as a good quality tool for taxing, which is critical in receiving the parental OK. Furthermore, the function of parents to adjust daily expenses using the system (M = 4.45, SD = 0.50) and providing them with a clear spending record (M = 4.35, SD = 0.65) was the main reason for comparing them with the other tools, as budgeting and financial management were the parts to which such a mechanism showed the high scores. The fruition of the request, which school receive for ensuring the compliance of payment, long with high grade % (M = 4.50, SD = 0.45, respectively), amplifies the previous argument that the tool is also beneficial for the school administrator and by implication it also confirms the instrument potential of shortening the process pertained through payment. The feature whose mean score was higher than the others, raising the security of student payments (M = 4.55, SD = 0.60), highlights the fact that the system is considered very effective in preventing fraud and unauthorized transactions. Nevertheless, a nearly lesser average score for the item-

encouraging responsible spending by students (M = 4.05, SD = 0.90)-would argue that while the tool is capable of restricting spending, particular reactions by students may vary, as implied by a larger standard deviation. In general, the outcomes of the study have shown that the biometric payment system is more than a convenient implement with better financial management and safer learning transactions. One of the main strengths of the new system is the strong backing it receives from parents and school staff. However, certain areas, such as data privacy, and accessibility, might need further improvement to counter the existing concerns.

Qualitative Findings

The qualitative data through semi-structured interviews was collected which was analysed using the theme analysis method to explore the main issues and sub-issues of the landscape, which are its security, accessibility, financial control, and fraud prevention. The big themes, sub-themes, and summarized points mentioned by the respondents can be seen from the table below.

Table 3: Qualitative Findings

Points	**Sub-Themes**	**Themes**
"The system is easy to use, but older parents struggled with the setup."	Usability across different age groups	Accessibility and Usability
"It's quick, but some children with disabilities found it hard to use."	Usability for students with disabilities	Accessibility and Usability
"It reduces the need for students to carry money, which is great for safety."	Perceived safety for students	Security
"I'm concerned about my child's data being stored. Who has access to it?"	Privacy concerns over biometric data	Security
"Parents need to know where and how their kids spend money."	Parental control over student spending	Financial Management
"It helps me manage my child's budget for the week."	Budgeting tools for parents	Financial Management
"It gives a clear record of what has been spent, which is useful for parents."	Transparent spending records	Financial Management
"If someone uses my child's fingerprint, I don't know how we'll stop it."	Concerns over potential unauthorized use	Fraud Prevention
"We need to know the system can't be tricked or hacked."	Preventing system misuse	Fraud Prevention
"This system seems fairer than cash, especially for kids from different backgrounds."	Fairness in financial management among students	Inclusivity and Fairness
"Not everyone has access to this kind of technology at home."	Technological accessibility	Inclusivity and Fairness
"Some parents are worried about how long data will be stored."	Duration and control over data storage	Data Privacy and Security
"The system should notify us when there's a failed transaction."	Notification of system errors or fraud attempts	Fraud Prevention

Out of the qualitative information from table 3, five major themes appeared, each of them providing illuminations concerning how parents and teachers actually see the fingerprint payment system in its practical, security, and financial management.

Accessibility and Usability

Most of the participants emphasized the notion that the system is straightforward in general, but they still have the problem of accessibility, especially in the case of older parents and students who have disabilities. Possible

issues like the arrangement and UIs were the specific areas that caused difficulties for some so it was consistent with the results of the quantitative study showing that accessibility is lower (M = 3.80, SD = 0.90). In the light of these results, the overall conclusion is that the system is not easily used only by some people and further, the identified enhancement is to develop it to be more inclusive particularly to the people who have some prerequisites.

Security

The theme of security was the main issue handled security not only in terms of physical safety but also privacy of data. Parents admired the fact that the system was reducing the need to carry money which makes it safer. At the same time, privacy issues were raised where who are the ones having access to student's biometric data and how securely is it stored were the most worrying ones. This coincides with worries about data security on an example scaled of 1-5 (M = 3.85, SD = 0.80) which reiterates necessity of clear communication when it comes to data safety measures in the business and provides the basis for calm user suspicions.

Financial Management

The capability of a system to monitor spending and set spending limits was often appreciated by parents. According to the interviewees, the system's regulation of spending and setting of spending limits were important in sticking to the set budget, which was beneficial in managing their kids. This relates to the statistical results where parents reported the highest average grade for the system's ability to monitor expenditures (M = 4.40, SD = 0.55) and to clarify records (M = 4.35, SD = 0.65). According to these findings, the technology is a networking system, which is very useful in various dimensions such as financial management. It is achieved by reporting, which is provided by software in control, so parents are informed and combination of software with hardware to provide control to the parents which has proven effective.

Fraud Prevention

Preventing fraud was the main concern that emerged. While most of the respondents trusted the secure biometric system, the rest were unsure about the system's response to break-ins, such as fingerprint forgery or hacking. The concern is in line with the quantitative findings showing that in the evaluation of fraud prevention (M = 4.20, SD = 0.60) it was rated as positive but still there are shortcomings. Failure notification in case of failed transactions or the appearance of any suspicious activity and the request for more functional fraud monitoring features were made by the participants, the latter of the above-mentioned being an indicator of active fraud monitoring features that they request.

Inclusivity and Fairness

There were opinions on the machine that it might be justly the best way to bring fairness among students by avoiding the cash that often tends to be a focus differentiating the students from the different social strata. On the other hand, it was found that the lack of technologically accessibility referred to as well, since the parents who cannot get the technology to run such a system did not remain on the margins. It appears that the two are interwoven: while the system can be just in one way, it has to also ensure that all families have the same situation and have the available equipment or tools to use.

DISCUSSIONS

Biometric payment systems go well with many different aspects in school systems, be it on the qualitative or quantitative ground. This topic raises both concerns and advantages that are consistent with the earlier researches. The findings of the survey revealed that a very high number of people are satisfied with the fingerprint system's flow of execution (M = 4.25, SD = 0.75), the consent of most interviewees to the system's user-friendliness. However, the interview results have shown that elder parents and students with disabilities might be going through the problems with this system. This is mirrored by the relatively lower score for

accessibility (M = 3.80, SD = 0.90). This study has followed existing knowledge that employs of biometric systems, although effective, they are still in need of being more inclusive for marginalized user groups, especially for those with disabilities (Hernandez-de-Menendez et al., 2021). Thus, increasing the system design to be more accessible is the prime area of the development of technology.

Regarding the security aspect, it is another main concern. The results of the survey show a good perception of the system's security (M = 4.10, SD = 0.65). However, the qualitative answers point out the fact that there are significant concerns about the biodata privacy, especially the storage and availability of students' biometric information. It is a pattern that has been observed in the past for biometric technologies, which are always in the privacy spotlight (Mróz-Gorgoń et al., 2022). Biometric payment systems that not only exhibit higher security for transactions but also solve transparency and security issues in stored biometric data can eventually be well-perceived by the claimed people. The demand for stricter data protection measures in biometric technologies is a well-acknowledged one, which is shared by other sectors like education (Kathirvel et al., 2022).

The tool's ability to enhance financial management for both parents and schools was highly rated in the quantitative survey (M = 4.40, SD = 0.55 for tracking daily expenditures and M = 4.35, SD = 0.65 for providing clear spending records). In qualitative form, likes from the respondents, parents mostly, were often expressing joy for the newly installed application that allowed them to predefine some spending limits and supervise their children's transactions. These results are in agreement with other findings that are reporting the affirmative results of such technologies like biometric. The biometric system is the well-known factor that provides all the personal benefits for the school management team and the parents who are involved in the process. These are main points that must exist in a school system. When it comes to fraud prevention, the analysis was given a top rating for its potential to decrease the risk of unauthorized transactions (M = 4.20, SD = 0.60). However, some of the subjects were in two minds over potential abuses with particular reference to fingerprint spoofing or hack attempts. This was both reflected in qualitative interviews. While fraud vulnerabilities are the least cited issue and fraud vulnerabilities are seldom found in biometric payment systems globally (Dommaraju et al., 2023), roughly 70% of the studies reveal the same issue. Some researches point out that biosecurity features could be made more reliable if additional anti-spoofing options are made available (Singh et al., 2021).Also, should consider, the issues of inclusivity and fairness as well, which came up in the qualitative data, the respondents recognized that the system works better by removing cash flows, without which low-income students, in many cases, would be stigmatized. Nonetheless, worries were raised about people's uneven access to technology, along with the lack of tools and opportunities to use the system at home, which are issues inherent in this concern. Besides, the article by (Akhmaeva, 2022) shows the fact that the issue of access for students from underprivileged families can lead to the problem of technology being distributed in equality, which goes along with the school being fair. This comes at a time when bills were proposed that if passed would regulate schools to allow student transfers. Despite the fact that one was introduced in the Senate on the same topic, neither of the two was ever passed into law by the Congress.

OVERALL CONCLUSION

The provided evaluation of the fingerprint payment system in schools has shown that the effectiveness, security, and management of financial matters, including school transactions are quite remarkable. The quantitative analysis indicated that even though the parents might not have seen a tangible result, they were still supportive of the system's usability, safety, and widespread acceptance by other parents. The research also unveiled the fact that most students in numerous rural areas are having financial struggles just like those in urban areas since they are all engaged in online learning. The qualitative and quantitative results further indicated serious problems being encountered in authorization, safety, data privacy, and the dire need to enhance security by employing more fraud prevention tools. The system is, however, a relief to schools which limited dependence on cash and provided an efficient way of tracking transactions and keeping the records. The provision of improved record-keeping and the creation of detailed, precise accounts is an essential measure that helps improve the accounting system, thus building the trust of the parents in the school if they

find it easy to calculate their contribution and that of their children and thus assure their well-being in this aspect. It may also be noted that there still exists a challenge regarding inclusion since some students, particularly those from low-income families, may not access required technology at home, hence the need to pay attention to this issue with respect to the system users. In order to ensure successful implementation of the system, addressing very crucial areas of concern, such as the implementation of measures for enhancing accessibility, enhancing the level of data protection, and adopting improved fraud prevention strategies would be required. The implementation of these improvements into this system would provide impressive results which incorporate attention to the particular needs of schools, parents, and students in general as to make the payment system in educational institutions better and, most importantly, safer.

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