# A Study on the Effectiveness of Smart ID Cards for Student Injury Management

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**Abstract:** Smart cards have been widely used in the fields of transportation, telecommunications, and retail for monetary storage and identity verification. In educational field, smart student ID cards are also utilized in the construction of smart campuses. This study focuses on student injury and illness management, exploring the effectiveness of the smart student ID card (referred to as the "Chia-E-Card") promoted by the Chiayi City Government in Taiwan for managing student injuries and illnesses. It delves into its actual impacts on students, teachers, school nurses, and parents. Through questionnaire surveys and comprehensive quantitative data analysis, the results indicate that the Chia-E-Card significantly enhances the efficiency and quality of injury and illness management. Users generally provide positive evaluations of their experience and satisfaction with the card. The application of the Chia-E-Card not only accelerates the response time for student injuries and illnesses but also increases information transparency, enabling teachers and parents to obtain timely information regarding student health issues. This study finds that factors such as system quality, information quality, service quality, perceived ease of use, and perceived usefulness are significantly positively correlated with user satisfaction and behavioral intentions. Based on the findings, several improvement suggestions are proposed, including enhancing system quality, improving information quality, optimizing service quality, enhancing perceived ease of use, and strengthening perceived usefulness. Future research recommendations include technological advancements and application expansion, interdisciplinary collaboration, long-term benefit assessments, and the development of policy and practical guidelines. This study aims to provide valuable information for the field of school health and injury management to ensure that students enjoy a safer and healthier environment during their learning process.

**Index Terms**: Smart Card, Smart Student ID Card, Chia-E-Card, Smart Campus, Student Injury Management

## Introduction

In today's fast-paced educational environment, ensuring the safety and well-being of students is of paramount importance. With the increasing prevalence of injuries and emergencies within schools, there is a pressing need for efficient management systems that can quickly address these situations while keeping all relevant parties informed. Traditional methods of managing student injuries often rely on paper records and manual processes, which can lead to delays in response and potentially jeopardize student safety. With millions of students attending schools globally, the potential for accidents—ranging from minor injuries such as cuts and bruises to more severe emergencies like allergic reactions or concussions—is significant. Traditional methods of handling these injuries often involve cumbersome paperwork and manual communication, which can hinder prompt action in critical situations.

In response to these challenges, many schools in Taiwan have adopted smart ID cards as a modern solution for injury management. These digital identification cards, often embedded with advanced technologies like RFID (Radio Frequency Identification) or QR codes, can streamline access to essential student information. Smart ID cards are equipped with advanced technology such as RFID chips or QR codes, enabling them to serve as multifunctional tools that provide immediate access to crucial student information. This includes not only basic identification but also medical history, emergency contacts, and allergy alerts. Smart ID cards can not only serve as a means of identification but also provide immediate access to a student's medical history, known allergies, and emergency contacts, which are vital during injury management.

The concept behind using smart ID cards for injury management revolves around enhancing communication and streamlining processes in emergency situations. When a student suffers an injury, staff can quickly scan the smart ID card to retrieve necessary information, allowing for faster and more informed responses. This technological integration is not only aimed at improving efficiency but also at fostering a safer school environment where students and parents feel more secure. This case study aims to explore the effectiveness of smart ID cards in managing student injuries in a school setting, assessing their impact on operational efficiency, overall stakeholder satisfaction and behavioral intention . By analyzing real-life implementation scenarios and collecting relevant data, this study seeks to highlight the potential benefits and challenges associated with adopting this technology in educational institutions. As schools continue to evolve and embrace technological advancements, understanding the role of smart ID cards in injury management will be essential for future developments in student safety protocols.

TheChia-E-Cardis a smart student ID card which is an innovative smart campus service officially launched by the Chiayi City Government in Taiwan in 2021. It has multiple functions such as identity identification, important school information notification, consumer mobile payment, book borrowing, etc., and student health information. In addition to theChia-E-Card, supplemented by the establishment of a mobile APP (called

school+) for the school administration system, through digital management, digitized data and real-time contact, theChia-E-Card is no longer just a physical card, but enables the vision of smart campus services to be realized. The combination ofChia-E-Card and mobile app can be used to manage students' injuries on campus. When a student arrives at school, if an injury or illness occurs, he or she must first go to the health center to register using the Chia-E-Card sensor or its system interface to register and input. Then the school nurse will examine and classify the student's injuries and provide appropriate treatment immediately, and the treatment situation will be reported in the student injury management system. For seriously injured students, the school nurse can immediately notify the student's guardian or legal representative through the system, informing them of the student's injury and illness at school, as well as subsequent treatment situations and suggestions. Compared with the traditional method of handwritten paper records and telephone notification to parents, the establishment and program operation of this system reflect higher efficiency. However, in summary, despite the potential ofChia-E-Card in student injury management, there is currently insufficient research on its actual effectiveness. Therefore, this study aims to explore the actual effectiveness ofChia-E-Card in student injury management, user experience satisfaction, and evaluate its impact on schools and students' usage intentions.

This study aims to explore the effectiveness ofChia-E-Card in student injury management. Its specific purposes are as follows: (1) Analyze the functional features and operating procedures ofChia-E-Card in student injury management.(2) Evaluate the impact ofChia-E-Card on improving the efficiency and quality of student injury management.(3) Understand the experience and satisfaction of students, teachers, school nurses and parents with the use ofChia-E-Card for injury management.These studies will help evaluate the actual effectiveness ofChia-E-Card in student injury management, and provide improvement suggestions based on the study results to ensure that students' safety and health can be properly managed and handled on campus.

## 1. Literature Review

With the advent of the digital age of technology, artificial intelligence (AI) technology is advancing rapidly. The security and multi-functional application features of Smart Card have created the rise of many smart business models. The circulation and sales volume of smart cards in the global card market have continued to grow year by year. In recent years, there have been many applications and related research in many fields. Gupta et al. (2022) used the smart card technology of the Internet of Things and RFID to combine the smart card system with the medical, electricity, QR code and banking fields, and integrate the automation systems of various industries into a singlE-Card system. Helps people consolidate information from all different medical, electricity and bank cards into onE-Card, thereby eliminating the need to carry documents as well as different bank, identification and medical cards. Chen et al. (2022) used smart cards to explore the year-by-year behavior patterns of shared bicycle commuters. They collected and analyzed station shared bicycle

(SBBS) smart card data for five years (2016 to 2020) in Nanjing, China, to track each user's commuting behavior and year-by-year dynamics, and to identify users' spatio-temporal patterns and identify various types of commuters. Mo et al. (2022) also used smart card data to analyze passengers' reactions to urban rail transit services. Based on the time and place where passengers use smart cards, 19 possible reactions of passengers are identified, including changing routes, canceling trips, waiting and delaying departure, etc. Based on the Chicago Transit Authority's (CTA) public transportation system, real-world rail disruption cases are studied. The prediction method proposed by the author can well estimate passenger behavior to provide reference for subsequent transportation planning and related applications. In Taipei MRT and Taiwan's subway system, Mützel&Scheiner (2022) also conducted an in-depth study of the subway passenger flow pattern from Taipei Station to other stations based on the impact of the coronavirus (COVID-19) pandemic, using trip data from the smart card system (EasyCard) of the Automated Fare Collection to compare the flow from January to March 2019 (representing normal conditions) and January to March 2020 (representing the COVID-19 pandemic). Subway traffic changes under the influence of the coronavirus pandemic. Its findings could provide information on how to prepare for similar events in the future, including improving sanitation on vehicles and stations, increasing physical distance between customers to increase capacity, and developing new business models. There are also related studies on smart cards combined with mobility as a service (MaaS) in Kaohsiung. Chao & Yang (2021) applied latent class analysis (LCA) to analyze smart card and mobile payment behavior in Kaohsiung City, Taiwan. Combining smart cards with Mobility as a Service (MaaS) transforms smart cards into Maas for instant mobile services. The author used the Kaohsiung City bus passenger data set to analyze payment behavior. The findings found four categories of different payment behaviors and provided future management and development directions. Guptawt al (2023) studies a two-factor authentication scheme of machine learning and smart cards and applies it to Telecare Medical Information System (TMIS) to maintain anonymity and protect personal information. Use patients and doctors in different locations to connect and implement, and use smart cards to keep the identity verification of users and systems confidential and protected. A secure identity verification mechanism is proposed and a smart card is used for a two-factor authentication mechanism to provide a relatively more efficient and secure TMIS system. Purkayastha& Roy (2023) used smart cards and blockchain to provide a decentralized and secure voting system to improve the traditional Electronic Voting Machine (EVM) voting system. Voting systems are prone to various limitations, such as fake votes, manipulation of electronic voting machines, and vote manipulation. The authors proposed using blockchain technology to give immutability, security, and decentralization to the proposed Cloud Voting System (CVS) system. This cloud voting system uses smart cards to implement Multipurpose Electronic Cards (MEC) to provide an integrated and unified interface for providing electronic services to people across the country, enhancing the security and reliability of traditional voting systems. Smart cards have been widely used

in Taiwan, including e-commerce transactions, transaction authentication, identity documents, health insurance E-Cards, transportation tickets, access cards, points cards, pre-attached cards, etc. Due to the serious situation of forged barcodes in Taiwan, the use of smart cards will be a trend for security considerations, and user-related usage behavior is also a topic worthy of study in the future.

Smart cards also have many applications in the field of education. Many public and private universities, counties and municipalities have launched smart student ID cards. The student ID card can integrate many electronic ticket functions to achieve multiple applications related to student digital check-in, digital borrowing of books, injury management, and digital commuting travel. Smart cards have been used as smart student ID cards for many years. However, in recent years, there have been many related studies on smart cards in the field of education. In Taiwan, Wu et al. (2011) took a private university in Taiwan as an example to study the application of smart cards. The impact of users with different roles on technology can directly affect the development direction of smart cards. When universities introduce the application of smart cards and focus on different value-added electronic services, unexpected results can appear in practical verification. In particular, thesmart student ID card is not only an identification and payment tool, but also can shape students' different lifestyles and consumption patterns. In South Korea, Lim et al. (2022) used smart student ID cards to record the life trajectories of university students and explore the relationship with academic performance. The authors conducted evaluations and comparisons based on Grade Point Averages (GPA) and confirmed that a student's footprint affects a student's GPA. The activity level of students' footprints is positively correlated with GPA, that is, the more times they use campus facilities, the better their GPA, and can be used to understand students' learning characteristics in higher education and predict their academic performance. In Indonesia, the Indonesia Smart Card (KIP) is a national education development equitable distribution plan launched by the government for those who are unable to receive higher education. It is hoped that Indonesian smart cards can create internationally competitive and innovative human resources. Audia et al. (2021) used smart cards to help primary school students develop teaching media on the theme of biological conservation. Through the ADDIE development model, it was divided into five stages: analysis, design, development, implementation and evaluation. The effectiveness of smart cards was evaluated, and the use of smart cards was verified by media material experts, teachers and participating students. It was confirmed that the use of smart cards in biological conservation courses meets the conditions for substitute learning for fourth-year primary school students. In Japan, Daynasti&Linuwih (2021) used smart cards to create a Physics Smart Card (YOPSA) and implemented learning media to improve students' interest in learning static fluid materials. According to the evaluation and analysis of educational scholars and physics experts, the Physics Smart Card (YOPSA) developed by it is a very suitable learning media product, which can help improve students' average grades and can stimulate and increase students' interest in learning physics. In Arabia, Ahmed et al. (2020)

took Sharjah University in the United Arab Emirates as an example to evaluate the development standards and related challenges of building a smart campus using smart cards. The author proposes the main standards and applications based on the Internet of Things and cloud computing platforms that a smart campus needs to cover, and verifies that these smart campus standards and applications meet the needs of Sharjah University. In Malaysia, Musa et al. (2021) explored the smart campus measures currently being implemented by Malaysian universities and compared the smart campus usage areas of several universities. The results found that the highest proportion of smart card applications is in the smart management field, and the second highest area is smart learning, followed by green campus. Based on its findings, Smart Card can help most universities in Malaysia implement smart campuses and actively improve their workflow and environment. To sum up, schools around the world are actively planning and building smart campuses, hoping to provide a campus environment with high performance and friendly facilities to support the overall teaching environment, improve and optimize the teaching process, and enhance student experience services. Therefore, this study uses the Chia-E-Card promoted by the Chiayi City Government in Taiwan to conduct research on the application of smart campuses, and takes student injury management as the theme to explore the actual effectiveness of Chia-E-Card in student injury management, user experience satisfaction, and evaluate its impact on schools and students to provide a better campus environment and student service measures.

## I. Materials And Methods

This study adopts quantitative research methods, using questionnaires as the main data collection tool, and statistical analysis as the main data processing method. Students, teachers, school nurses and parents were used as the main subjects, and five evaluation indicators were used for discussion, which are: (1) Functional characteristics evaluation: refers to the functional characteristics ofChia-E-Card in student injury management, such as automatically reading data, recording injuries and illnesses, notifying parents, etc.(2) Injury management efficiency evaluation: Refers to whether usingChia-E-Card can reduce students' waiting time in the health center, speed up the injury and illness treatment process for school nurses, and improve the speed at which parents receive notifications.(3) Injury management quality evaluation: Refers to whether usingChia-E-Card can improve the quality of students' injury management, reduce the error rate of school nurses, and increase parents' trust.(4) Injury management experience evaluation: Refers to whether using theChia-E-Card can improve students' feelings about injuries, improve school nurses' job satisfaction, and increase parent participation, etc.(5) Injury management satisfaction evaluation: refers to the overall satisfaction of students, teachers, school nurses and parents with injury management after usingChia-E-Card.Based on the above evaluation indicators, this study collects relevant literature on system usage evaluation at home and abroad, summarizes and establishes the possible research aspects ofChia-E-Card on student injury

management, including: System quality, Information quality, Service quality, Perceived ease of use, Perceived usefulness, Usage attitude, Behavioral intention, Usage satisfaction, etc.

In order to understand and evaluate the cognitive effects of students, teachers, school nurses and parents on the effectiveness of use in different aspects, eight research aspects of the effectiveness of injury management were formulated with reference to relevant domestic and foreign literature. Each aspect refers to System Quality proposed by scholars DeLone& McLean (1992), Information Quality proposed by Rai et al. (2002), Service Quality proposed by DeLone& McLean (2003), Perceived Ease of Use and Perceived Usefulness proposed by Davis (1989), and Taylor & Todd (1989). 95), behavioral intention proposed by Bedard et al. (2003), and user satisfaction (User Satisfaction) proposed by DeLone& McLean (1992), etc., to evaluate the cognitive effects of teachers, staff, parents, and students on different aspects of use effectiveness. The effectiveness of smart student injury management includes eight aspects, including: (1)System quality,(2)Information quality, (3)Service quality,(4)Perceived ease of use,(5)Perceived usefulness,(6)User attitude,(7)Behavioral intention, and(8)User satisfaction. This research framework is based on the Technology Acceptance Model (TAM) proposed by Davis (1989) and the Information System Success Model (ISSM) proposed by DeLone& McLean (1992), as shown in Figure 1.

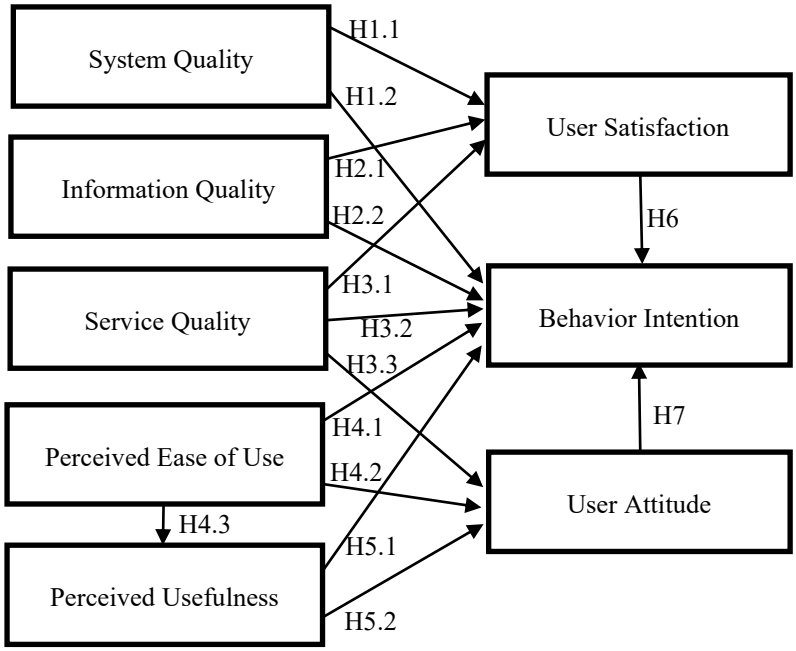

Figure 1.Research framework

Based on the ISSM information system success model proposed by DeLone& McLean (1992), this study revised the research hypotheses H1, H2, H3 and H6. It is assumed that the aspects "system quality", "information quality" and "service quality" have a positive and significant impact on "user satisfaction" and "behavioral intention". In addition, based on the TAM technology acceptance model proposed by Davis (1989), the research hypotheses H4, H5 and H7 were revised, assuming that the aspects "perceived ease of use" and "perceived usefulness" have a positive and significant impact on "usage attitude" and "behavioral intention". Based on this, the following hypotheses are formulated:

H1: "System quality" has a positive impact on "user satisfaction" and "behavioral intention" ofChia-E-Card related systems.

H1.1: "System quality" has a positive impact on "user satisfaction" ofChia-E-Card related systems.

H1.2: "System quality" has a positive impact on users' "behavioral intention" ofChia-E-Card related systems.

H2: "Information quality" has a positive impact on "user satisfaction" and "behavioral intention" of theChia-E-Card related system.

H2.1: "Information quality" has a positive impact on "user satisfaction" ofChia-E-Card related systems.

H2.2: "Information quality" has a positive impact on users' "behavioral intention" ofChia-E-Card related systems.

H3: "Service quality" has a positive impact on "user satisfaction", "behavioral intention" and "usage attitude" of theChia-E-Card related system.

H3.1: "Service quality" has a positive impact on "user satisfaction" ofChia-E-Card related systems.

H3.2: "Service quality" has a positive impact on users' "behavioral intention" ofChia-E-Card related systems.

H3.3: "Service quality" has a positive impact on the "usage attitude" of users of theChia-E-Card related systems.

H4: The user's "perceived ease of use" has a positive impact on the "behavioral intention", "usage attitude" and "perceived usefulness" of theChia-E-Card related system.

H4.1: The user's "perceived ease of use" has a positive impact on the "behavioral intention" of theChia-E-Card related system.

H4.2: The user's "perceived ease of use" has a positive impact on the user's "usage attitude" of theChia-E-Card related system.

H4.3: Users' "perceived ease of use" has a positive impact on users' "perceived usefulness" ofChia-E-Card related systems.

H5: The user's "perceived usefulness" has a positive impact on the "behavioral intention" and "usage attitude" of theChia-E-Card related system.

H5.1: The user's "perceived usefulness" has a positive impact on the "behavioral intention" of theChia-E-Card related system.

H5.2: The user's "perceived usefulness" has a positive impact on the user's "usage attitude" of theChia-E-Card related system.

H6: "User satisfaction" has a positive impact on users' "behavioral intention" of theChia-E-Card related system.

H7: The user's "usage attitude" has a positive impact on the user's "behavioral intention" of theChia-E-Card related system.

## II. Result and Discussion

This study uses 28 elementary and junior high schools in Chiayi City as the survey population, with participants including students, teachers, school nurses, and parents. The distribution and collection period for the questionnaires is fromJanuary to April 2024.When students encounter injuries or illnesses on campus, they visit the school health center and use the Chai-E-Card to register at the machine. The school nurse conducts an initial assessment and appropriate treatment, and then records the student's injury or illness condition and subsequent management on the injury management system platform. If a student has more serious injuries or requires ongoing monitoring by parents, the injury management system platform will send notifications to parents and teachers regarding the situation. Both parents and teachers can receive relevant information through the mobile APP.After the relevant service operations, this study conducted an anonymous survey to protect the privacy rights and related interests of the research participants. A total of 250 questionnaires were collected.

This study adopted a five-point Likert scale to measure the questionnaire options and used Cronbach's α coefficient as an indicator of reliability. There are 8 constructs in the study, with a total of 24 questions. The Cronbach's α values for each construct variable (system quality, information quality, service quality, perceived ease of use, perceived usefulness, user attitude, behavioral intention, and user satisfaction) were 0.885, 0.827, 0.787, 0.781, 0.812, 0.830, 0.824, and 0.837, respectively (>0.7). The examination of the Cronbach's α values for each construct variable shows that the questionnaire in this study has a high level of consistency and stability, both individually and overall.

The validity analysis of each construct was conducted using the KMO value (Kaiser-Meyer-Olkin Measure) and Bartlett's test of sphericity to assess the validity of the items in the scale for each construct and to determine whether factor analysis is appropriate.The two common methods of factor analysis are Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). This study employed Confirmatory Factor Analysis (CFA) as its approach.The CFA method of the questionnaire items and construct variables in this study utilized convergent validity and discriminant validity for verification. In the questionnaire, convergent validity was employed to measure the degree of convergence between each question and the construct variables, where multiple items within the same construct measured their corresponding agreement levels. This study analyzed convergent validity using factor loading (FL), composite reliability (CR), and average variance extracted (AVE). According to the recommendations by Fornell&Larcker (1981), the factor loading (FL) should be greater than 0.7, composite reliability (CR) should be greater than 0.6, and average variance extracted (AVE) should be greater than 0.5 to be considered as having convergent validity. The factor loading (FL), composite reliability (CR), and average variance extracted (AVE) for the measurements in this study are shown in Table 1.

Table 1.Convergent validity of the research constructs and questionnaire items.

| Questionnaire items | Constructs | FL | CR | AVE |
|---|---|---|---|---|
| Chia-E-Card related systems can provide services at any time without malfunctions | System Quality | 0.882 | 0.888 | 0.726 |
| Chia-E-Card related systems can execute tasks promptly without delays | | 0.899 | | |
| Chia-E-Card related systems can operate accurately without crashing. | | 0.769 | | |
| Chia-E-Card revantsystems can provide accurate information without errors | Information Quality | 0.844 | 0.845 | 0.647 |
| Chia-E-Card revantsystems an provide the necessary information without omissions | | 0.864 | | |
| Chia-E-Card revant systems provide reports and information that meet our requirements | | 0.694 | | |
| Chia-E-Card revantservices can provide immediate service without waiting | Service Quality | 0.739 | 0.792 | 0.559 |
| Chia-E-Card revant services can provide reliable information without errors | | 0.786 | | |
| Chia-E-Card revant services can provide high-quality informations and knowledges | | 0.717 | | |
| Chia-E-Card related systems are easy to use | Perceived Ease of Use | 0.723 | 0.791 | 0.559 |
| Chia-E-Card related systems allow for convenient interaction | | 0.778 | | |
| Chia-E-Card related systems have clear and easy-to-understand operating procedures | | 0.74 | | |
| Chia-E-Card related systems can improve efficiency | Perceived Usefulness | 0.768 | 0.818 | 0.600 |
| Chia-E-Card related systems can | | 0.746 | | |

| | | | | |
|---|---|---|---|---|
| enhance user performance | | | | |
| Chia-E-Card related systems can quickly complete service tasks | | 0.809 | | |
| Chia-E-Card related systems are a great idea or concept | User Attitude | 0.77 | 0.834 | 0.625 |
| Using Chia-E-Card related systems is a wise choice | | 0.802 | | |
| Using Chia-E-Card related systems is a pleasant experience | | 0.8 | | |
| I will continue to use Chia-E-Card related systems | Behavior Intention | 0.816 | 0.843 | 0.643 |
| I recommend using Chia-E-Card related systems | | 0.852 | | |
| I will use Chia-E-Card related systems frequently | | 0.732 | | |
| I am very satisfied with the equipment related to Chia-E-Card related systems | User Satisfaction | 0.86 | 0.831 | 0.622 |
| I am very satisfied with the information provided by tChia-E-Card related systems | | 0.704 | | |
| I am very satisfied with the overall usage of Chia-E-Card related systems | | 0.795 | | |
| Effective N (completely excluded) | 250 | | | |

According to Table 1, the overall questionnaire's convergent validity meets the criteria of FL greater than 0.7, CR greater than 0.6, and AVE greater than 0.5, indicating that the convergent validity analysis results of the various facets of this study (system quality, information quality, service quality, perceived ease of use, perceived usefulness, user attitude, behavioral intention, user satisfaction) have good convergent validity.On the other hand, discriminant validity refers to the correlation between different facets, which can determine whether the problem items of different facets can be clearly distinguished. The discriminant validity of this study is measured by comparing the square roots of the AVE values of each facet with the correlation coefficients between other facets. If the square root of the AVE values of the facets (system quality, information quality, service quality, perceived ease of use, perceived usefulness, user attitude, behavioral intention, user satisfaction) is greater than the correlation coefficients between that facet and other facets, it indicates good discriminant validity between the two facets, as described by Chin

&Newsted (1999). The square roots of the average variance extracted (AVE) and the correlation coefficients between different facets are shown in Table 2.

Table 2. Discriminant validity among the research facets.

| Facets | Behavior Intention | System Quality | Information Quality | Service Quality | Perceived Ease Use | Perceived Usefulness | User Attitude | User Satisfaction |
|---|---|---|---|---|---|---|---|---|
| Behavior Intention | **0.802** | | | | | | | |
| System Quality | 0.490 | **0.852** | | | | | | |
| Information Quality | 0.512 | 0.703 | **0.804** | | | | | |
| Service Quality | 0.496 | 0.719 | 0.683 | **0.748** | | | | |
| Perceived Ease of Use | 0.595 | 0.586 | 0.535 | 0.719 | **0.747** | | | |
| Perceived Usefulness | 0.619 | 0.613 | 0.575 | 0.670 | 0.705 | **0.775** | | |
| User Attitude | 0.760 | 0.652 | 0.567 | 0.580 | 0.718 | 0.716 | **0.791** | |
| User Satisfaction | 0.701 | 0.648 | 0.636 | 0.615 | 0.652 | 0.703 | 0.738 | **0.789** |

According to Table 2, the square roots of the Average Variance Extracted (AVE) for each facet of this study are as follows: behavioral intention (0.802), system quality (0.852), information quality (0.804), service quality (0.748), perceived ease of use (0.747), perceived usefulness (0.775), user attitude (0.791), and user satisfaction (0.789). The correlation coefficient between different facets ranked the highest at 0.738, as shown in Tables 2. The results indicate that the square roots of the AVE values for any two factor facets are higher than the correlation coefficients between other facets, demonstrating good discriminant validity among the facets in this study's questionnaire.To avoid high correlations or multicollinearity among variables that could increase the degree to which their predictive or explanatory power is influenced by other variables, this study conducted a multicollinearity analysis. When multicollinearity exists between variables, it can negatively impact the stability and explanatory power of the statistical models. This study assessed multicollinearity using Pearson correlation coefficients; the closer the coefficient is to ±1, the stronger the linear relationship, while the closer it is to 0, the weaker the linear relationship. Generally, a correlation coefficient greater than 0.8 indicates the presence of high multicollinearity. The Pearson correlation coefficients for each facet of this study are shown in Table 3.

Table 3. Pearson Correlation Coefficients for Each Research Facet.

| Facets | System Quality | Information Quality | Service Quality | Perceived Ease Use | Perceived Usefulness | User Attitude | Behavior Intention | User Satisfaction |
|---|---|---|---|---|---|---|---|---|
| System Quality | 1 | .611** | .615** | .488** | .516** | .538** | .408** | .545** |
| Information Quality | .611** | 1 | .564** | .458** | .484** | .479** | .438** | .544** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Service Quality | .615** | .564** | 1 | .570** | .540** | .464** | .402** | .513** |
| Perceived Ease of Use | .488** | .458** | .570** | 1 | .561** | .580** | .489** | .540** |
| Perceived Usefulness | .516** | .484** | .540** | .561** | 1 | .596** | .513** | .580** |
| User ttitude | .538** | .479** | .464** | .580** | .596** | 1 | .633** | .623** |
| Behavior Intention | .408** | .438** | .402** | .489** | .513** | .633** | 1 | .587** |
| User Satisfaction | .545** | .544** | .513** | .540** | .580** | .623** | .587** | 1 |

** Significant at the 0.01 level (two-tailed), indicating that the correlation is statistically significant.

In Table 3, multicollinearity testing was conducted on 250 valid responses for each research facet. The results indicated that the highest correlation among the research facets was 0.633, all of which are less than 0.8. Therefore, there is no significant multicollinearity present among the research facets.

This study employs the Structural Equation Modeling (SEM) and Regression Path Analysis (RPA) to explore the relationships and influences between independent variables and dependent variables within the research framework. The verification of the study is determined by analyzing the P-values (significance) obtained from SEM and RPA to assess whether the relationships and influence levels between independent and dependent variables are valid.Without considering the background attributes of the respondents, the study examines the impact of the research facets "System Quality," "Information Quality," and "Service Quality" on "User Satisfaction" and its "Behavioral Intention." Additionally, it explores the influence of the research facets "Perceived Ease of Use" and "Perceived Usefulness" on "User Attitude" and its "Behavioral Intention." Based on the research framework and hypotheses, structural equation modeling and regression path analysis are conducted. The path coefficients and significance estimates for the structural model of the research framework are determined using the obtained P-value, assessing the significance levels of the path coefficients to validate the hypotheses. The unstandardized regression path coefficients and significance analysis results of this study are illustrated in Figure 2. Among them, the coefficients (***) indicate a significance level of 0.001 (two-tailed), denoting significant relevance.

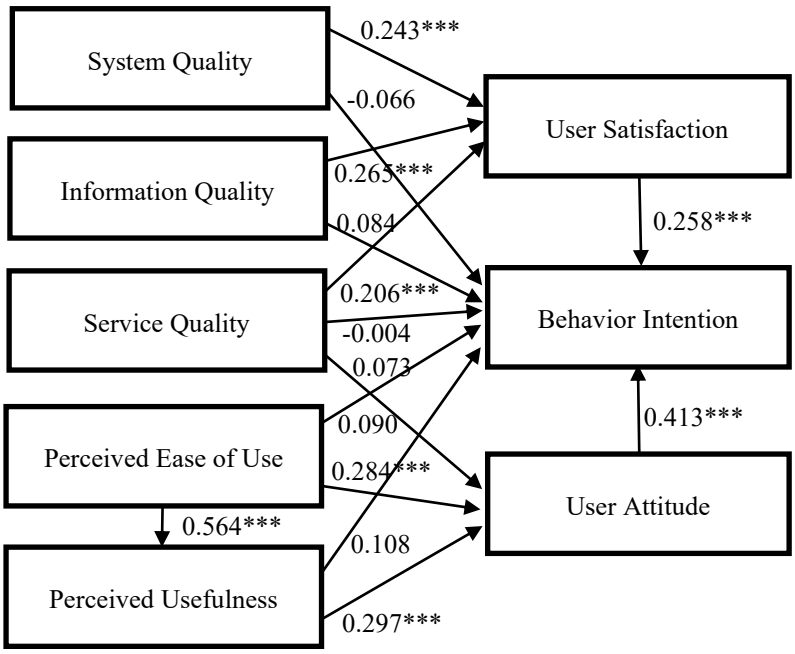


Figure 2.Unstandardized regression path coefficients and significance.

This study hypothesizes that the research dimensions of H1, H2, H3, and H6, which include 'system quality,' 'information quality,' and 'service quality,' all have a positive and significant impact on 'user satisfaction' and its 'behavioral intention.' Additionally, the research dimensions of H4, H5, and H7, which include 'perceived ease of use' and 'perceived usefulness,' are also hypothesized to have a positive and significant impact on 'usage attitude' and its 'behavioral intention.' Accordingly, this study summarizes the path analysis coefficients and the test results of the research hypotheses, as shown in Table 4.

Table 4. Path analysis coefficients and research hypothesis test results

| Research Hypothesis | Path Analysis coefficients | Significance | Standardized Coefficients | Test Results |
|---|---|---|---|---|
| H1.1 | 0.243 | *** | 0.283 | Established |
| H1.2 | -0.066 | 0.175 | -0.072 | Not Established |
| H2.1 | 0.265 | *** | 0.311 | Established |
| H2.2 | 0.084 | 0.083 | 0.093 | Not Established |
| H3.1 | 0.206 | *** | 0.228 | Established |
| H3.2 | -0.004 | 0.944 | -0.004 | Not Established |
| H3.3 | 0.073 | 0.105 | 0.079 | Not Established |
| H4.1 | 0.090 | 0.158 | 0.092 | Not |

| | | | | |
|---|---|---|---|---|
| | | | | Established |
| H4.2 | 0.284. | *** | 0.315 | Established |
| H4.3 | 0.564 | *** | 0.561 | Established |
| H5.1 | 0.108 | 0.091 | 0.111 | Not Established |
| H5.2 | 0.297. | *** | 0.332 | Established |
| H6 | 0.258 | *** | 0.246 | Established |
| H7 | 0.413 | *** | 0.380 | Established |

***. At a significance level of 0.001 (two-tailed), the correlation is significant.

Based on Table 4, eight hypotheses in this study are established. The path coefficients indicate that the hypotheses showing significant relationships are positively correlated. The results of the standardized regression path analysis of this study's framework are shown in Figure 3:

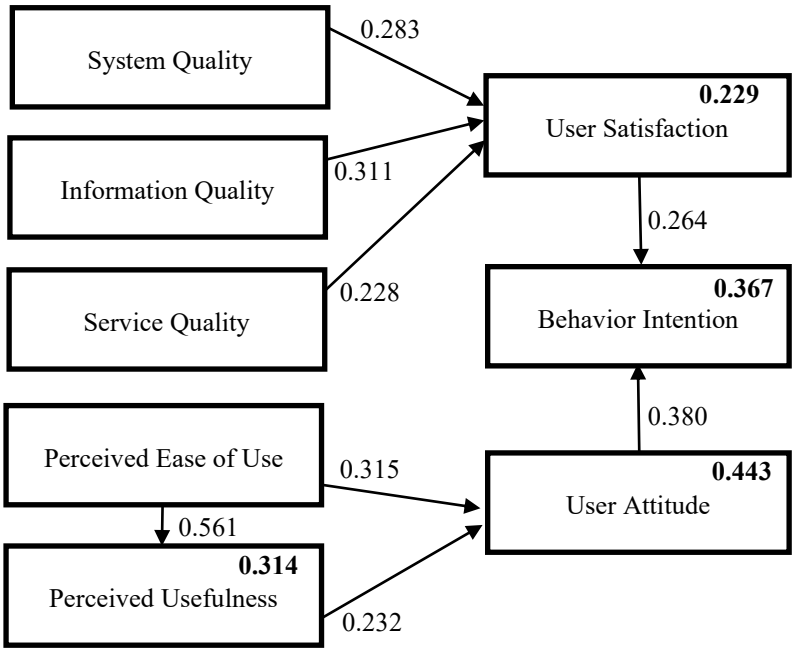


Figure 3. Standardized Regression Path Analysis Results.

According to Figure 3, the results of the standardized regression path analysis of this study's framework and hypotheses indicate that:

(1) 'System quality,' 'information quality,' and 'service quality' all have a significant positive correlation with 'user satisfaction,' with an explanation power of 22.9% for 'user satisfaction.' This indicates that these three factors have a considerable impact on user satisfaction. When users utilize the system, if the system quality is high, the information quality is high, and the service quality is good, they will have a higher level of satisfaction with the system.

(2) 'Perceived ease of use' and 'perceived usefulness' both exhibit a significant positive correlation with 'user attitude,' with an explanation power of 44.3% for 'user satisfaction.' This suggests that these two factors greatly influence user attitude. When users use the system, if they find it easy to use and the functions to be useful, they will have a more positive attitude toward the system.

(3) 'Perceived ease of use' has a significant positive correlation with 'perceived usefulness,' with an explanation power of 31.4% for 'perceived usefulness.' This indicates that perceived ease of use is one of the important factors affecting perceived usefulness. When users find the system easy to use, they are more likely to understand its functions and leverage its value, thereby enhancing their perception of its usefulness.

(4) 'User satisfaction' and 'user attitude' all have significant positive correlations with users' 'behavioral intention,' with an explanation power of 36.7% for 'behavioral intention.' This indicates that these two factors significantly impact user behavioral intention. When users are satisfied with the system and have a positive attitude, they are more likely to continue using the system and recommend it to others."

The study results and data analysis indicate that factors such as system quality, information quality, service quality, perceived ease of use, and perceived usefulness all have significant positive correlations with user satisfaction and behavioral intention. Based on the findings and conclusions mentioned above, this study proposes the following recommendations:

1. Enhance System Quality:Suggested feasible strategies include (1) Ensure the stability, functionality, and performance of the JiaE card injury and illness management system. (2) Conduct regular system maintenance and updates to ensure system security and stability.(3) Establish a comprehensive system monitoring mechanism to detect and resolve system failures promptly.

2. Improve Information Quality: Suggested feasible strategies include (1) Ensure the management system provides accurate, complete, timely, and useful information. (2) Establish a robust information review mechanism to ensure the reliability of the information. (3) Regularly update information and strengthen information security management.

3. Optimize Service Quality: Suggested feasible strategies include (1) The system provider should offer high-quality services and continuously optimize the system to provide a good user experience. (2) Establish a convenient user feedback mechanism to collect user opinions and improve the system. (3) Regularly conduct user training activities to enhance users' mastery of the system.

4. Improve Perceived Ease of Use:Suggested feasible strategies include(1) Simplify system operation processes, reduce the learning curve, and provide clear information prompts. (2) Design a user-friendly interface to facilitate user operation. (3) Develop customized user interfaces for different user groups.

5. Strengthen Perceived Usefulness:Suggested feasible strategies include (1) Ensure that the injury and illness management system functions meet user needs and enhance service

value. (2) Collect user requirements and develop new functions and services accordingly.(3) Actively promote the system to increase user awareness."

## III. Conclusion

This study focuses on student injury and illness management, exploring the effectiveness of the smart student ID card (referred to as the Chia-E-Card) promoted by the Chiayi City Governmentin Taiwan, and understanding its actual impact on students, teachers, school nurses, and parents. Through questionnaires and comprehensive quantitative data analysis, the study aims to assess the overall effectiveness of the Chia-E-Card and provide recommendations for improving the student injury and illness management system. This research hopes to provide valuable information in the field of school health and injury management to ensure that students can enjoy a safer and healthier environment during their learning process. Through questionnaire surveys and comprehensive quantitative data analysis, the results show that the Chia-E-Card has significant effectiveness in enhancing the efficiency and quality of injury and illness management. Students, teachers, school nurses, and parents generally provide positive feedback regarding their experiences and satisfaction with using the JiaE card for injury and illness management. The application of the JiaE card not only accelerates the response time for student injuries and illnesses but also improves information transparency, allowing teachers and parents to obtain student injury and illness information in real time.

Our future research will explore the effectiveness of the Chia-E-Card in other applications within smart campuses, such as student attendance management and campus safety monitoring. Additionally, consideration can be given to integrating the Chia-E-Card with more advanced Internet of Things (IoT) technologies to realize a more comprehensive smart campus ecosystem. Through continuous technological innovation and application, it is expected to bring more positive impacts on school management and student welfare. Specifically, the following are some suggested future research directions:

1. Technological Advancement and Application Expansion: Feasible research or strategies include (1) Focus on further improvements to smart student ID cards technology, such as enhancing data encryption and privacy protection measures, to improve the stability of the injury and illness management system and user interface friendliness. (2) Explore the application of this technology in other campus management functions, such as student attendance management, campus safety monitoring, and event participation tracking, to achieve a comprehensive smart campus environment. (3) Research application models that combine smart student IDs with IoT technologies, such as using wearable devices to monitor student health and transferring data to the injury and illness management system for more comprehensive student health management.

2. Cross-Disciplinary Collaboration: Feasible research or strategies include (1) Promote collaboration between education, healthcare, and information technology fields to jointly develop integrated solutions. (2) Invite experts from various fields to participate in the

research and application of smart student IDs to enhance their effectiveness in student injury and illness management, ultimately playing a significant role in preventing health issues and promoting overall student welfare.

3. Long-Term Benefit Assessment: Feasible research or strategies include (1) Conduct long-term follow-up studies to evaluate the ongoing benefits of smart student IDs in student injury and illness management. (2) Analyze whether the use of smart student IDs positively impacts students' academic performance, mental health, and the overall school environment, and explore their long-term contributions to educational quality. (3) Establish long-term benefit assessment indicators and methods to provide scientific basis for the promotion and application of smart student IDs.

4. Policy and Practical Guidelines: Feasible research or strategies include (1) Based on research results, formulate and revise relevant policies and practical operation guidelines to support the continuous development and innovation of smart student IDs. (2) Policies and practical guidelines should include implementation standards, benefit assessment methods, and promotion strategies, aiming to facilitate the nationwide promotion and application of smart student IDs while ensuring their effectiveness in enhancing the educational environment and student welfare.

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