

Analysis of Mathematics Education Students' ICT Behavior at IAIN Syekh Nurjati Cirebon Post-Pandemic

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Article Info

Article history:

Received 2024-12-14

Revised 2025-01-14

Accepted 2025-01-15

Keywords:

ICT

LMS

Online Learning

Pandemic

TAM

ABSTRACT

This study analyzes student behavior in using ICT when using LMS at IAIN Syekh Nurjati Cirebon. This study used quantitative methods with a survey research design. The type of survey used is a cross-sectional survey design. Samples were taken from Mathematics Education students in semesters I, III, V, and VII, as many as 258 from 627 active students in 2021/2022 using the stratified random sampling method. The instrument was developed following the aspects and indicators in the TAM model, containing (1) perceived ease of use, (2) perceived usefulness, (3) attitude towards using, (4) behavioral intention to use, and (5) actual usage. The instrument will be tested for validity using CVR and reliability using the Guttman Split-Half Coefficient correlation. Data on student behavior using ICT were analyzed using Widoyoko categorization. The study results showed that the instrument was confirmed to be valid and reliable, with students' behavior in using ICT categorized as "good." The findings suggest that students are generally well-prepared to engage with ICT tools for online learning, reflecting their adaptability and positive attitudes toward technology adoption. However, to maximize the potential benefits of ICT in education, the study highlights the need for institutions to implement targeted strategies. These include providing more comprehensive ICT training programs, upgrading and maintaining digital infrastructure, and creating policies encouraging consistent and meaningful use of ICT in learning activities.

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1. INTRODUCTION

Primary, Secondary Education, and Higher Education are three levels of education in the formal education path in Indonesia. The role of the three is vital in maintaining the quality of education in Indonesia. Every citizen must attend at least 9 years of education up to junior high school level or equivalent as stated in the National Education System Law. It is mentioned in the Indonesian Education Roadmap 2020-2035 that compulsory education

has been increased to 12 years up to the Senior High School level or equivalent [1]. The provision of School Operational Assistance fees is a form of seriousness and willingness of state administrators to realize this.

Along with the rapid development of technology in recent decades, the world of education is also faced with various increasingly diverse challenges. Online Learning or Webinars using computers, smartphones, internet, and WiFi are common today in the 21st century. Information and Communication Technology (ICT) use in education systems has been a policy priority over the past few decades [2]. The use of this online tool increased at the end of 2019, when the COVID-19 pandemic occurred. ICT and electronic gadgets can improve and enhance learners' learning process and provide better teaching methods [3]. Online learning has proven its effectiveness during the pandemic [4]. The rapid development of technology has also led to the change of textbooks from print to digital forms that learners can access regardless of their location, thus improving their overall academic performance. This change corresponds to continuous learning programs, where digital textbooks support online learning, and students can access materials from anywhere and anytime [5]. Learners become more engaged in their studies when educators integrate ICT into their learning [6]. It has been approximately 2 years of online learning, and students are getting used to using online media. However, a few complaints and problems arising during online learning show that online systems have weaknesses. Students, schools, and teachers who do not learn to understand and master ICT quickly fall behind and do not easily adapt to new situations during the COVID-19 pandemic. Implementing information and communication technology (ICT) in education is defined as incorporating ICT into teaching and learning activities inside and outside the classroom [7]. In addition, ICTs have impacted almost every aspect of our lives, transforming people's communication, information access, and learning [3].

This is also where the condition of lectures at IAIN Syekh Nurjati Cirebon during the COVID-19 pandemic is by implementing online learning. Initially, lecturers were given the freedom to choose the desired online media. In general, WhatsApp media is the most widely used, after Google Classroom, Zoom, Google Meet, and LMS. In many cases, lecturers use only one media, and some lecturers use a combination of several media. The widely used media is Google Classroom, especially in Mathematics Education IAIN Syekh Nurjati Cirebon. Some lecturers also combine this media with Zoom or Google Meet as a means of meeting face-to-face, and they still use WhatsApp as a medium for discussion or question-and-answer. Only in 2022 is it recommended to use the LMS developed by the IAIN Syekh Nurjati Cirebon campus.

Although the lecture implementation process used the ICT media mentioned above, lecturers and students still faced several obstacles when implementing it. Some students may not have mastered using the ICT media needed for online learning, thus hampering lectures. In general, the potential learning barriers that occur due to the behavior of using ICT are still not discussed in depth in a study, especially in mathematics education. Therefore, it is necessary to evaluate the behavior of using ICT media for Mathematics education students before carrying out online learning activities. Good readiness and knowledge of the behavior of using ICT media as a thriving online learning capital are considered a must. After analyzing the behavior of mathematics education students using ICT media, it is hoped that

lecturers can choose the right ICT media to implement lectures. Mathematics education IAIN Syekh Nurjati Cirebon was chosen as a research subject because most mathematics lecturers have used various ICT media. In addition, some courses require students to actively use several devices at once, so the behavior of using ICT must also be considered.

Several studies related to the use of ICT, including research by Alharbi and Drew, suggest using TAM to measure behavioral intentions in using LMS [8]. His research also stated that all variables mentioned in the study directly or indirectly influenced the behavioral intention to use LMS. Furthermore, Srinadi and Puspita mention that the TAM model can explain user perceptions and determine their attitudes toward accepting the use of Information Technology (IT) [9]. The results showed that e-learning self-effectiveness, perceived usefulness, perceived ease of use, attitude toward using, and attitude toward using significantly influenced behavioral intention to use and could predict behavioral intentions using e-learning [10]. Found that Faculty of Social & Political Sciences Universitas Airlangga students use the internet with cognitive motives and social integrative motives with internet usage patterns included in the heavy user category [11]. Stated that changes in student lifestyles are often a waste of time, and more negative content appears on social media. Students must be able to distinguish what is good to do and not to do [12].

Stated that the infrastructure used to apply technology in education in each region is not evenly distributed, and some existing human resources are not ready to apply ICT in learning activities [13]. Concluded that students prefer offline learning, but during these difficulties, parental support motivates students to continue carrying out online learning [14]. Stated that regarding the use of online media in mathematics learning, as many as 23.3% of respondents considered learning very effective, 46.7% considered it adequate, and the remaining 10% considered it ineffective [15]. Yensy stated that the WA Group is effective judging from student learning outcomes [16].

The research looked at factors impacting ICT and electronic gadgets in children for educational purposes [3]. The results of this study may be helpful for educators and educational organizations to consider factors that may significantly impact the use of ICTs and electronic gadgets. These impacts can be like digital addiction, which is an important factor that can affect academic achievement [17]. Furthermore, Mohamad's research aims to investigate ICT's effect on lecturer behavior and changes in Libyan University society towards the use of ICT [18]. They used the TAM model and theories of planned behavior (SDG) and attitudes, perceived ease of use, perceived usefulness, behavioral intention, and social influence to explain the use of ICT. Therefore, the study found that when lecturers have adequate knowledge about ICT, it can influence them to use it. Semerci and Aydin conducted a study aimed at determining the attitude of educators in secondary schools towards the use of ICT in education [19]. Participants comprised 353 educators working in various secondary schools in Ankara in the academic year 2016-2017. The results illustrate that educators have a high level of positive attitudes toward using ICT in the classroom. Observed and explored universities' adoption of information communication technology and its impact on student academic performance [20]. By using a quantitative research approach and a sample size of 1000 students. The findings reveal a relationship between ICT adoption and academic performance. Daud *et al.* examined the relationship between ICT use,

attitudes, behavior, and interest in achievement in chemistry, involving 78 learners from four secondary schools in Selangor County [21].

Research conducted by Granados *et al.* to determine learning styles (LS) and ICT use in students in competency-based training models, as well as to identify possible differences related to the frequency of ICT use in terms of gender [22]. The study used a non-probabilistic sample of 113 students in undergraduate programs in psychology, public accounting, and business administration at private Columbia universities. The results showed no significant difference between LS or the frequency of ICT use in students with competency-based training. Research by Saarinen *et al.* observed the use of ICT in schools related to the learning outcomes of learners in Finland [23]. His findings suggest that learners with ICT skills are good at using digital devices mechanically, but they may lack the ability to use goal-oriented, self-sustaining digital technologies that can promote their learning. Arber and Kyyete identify the importance of ICT training and skills acquired by learners [24]. He used a combination of two methodologies: quantitative and qualitative. The data was obtained through questionnaires distributed to the Faculty of Education, University of Pristina students. Our sample consisted of 155 students in primary school, early childhood education, and general pedagogy. Explore the relationship between computer self-efficacy (basic technology skills, advanced technology skills, and technology for pedagogy) and pre-service educators to use technology (use of traditional technology and use of constructivist technology) [6]. Data were collected from 267 Bahrain Teachers College students.

Vargas *et al.* discuss whether the relationship between the use of ICT for learning in schools and outcomes in learners differs from developed to developing countries [2]. We used data from 236,540 learners attending 10,193 schools in 44 countries. The results conclude that policymakers should be cautious about replicating interventions and technological applications from developed to developing countries (and vice versa). Explore what factors influence the acceptance and learning of educators using ICT in vocational colleges in China [25]. Lomos *et al.* used data from 420 educators in Luxembourg, identifying that in a technology-based digitalization approach, educators' vision of the use of ICT in teaching, Level of expertise, and use of digital learning materials in the classroom is a significant support [25]. Research provides important information for governments in decision-making and schools on the future use of digital textbooks at the elementary Level [26].

Research by Antón-Sancho *et al.* found educators' perceptions of ICT integration into Mathematics teaching and learning in Ghanaian High Schools and found potential barriers hindering effective ICT integration, of which the population comprises all educators in the Greater Accra Region [27]. Analyzing digital concepts in universities during the COVID-19 pandemic on the habits of using Information and Communication Technology (ICT) professors in Science, Health, and Engineering involving 340 professors in these fields conducted by Budiman and Syafrony [28]. Croker's research aims to gain a comprehensive understanding of the digital literacy skills possessed by learners in the first year and how they affect student participation in online classes [29], involving 902 learners from 19 classes who filled out an online survey questionnaire. The results showed that students' digital literacy in the first semester was generally still in the low category.

From the literature review above, several interesting researchers are related to further research in the form of suggestions, including Mohamad, who suggests that future research focuses on empirical evidence to support educators' behavior toward ICT use [18]. Even Basri *et al.* further work is needed to observe all fields of scientific areas [20]. While Lomos *et al.* further studies may need to consider objectively collecting data related to ICT use behavior [25]. Using these suggestions, researchers tried to analyze students' behavior using ICT (Information Communication and Technology) in mathematics education (IAIN Syekh Nurjati Cirebon).

This study will discuss the Student behavior of Using ICT use indicator in TAM (Technology Acceptance Model) containing (1) perceived ease of use, (2) perceived usefulness, (3) attitude towards using, (4) behavioral intention to use, and (5) actual usage. This research focuses solely on using LMS, which has been implemented at the IAIN Syekh Nurjati Cirebon campus. At the same time, other media are only analyzed descriptively. This research is expected to obtain data predicting whether today's applications will survive. Therefore, this research is needed as a data source for future learning.

2. METHOD

The research approach used is quantitative. The research design used in this study is a survey research design. The type of survey used is a cross-sectional survey designed to measure the behavior of several populations through samples regarding the behavior of ICT mathematics students using TAM as an analytical framework in research. The research was conducted at the Mathematics Education in IAIN Syekh Nurjati Cirebon for approximately 4 months (August – November 2022). This study's population is all Mathematics Education students IAIN Syekh Nurjati Cirebon in the 2022/2023 academic year. Based on data from Higher Education, in the even semester of 2021, there are 627 active students in the Department of Mathematics Education IAIN Syekh Nurjati Cirebon. The samples were taken using the stratified random sampling method. Each batch will be taken from semesters I, III, V, and VII as samples, so the total number of classes taken as samples will be 9. Respondents who have filled out ICT usage behavior instruments are 258 students, while respondents who have filled out ICT mastery instruments are 265 students from a total population of 627. We ensured that all of the populations we used in this study had obtained consent from the participants and kept the data confidential.

Instruments used for the data collection process, namely the Student Behaviour of Using ICT instruments. The data collected in this study are the Student Behaviour Using ICT results, which will be collected using questionnaire sheets. Before the questionnaire is used, it will be tested to determine the instrument's feasibility. The instrument was validated by six experts (expert Judgment): 2 experts each in the field of mathematics education, two experts in the field of computer / ICT, and two experts in the field of educational psychology. The results obtained from expert Judgment were then analyzed using CVR (Content Validity Ratio) as in (1) [29], as follows:

$$CVR = \frac{n_e - \frac{N}{2}}{\frac{N}{2}} \tag{1}$$

Categorization to determine the level of reliability of instruments using classification according to Crocker [29]:

Table 1. Classification of reliability levels

No	Criteria	R-Value
1	Very High	>.90
2	High	.80 - .89
3	Acceptable	.70 - .79
4	Moderate	.60 - .69
5	Low/Unacceptable	<.59

The variables in this study are ICT Use Behavior and ICT mastery. ICT usage behavior is an individual's response or reaction when using ICT technology. The mastery of ICT is defined as the process, method, and act of mastering a technology or system that can reduce various limitations of space and time to move, retrieve, present, analyze, store, and convey data information into important information.

The data analysis techniques used are descriptive analysis and TAM (Technology Acceptance Model). Descriptive analysis will be used to describe the average value and standard deviation of ICT mastery data and ICT usage behavior. The TAM analysis will test the LMS acceptance developed by the IAIN Syekh Nurjati Cirebon campus. This LMS acceptance results from the behavior of using ICT students in Mathematics Education IAIN Syekh Nurjati Cirebon. 6 hypotheses will be analyzed using TAM analysis. The analysis process will use the help of SPSS software. The results of ICT mastery will be analyzed descriptively, and the assessment will use the categories proposed by Widoyoko [30]. The reference formula used is as follows:

Table 2. Widoyoko's categorization

Score Range	Criteria
$X_i + 1,8 S_{Bi} < X$	Excellent
$X_i + 0,6 S_{Bi} < X \leq X_i + 1,8 S_{Bi}$	Good
$X_i - 0,6 S_{Bi} < X \leq X_i + 0,6 S_{Bi}$	Enough
$X_i - 1,8 S_{Bi} < X \leq X_i - 0,6 S_{Bi}$	Less
$X \leq X_i - 1,8 S_{Bi}$	Very Lacking

3. RESULTS AND DISCUSSION

3.1. Result

The criterion for maintaining an indicator according to the CVR test is if the indicator is one and has a positive value (+). The CVR indicator should be discarded if it is negative (-). Based on validation tests by six experts, it was found that all behavioral indicators of ICT use were one or positive (+). Based on these results, researchers will use all indicators contained in the behavioral variables of ICT use. In addition, based on input from experts, researchers added an indicator "Able to use a photo, image, video, audio and programming software." The CVR value of all items is positive (with the highest value of 1 and the lowest

value of 0.7), so the value is valid and can be used. It was also obtained that the CVI value was 0.901. The reliability test used is the Guttman Spilt-Half Coefficient correlation test.

Reliability Statistics

Cronbach's Alpha	Part 1	Value	.962
		N of Items	55 ^a
	Part 2	Value	.945
		N of Items	55 ^b
Total N of Items			110
Correlation Between Forms			.699
Spearman-Brown Coefficient	Equal Length		.823
	Unequal Length		.823
Guttman Split-Half Coefficient			.821

Figure 1. Results table reliability of ICT use behavioral instruments

A reliability value of 0.821 in Table 4 means that the instrument has a high level of consistency, so it can produce a consistent score on each item and is feasible to use to examine student behavior using ICT.

The first variable discussed in the description of these results is the behavioral variable of ICT use using the TAM indicator. Table 6 displays the results of student behavior using ICT in PEU, PU, ATU, BIU, and AU aspects in each sample class and the average of all sample classes.

Table 3. Student behavior of Using ICT per TAM aspect

Semester_Class	PEU	PU	ATU	BIU	AU
Class A Semester 1	36	43	22	35	43
Class B Semester 1	32	42	20	33	41
Class C Semester 1	35	44	21	34	43
Class A Semester 3	39	50	22	37	45
Class B Semester 3	40	51	21	35	47
Class C Semester 3	39	47	22	36	46
Class A Semester 5	38	48	22	36	45
Class B Semester 5	38	49	24	38	46
Class C Semester 5	38	48	22	37	45
Class A Semester 7	39	54	26	41	47
Class B Semester 7	38	51	26	42	45
Class D Semester 7	40	50	24	38	48
Class E Semester 7	37	51	24	40	46
Means	37	47	22	36	45

The Student Behaviour of Using ICT Instrument consists of 50 statement items consisting of 10 PEU items, 12 PU items, 6 ATU items, 10 BIU items, and 12 AU items. For the results in Table 3 to be read and explained correctly, the data will be compared with

the categorization made by Widoyoko. The following is a comparison graph of Student behavior Using ICT results based on TAM aspects.

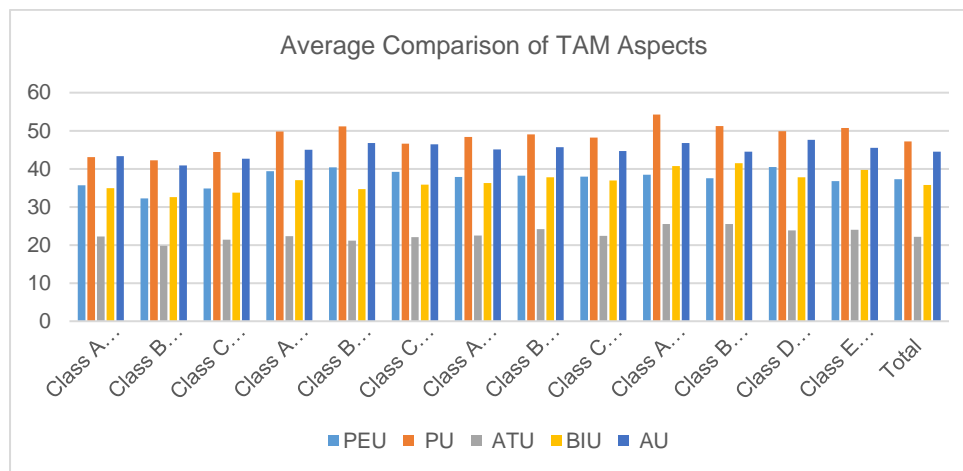


Figure 2. Student Behavior of Using ICT per TAM Aspect

After discussing the results of ICT use behavior per an aspect of TAM, this section will discuss the results of ICT use behavior as a whole and the average of all sample classes.

Table 4. Average of Student Behavior Using ICT

Semester_Class	Mean Total	Std. Deviation	N
Class A Semester 1	179	14,84618	30
Class B Semester 1	168	27,04243	29
Class C Semester 1	177	22,30846	29
Class A Semester 3	194	23,33428	33
Class B Semester 3	194	23,80887	24
Class C Semester 3	190	17,20091	19
Class A Semester 5	190	22,93727	23
Class B Semester 5	195	13,45708	22
Class C Semester 5	190	17,01131	26
Class A Semester 7	206	15,71358	4
Class B Semester 7	200	37,88909	4
Class D Semester 7	200	12,99440	11
Class E Semester 7	197	18,75056	4
Total	187	22,61458	258

Using Widoyoko's categorization, the average results of all classes showed a score of 187, including in the "good" category. Figure 3 shows a comparison graph of Student behavior results Using ICT in all sample classes.

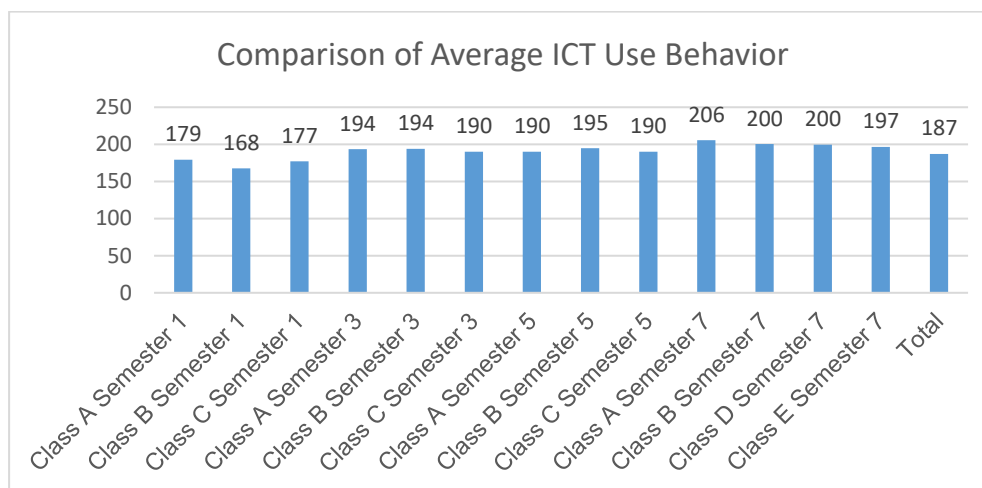


Figure 3. Average of Student Behaviour of Using ICT

3.1. Discussion

The first variable analyzed in this study is the behavioral variable of ICT use among Mathematics Education students, assessed through the Technology Acceptance Model (TAM) indicators: Perceived Ease of Use (PEU), Perceived Usefulness (PU), Attitude Toward Use (ATU), Behavioral Intention to Use (BIU), and Actual Use (AU). Table 5 presents the detailed scores across various classes and semesters, revealing several noteworthy trends. The PEU scores, which measure how easy students find ICT tools to use, average 37, with higher scores in Semester 7 classes, such as Class D achieving 40. This suggests that senior students are more comfortable using ICT tools than Semester 1 students, where scores like Class B’s 32 indicate the need for foundational ICT training for newer students.

In the PU aspect, which reflects students' perceptions of ICT usefulness, the average score is 47, making it the highest-performing TAM indicator. PU scores tend to increase across semesters, with Semester 7 students showing the most substantial results, such as Class A achieving 54. This indicates that as students progress academically, they increasingly recognize the benefits of ICT tools in supporting their learning processes. On the other hand, Semester 1 students score lower, reflecting an initial lack of awareness or experience with ICT’s potential advantages, emphasizing the need for early-stage interventions to highlight its usefulness.

The ATU scores, which assess students' attitudes toward using ICT, average 22, the lowest among all TAM indicators, with minimal variation across classes and semesters. This result suggests that while students may recognize ICT tools' ease of use and usefulness, their enthusiasm and motivation to adopt them remain moderate. This could stem from a lack of engaging ICT experiences or confidence in their abilities. Therefore, efforts to improve attitudes, such as introducing innovative ICT-based learning activities or showcasing success stories, are necessary to foster positive perceptions. The ATU results of this study are very low because only six items are used, and in the future, it is hoped that ATU items can be added to be balanced with other items to increase students' attitudes towards ICT.

Regarding BIU, which measures students' intention to use ICT tools, the average score is 36, with Semester 7 classes achieving higher scores, such as 42 in Class B. This

upward trend indicates that senior students develop stronger intentions to utilize ICT as they advance, likely due to growing academic demands and experience. However, lower scores in Semester 1 highlight the importance of fostering intentional ICT use early on. Lastly, the AU scores, representing actual ICT usage, average 45, reflecting consistent ICT adoption behavior across semesters, with Semester 7 classes like Class D scoring 48. This trend aligns with the higher PEU and PU scores observed among senior students, suggesting that familiarity and recognition of ICT benefits translate into consistent usage.

Compared to Widoyoko's behavioral categorization, the results for PEU, PU, ATU, BIU, and AU aspects fall into the "good" category, indicating satisfactory ICT usage behavior among students. However, the lower ATU scores highlight a gap that must be addressed to drive more effective ICT adoption. The findings suggest a gradual improvement in ICT readiness as students progress through semesters, but a focused effort is needed to enhance students' attitudes toward ICT. Educators must prioritize foundational ICT training for new students, introduce engaging and motivational ICT-based activities, and ensure consistent access to reliable ICT tools and infrastructure. By addressing these areas, students' ICT usage behavior can improve significantly, moving closer to the "very good" category and enhancing their ability to maximize ICT tools in learning.

3.3. Research Limitation

Research on the behavior of using ICT students of Mathematics Education IAIN Syekh Nurjati Cirebon has limitations, namely: The research sample or respondents used were limited to students of Mathematics Education IAIN Syekh Nurjati Cirebon. In addition, there are several obstacles when conducting surveys, so not all 7th-semester students enter the sample or become respondents. At the same time, semester 9 students are not the target sample or respondents because some students have graduated and others are doing a thesis, so it is not affordable when the survey is conducted. Future research could address these limitations by involving students from different programs or institutions and using mixed methods, such as combining surveys with interviews or focus groups, to gain deeper insights. Longitudinal studies could also track changes in ICT behavior over time as students progress academically and adapt to new technologies.

4. CONCLUSION

This study provides insights into the behavior of mathematics education students at IAIN Syekh Nurjati Cirebon who use ICT through an LMS (Learning Management System). The research effectively captured data from a diverse sample across different academic levels using a quantitative approach with a cross-sectional survey design. By applying the TAM model's aspects—perceived ease of use, perceived usefulness, attitude towards usage, behavioral intention, and actual usage—the developed instrument was rigorously tested for validity and reliability, achieving a minimum CVR score of 0.99 and a reliability coefficient of 0.821, demonstrating both high validity and consistency. With an average student behavior score of 187, classified as "good," these findings underscore a favorable adoption of ICT through LMS usage, suggesting that students are well-adapted to utilizing digital tools in their learning process. This study highlights students' readiness and favorable

disposition toward ICT, contributing valuable insights for enhancing LMS-based learning strategies at IAIN Syekh Nurjati Cirebon.

Future research related to ICT mastery is recommended using the same model or other models besides TAM or by adding and developing TAM indicators. Furthermore, the questionnaire questions about behavioral intention to use (BIU) should be deepened. If necessary, conduct an in-depth interview regarding satisfaction in using the LMS. With in-depth interviews, researchers can use qualitative methods to obtain qualitative results that will enrich research results.

ACKNOWLEDGEMENTS

Thank you to the Ministry of Religious Affairs of the Republic of Indonesia, Rector IAIN Syekh Nurjati Cirebon and LPPM IAIN Syekh Nurjati Cirebon for funding this research from LITAPDIMAS 2022 at IAIN Syekh Nurjati Cirebon, with contract number: 122/In.8/L.I/TL.01/06/2022 on behalf of Darwan, Sirojudin Wahid, and Shintia Bella Ningtias. Thank you also to mathematics education students who are willing to become research objects.

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