Learning management system instrument development based on Aiken’s V technique

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ABSTRACT

The use of the learning management system (LMS) at the Malaysian Polytechnic is constantly changing according to the current situation. In addition, the relatively low acceptance of LMS in technical and vocational education training (TVET) institutions requires further study. This paper will discuss accurate construct of measurement for LMS TVET using expert consensus through Aiken's V analysis. Based on the analysis coefficient and the reliability of the content, several important constructs have been identified involving system quality, information quality, service quality, motivation, user satisfaction, intention-to-use, self-discipline, practical training, and actual use. Through quantitative analysis, every item in constructs is calculated and reviewed by an expert in order to validate the items. The minimum validity value accepted in this study is 0.75 based on Aiken’s V table, thus, two items were rejected. These items were rejected due to the same meaning and being inappropriate. This study proves the instrument’s content validity based on expert agreement using the Aiken agreement index. This study contributes to a suitable instrument for measuring LMS in TVET for use in subsequent studies.

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1. INTRODUCTION

Today's new challenge for the technical and vocational education training (TVET) sector is to meet the demand for post-industrial human resources due to changing jobs and competent and knowledgeable people [1]. With no exception, polytechnic institutions are among the institutions that actively use learning management systems (LMS) in their teaching and learning. LMS help to increase the capability of teaching, communication, monitoring and evaluation of student learning effectively. To ensure that the use of LMS is used to the maximum, it is necessary to identify constructs that influence the use of LMS [2]. Understanding the system used allows interest and the system to be used continuously. Some academics emphasize the importance of information system content in attracting users to return to it [3]. Users of LMS stress system availability during periods with significant demand, while others are also interested in the information found in an LMS system. There are questions related to the use of LMS in TVET institutions, whether it is used fully or whether there are other constraints. Some studies show inconsistent use of LMS from year to year [4]. A study by Mpungose and Khoza [5] also shows that students are less interested when using LMS.

There are numerous issues that develop, such as poor student motivation, the availability of student and instructor facilities, and changes in student learning styles [6]. According to Delone and McLean [7], there are six factors that influence users to use information systems: system quality, information quality, service quality, intention to use, user satisfaction, and net benefit. The COVID-19 epidemic showed the necessity for active online learning to improve the online learning system [8]. Researchers must first define crucial LMS supporting criteria to ensure that the online learning objective is met [9]. The study by Al-Hunaiyyan *et al*. [10] also identified several obstacles that prevent the use of LMS involving student interaction with the system, interface complexity, student readiness, as well as student awareness and confidence in the potential of LMS and the functionality of tools and resources that enrich the teaching and learning process. Online learning systems are also closely related to student satisfaction factors; this is important to ensure the long-term investment of a system and avoid a low system acceptance rate.

Therefore, using LMS in learning activities can help students improve their skills and master the learning experience [8]. According to Fernando *et al*. [11], a good system refers to a quality system that facilitates users. A good system is also linked to the information and services provided to users. Although there have been several studies on LMS, only a few have examined its usage in TVET institutions [12]. Therefore, this paper will study a suitable instruments and items for measuring LMS use in TVET institutions. The aim of this paper is to discuss the development of the constructs focusing on its content validity to present a comprehensive instrument. The remainder of this paper has been structured as follows. The first section will describe LMS in TVET. This study also discusses the content validity method for instrument development. The subsequent section discusses the study methodology, followed by sections on the expert evaluation, findings and discussion. The acquired results will be summarized at the end of this study.

2. LEARNING MANAGEMENT SYSTEM IN TVET

The use of LMS in TVET differs from conventional LMS because TVET education involves transferring technical knowledge [13]. The implementation of LMS in TVET institutions differs from conventional educational institutions because the education of technical institutions emphasizes not only cognitive skills alone but also technical (psychomotor) skills [14], [15]. Therefore, the developed LMS for vocational education needs to consider students' needs and characteristics and the current progress in science and technology [16]. A good system is also linked to the information and services provided to users [11]. The availability of other supports such as technical and resource are also important for the continuance usage of the distance learning system [17]. Additionally disciplined users can also ensure continuous use of the system [18]. Implementing online video lectures allows students to focus more on their studies. This method sometimes makes students less satisfied and skilled because there is no social activity with their peers. In addition, knowledge sharing enables self-learning skills through shared learning materials [1]. Discipline also helps students stay focused, manage their time effectively, and complete their tasks independently. This is important in LMS learning in TVET, where students must work independently and take initiative to seek resources and support when needed. In TVET, practical training is a fundamental component that provides students with skills and knowledge. It helps bridge the gap between theoretical knowledge and practical skills, enabling students to apply what they have learned in real-world contexts. Through the LMS TVET, students can understand the concept of TVET more clearly before the actual training is carried out.

3. RESEARCH METHOD

3.1. Content validity

Content validity is important in instrument development and evaluation [19]. This process is done by using professional judgment and involving experts in the field. Aiken's V is a technique used mainly in content validation studies since the 1980s. This technique has guided users in accepting or rejecting research instruments. This validity analysis technique to evaluate the instrument's content validity was developed based on Aiken's V formula [20], [21]. The validity coefficient of Aiken (V) is the analytical approach used to assess the significance of each test construct and is determined using expert consensus [22]. The amount to which the measures utilized can accurately represent the idea, as well as the extent to which the selected items correlate to the construct, is referred to as validity. According to Retnawati [23] who compared the validity coefficient scale to Aiken's V formula and the Gregory formula, Aiken's V formula is more stable in obtaining the output validity coefficient scale. In addition, the findings also show that the validity coefficient calculated using Aiken's V formula is higher than other methods. Aiken's V was used for the content validity study for this study [24]. The formulas of Aiken can be shown in (1):

$$V = \sum_{[n(c-1)]}^{S} \quad (1)$$

The "V" refers to the agreement index of validators in regards to item validity; "s" is the assessment score of validators subtracted by the assessment's lowest score; "n" refers to the number of validators; "c" is the number of categories that validators can choose. All test items are valid if the value of Aiken's V index falls under the range of 0.37 to 1.00 [25]. A study by Fibonacci *et al*. [26] also agreed that a validity value over 0.40 is acceptable. The closer an item is to 1, the better it is because it is more relevant to the items and constructs [23]. The value of Aiken's V of every test item was calculated based on the assessment items of every validator. There was also an evaluation process in this stage, i.e., revising questions by following validators' corrections and suggestions. Following Aiken's method, the content validity coefficient (V) indicates the significance of each item in the constructs. As stated, the content validity is determined by expert judgment and relies on expert consensus for major elements in the proposed constructs. In this paper, the process of validating the content of the instrument was carried out by submitting questionnaires to an expert to analyze quantitatively and qualitatively. Expert evaluation methods are among the most popular in validating constructs and items [27]. Involving experts in the construct under study increases the fidelity of the process and supports consistency between the final measure and the original theory guiding the construct.

Experts in their fields are recognized because of their extensive knowledge and experience. They are responsible for carefully reviewing suggested items before determining whether or not to accept it. Typically, two categories of experts are contacted for content validation: professional experts and lay experts [28]. Professional experts are those who have studied or worked in the field, whereas lay experts are those who are knowledgeable about the subject under study. The selection criteria for experts include a background in the research field, relevant job experience, the ability to provide varied opinions, and current knowledge. The experts' task is to determine whether the indicators are suitable for the material covered and check the development of the instrument is appropriate and suitable. All the experts must fill out the validation assessment sheet for the content validation process to be quantified. The seven experts assessed the observation rubric item by filling in the score (score 1=irrelevant, score 2=less relevant, score 3=quite relevant, score 4=relevant, and score 5=highly relevant). Based on the entries of seven experts, the researcher then calculates the expert agreement index as a validator using Aiken's table [20].

3.2. Instrument design

Instrument development relies on content validity to determine whether items measure specific domain content. Content validity depends on the extent to which the measure accurately describes the intended content domain. It refers to conceptualizing statements to develop a scale for the study. If the researcher has focused too closely on only one type or narrow dimension of a construct or concept, then it is conceivable that other indicators have been overlooked. In such cases, the study lacks content validity. An estimate of the content validity of a test is obtained by thoroughly and systematically examining the test items to determine the extent to which they reflect and do not reflect the content domain. Based on a study conducted by Ahmad *et al*. [4] nine constructs and 55 items have been identified, as shown in Table 1.

3.3. Research design

The research design refers to the systematic sequence of steps and activities researchers follow to conduct a study, gather data, analyze information, and draw conclusions. It is a structured approach to ensuring that research is conducted rigorously and organized, leading to reliable and valid results. There are several techniques in the development of research instruments. For this research paper, the researcher adapted the methods used by previous researchers in the development of research instruments. Adapting the previous research design allows the researcher to save research time. In addition, this method is reliable because the research design used has gone through the process of validity and reliability in previous studies. According to Alias *et al*. [29], there are six steps in the instrument development process as shown in Figure 1.

3.3.1. Step 1: develop a conceptual procedure for the constructs

Based on the literature review, a conceptual framework has been developed to assess the acceptance of using the LMS among users in Malaysian polytechnics. Nine constructs that influence the acceptance of LMS among users in Malaysian polytechnics were identified. The constructs are system quality, information quality, service quality, user satisfaction, intention-to-use, motivation, self-discipline, practical training and actual use.

3.3.2. Step 2: generate the items to for the constructs

According to Harvey *et al*. [30], at least four items per scale are needed to test the homogeneity of items within each latent construct. While Worthington and Whittaker [31], suggested at least two items. Hair *et al*. [32] also suggest in order to provide stability, each construct should have at least three items. For this study, researchers prepared five items for each construct. Items are selected based on high weighted values, as low weighted values are constructs that are not properly measured.

Table 1. Constructs and items of LMS acceptance

No	Constructs	Items	Number of Items	No	Constructs	Items	Number of Items
1	System quality	• Ease of use • Availability • Functionality • Flexibility • Usability • Integration • Adaptability • Ease of learning • Convenience • System features	10	2	Information quality	• Understand ability • Conciseness • Completeness • Timeless • Usability • Usefulness • Format	7
3	Service quality	• Responsiveness • Reliability • Tangible • Assurance • Empathy	5	4	Motivation	• Obstacle • Rewards • Enjoyment • Environment • Motivation	5
5	Self-discipline	• Commitment • No delay • Self-direct learning • Clear goals • Awareness	5	6	Intention to use	• Frequency of use • Extent of use • Purpose of use • Trust • Appropriateness of use	5
7	User satisfaction	• Effectiveness • Efficiency • Compatibility • Information satisfaction • System satisfaction • • •	5	8	Practical training	• Psychomotor • Imitation • Manipulation • Precision • Articulation • Naturalisation • Perception • Guide response	8
9	Actual usage	• Improved services • Cost reductions • Improved decision-making • Improved productivity • Improved creativity	5				

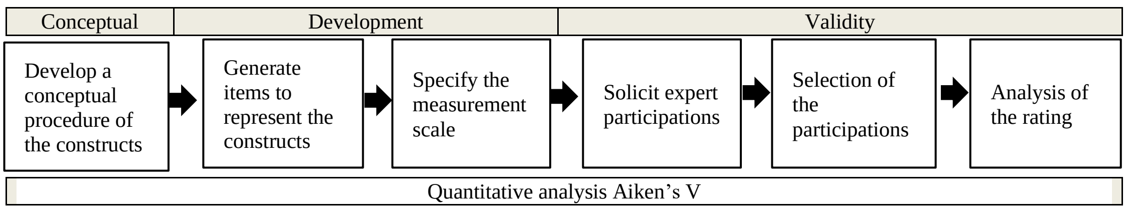

Figure 1. Instrument development process

3.3.3. Step 3: specify the measurement scale

The researcher can use several perspectives on the measuring scale in this study. According to Likert [33], a Likert scale may be used to determine the rate or degree of agreement with a question. The muti-item Likert scale has been widely used in technology acceptance studies [34], [35]. For this study, 5-point Likert scales were used as measurement scores. With score 1=irrelevant, score 2=less relevant, score 3=quite relevant, score 4=relevant, and score 5=highly relevant.

3.3.4. Step 4: solicit expert participation

The formal invitation to participate in this study was sent by email to the panel of experts by enclosing i) a cover letter and ii) a review of the content material. The expert panel is given a week to complete the online form. Before filling out this form, the expert panel is briefed on the study conducted before the expert verification process. All recorded answers are confidential. A panel of experts who had given consent to participate in the study was given a date and time for a determined interview session online or offline.

3.3.5. Step 5: selection of the participation

There are several different views on the number of experts involved in research. From Aiken's V table, at least two experts must involve in the content validity study. This view differs from Lawshe [36], who suggested that the expert panel should consist of at least four people. Allahyari *et al*. [37] suggested 8 to 16 experts, while Nor'ashikin *et al*. [28] argued that an expert panel should consist of 2 to 20 people. This study involved seven experts from Malaysian Polytechnics and the Department of Polytechnic Education. All experts were involved in the LMS implementation in the technical and vocational fields as seen in Table 2. These experts were chosen based on the following factors: i) knowledgeable and experienced in the technical field and vocational, and ii) experienced in developing and implementing LMS in technical and vocational studies.

Table 2. Expert's profile

Expert ID	Organization	Year of experience	Expertise
Expert 1	Polytechnic	20	Tech & vocational
Expert 2	Polytechnic	19	Tech & vocational
Expert 3	Polytechnic	15	Tech & vocational
Expert 4	Polytechnic	20	Tech & vocational
Expert 5	Polytechnic	18	Tech & vocational
Expert 6	Industry	14	Information technology
Expert 7	Industry	20	Information technology

3.3.6. Step 6: analysis of the rating

The information obtained from an expert is reviewed and evaluated based on the expert's overall acceptance and rejection. Items from constructs that meet the criteria are accepted and taken to the next level of the study. The expert panel discusses its findings in next section.

4. RESULTS

Content validity analysis is a set of procedures performed by experts to review a construct. The experts review the blueprint of the instrument, its content, and sources of the data for the instrument. As a result of the evaluation by seven experts as validators have used the item validity formula suggested by the Aiken index, the researcher calculated each item to obtain the best validity value. From the calculations done, it shows a high coefficient and concludes the validity agreed between the experts. According to Aiken [20], based on Aiken's V table, the minimum value accepted for seven experts must be above 0.75. The Fibonacci study [26], also agrees with this recommendation, which examines the significance of validation for e-learning systems that set a validity value above the minimum value of 0.40 as acceptable as presented in Table 3. Even so, according to Aiken's method, the closer an item is to 1, the better its value is because it is more relevant in representing indicators [23].

Table 3. Aiken's validation criteria

No	Index	Category
1	0.81-1.0	Very good
2	0.41-0.80	Good
3	<0.4	Very poor

Source: Fibonacci [26]

From Aiken's formula, the content validity coefficient (V) is measured to indicate how significant each item is in the instrument. Based on expert judgment, two items were invalid and eliminated from the instrument because they could not meet the minimum requirement (V>0.75). Two rejected items were system features (V=0.714) from system quality construct and guide response (V=0.678) from practical training construct. Among the issues raised by these experts on the two invalid items is the meaning that is almost the same as other items and items that are inappropriate. Overall, the panel of experts agreed with the items presented in the instrument. In conclusion, 53 items are valid and reliable based on expert judgment (see Table 4). It means that the instrument meets the content validity requirements. A total of 53 important items have been identified based on expert judgment to be used in the next stage of the study.

Table 4. Result of content analysis using the Aiken's V formula

No	Items	V index	Status	No	Items	V index	Status
1	Item 1	0.857	Valid	29	Item 29	0.678	Invalid
2	Item 2	0.928	Valid	30	Item 30	0.821	Valid
3	Item 3	0.892	Valid	31	Item 31	0.785	Valid
4	Item 4	0.892	Valid	32	Item32	0.857	Valid
5	Item 5	0.892	Valid	33	Item 33	0.785	Valid
6	Item 6	0.857	Valid	34	Item 34	0.821	Valid
7	Item 7	0.785	Valid	35	Item 35	0.892	Valid
8	Item 8	0.821	Valid	36	Item 36	0.857	Valid
9	Item 9	0.857	Valid	37	Item 37	0.821	Valid
10	Item 10	0.714	Invalid	38	Item 38	0.785	Valid
11	Item 11	0.821	Valid	39	Item 39	0.821	Valid
12	Item 12	0.928	Valid	40	Item 40	0.821	Valid
13	Item 13	0.892	Valid	41	Item 41	0.750	Valid
14	Item 14	0.821	Valid	42	Item 42	0.785	Valid
15	Item 15	0.928	Valid	43	Item 43	0.821	Valid
16	Item 16	0.892	Valid	44	Item 44	0.857	Valid
17	Item 17	0.785	Valid	45	Item 45	0.785	Valid
18	Item 18	0.857	Valid	46	Item 46	0.750	Valid
19	Item 19	0.750	Valid	47	Item 47	0.785	Valid
20	Item 20	0.928	Valid	48	Item 48	0.785	Valid
21	Item 21	0.928	Valid	49	Item 49	0.750	Valid
22	Item 22	0.892	Valid	50	Item 50	0.821	Valid
23	Item 23	0.857	Valid	51	Item 51	0.785	Valid
24	Item 24	0.785	Valid	52	Item 52	0.821	Valid
25	Item 25	0.821	Valid	53	Item 53	0.750	Valid
26	Item 26	0.785	Valid	54	Item 54	0.785	Valid
27	Item 27	0.857	Valid	55	Item 55	0.821	Valid
28	Item 28	0.785	Valid				

5. DISSUSSION

The researcher's firsthand experience in systematically developing a comprehensive instrument, step by step, can serve as a valuable guide for the design of a questionnaire tool. This study can also be used as a resource for future scholars in their respective domains. The establishment of a complete and orderly instrument can increase research management quality while delivering good and dependable outcomes. As a result, poor instruments are incapable of producing high-quality outputs, resulting in questionable conclusions. The instrument needs to be valid and accurate and can be used to measure the level of acceptance of LMS in technical and vocational institutions. In this study, the expert panel rejects the item system complexity because there is an exact meaning of system complexity with other items. According to Al-Rahmi *et al.* [38], complexity refers to the degree of difficulty in understanding the innovation and its perceived ease of use by the end-user. A study also states that the more complex a system is, the less interest users have in using it. Furthermore, complexity will reduce the usability of the system by students [39]. It shows that students are more interested in an easy-to-use LMS system. This study is similar to previous researchers' statements stating the LMS system needs to be more flexible for students to build knowledge together, motivate, and communicate to create an efficient online and collaborative learning environment [40].

System availability, system conciseness, system usability, system tangible and system assurance are among the items that received the highest value from the list of items. These items which experts believe are the main items for the technology construct. Among the five items, system availability is an item that is considered as important to attract students to use LMS TVET. A good system is when it can be accessed at any time and any place. High system availability is also related to access to learning resources involving course materials, assessment tasks and other resources to facilitate learning. High system availability contributes to user satisfaction, engagement and motivation, as students can rely on the system for their educational needs without frequent interruptions or downtime. In addition, students can focus more on learning objectives. System simple and easily accessible information can attract users and encourage students to use the system. In the quality of service, computer readiness and equipment that must be available before LMS is used. Readiness usage to use the LMS service is also affected by the LMS warranty. In the context of tangible, system availability can be related to the hardware and infrastructure components that support the system. A well-designed and well-maintained physical infrastructure, including servers, network equipment, power supplies and backup systems, ensures high system availability while minimizing the risk of failure and downtime. High system availability is also an important aspect of ensuring system reliability.

Finally, the use and satisfaction of the e-learning system increases the success of the online learning system. The technology and satisfaction of LMS can help students improve their classwork, knowledge and self-efficacy. Even though the panel of expert were carefully chosen, more insights can be gained and the study can be enhanced by incorporating more experts from a wider range of topics in the scope of our research.

6. CONCLUSION

This research has emphasized strategies to validate the content of a survey instrument created to explore the elements that drive the use of LMS among TVET users. Aiken's V technique was proven to get expert agreement clearly and quickly. A total of 55 items from nine constructs were reviewed by a panel of experts, with two items being rejected. The results of the 53 improved items will be distributed in the next phase of the pilot test by allocating the questionnaire to the intended respondents. A major limitation of previous studies is that they mainly focused on measuring the use of typical LMS systems. In other words, most existing research focuses on non-technical institutional users. Therefore, the intention to use LMS by those in the technical field is not considered. The advantage of this research is that the success factors of LMS TVET can be identified to prevent the development of the LMS TVET system from failing to be implemented appropriately. Even so, the researcher's study at this stage only involves a small number of respondent and has yet to be tested with actual respondents. The researcher’s investigation at this stage also involves LMS usage on computer. It does not include specialization in using gadget such as smart phone and tablet which can subsequent researchers can study. For future study, it is suggested that the study also consists of the scope of the respondents from other TVET institutions in the survey to obtain a more comprehensive research result.

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