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Measuring Virtual Learning Environment Success from the Teacher's Perspective: Scale Development and Validation

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Abstract. This paper reports on the development of an instrument designed to measure the VLE success (VLES) amongst teachers. The items for VLES instrument were constructed in several steps including items' face validation, content validation and reliability analysis. Forty-five final items have been produced after the analyses, with the deletion of 33 initial items. This validated VLES scale will be useful for future researchers in developing and testing VLE models or theories while at the same time will provide the tool for VLE stakeholders to evaluate the implementation from the teachers' point of view.

INTRODUCTION

Virtual Learning Environment (VLE) is defined as a type of Information Systems (IS) that enables schools to manage their educational resources, and support the conventional classroom and distance education [1]. The central theme of this system is the capability to defy the barriers of time and location, as it allows asynchronous teaching and learning where the teachers and student no longer have to be physically present at the same place [2]. Even so, the VLE still retain the nature of traditional learning by providing the basic functions such as management, assessment and communication. Since it was first introduced, various type of VLE has been develop to suit the miscellaneous educational setting including higher institutions and schools. Among them, the most prominent are such as Blackboard, Moodle and Frog. Despite the large-scale investment to implement VLE, the issue of low usage, particularly among teachers, is commonly heard, which indicates that the system is not on the right track of success. In order for VLE applications to be used effectively by teachers, we need dependable ways to measure the success of the system. Besides, the evaluation of VLE success has been recognized as an essential process in managing this type of system [3]. The development and implementation of VLE are costly and thus requires strong justifications, particularly in the form of benefits that it conveys to the teachers. Hence, the empirically validated instrument is necessary for the researchers and practitioners to examine the level VLE success [4].

THEORETICAL UNDERPINNINGS

From the literature, we found that the evaluation of VLE success could be engaged using the updated DeLone and McLean IS Success Model (D&M) [5]. Previous studies have proved that this model fits all the measurement for IS success evaluation [6], [7]. The D&M aim to produce a comprehensive understanding of IS success by describing the inter-relationships between six identified dimensions, namely Information Quality, System Quality, Service Quality, Use, User Satisfaction and Net Benefits. Looking at the trend of studies conducted to date on the D&M model, majority of them have only adopted selected parts of the model for measurement and assessment [8]. According to DeLone and McLean [5], IS success involves the interrelated dimensions, therefore it should not be

measured based on only single dimension. This stance implies that several studies that concentrate on the only certain dimension of IS success, such as, IS usage [9], [10] or user satisfaction [11], [12] are incomplete in the perspective of IS success research discipline. In light of this, Urbach and Müller [8] recommended the application of the entire model as an attempt to present a holistic approach and to extend the overall validity of D&M Model. Additionally, DeLone and McLean [5] also suggest that the application of D&M should consider the context of IS under investigation. They further encouraged the future researchers to continue enhancing and refining the model to suit the variability of IS research disciplines. Therefore, we respond to this suggestion by retaining all the original constructs and the relationships between these IS success dimensions. However, the current use and the future intention to use are two different dimensions that are interrelated to each other [13]. The current use is expected to influence future intention to use. Given this point, DeLone and McLean [5] added that the positive initial use would lead to greater user satisfaction and thus lead to intention to use again. As a result, the use is also expected to increase. Building on these arguments, we propose the separation of these two dimensions. By doing so, it will allow the future researchers to examine the issue of VLE continuous usage and will increase the explanatory power of D&M [13], [14].

MEASUREMENT SCALE

From the literature, we found that there are many possible items to measure VLE success. After conducting a thorough review on the related topics such as IS success, e-learning satisfaction and IS usage, we had managed to create a pool of 78 items, which represent seven dimensions (see Table 1). These items were further adjusted to ensure the precise wording and to meet the scope of the study.

TABLE 1. Measurements for VLE Success amongst Teachers

Construct	Measurements	Sources
Information Quality	Accuracy, Relevance, Sufficiency, Format, Currency, Timeliness & Reliability.	[15]-[17]
System Quality	Availability, Usability, Accessibility & Reliability.	[18]-[20]
Service Quality	Responsiveness, Assurance, Empathy & Tangible.	[12], [21], [22]
Intention to Use	Future Intention to Use/Reuse	[17], [23]
Use	Regularity of Use, Nature of Use	[18], [13]
User Satisfaction	User Survey, Enjoyment & Overall Satisfaction.	[15], [20], [24]
Net Benefits	Time-Saving, Improved Productivity & Personal Valuation.	[4], [25]

SCALE PURIFICATION

Face Validity

We conducted face validity of the instrument in two phases. During the first phase, the pool of items for each variable has been created, retrieved from the literature. Then, these items were presented to six experts, which consist of one language expert to check the grammar and language structure, three experts in IS and e-learning to check for accuracy of the items (double-barreled, ambiguity, leading questions etc.) and two statisticians to check the scale development. Later in the second phase, the instrument has been pre-tested to 16 participants using focus group procedure. The sampling procedure for this instrument pre-testing was systematically designed to ensure that it represents each of characteristics of real respondents. The time for answering the questionnaire was recorded for every participant with the average time of 19.75 minutes. After that, the discussion session has been conducted to get the consensus among the participants. From this session, a number of issues and suggestions regarding the bilingual applicability, sentence structure, the number of items and scales have been captured. Based on the feedbacks, all the experts (phase one) and respondents (phase two) are satisfied with face validity of the VLES instrument.

Content Validity

We reduced the number of items in the pool based on the analysis of content validity by a group of experts. To determine the consensus among them, the analysis of content validity is done using Content Validity Index (CVI). The CVI is the measurement of the item's appropriateness to represent the certain construct under investigation [26].

The content validity should be validated by three to ten experts. Nevertheless, a minimum of six experts are required to control the disagreement among them [27]. Accordingly, our VLES items were validated by seven experts in IS, E-learning and ICT in education. Each of them has been provided with sufficient information on the objectives and research questions of the study, research model, hypotheses and the instruction for CVI rating. All the experts have rated the instrument items based four scales (1 = Not Relevant, 2 = Somewhat Relevant, 3 = Quite Relevant, 4 = Highly Relevant), as suggested by [28]. The CVI value can be calculated based on each item (i-CVI) and the overall scale (s-CVI) [26]. The acceptable cut-off point for i-CVI using seven experts is 0.78 [27]. On the other hand, s-CVI can be calculated using s-CVI/UA (Universal Agreement method) and s-CVI/Ave (Averaging method) [26]. As for the current study, we have choose the s-CVI/Ave with the cut-off value of 0.8 [28]. Table 2 summarized the CVI analysis of our study.

TABLE 2. Analysis of Content Validity

Construct	Initial Items	Removed Items	s-CVI/Ave
Information Quality	10	3	0.86
System Quality	19	12	0.81
Service Quality	18	9	0.81
Intention to Use	6	2	0.81
Use	12	3	0.88
User Satisfaction	7	3	0.82
Net Benefits	6	1	0.93

Factor Structure

Using the pilot data, the Exploratory Factor Analysis (EFA) is carried out to identify the factor structure. EFA also allow the researchers to confirm the consistency of the extracted factors from the real data and the theoretical perspective [29]. Therefore, instead of running the EFA procedure to all 45 items at once, we execute it based on each construct. This is mainly because we adopt the items from the sources that already been used to measure the particular construct. In this sense, our aim is only to confirm the structure of these items. Hair et al. [29] recommended the following common rules based on certain cut-off values in conducting EFA; Sphericity Bartlett Test < 0.5 , Kaiser-Meyer-Olkin (KMO) > 0.8 , Factor Loading ≥ 0.5 , Communalities ≥ 0.3 , and Eigen Value ≥ 1.0 . All the VLES items are above these values (see Table 3); therefore, no deletion of the item was done during this procedure.

TABLE 3. Summary of EFA Result

Construct	KMO	Eigen Value	Bartlett Test	Item with Factor Loading < 0.5	Item with Communalities < 0.3	Deletion
Information Quality	0.93	5.94	0.00	-	-	-
System Quality	0.89	5.49	0.00	-	-	-
Service Quality	0.93	7.46	0.00	-	-	-
Intention to Use	0.86	3.57	0.00	-	-	-
Use	0.91	7.36	0.00	-	-	-
User Satisfaction	0.81	3.68	0.00	-	-	-
Net Benefits	0.87	4.53	0.00	-	-	-

Reliability

We use the Cronbach alpha (CA) value as an indicator of internal consistency of each variable. The CA value should be greater than 0.7 to assure the reliability coefficient of an item. However, the value of 0.6 is considered as acceptable for the exploratory type of studies [29]. According to the basic rules, the item that did not contribute to the increment of CA should be deleted. Nevertheless, our result indicated that no item is below the threshold value, and thus should not be removed. Moreover, the data from our pilot study has shown that the values of CA are within 0.95 to 0.97 (see Table 3). Therefore, we concluded that our instrument achieved a high level of construct reliability.

TABLE 4. Result of Reliability Analysis

Construct	Initial No. of Items	Initial CA	Final No. of Items	Final CA
Information Quality	7	0.97	7	0.97
System Quality	7	0.95	7	0.95
Service Quality	9	0.97	9	0.97
Intention to Use	4	0.96	4	0.96
Use	9	0.97	9	0.97
User Satisfaction	4	0.97	4	0.97
Net Benefits	5	0.97	5	0.97

IMPLICATION FOR PRACTICE

The analysis that we have presented in the earlier section has produced 45 items instrument with good psychometric attributes to measure VLE success among the teachers. More importantly, we have successfully developed and validated factor structure of the updated D&M which applies to any type of VLE, e-learning or Learning Management Systems (LMS). In addition, our study also provides several directions for effective VLE management. Based on the empirical evidence provided, it is apparent that the multifaceted approach to evaluate VLE success is crucial. Parallel to the suggestion by DeLone and McLean [5], it is very significant for the VLE stakeholders such as the service provider and policymakers to consider every level of VLE success, which are technical-semantic level (Information, System and Service Quality), and effectiveness level (Intention to Use, Use, User Satisfaction and Net Benefits). Thus, we strongly believed that it is very wise for them to view the VLE success in various angles and to promote the sustainable VLE adoption. Considering that notion, we conceived that the main advantage of our validated instrument is to allow the stakeholders to examine the success of VLE implementation from the teachers' perspective. This evaluation will hand over fast feedback that is useful for further enhancement of the system.

IMPLICATION FOR RESEARCH

IS success in an interdependent and multi-dimensions construct, therefore should not be measured on a single dependent variable such as usage and user satisfaction [5]. We totally agree with this notion as we add the Intention to Use as a complement to the construct of Use, which will allow the researchers to investigate the issue of continuous usage. As a result, we hope that this instrument will provide a better explanation for VLE success. The VLES instrument is applicable for researchers to develop and test the hypotheses related to VLE success. For instances, future research might be interested to investigate the relationships between our proposed factors or to compare the effect of those factors between certain groups of respondents.

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

Since this instrument was developed under the Malaysian education setting, its applicability to other settings might be restricted. In that case, the future studies should focus on investigating other external factors that represent the local scenario of VLE implementation. However, we still believe that the seven main success dimensions (Information Quality, System Quality, Service Quality, Intention to Use, Use, User Satisfaction and Net Benefits) are pertinent across various setting regardless of the cultural, economic and political discrepancies. Another limitation of our proposed instrument is that it is developed to measure VLE success among the teachers only. Hence, we highly encourage the future researchers to extend our study by validating this instrument to other VLE users such as student, administrative staff or parent.

CONCLUSION

The primary contribution of our study is to set up an initial effort to investigate the VLE success. Despite the increasing interest among researchers toward VLE, little attention has been paid to evaluate the VLE success. Through this paper, we presented the validated instrument that is ready for the consecutive studies. In the future, we

already planned to use this instrument to evaluate the Frog VLE implementation in Malaysia. Yet, this instrument cannot be simply applied without revision, especially for other settings with different cultures and environments.

APPENDIX

Validated Measurement for Virtual Learning Environment Success (English Version)

Information Quality

1. The VLE provides information that is exactly what I need.
2. The VLE provides information that is relevant to teaching.
3. The VLE provides sufficient information.
4. The VLE provides information that is easy to understand.
5. The VLE provides up-to-date information.
6. Through VLE, I get the information I need in time.
7. Information provided by VLE is reliable.

System Quality

1. The VLE is always available.
2. The VLE is user-friendly.
3. The VLE has attractive features that appeal to me.
4. The VLE enables me to accomplish task quicker.
5. The VLE is easy to navigate.
6. The VLE provides high-speed information access.
7. The VLE functions accurately most of the time.

Service Quality

1. The VLE helpdesk is prompt in responding to my queries.
2. The VLE helpdesk is available in case I have a technical problem.
3. The VLE helpdesk is willing to help whenever I need support.
4. The VLE helpdesk gives users individual attention.
5. The VLE helpdesk is highly knowledgeable.
6. The VLE helpdesk dedicates enough time to resolve my specific technical concerns.
7. The helpdesk shows a sincere interest in solving technical problems related to VLE.
8. The VLE has up-to-date equipment.
9. The VLE's physical facilities are visually appealing.

Intention to Use

1. I intend to continue using the VLE.
2. I will regularly use the VLE in the future.
3. Assuming that I have access to the VLE, I intend to use it.
4. I intend to be a heavy user of VLE.

Use

1. I frequently use the VLE.
2. I use the VLE whenever appropriate.
3. I use VLE voluntarily.
4. I use VLE for teaching.
5. I use VLE to give tests to my students.
6. I use VLE to communicate with students.
7. I use VLE to collaborate with other teachers.
8. I use VLE to retrieve educational information.
9. I use VLE to retrieve teaching resources.

User Satisfaction

1. I feel contented using VLE.
2. I feel pleased using VLE.
3. I think the VLE is very helpful.
4. I think the VLE is successful.

Net Benefits

1. The VLE is time-saving.
2. The VLE enhances my teaching skills.
3. The VLE helps me improve my job performance.
4. The VLE empowers me.
5. The VLE contributes to my career success.

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