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E-learning, assessment competency, and academic performance: A structural equation modeling approach

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ABSTRACT

E-learning practices and the competency in assessment should facilitate one's academic performance. The main purpose of this study is to explore the degree of influence of e-learning practices and competency in assessment on academic achievement of students. This study is a quantitative approach using survey method involving the process of data collection through the administration of constructed instruments. The population of the study involves student teachers from the three selected universities in Selangor and Perak. Sample selection is drawn using random sampling technique. A total of 460 student teachers are selected. The questionnaire for e-learning practices is adapted from OLES (Renee, 2011) and the competency in assessment comes from Zahari (2018). The structural equation modeling (SEM) analysis is used to test the hypothesized relationship. The results show that e-learning practices, knowledge in assessment, skills in assessing, and attitude in assessment significantly influence students' academic achievement. E-learning practices emerge as the strongest predictor of student achievement, with a significant standardized regression coefficient of 0.39. This is followed by skills in assessing (0.27), knowledge in assessment (0.09), and lastly attitude in assessment (0.08). The core findings of the study have some implications for higher education and practice, measurement and theory development, and future research.

Keywords: e-learning, assessment competency, academic performance, structural equation model

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INTRODUCTION

The use of e-learning and online assessment has grown exponentially in both industrial and educational sectors. In the education sector, e-learning grew in 2008 with an estimated 3.5 million students participating in the study. More and more institutions of higher learning offer courses online and the program has proliferated (Hara & Kling, 2000). In Malaysia, e-learning is still new compared to Western countries and other developed countries. A study found that web-enabled pedagogies using e-learning with problem-based learning and self-regulated learning have improved students with low-achieving performance (Hara & Kling, 2000). A study was conducted among students at the School of Mathematical Sciences, UKM. The study found that students' learning techniques and social interaction with their lecturers are why they achieved low-grade and cumulative grade point averages during Semester 1, Session 2009 – 2010 (Ismail, 2011). More study time does not necessarily influence the students' performance as they do not pay attention to what they read (Boyatzis, 2006). In addition, there has been little research investigating the influence of e-learning and competence in assessment on students' performance,

especially those with low academic achievement. So, there is an urgent need to look at the influence of both factors on the students' academic performance to make sure that we have the right perception on this issue. In addition, to date, no study has investigated the associations between e-learning, competence in assessment, and students' academic performance.

E-learning can be defined as learning that utilizes electronic devices such as computers, telephones, and other instructional tools (Stockley, 2003). Kalpana (2010) offers another definition of e-learning, describing it as any teaching and learning that utilizes electronic networks, such as the internet, LANs, or WANs, to deliver content, facilitate interaction, and provide explanations. Examples of electronic media involved include the internet, intranet, audiotapes, videotapes, interactive television, and CD-ROMs. Universiti Pendidikan Sultan Idris utilizes two forms of e-learning, synchronous and asynchronous learning.

Synchronous e-learning is an e-learning where everyone learns at the same time. Some examples of synchronous learning include audio conferencing like Skype, video conferencing, web conferencing, chat, instant messaging, Microsoft whiteboard, or application sharing using Google documents (Susilana et al, 2022). This method allows for "live lectures" but without physical contact between participants. It also facilitates interaction among all participants (Kalpana, 2010). The problem with this type of e-learning is that all the participants must be there at the same time if they choose to join the lecture. This can be problematic for those with unreliable internet access. However, synchronous learning can also be effective. It fosters a sense of urgency that can lead to increased participation. Students are more likely to ask questions directly to the lecturer, and they can receive immediate feedback.

Asynchronous learning is another form of e-learning where participants learn with materials, and not directly with instructors (Kalpana, 2010). The tools used include databases, document libraries, e-books, forums, messaging, audio/video streaming, blogs, or website links. Asynchronous e-learning offers flexibility and convenience for learners wherever they are (Koohang & Harman, 2005). Learners can apply concepts realistically using multimedia tools. Additionally, animations can be used to demonstrate complex ideas effectively (Smart & Cappel, 2006). In conclusion, asynchronous e-learning has the potential to enhance teaching and learning compared to the traditional way of teaching.

Competence refers to an individual's capability to perform a task, regardless of time, context, or whether it is a daily activity (Rohmadi et al., 2023). Competence in assessment specifically refers to an individual's assessment of his/her knowledge, skills, and internal characteristics needed to achieve set performance standards (Zahari, 2018). To improve the teaching and learning process in schools, teachers must make effective decisions based on accurate interpretations of information (Nordin, 2008). This information is primarily gathered through assessments conducted during the teaching and learning process. However, the effectiveness of such assessments depends on the teacher's competency level in assessment. Teachers with weak assessment skills will struggle to conduct assessments effectively, potentially leading to inaccurate data that does not reflect students' actual performance. This can lead to poor decision-making and hinder improvements in student learning. Student teachers particularly need a good competency level in assessment skills, especially in classroom assessment. This ensures their independence and effectiveness when they enter the workforce. Nordin (2008) emphasizes the importance of effective assessment for teachers. A significant portion of a teacher's daily routine involves assessment activities, such as reviewing exercises, notes, and test answers, conducting student interviews, and observing student behaviour. This aligns with Suah's (2012) observation that teachers dedicate a substantial amount of time to assessment. Therefore, competency in assessment, particularly classroom assessment, is crucial for teachers in Malaysia. Effective assessment practices would positively impact students, parents, and schools alike.

In this study, knowledge in assessment refers to teachers' self-assessment of their knowledge in the design of the school-based assessment, the instrument administration, the instrument development, achievement, scoring and grading, statistical analysis, the use of the assessment results, the use of ICT, and the ethics in assessing. Skills in assessing refer to the individual's ability to carry out certain physical or mental tasks (Nordin, 2008). Similarly, for teacher trainers, skills in assessing refer to their self-assessment of proficiency in aspects like

school-based assessment design, instrument development and administration, performance assessment, scoring and grading, statistical analysis, use of assessment results, ICT utilization, and assessment ethics. Finally, attitude in assessment refers to a teacher's character that provides strong values, trust, and skills for teachers to make decisions and actions in carrying out their duties in the future (Suah, 2012). Competency theory suggests that attitude is an internal characteristic that helps distinguish high achievers from ordinary ones. Attitudes also play a role in guiding individuals to use their knowledge and skills to carry out assessment activities to support learning (Zahari, 2018). In this study, attitudes towards assessment refer to teacher trainers' self-assessment of the importance of assessment practices, statistical analysis, assessment courses, and changes in assessment practices.

A competency model by Parry (1996) links competency to performance. This model highlights that everyone possesses a unique combination of competency which allows them to reach a certain level of performance. The learning process itself aligns with this concept, as it involves three key psychological components: cognitive, affective, and psychomotor. Parry (1996) believes that if someone were to teach any type of competency, all three psychological components must be in the conceptual framework of competencies. Neglecting any of these components can hinder the desired behavioral outcomes. Therefore, this competency model supports the focus of this study. In this study, the data for students' academic performance is collected from their previous semester's cumulative grade point average (CGPA).

Teachers require a high level of competence to perform school-based assessments (Zanaton et al., 2014). However, the findings of previous studies show that the implementation of assessment activities of teachers is still unsatisfactory (Suah et al., 2010). Teachers are said to not adhere to legitimate assessment practice procedures (Boyatzis, 2006) and favor traditional methods. They rarely engage in activities like preparing test determinants, constructing their own test items, or performing item analysis (Suah et al., 2010). These findings point to weaknesses in teachers' knowledge, skills, and even attitudes towards school-based assessment implementation. Furthermore, limited research exists on measuring trainee teacher competency in assessment (Volante & Beckett, 2011). This is also true in Malaysia, where the ministry lacks comprehensive data on teacher training programs offered by public universities. Additionally, most of the studies conducted in this country focus more on measuring the level of competence of school-based assessment activities of in-service teachers.

This study utilizes structural equation modeling (SEM) to assess the measurement properties and test the theoretical relationships among the five proposed constructs. This approach is particularly relevant given the growing use of e-learning nowadays. Investigating the combined influence of these components on students' cumulative grade is becoming increasingly important. This study also has the potential to inform teachers' professional development, particularly in the area of assessment competency. There is an urgent need to understand more about the challenges that teachers are facing (Kumar, 2010).

METHOD

The purpose of this study is to explore the influence of e-learning practices and assessment competency on academic achievement. This investigation has two main foci: (a) to investigate whether e-learning practices, knowledge of assessment, assessment skills, and attitude in assessment have significant relationships with academic achievement; and (b) to develop a structural equation model that explains the interrelationships among the study variables.

This study employs a quantitative approach using a cross-sectional survey method. Data collection involved the administration of constructed instruments. A post-hoc correlational design served as the framework. The relationships among variables were explored to develop a model examining associations between key variables of the study. SEM with AMOS software was chosen for data analysis due to its comprehensiveness in assessing theoretical models. This method can also generate meaningful conclusions regarding the interrelationships among all theoretical constructs. In conclusion, structural equation modeling is used to develop and subsequently test the theory proposed based on the existing literature. The population of the study

encompasses all university students from three selected universities in Selangor and Perak. Group random sampling was employed, where the researcher divided the population according to faculty and randomly selected a predetermined number of students from each faculty. Krejcie & Morgan (1970)'s table suggested a minimum sample size of approximately 370 students. However, the study ultimately recruited 460 student teachers through random sampling.

The questionnaire comprised three main sections. The first section measured e-learning practices adapted from OLES (Renee, 2011). It included sample items like "I can collaborate with others in class activities" or "I can relate my work to the real world." All items used a six-point Likert-type scale (1 = never, 5 = always). The second section assessed competency in assessment. Adapted from Zahari (2018), it consisted of three constructs: (i) knowledge in classroom assessment, (ii) skills in assessing, and (iii) attitude in classroom assessment. All items used a five-point Likert-type scale (1 = strongly disagree, 5 = strongly agree). The third section measured students' academic performance, using their marks for their Teaching Practical from the previous semester. The questionnaire was then pilot-tested on 100 respondents from a different university, mirroring the actual study. Pilot studies are crucial for research, allowing respondents to provide feedback on the questionnaire. Cronbach's alpha reliability coefficients were then calculated from the pilot data (see Table 1).

Table 1. Cronbach alpha reliability coefficients

Variable	Variable description	Value of Cronbach Alpha
E-L	E-learning practices	0.86
KA	Knowledge in assessment	0.78
SA	Skills in assessing	0.81
AA	Attitude in assessment	0.92

FINDING AND DISCUSSION

Finding

There were 75% female (n=337) and 25% male (n=113) participants involved. The majority (83%) identified as Malay, with the remaining participants being Chinese and Indian. In terms of teaching practice experience, the distribution was similar, with 55% having experience in urban schools and 45% in rural schools.

The measurement model

This study employed a two-stage approach, as suggested by Anderson & Gerbing (1988). This approach includes validating the measurement model first, followed by the analysis of a structural equation model. The first step is necessary to avoid unreliable measures and interaction issues between both models (Hair et al., 2006). The first step involves examining the correlation values between all constructs. As Kalpana (2010) suggests, correlations between constructs should be less than 0.85 to avoid multicollinearity problems. Table 2 summarizes the measurement model results. The model's goodness-of-fit indices fall within acceptable limits. Acceptable values for NFI, CFI, and GFI indices are those closer to 1.00. For RMSEA, values below 0.08 are considered acceptable, and RMR values as close to zero as possible are preferred. The results shown in Table 2 indicate a good fit of the variables to all four measurement models.

Table 2. Hypothesized fit statistics for measurement models of study variables

Measurement Model	x^2	df	GFI	CFI	NFI	RMR	RMSEA
E-learning practices (E-L)	26.34	9	0.92	0.93	0.91	0.049	0.06
Knowledge in Assessment (KA)	19.90	9	0.91	0.95	0.92	0.011	0.05
Skills in assessing (SA)	8.57	8	0.91	0.88	0.82	0.019	0.08
Attitude in Assessment (AA)	19.44	6	0.95	0.92	0.99	0.010	0.03

Figure 1 presents the correlation coefficients among the SEM's exogenous latent variables (KA, SA, and AA) and the path coefficients between each exogenous variable and the endogenous latent variable (GPA). This figure serves as a guide for the development of the structural equation model, examining the influence of all four sets of variables on students' grades. Oval figures represent latent variables, which are the constructs inferred from the measured variables previously developed using confirmatory factor analysis (CFA) procedures. Paths from latent variables to measured variables are omitted due to the extensive number of paths. All the measurement weights loadings were significantly different from zero. Standardized regression coefficients, represented by paths from the latent variables (E-L, KA, SA, and AA) to GPA, indicate the extent to which each independent variable affects the dependent variable (GPA). Double-headed arrow lines show bivariate correlations between the various latent variables. The small arrow, d1, represents the disturbance signifying the influence on the latent variable (GPA) from factors not included in this study (other than E-L, KA, SA, or AA).

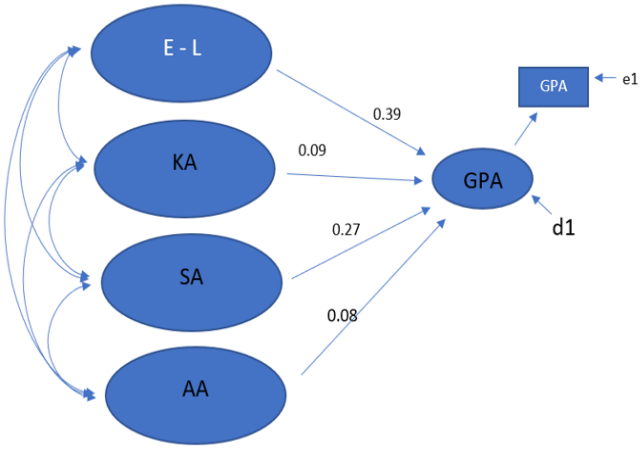

Figure 1. Structural Equation Model (SEM) for Study Variables using the Student Marks during Teaching Practical as the Dependent Variable

Note: *p < 0.05; E – L: E- Learning practices; KA: Knowledge in assessment; SA: Skills in assessing; AA: Attitude in assessment; GPA: Cumulative Grade Point Average

Table 3 displays the correlations between the study's constructs. As recommended by Kline (2005) to avoid multicollinearity issues, all correlations between constructs need to be than 0.85, supporting the assumption of no significant multicollinearity.

Table 3. Correlations between constructs

Factor Correlations			Estimate
E-L	<-->	KA	0.782
E-L	<-->	SA	0.807
E-L	<-->	AA	0.672
KA	<-->	SA	0.601
KA	<-->	AA	0.810
SA	<-->	AA	0.697

Note: E – L: E-Learning practices; KA: Knowledge in assessment; SA: Skills in assessing; AA: Attitude in assessment

Following the first stage of measurement model assessment, the second stage involved analyzing the structural equation model. The final SEM model demonstrated a reasonable fit to the data (χ^2 (221) = 541.83, p = 0.00; GFI = 0.91, CFI = 0.93, NFI = 0.95, RMR = 0.021, RMSEA = 0.028). Examining the paths, the coefficient for E-learning practices (E-L) to student academic achievement (GPA) was 0.39. This indicates that a one standard deviation increase in E-L practices is associated with a 0.39 standard deviation increase in student GPA. This result suggests a positive and statistically significant relationship between E-L and student academic

achievement. The three paths from assessment competency also showed positive and statistically significant relationships with student GPA. A one standard deviation increase in knowledge in assessment (KA) was associated with a 0.09 standard deviation increase in GPA. Similarly, a one standard deviation increases in skills in assessing (SA) and attitude in assessment (AA) were associated with 0.27 and 0.08 standard deviation increases in GPA, respectively.

Discussion

Looking at the findings of the study, there are several practical implications. The study contributes to understanding the factors influencing student academic achievement, particularly during the pandemic. In higher education institutions, university management teams, especially the academic leadership, should prioritize effective e-learning implementation strategies and focus on improving faculty knowledge and skills in assessing. These efforts can significantly impact student academic performance, as the study demonstrates a positive and statistically significant relationship between all four investigated factors (e-learning practices, knowledge in assessment, skills in assessing, and attitude in assessment) and student GPA. By recognizing these key factors, university professionals can design interventions to improve students' performance.

Examining practical implications in detail reveals three key areas: teacher training, teacher practices, and national assessment policies. Knowledge and skills in assessing are initially developed in student teachers at the university level. However, ongoing professional development remains crucial throughout their careers. The ministry should identify areas of assessment competency requiring focused attention to ensure educators are well-equipped with the knowledge and skills in assessing. Crucially, this training should be hands-on. Furthermore, Wahyu & Yahya (2007) emphasize the importance of sustained professional development focused on minute-by-minute formative assessment for effective implementation during teaching and learning. The e-learning framework by Farjana et al. (2021) could also serve as a valuable tool for educators to improve student learning.

The use of structural equation modeling (SEM) to examine interrelated relationships between variables, along with the use of theoretically-driven measurement models, holds significant promise. SEM facilitates data analysis for inferential purposes, going beyond mere description. Additionally, SEM provides explicit estimates of error variance parameters, enhancing the accuracy of relationships within hypothesized models (Byrne, 2010).

CONCLUSION

In conclusion, the results demonstrate that e-learning practices (E-L), knowledge in assessment (KA), skills in assessing (SA), and attitude in assessment (AA) all significantly and positively influence student academic achievement. Standardized regression coefficients (path coefficients) are presented in Figure 1. This study's findings contribute to the existing body of knowledge on student academic performance in several ways. The results support the psychometric adequacy of the measures used for e-learning practices and assessment competency in relation to academic performance. These measures appear sufficient to represent overall e-learning practices, assessment competency, and academic performance among student teachers. The results also indicate that e-learning practices directly influence and have a significant effect on student academic performance. This finding aligns with Masrom (2007), who demonstrated that effective e-learning practices are an important resource for academic success. The study's findings also support the competency model. An examination of the overall contributions to academic achievement by the four predictor variables included in the model indicated that these predictors have varying impacts on student achievement, as shown in Figure 1. All four predictors are significantly related to student achievement, with e-learning practices (E-L) having the highest value and a significant standardised regression coefficient (0.39). Skills in assessing (SA) follows with a coefficient of 0.27, knowledge in assessment (KA) at 0.09, and lastly, attitude in assessment (AA) at 0.08.

Several limitations to this study need to be addressed. First, the study focuses on final-year education students at public universities. To provide more rigorous results, future research could compare findings with those of students from private universities, who may have greater internet

access and resource availability. Second, the study's focus on final-year education students limits generalizability to other student populations. Finally, the sample, drawn from three public universities in central Malaysia, may not be representative of students in other countries with different background.

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