Mediating effects of quality learning on metacognitive knowledge, metacognitive experience and outcomes

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This study examined the mediating effects of quality learning on metacognitive knowledge, metacognitive experience, and learning outcomes for a sample of 1274 university students. Data were collected using the *Quality Assurance Perception Questionnaire for Students* (QAPQ-S), a self-report questionnaire designed to measure students' perceptions of quality learning in higher education. Metacognitive theory was used as the framework to build a research model with seven constructs which was analysed using *SmartPLS*. The independent variables were metacognitive knowledge (resources, learning environment, curriculum) and metacognitive experiences (delivery and support, learning skills), quality learning was the mediating variable, and learning outcome was the dependent variable. The results showed significant relationships between learning outcome and metacognitive experiences which are students' perceptions of quality of teaching and learning support given by a university. Quality learning partially mediated the influence of delivery and support on learning outcomes. Quality learning also partially mediated learning outcomes and curriculum, the process of perceiving and organising new information in order to achieve learning outcomes in metacognitive knowledge. Quality learning did not mediate learning outcomes and learning environment and there was no relationship with resources. Limitations and implications for practice are also discussed.

Introduction

The aim of many universities today is to ensure that its graduates have a set of skills that will work across conventional boundaries, allow them to make connections between processes, functions and disciplines, and in particular manage the learning which will support their careers (McCowan, 2015). The aspiration of these universities is to help students achieve attributes ranging from ethics and thinking skills to knowledge aimed at developing mastery of their own disciplines, applying and connecting all knowledge learned, as well as developing an appreciation for the arts and culture (Ellis, 2016). Hence the focus for universities is on the personalisation of learning outcomes, as well as actively pursue technologies and innovations that address students' needs and their employability, all of which are influenced by the quality of learning (McCowan, 2015) that takes place.

Quality learning in this study is the learning that nurtures students' ability to acquire knowledge and understanding that can then be utilised in real situations to make valid and informed decisions, as well as enhancing their ability to be positively involved in sharing ideas and opinions (Biggs & Tang, 2011). This quality can be enhanced through the learning environment, including quality of teaching approaches and strategies, students' understanding of course goals and standards, and the physical and virtual environments (Ellis, 2016), suggesting its influence on learning outcomes. Learning outcomes in this context is defined as achieved, demonstrable learning that is mapped and aligned with a

set of goals which are thought to be influenced by experiences and perceptions of quality learning (Biggs & Tang, 2011). Metacognitive theory underpins this study because students' perceptions of their motives for learning include their conscious and affective experiences, that is, their metacognitive experiences (Kuhn, 2000) together with their metacognitive knowledge (Flavell, 1979) Metacognitive knowledge refers to prior acquired knowledge and beliefs that can affect their learning outcomes, which in turn influences the overall quality of learning in a university (Biggs & Tang, 2011).

Previous studies have highlighted differences in student engagement (Laird et al, 2011) and the influence of academic self-concept (Nagengast & Marsh, 2012) in students' approaches to learning, perceptions of quality learning and learning outcomes at university. Hake (1998) and Handlesman (2004) noted that teaching methods designed to promote metacognitive experience and knowledge resulted in the most improvement in student learning outcomes. Other studies (Whalen & Shelley, 2010; Bolkan & Goodboy, 2011) have also found that a supportive learning environment with appropriate teaching strategies can significantly influence students' perceptions of quality learning, and eventually aid in achieving their learning outcomes. Teacher support of students can have a significant influence on learning quality and eventually their learning outcomes (Goodboy & Myers, 2008). Further to this, the communication styles of teachers (verbal and non-verbal), their availability to give student support (Mottet et al. 2005) and willingness to help develop positive student learning attitudes (Christophel, 1990) is related to quality learning and eventually learning outcomes for students. Teacher management of a subject can also significantly influence overall quality learning for students and their learning outcomes (Goodboy & Bolkan 2009). The design and delivery of courses has been found to determine quality learning (Langstrand et al. 2015) specifically if they are focused on learning outcomes for students. Hence, quality learning can be viewed as a dynamic concept where the actions of teachers and the university can have a significant influence on students' overall learning outcomes.

However, with universities today needing to ensure that their graduates have a set of marketable skills, quality can also be viewed more as a concept of "standards" with conditions to be met for accreditation (Elassy, 2015), which may cause an overall negative effect on students' perceptions of quality learning, especially when the overall learning experience on campus is not given adequate consideration. Further to this, a study that specifically addresses student perceptions of quality learning and its influence on metacognitive learning is still lacking. A notable study by Kek and Huijser (2011) found that students tended to experience quality learning when they are taught using student focused approaches and are highly engaged in their campus co-curricular activities. Further to this, Sohail and Saeed (2003) found that university students equate quality learning to approaches used to teach them and the necessity of having teachers specialised in their fields. These studies did not address the mediating role of quality learning on learning outcomes. Other studies on learning outcomes have not specifically addressed the role of quality learning in their research (Asif & Searcy, 2014; Ali et al., 2016). In order to fill this gap in the research, this study will investigate how quality learning mediates learning outcomes and students' metacognitive experiences (conscious and affective

experiences), and metacognitive knowledge (prior knowledge, beliefs), in terms of how it aids to enhance learning experiences for students (Oliver, 2001).

Metacognitive theory

Conceptualisation of metacognitive theory can be thought of as a developmental framework beginning with the emerging awareness of young children, who undergo developmental progression resulting in complex metaknowing which may not be mastered even when they reach adulthood (Kuhn, 2000). As metacognition becomes more explicit and comes under greater conscious control by the adult, it can become more powerful and effective. Metacognition can be considered a supporting condition for monitoring the quality of thought and beliefs, resulting in critical thinking and eventually quality learning (Lai 2011), that will in some form influence the way students think and learn. In order to bring about quality learning, Flavell (1979) suggested that learning episodes occur through the interaction of four phenomena: metacognitive knowledge, tasks to be achieved, strategies used, and metacognitive experiences. Metacognition, according to Flavell (1979), is the process of cognition about cognition. Hence, when executing a specific task, the effect of the personality of an individual decreases and information from monitoring a task (e.g. fluency, conflicts, and interruptions) receives more attention; this will in turn trigger control decisions (Efklides, 2006). At this level, metacognition and affect can take the form of subjective experiences where students are aware of on-going thinking and feelings that denotes exertion of efforts (behaviours) when processing a task. From the perspective of behaviour, Ajzen (1991) noted that individuals will act according to their perceptions of control over their behaviour. Hence in this study, the perceptions of students towards their learning environments in a university will be used to study the mediating effects of quality learning on learning outcomes.

Metacognitive knowledge can be equated to the prior knowledge and acquired beliefs of students (Fernandez-Duque et al., 2000). Prior knowledge and experience influences how students perceive and organise new information and make connections between ideas. These connections will contain beliefs about what and how three factors (person, task, and strategies) can interact to affect quality learning (Veenman, Wilhelm & Beishuizena, 2004). In the context of this study, the persons involved are the teachers and students. The strategies used are dependent on the available resources, the conducive learning environment, and the proper curriculum design of each program (Handelsman et al., 2014). The perceptions and beliefs formed by students about their quality learning and eventually their learning outcomes in terms of the strategies used will be influenced by their metacognitive knowledge. Tasks to be achieved refer to the learning objectives and the strategies used to achieve these outcomes, which can help students monitor quality learning and their learning progress. Biggs (1999) noted that learning outcomes focusing explicitly on quality learning require the use of teaching and learning processes that are active and contextualised to constructing knowledge (metacognitive knowledge and metacognitive experience) based on personal experiences. In the context of this study, metacognitive knowledge will be students' perceptions of the design of their learning

experiences (*curriculum*) and the resources (*resources*) available to them in their learning environment (*learning environment*).

Any conscious and affective experiences associated with learning are considered as metacognitive experience (Kuhn, 2000). Students can use these experiences to make an assessment of the progress they are making, or are likely to make, and these experiences can occur in situations that require a lot of highly conscious thinking of the learning process taking place. Making evaluations of the learning progress allows for quality control of thought processes (Flavell, 1979). The main difference between metacognitive experience and metacognitive knowledge is in the content and function of what is being learned. In the context of this study, metacognitive experiences will be students' perceptions of the quality of teaching and learning support provided by a university (delivery and support) and the approaches and strategies they use to learn (learning skills).

This study seeks to determine whether quality learning can explain the relationships between metacognitive experiences (delivery and support and learning skills), metacognitive knowledge (resources, learning environment and curriculum), and learning outcomes.

Research hypotheses and operational definitions

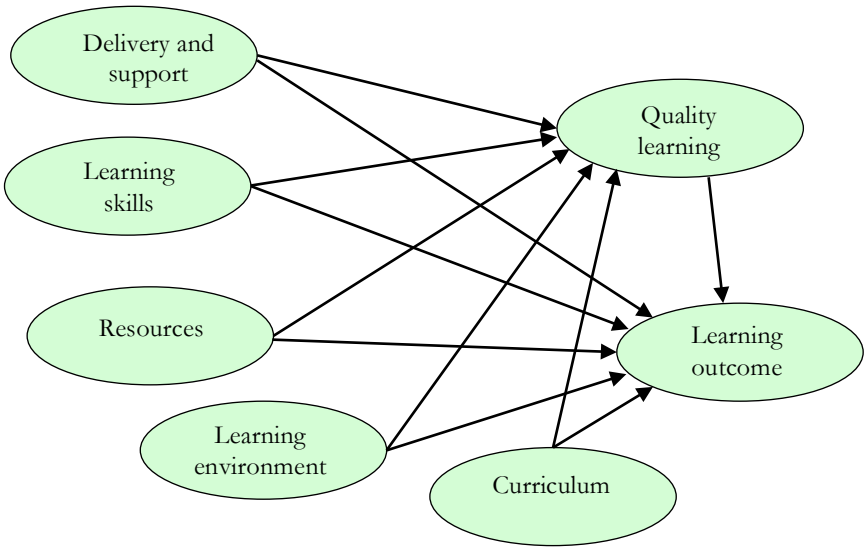

Figure 1: Conceptual framework of the mediating effects of quality learning on student perspective of learning and learning outcomes

Figure 1 provides the conceptual framework of the mediating effects of quality learning on students' perceptions of learning and learning outcomes, based on the metacognitive theory which has been used in other studies of a similar nature (Asif & Searcy 2014; Ali et al. 2016). Based on this framework the following research questions were formulated:

RQ1: Are there any significant relationship between metacognitive experiences (learning skills, delivery and support), metacognitive knowledge (resources, learning environment, curriculum) and learning outcomes when the mediator variable quality learning is excluded from the path model?

RQ2: Are there any mediating effect between metacognitive experiences, metacognitive knowledge and learning outcomes when quality learning is included as the mediator variable in the path model?

The following hypotheses were formulated:

Hypothesis 1 (H1):	Delivery and support will have a significant influence on learning outcomes.
Hypothesis 2 (H2):	Learning skills will have a significant influence on learning outcomes.
Hypothesis 3 (H3):	Resources will have a significant influence on learning outcomes.
Hypothesis 4 (H4):	Learning environment will have a significant influence on learning outcomes.
Hypothesis 5 (H5):	Curriculum will have a significant influence on learning outcomes.
Hypothesis 6 (H6):	Quality learning will have a significant influence on learning outcomes.
Hypothesis 7 (H7):	Quality learning mediates the relationship between delivery and support and learning outcomes.
Hypothesis 8 (H8):	Quality learning mediates the relationship between learning skills and learning outcomes.
Hypothesis 9 (H9):	Quality learning mediates the relationship between resources and learning outcomes
Hypothesis 10 (H10):	Quality learning mediates the relationship between learning environment and learning outcomes
Hypothesis 11 (H11):	Quality learning mediates the relationship between curriculum and learning outcomes.

The operational definitions of the constructs are shown on Table 1.

Methods

Measurement scales

The study's main constructs were measured using items adapted and adopted from the *Quality Assurance Perception Questionnaire – Student* (QAPQ-S) (Choy, Yim & Tan, 2017), a questionnaire designed to determine the following areas: learning outcomes, curriculum design, teaching delivery and student support, learning environment, educational resources, English exposure, and quality learning. A total of six items on students' learning skills were added to the questionnaire which were adapted from items developed by Entwistle and Tait (1995), Heikkila and Lonka (2006), and McCardle and Hadwin (2015). as we were not interested in measuring English exposure, these items were not used. the

Table 1: Definition of construct

Construct	Definition	Literature
Quality learning	The support structure for personal attribute development provided to students that will allow them to develop the confidence to make decisions for their own learning. These decisions are consistent with policies and procedures of the university and within an organised learning environment. Personal attributes are the self-development processes that results in abilities in problem solving, communicating effectively, and critical thinking. All as a result of their perceptions of the total learning experience at university.	Biggs and Tang (2011)
Learning skills	Learning strategies used to facilitate acquisition of knowledge and the self-management and monitoring of one's own learning. This is measured using students' perceptions of their learning strategies and management of their learning.	Hattie, Biggs and Purdie (1996)
Learning outcomes	The intended learning that will enable students to better their performances of understanding, rather than their verbal declarations of understanding. These are student perceptions of the clarity of the learning outcomes in terms of their ability to execute the work required.	Biggs and Tang (2011)
Delivery and support	The support provided to students both academically and administratively by their teachers. Good delivery characterised by complete explanations, good instructions and elaborations of difficult concepts results in the highest levels of student learning, measured using students' perceptions of teacher behaviour and strategies used.	Samudra, et al. (2016) Hill, (1995)
Resources	The infrastructure and facilities provided by a university in terms of quality of teaching staff, volumes available in the library and quality and type of equipment available to students. This is measured using students' perceptions of the resources and facilities provided in the university.	Nicholson (2011)
Learning environment	Students' perceptions of the teaching and assessment procedures used in the university.	Entwistle, McCune and Hounsell (2002)
Curriculum	The arrangement of courses that are structured for a specified duration and learning volume to achieve the stated learning outcomes. It provides a 'map' to indicate what students can do after teaching and is measured using their perceptions of the coursework load and ability to complete assignments.	Biggs and Tang (2011)

5-point Likert scale recommended by the authors of the questionnaire was used for each item, with a 5 indicating strongly agree; 4 agree; 3 neutral; 2 disagree; and 1 strongly disagree.

Metacognitive knowledge in this study was measured using three factors from the QAPQ-S: educational resources, curriculum design and learning environment. Examples of these items are "I can get the books I need for this course from the library" and "I learned

something in this course that helped me rethink my understanding of some parts of the course". Metacognitive experiences were measured using one factor for the QAPQS: teaching delivery and student support, and the specially developed items for learning skills. Examples of the items are "The feedback given on my work helped me to improve my ways of studying" and "I like to use memorisation to help me learn my course materials". All the items in the questionnaire were reflective, similar to those used in other studies (Kek & Huijser 2011).

Sampling and data collection

A total of 1274 students enrolled in various bachelor and diploma programs at a private university in Malaysia participated in this study (Table 2). The participants were not given inducements of any kind for completing the paper questionnaire, which was administered between classes and took 15 to 20 minutes to complete it. They were also informed about the nature of the study and were told they could withdraw anytime during or after the study. They were assured of their anonymity and that all data they provided will be kept private and confidential. The data were then screened for missing data and outliers.

Table 2: Profile of students

	Description	Frequency
Gender	Male	417
	Female	857
Program	Bachelor	452
	Diploma	822

Methodological consideration

The present study employed *structural equation modeling* (SEM) to analyse collected data. SEM is a second generation multivariate data analysis approach which allows researchers to simultaneously analyse a complex model with multiple independent and dependent variables. Data were subjected to test of multivariate normality with the *WebPower* online software available at https://webpower.psychstat.org/. Results showed that the distribution is not normally distributed as indicated by Mardia's multivariate skewness (β = 1.219, $p < 0.001$) and kurtosis (β = 86.921, $p < 0.001$). The *partial least squares* (PLS) SEM approach was used to analyse data using the non-parametric software *SmartPLS* 3.0 (Ringle, Wende & Becker, 2015). PLS-SEM has been described as a "silver bullet" in handling non-normal data, capable of maximising the explained variance in endogenous latent variables with partial model relationship estimation in an iterative sequence of ordinary least squares (OLS) regression (Hair, Ringle & Sarstedt, 2011). The hypotheses were tested with bootstrapping of 5000 resamples. To analyse the mediation effects, Preacher and Hayes's (2004) recommendation of bootstrapping was used and interpretation of the mediation output was carried out using guidelines recommended by Zhao, Lynch and Chen (2010).

Results

Measurement model

The model specified in this study has seven constructs with reflective measurements and the path model was estimated using *Smart-PLS 3.0*. Table 3 shows the assessment of the measurement model. The composite reliability for each construct was 0.7 and above and showed satisfactory levels of internal consistency reliability. In assessing convergent validity at the construct level, the average variance extracted for all the constructs were between 0.556 and 0.728, satisfying the requirement for convergent validity. At the indicator level, Hair et al. (2017) had established that the standardised outer loading for all items which measured the constructs should be above 0.7. From Table 3, the values of indicator loadings were all above 0.7 demonstrating adequate convergent validity for constructs measured.

Table 3: Assessment of the measurement model

Construct		Standard loadings	Cronbach's alpha (>0.60)a	Composite reliability (>0.70)a	Average variance estimated (AVE) (>0.50)a
Curriculum (C)			0.601	0.790	0.556
	C1	0.769			
	C2	0.747			
	C3	0.720			
Delivery and support (DS)			0.760	0.848	0.582
	DS1	0.709			
	DS2	0.781			
	DS3	0.776			
	DS4	0.784			
Learning environment (LE)			0.628	0.842	0.728
	LE1	0.780			
	LE2	0.803			
Learning outcomes (LO)			0.763	0.849	0.584
	LO1	0.779			
	LO2	0.733			
	LO3	0.712			
	LO4	0.723			
Learning skills (LS)			0.648	0.810	0.588
	LS1	0.716			
	LS2	0.779			
	LS3	0.802			
Quality learning (QL)			0.568	0.822	0.698
	QL1	0.848			
	QL2	0.823			
Resources (R)			0.792	0.866	0.617
	R1	0.816			
	R2	0.762			
	R3	0.729			
	R4	0.832			

a. Indicates an acceptable level for respective indices

In establishing discriminant validity, Table 4 shows the Fornell-Larcker criterion where the square-roots of AVE for all constructs were greater than its correlations with other constructs (Fornell & Larcker 1981). In addition, Table 5 shows the heterotrait-monotrait (HTMT) criterion which imposes a more stringent assessment than the Fornell and Larcker criterion suggests that constructs are distinct from other constructs at $HTMT_{0.90}$ (Hensler, Ringle & Sartstedt 2015).

Table 4: Fornell-Larcker criterion

Constructs	C	DS	LE	LO	LS	QL	R
C	0.746						
DS	0.516	0.763					
LE	0.44	0.559	0.757				
LO	0.478	0.569	0.452	0.726			
LS	0.319	0.365	0.422	0.378	0.767		
QL	0.504	0.587	0.418	0.49	0.309	0.836	
R	0.223	0.288	0.269	0.229	0.365	0.232	0.786

Table 5: Heterotrait-monotrait criterion

Constructs	C	DS	LE	LO	LS	QL	R
C							
DS	0.765						
LE	0.709	0.799					
LO	0.692	0.737	0.641				
LS	0.511	0.517	0.666	0.528			
QL	0.86	0.892	0.696	0.734	0.507		
R	0.323	0.371	0.382	0.29	0.509	0.345	

Criteria: Discriminant validity is established at $HTMT_{0.90}$

Structural model assessment

Before the testing of hypotheses, collinearity assessment was performed to ensure that it would not pose any problems to interpretation of results. Table 6 shows the variance inflation factor (VIF) for each construct to be lower than 3.3 (Diamantopoulos & Siguaw 2006), suggesting that collinearity is not an issue and independent variables are measuring different aspects of quality learning and learning outcomes.

Table 6: Collinearity assessment with VIF

	Learning outcomes	Quality learning
Curriculum	1.554	1.448
Delivery and support	1.991	1.721
Learning environment	1.640	1.634
Learning skills	1.366	1.362
Quality learning	1.685	-
Resources	1.199	1.197

As proposed in the hypotheses, the predictor variables in this study are delivery and support, learning skills, resources, learning environment and curriculum. The criterion variable is learning outcomes and the mediating variable is quality learning. When the path model was estimated using bootstrapping of 5000 cases, without the interaction of a mediator, the results (Table 7) showed that the path coefficients between the five predictor variables and learning outcomes were significant, except for resources. Learning outcomes was significantly influenced by delivery and support (β = 0.291, *t*-value =9.656), learning skills (β = 0.131, *t*-value = 4.952), learning environment (β = 0.097, *t*-value = 3.466), curriculum (β = 0.165, *t*-value = 5.968), and quality learning (β = 0.155, *t*-value =5.612). This leads to the acceptance of hypotheses 1, 2, 4, 5, and 6. Hence the inclusion of quality learning as a mediator is meaningful because it can possibly explain why there is a relationship between the predictor variables and learning outcomes, potentially revealing the true relationships between the variables (Hair et al., 2017).

Table 7: Hypotheses testing for direct relationship

Hypotheses		Path coeffs	Std error	*t*-value	*p*-values	Supported
H1	Delivery and support -> Learning outcomes	0.291	0.030	9.656 **	0.000	Yes
H2	Learning skills -> Learning outcomes	0.131	0.026	4.952 **	0.000	Yes
H3	Resources -> Learning outcomes	-0.001	0.023	0.063	0.949	No
H4	Learning environment -> Learning outcomes	0.097	0.028	3.466 **	0.001	Yes
H5	Curriculum -> Learning outcomes	0.165	0.028	5.968 **	0.000	Yes
H6	Quality learning -> Learning outcomes	0.155	0.028	5.612 **	0.000	Yes

Note: ** *t*-value >1.96, (two-tailed), *p*-values < 0.05

Examination of the predictive power of the model shows that the predictor variables explained 40.4% of variance in learning outcomes with a moderate R^2 value 0.404 (Hair et al, 2017). In support of the predictive relevance of the model, the Geisser-Stone's predictive relevance (Q^2) for learning outcomes was greater than 0 at Q^2 = 0.257. This demonstrated the predictive relevance of the predictor variables of the study for learning outcomes (Akter, D'Ambra & Ray 2011; Hair et al., 2017).

Mediating effects of quality learning

The mediating effects of quality learning as a mediator were examined using the bootstrapping approach through *SmartPLS*, and Sobel's test for significance of mediation through an online software, http://quantpsy.org/sobel/sobel.htm (Preacher & Leonardelli, n.d.). *SmartPLS* only indicates the significance of a mediator in mediational analysis, it does not interpret the extent of the mediation effects. Hence, Zhao et al.'s classification of mediation effects was referenced as suggested by Hair et al. (2017). In

order to answer RQ 2, Table 8 shows that there are complementary partial mediation effects on the relationship between learning outcome with delivery support (H7) and curriculum (H11). This is evident from the indirect and direct effects which are all significant and point in the same direction. However, quality learning did not have any mediation effect on the relationship of learning outcome and learning skills (H8), resources (H9), and learning environment (H10), indicated by the non-significance of indirect effects. This leads to the acceptance of Hypotheses 7 and 11. Results of the mediation effects are shown in Table 8.

Table 8: Hypotheses testing for mediated relationship

Predictor –> Mediator -> Criterion		Effects		*t*-value	Mediation type	Sobel (*p*-values)
H7	DS -> QL -> LO	Direct	0.291	9.656**	Complementary	0.000
		Indirect	0.062	5.105**	(partial mediation)	
H8	LS -> QL -> LO	Direct	0.131	4.952**	Direct only	0.085
		Indirect	0.008	1.678	(no mediation)	
H9	R -> QL -> LO	Direct	0.001	0.063	No effect	0.196
		Indirect	0.004	1.060	(no mediation)	
H10	LE -> QL -> LO	Direct	0.097	3.466**	Direct only	0.070
		Indirect	0.009	1.716	(no mediation)	
H11	C -> QL -> LO	Direct	0.165	5.968**	Complementary	0.002
		Indirect	0.039	4.877**	(partial mediation)	

Notes: C = Curriculum; DS = Delivery and support; LS = Learning skills; LE = Learning environment; LO = Learning outcomes; R = Resources; QL = Quality learning.
** *t*-value >1.96, (two-tailed), *p*-values < 0.05

Summary of findings

The objective of the data analysis was to determine the mediating effects of quality learning on the five predictors: delivery and support, learning skills, resources, learning environment, curriculum on the criterion of learning outcomes. All the variables except resources had significant direct effects with learning outcomes, suggesting that metacognitive experience and metacognitive knowledge had significant direct effects upon learning outcomes.

Quality learning partially mediated the relationships between learning outcome and delivery support, a component of metacognitive experience. This implies that there could be an unidentified mediator which intervenes in this relationship. The mediating effect of quality learning on learning outcomes was also partial for curriculum, a component of metacognitive knowledge, and there could be another unidentified mediator in the same direction as the direct effect (Hair et al., 2017). No mediating effects were found for quality learning between learning outcomes and the predictors of resources and learning environment (components of metacognitive knowledge), and also learning skills (component of metacognitive experience). The results show that quality learning is an important factor in helping students achieve their learning outcomes and must be

recognised as playing a vital role in certain aspects of the overall learning experience at university.

Discussion

The study examined the role of quality learning in students' achievement of their learning outcomes in a university. In this study, quality learning is the structure and process provided to help students develop confidence and decision-making skills and is described in metacognitive theory as the process of developing awareness and eventually metacognitive thinking, which Flavell (1979) suggested occurs through a series of learning episodes which involves using strategies and achievement of skills. Evidence from this study showed that learning skills, one of two components of metacognitive experiences, the strategies and tactics used by students to manage themselves (Hattie at al., 1996), was found to directly influence learning outcomes, suggesting the structure provided to students which addresses personal development attributes will influence the overall achievement of learning outcomes (Kek & Huijser, 2011). However, it is interesting to note that quality learning did not have any significant influence on learning skills. Hence, students who are given challenging but achievable learning goals, experience improved learning, especially if they are allowed and trusted to make decisions and take responsibilities for their own learning in an environment that is organised and supportive of their learning experience (Biggs & Tang, 2011).

However, it must be noted that although learning skills directly influenced learning outcomes, there could be other unknown factors that influence achievement of these outcomes. One possible factor could be the type of thinking, deep, surface or strategic (Biggs & Tang, 2011), students engage in when using learning skills. Universities need to address this when designing the type of quality learning they aim for students to experience. This will have to be further examined in future studies. The other component of metacognitive experiences, delivery and support, was partially influenced by quality learning. According to Kuhn (2000), students' perceptions of the quality of teaching that takes place will influence their conscious and affective thinking. Students may feel more positive about themselves as well as the person teaching the lesson (Samudra et al., 2016). The results also imply that support given by a university in the form of student support services like counselling and financial services, all of which make up quality learning, may also need to increase significantly over time (Hill, 1995), to aid in the achievement of student learning outcomes. However, it must be cautioned that the influence of quality learning is partial on this factor, suggesting that there could other influences to achieving learning outcomes.

Only one component of metacognitive knowledge, curriculum, was found to be partially mediated by quality learning. Curriculum, defined as the 'map' of what students can do after a stipulated period of learning, was also partially influenced by quality learning in the achievement of learning outcomes. Metacognitive theory posits that prior knowledge and acquired beliefs of students will influence the way students organise new information, and the curriculum of a course of study constitutes part of the process of acquiring new

information (Fernandez-Duque, 2000). It is possible that students perceive a supportive teaching environment with appropriate teacher affirmation can significantly mitigate course difficulty (Bolkan & Goodboy, 2011), and together with a well-structured curriculum can help them achieve their learning outcomes.

However, quality learning exerts a stronger influence on curriculum compared to delivery and support, as evidenced by the larger indirect effect of 0.165 for curriculum, compared to 0.062 for delivery and support. A well organised and fully explained lesson helps students sustain their attention, leading to better understanding and subsequently more learning. This finding suggests that the structure and support provided by a university in the form of its curriculum can, together with the support given by teachers to their students, influence the achievement of learning outcomes. Hence the design and delivery of courses is influenced by quality learning and care needs to be taken that it is tailored to the needs of students (Langstrand et al., 2015) and should not be viewed by universities as a means of achieving required standards (Elassy, 2015).

The results showed that quality learning did not have any significant influence on two components of metacognitive knowledge, resources and learning environment, defined as the facilities and infrastructure of a university and the quality of the academic staff and procedures of a university respectively, although learning environment had a direct effect on learning outcomes. Interestingly, resources had no relationship with quality learning or learning outcomes. This could indicate a change in the focus of students from the physical environment to the virtual environment. With the increased use of mobile phones and tablet computers to gather and access information, students may no longer view these two factors as influenced by quality learning in attaining their learning outcomes. According to Wojciechowski and Cellary (2013), the highest level of interactivity in traditional learning can be achieved in teaching labs, where students conduct hands-on experiments, within limitations. However, in virtual environments there may no longer be such limitations that will negatively affect quality learning. Students can interact directly with software applications like virtual reality simulations that will enhance their learning environment and ultimately quality learning (Greenwald et al., 2017). Further research is needed on the influence of virtual environments on students' perception of quality learning.

Quality learning partially mediated delivery and support and curriculum to influence the achievement of learning outcomes. The other three factors did not show significant mediation levels by quality learning. This shows that only certain components in metacognitive experience and metacognitive knowledge are influenced by quality learning. The findings imply the importance placed by students on the support structure provided by a university in terms of the structure of their courses and how they are taught and delivered, and the guidance given to help in the personal development of students. Interestingly, the other three factors did not show significant mediation by quality learning, possibly because students may no longer perceive these factors as being associated with quality learning.

Limitations of the study

It must be noted that the data were collected from only one university in Malaysia. Although the sample provided an acceptable quality in terms of outer loadings of 0.70 (Hair et al., 2017), it is still a self-report instrument and hence the truthfulness of the respondents cannot be assured. The potential that true associations between variables may be inflated cannot be ruled out. We have also avoided interpreting data from the current study as trait-like entities, hence the interpretations are from more systemic views of quality in learning. Students' perceptions may change with different contexts.

Implications for practice

Although universities aspire for students to develop mastery of their own disciplines, as well as apply and connect all knowledge in order to possess marketable job skills, the results of this study indicate students are more focused on having institutions meet their individual needs in terms of self-development, with their teachers providing the necessary guidance. This is supported by results indicating students' association of acquiring learning skills to the type of quality learning provided by the university. Hence students may tend to view quality learning more in terms of their teachers and the structure of their program rather than the university environment and experience as a whole. These results have clear implications for university teachers and administrators alike. There must be more effort in place to help students experience holistic learning to mould and develop them to be graduates with the necessary skills that meet market demands for employability.

Conclusion

The results showed that metacognitive experiences which are students' perceptions of the teaching and learning support given by a university to achieve their learning outcomes are significantly influenced by learning outcomes, with quality learning significantly influencing the support given by teachers. However, in metacognitive knowledge, the process of perceiving and organising new information in order to achieve learning outcomes, made up of three factors, resources, learning environment and curriculum, only curriculum is significantly influenced by quality learning.

It must be noted that this study did not investigate the influence of virtual environments on students' perceptions of their learning experiences. These environments can exert a significant influence on their metacognitive experiences. Hence, further studies are needed to determine the influence of virtual learning environments on the quality learning of students.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Akter, S., D'Ambra, J. & Ray, P. (2011). An evaluation of PLS based complex models: the roles of power analysis, predictive relevance and GoF index. *17th Americas Conference on*

Information Systems (AMCIS2011) (pp. 1-7). Detroit: Association for Information Systems. https://aisel.aisnet.org/amcis2011_submissions/151/

Ali, F., Zhou, Y., Hussain, K., Nair, P. K. & Ragavan, N. A. (2016). Does higher education service quality effect student satisfaction, image and loyalty? A study of international students in Malaysian public universities. *Quality Assurance in Education*, 24(1), 70-94. https://doi.org/10.1108/QAE-02-2014-0008

Asif, M. & Searcy, C. (2014). Determining the key capabilities required for performance excellence in higher education. *Total Quality Management & Business Excellence*, 25(1-2), 22-35. https://doi.org/10.1080/14783363.2013.807676

Biggs, J. (1999). What the student does: Teaching for enhanced learning. *Higher Education Research and Development*, 18(1), 57-75. https://doi.org/10.1080/0729436990180105

Biggs, J. & Tang, C. (2011). *Teaching for quality learning at university: What the student does*. Berkshire: McGraw Hill.

Bolkan, S. & Goodboy, A. (2011). Behavioral indicators of transformational leadership in the college classroom. *Qualitative Research Reports in Communication*, 12(1), 10-18. https://doi.org/10.1080/17459435.2011.601520

Choy, S. C., Yim, J. S. & Tan, P. L. (2017). Students' and teachers' perceptions of learning quality and learning outcomes in a Malaysian university. *Journal of Institutional Research in South East Asia*, 15(1), 41-62. http://www.seaairweb.info/journal/JIRSEA_v15_n1_2017.pdf

Christophel, D. M. (1990). The relationships among teacher immediacy behaviors, student motivation, and learning. *Communication Education*, 39(4), 323-340, https://doi.org/10.1080/03634529009378813

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. New Jersey: Erlbaum.

Diamantopoulos, A. & Siguaw, J. A. (2006). Formative versus reflective indicators in organizational measure development: A comparison and empirical illustration. *British Journal of Management*, 17, 263-282. https://doi.org/10.1111/j.1467-8551.2006.00500.x

Efklides, A. (2006). Metacognition and affect: What can metacognitive experiences tell us about the learning process? *Educational Research Review*, 1(1), 3-14. https://doi.org/10.1016/j.edurev.2005.11.001

Elassy, N. (2015). The concepts of quality, quality assurance and quality enhancement. *Quality Assurance in Education*, 23(3), 250-261. https://doi.org/10.1108/QAE-11-2012-0046

Ellis, R. A. (2016). Qualitatively different university student experiences of inquiry: Associations among approaches to inquiry, technologies and perceptions of the learning environment. *Active Learning in Higher Education*, 17(1), 13-23. https://doi.org/10.1177/1469787415616721

Entwistle, N. J. & Tait, H. (1995). *The Revised Approaches to Studying Inventory*. Edinburgh: Centre for Research on Learning and Instruction, University of Edinburgh.

Entwistle, N., McCune, V. & Hounsell, J. (2002). *Approaches to studying and perceptions of university teaching-learning environments: Concepts, measures and preliminary findings*. Edinburgh: School of Education, University of Edinburgh. http://www.etl.tla.ed.ac.uk/docs/ETLreport1.pdf

Fernandez-Duque, D., Baird, J. A. & Posner, M. I. (2000). Executive attention and metacognitive regulation. *Consciousness and Cognition*, 9(2), 288-307. https://doi.org/10.1006/ccog.2000.0447

Flavell, H. J. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, 34(10), 906-911. http://psycnet.apa.org/doi/10.1037/0003-066X.34.10.906

Fornell, C. & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39-50. https://www.jstor.org/stable/3151312

Goodboy, A. K. & Myers, S. A. (2008). The effect of teacher confirmation on student communication and learning outcomes. *Communication Education*, 57(2), 153-179. https://doi.org/10.1080/03634520701787777

Goodboy, K. & Bolkan, S. (2009). College teacher misbehaviors: Direct and indirect effects on student communication behavior and traditional learning outcomes. *Western Journal of Communication*, 73(2), 204-219, https://doi.org/10.1080/10570310902856089

Greenwald, S. W., Kulik, A., Kunert, A., Beck, S., Frohlich, B., Cobb, S., et al. (2017). Technology and applications for collaborative learning in virtual reality. In B. K. Smith, M. Borge, E. Mercier & K. Y. Lim (Eds), *Making a difference: Prioritizing equity and access in CSCL, 12th International Conference on Computer Supported Collaborative Learning (CSCL)* (pp. 719-726). Pennsylvania: International Society of the Learning Sciences. https://cscl17.files.wordpress.com/2017/06/finalvol2cscl2017.pdf

Hair, J. F., Hult, G. T., Ringle, C. M. & Sarstedt, M. (2017). *A primer on partial least squares structural equation modelling (PLS-SEM).* Los Angeles: SAGE.

Hair, J. F., Ringle, C. M. & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, 19(2), 139-152. https://doi.org/10.2753/MTP1069-6679190202

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66(1), 64-74. https://doi.org/10.1119/1.18809

Händel, M., Lockl, K., Heydrich, J., Weinert, S. & Artelt, C. (2014). Assessment of metacognitive knowledge in students with special educational needs. *Metacognition and Learning*, 9(3), 333-352. https://doi.org/10.1007/s11409-014-9119-x

Handelsman, J., Ebert-May, D., Beichner, R., Bruns, P., Chang, A., DeHaan, R., Gentile, J., Lauffer, S., Stewart, J., Tilghman, S. M. & Wood, W. B. (2004). Scientific teaching. *Science*, 304(5670), 521-522. https://doi.org/10.1126/science.1096022

Hattie, J., Biggs, J. & Purdie, N. (1996). Effects of learning skills interventions on student learning: A meta-analysis. *Review of Educational Research*, 66(2), 99-136. https://doi.org/10.3102/00346543066002099

Heikkila, A. & Lonka, K. (2006). Studying in higher education: Students' approaches to learning, self-regulation, and cognitive strategies. *Studies in Higher Education*, 31(1), 99-117. https://doi.org/10.1080/03075070500392433

Hensler, J., Ringle, C. & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modelling. *Journal of the Academy of Marketing Science*, 43(1),115-135. https://doi.org/10.1007/s11747-014-0403-8

Hill, F. M. (1995). Managing service quality in higher education: The role of the student as primary consumer. *Quality Assurance in Education*, 3(3), 10-21. https://doi.org/10.1108/09684889510093497

Kek, M. & Huijser, H. (2011). Exploring the combined relationships of student and teacher factors on learning approaches and self-directed learning readiness at a

Malaysian university. *Studies in Higher Education*, 36(2), 185-208. https://doi.org/10.1080/03075070903519210

Kuhn, D. (2000). Metacognitive development. *Current Directions in Psychological Science*, 9(5), 178-181. https://doi.org/10.1111%2F1467-8721.00088

Lai, E. R. (2011). *Metacognition: A literature review*. Pearson. https://images.pearsonassessments.com/images/tmrs/Metacognition_Literature_Review_Final.pdf

Laird, T. F. N., McCormick, A., Sullivan, D. F. & Zimmerman, C. (2011). STEM/non-STEM differences in engagement at US institutions. *Peer Review*, 13(3), 1-7. https://www.aacu.org/publications-research/periodicals/stemnon-stem-differences-engagement-us-institutions

Langstrand, J., Cronemyr, P. & Poksinska, B. (2015). Practise what you preach: Quality of education in education on quality. *Total Quality Management & Business Excellence*, 26(11-12), 1202-1212. https://doi.org/10.1080/14783363.2014.925290

McCardle, L. & Hadwin, A. F. (2015). Using multiple, contextualized data sources to measure learners' perceptions of their self-regulated learning. *Metacognition and Learning*, 10(1), 43-75. https://doi.org/10.1007/s11409-014-9132-0

McCowan, T. (2015). Should universities promote employability? *Theory and Research in Education*, 13(3), 267-285. https://doi.org/10.1177%2F1477878515598060

Mottet, T., Parker-Raley, J., Cunningham, C. & Beebe, S. (2005). The relationships between teacher nonverbal immediacy and student course workload and teacher availability expectations. *Communication Research Reports*, 22(4), 275-282. https://doi.org/10.1080/000368105000317482

Nagengast, B. & Marsh, H. W. (2012). Big fish in little ponds aspire more: Mediation an dcross-cultural generalizability of school-average ability effects on self-concept and career aspirations in science. *Journal of Educational Psychology*, 104(4), 1033-1053. https://doi.org/10.1037/a0027697

Nicholson, K. (2011). *Quality assurance in higher education: A review of the literature*. Ontario: Council of Ontario Universities Degree Level Expectations Project, McMaster University. http://cll.mcmaster.ca/COU/pdf/Quality%20Assurance%20Literature%20Review.pdf

Oliver, R. (2001). Assuring the quality of online learning in Australian higher education. In M. Wallace, A. Ellis & D. Newton, *Proceedings of Moving Online II Conference* (pp. 222-231). Lismore: Southern Cross University. https://ro.ecu.edu.au/ecuworks/4792/

Preacher, K. J. & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers,* 36(4) 717-731. https://doi.org/10.3758/BF03206553

Preacher, K. J. & Leonardelli, G. J. (n.d.). Calculation for the Sobel test: An interactive calculation tool for mediation tests. http://quantpsy.org/sobel/sobel.htm

Ringle, C. M., Wende, S. & Becker, J. M. (2015). *SmartPLS 3*. https://www.smartpls.com

Samudra, P. G., Min, I., Cortina, K. S. & Miller, K. F. (2016). No second chance to make a first impression: The "thin-slice" effect on instructor ratings and learning outcomes in higher education. *Journal of Educational Measurement*, 53(3), 313-331. https://doi.org/10.1111/jedm.12116

Sohail, M. S. & Saeed, M. (2003). Private higher education in Malaysia: Students' satisfaction levels and strategic implications. *Journal of Higher Education Policy and Management*, 25(2), 173-181. https://doi.org/10.1080/1360080032000122642

Veenman, M. V. J., Wilhelm, P. & Beishuizena, J. J. (2004). The relation between intellectual and metacognitive skills from a developmental perspective. *Learning and Instruction*, 14(1), 89-109. https://doi.org/10.1016/j.learninstruc.2003.10.004

WebPower (n.d.). https://webpower.psychstat.org/

Whalen, D. & Shelley, M. (2010). Academic success for STEM and non-STEM majors. *Journal of STEM Education*, 11(1&2), 46-60. http://litee.org/jstem/index.php/JSTEM/article/download/1470/1292/

Wojciechowski, R. & Cellary, W. (2013). Evaluation of learners' attitude toward learning in ARIES augmented reality environments. *Computers & Education*, 68, 570-585. https://doi.org/10.1016/j.compedu.2013.02.014

Zhao, X., Lynch, J. G. & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, 37(2), 197-206. https://doi.org/10.1086/651257

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