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An Integrated Evaluation Model of Teaching and Learning

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An Integrated Evaluation Model of Teaching and Learning

Abstract
Knowledge transmission and knowledge construction are two common approaches adopted for teaching and learning in higher education. Applying the two different approaches, this paper developed an evaluation model of teaching and learning, which comprises three main conceptual blocks: teaching, learning and learning assistance. A quantitative survey was utilised, collecting data from the Student Assessment of Learning Gains (SALG) along with the Student Evaluation of Teaching (SET) from 108 randomly selected courses at a university in Taiwan. The results demonstrated an R^2 value of 0.794. The route between teaching and learning was not statistically significant (t=0.0359), indicating that knowledge is constructed in the mind of the student with learning assistance as the mediator.

Keywords
knowledge construction, knowledge transmission, SALG, SET

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Introduction

Currently, student populations are becoming increasingly diverse (Bramer 2011). The Ministry of Education in Taiwan implemented important higher-education reforms in 2002. The multi-route promotion program for college-bound seniors was one of the most important of these reforms (Ministry of Education 2014). According to the program, admission to Taiwan's colleges and universities can be achieved by following three paths: recommendation, application or examination.

Students who select the recommendation or application paths to admission are required to take the General Scholastic Ability Test, which assesses students' general competence in Chinese, English, mathematics and the natural and social sciences, and the Practical Test, which evaluates students' performance in the specialised subject areas in which they wish to major. The examination route represents a third option for students who have failed to gain admission to the institution of their choice through the first two methods. These students can take the Advanced Subjects Test, which is based on the individual requirements of the colleges and universities they wish to attend. Students are then assigned to colleges and universities based on their preferences and their performance on the examination (Executive Yuan 2014). Thus admission to higher education in Taiwan is multivariate; as a consequence, the student populations at colleges and universities are heterogeneous. Given the diverse student population, a single teaching method cannot suit the learning preferences of these different groups of students when they gather in one classroom.

According to Martin, Prosser, Trigwell, Ramsden and Benjamin (2002, p.124), college and university teachers approach their teaching in two ways: "knowledge as given" and "knowledge as constructed". The former emphasises the unidirectional process of imparting knowledge to the student, while the latter focuses on constructing knowledge through participating in an interactive socio-cultural process, where students develop and interpret knowledge collaboratively with their peers and teachers (Chellammal 2016). The aim of this study is to integrate the arguments of the two different approaches, developing an integrated evaluation model of teaching and learning, with the ultimate goal of helping colleges and universities to understand the teaching and learning patterns of their students.

Literature review

Knowledge construction versus knowledge transmission

In pedagogy, knowledge construction and knowledge transmission are two approaches representing rather different learning models. Knowledge construction originates from constructivism, a theory of learning evolving from the contribution of psychologists such as Jean Piaget, Lev Vygotsky, Jerome Bruner, Howard Gardner and Nelson Goodman (Chellammal 2016; Fosnot & Perry 2005). Constructivists believe that individuals build up their own understanding of how the world works. The process of knowing the world is through basing understanding on new knowledge learned in accordance with past experiences or with relevant information stored in memories (existing knowledge). Therefore, learning is not simply the process by which learners obtain new knowledge through absorbing information transmitted to them. Instead, using their own experiences and understanding, learners themselves construct knowledge (Zohar 2004).

Knowledge construction is not possible without a teacher who plays a critical role in "fostering, enabling and catalysing learning" (Ellerman, Denning & Hanna 2001, p.171). The student cannot learn in a vacuum or without skilled support. In other words, the student develops desired skills or

learns new knowledge via participating in an interactive socio-cultural process. This process is not unidirectional because communication and coordination are two vital elements for learning to occur. Both sides (the teacher and the student) must be active and participate in shared endeavours as they attempt to reach a common ground of understanding the activities or tasks at hand. This is what Mascolo (2009, p.12) referred to as the "dynamic teacher-object-student relation". The notion of the Zone of Proximal Development (ZPD) proposed by Vygotsky (Gass & Selinker 2008; Lightbown & Spada 2006; Mitchell & Myles 2004) provides a clear explanation of how learning construction takes place. The ZPD is the domain of knowledge or skills that are not yet functional for individual learners on their own. However, with the support or assistance of a capable other or others, learners can produce the desired outcome. This supportive process is called scaffolding (Wood, Bruner & Ross 1976). In other words, learning can be seen as a social activity, taking place through social interaction. Unskilled learners learn new things by carrying out or engaging in tasks under the support and guidance of more-skilled people. Later, the learners themselves come to develop the ability and knowledge to complete the tasks (Ellis 2008).

Knowledge transmission differs from knowledge construction in that the proponents of knowledge transmission are inclined to value the notion of teacher-centredness, in which teachers have sound subject knowledge and their main job is to pour knowledge into the students' minds. This concept is in fact consistent with the notion of what a good teacher should do in the Chinese educational tradition (Zhang & Watkins 2007). The students, for their part, play a relatively passive role, with their main responsibility being to sit quietly in class, digest the information and absorb knowledge. In the transmission theory of teaching, knowledge is believed to be true and certain. A way to enable the truth and certainties to be accumulated in another's mind is to teach (Swann 1998). Here, teaching means the process of imparting information to the learner. In this sense, "to teach is to give (e.g., give a lecture); to learn is to take (e.g., take notes; acquire knowledge)" (Mascolo 2009, p.6). A good teacher is thus regarded as one who has obtained a mastery of knowledge. Therefore, if students have difficulties understanding their teacher's instructions, this can be attributed to their learning deficiencies or to the teacher's failure to clearly and logically deliver instructions. Improving learning and teaching, in this sense, boils down to improving the test scores of students. This traditional belief, according to Kellaghan and Greaney (2001), has been criticised because it has overly emphasised the teacher at the expense of the student. Similarly, Rogoff, Turkanis and Bartlett (2001) indicated that the notion of knowledge transmission is to see educating students as merely producing products in a factory, in which the teacher is responsible for packaging knowledge and the student has no choice but to be filled with that knowledge. Swann (1998) noted that the notion of knowledge transmission remains questionable and flawed in that it has no convincing underpinning theory. Human beings are different from inanimate objects because a human being "grows through curiosity, play, learning from mistakes, making connections and surprise" (Zohar 1997, p.II).

Evaluation of teaching and learning effectiveness

In higher education, administrators and others rely heavily on student responses to evaluate teacher effectiveness (Ferguson 2012). Student Evaluation of Teaching (SET) and Student Assessment of Learning Gains (SALG) are two common assessment tools adopted by colleges and universities for this purpose (Wu & Chiu 2011). SET, according to Zabaleta (2007), is widely used in institutions of higher education worldwide (Loveland 2007). This may be due to the belief that an effective teacher, to a significant degree, exerts a positive influence on student learning and contributes to student success in academic performance (Darling-Hammond & Youngs 2002; Stronge & Hindman 2003; Stronge & Tucker 2000), and that having good teachers is the most important factor in improving student learning (Stronge, Ward, Tucker & Hindman 2007).

SALG is an on-line assessment tool developed by Seymour (1997) and Seymour, Wiese, Hunter and Daffinrud (2000) to determine the state of student learning in a specific area within a course. Students are asked a series of questions related to their learning that assess (1) content knowledge, (2) skill development, (3) learning attitudes and (4) learning integration. The instrument is based on a wider perspective than focusing only on subject-based outcomes. This corresponds to the arguments of Allan (1996) and Nichols (1991) that learning outcomes in higher education should be examined from more than one dimension. SALG not only stresses the end-products of the course but also devotes particular attention to the learning route; that is, how to start from the "lacks" – knowledge or skills that the learner does not yet have – to determine the "necessities" – knowledge or skills that the learner needs (Hutchinson & Waters 1987, p. 55-56). The learning route emphasises the process that the learner goes through to gain knowledge. The teacher plays a critical role in assisting learners during the process, in view of the fact that it is unlikely that learners will be able to learn knowledge and skills beyond their present level mostly on their own. For this reason, SALG asks questions related to (1) the class overall, (2) class activities, (3) assessments, (4) class resources, (5) information and (6) assistance to develop learner autonomy. These are characteristic of the knowledge-construction model introduced above, where knowledge is built up through various class activities and the learning assistance that is provided.

Originally developed for science and math students at the University of Wisconsin to effectively review their own learning, SALG is now widely used in many fields. For example, Yadav, Subedi and Lundeberg (2011) used SALG to examine students' perspectives on problem-based learning in an electrical-engineering course. Vogt, Atwong and Fuller (2005) described the process of using SALG to evaluate the learning outcomes of an advanced business course and concluded that SALG can effectively evaluate student learning and form accountability standards for academic purposes. Analysing the relationship between self-reported gains surveys and students' GPAs, Douglass, Thomson and Zhao (2012) noted that self-reported gains surveys, if properly designed, can reflect students' learning outcomes in different majors at a large university composed of various departments.

Theoretical framework of the study

The integrated evaluation model (Figure 1) developed in this study includes three conceptual blocks: teaching, learning and learning assistance. In its role as a framework to explore the teaching and learning mechanism, it represents differences between the principles of knowledge construction and knowledge transmission. Route A represents the path of knowledge transmission. Mascolo (2009, p.6) used the term "conduit" to describe such a unidirectional process. Thus, the arrow in this route is one-way, as the assumption is that teaching automatically translates into learning. In other words, if one is teaching (teaching here means imparting knowledge to the learner through the activity of lecturing), the students are learning (learning indicates acquiring knowledge from the teacher). Route B represents the path of knowledge construction. In this route, learning assistance, which aims to create discussion and promote communication among students and provide opportunities to construct new ideas and learn from each other, and which is assumed to exert a positive impact on learning, is provided. Teachers' roles are similar to those of facilitators, who "provide learners with experiences that allow them to hypothesize, predict, manipulate objects, pose questions, research, investigate, imagine and invent the process" (Chellammal 2016, p.54).

This evaluation model offers three possibilities. First, Route B does not exist. The relationship between teaching and learning, as indicated in Route A, is represented as a single-headed arrow

pointing from teaching to learning. Second, Route A does not exist. In this case, learning assistance is a prerequisite for teaching to lead to learning. Third, both Routes A and B exist. In this case, learning assistance is a partial mediator. These three combinations are the three hypotheses that the current research explores.

Hypothesis 1: Route A is valid; teaching can turn into learning.
Hypothesis 2: Route B is valid; learning assistance is a complete medial, catalysing teaching to learning.
Hypothesis 3: Both Routes A and B are valid; learning assistance is a partial mediator.

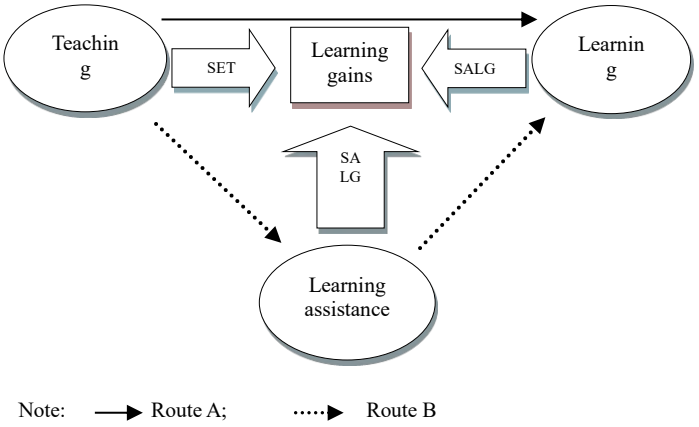


Figure 1. *The integrated teaching and learning model. This model comprises three main conceptual blocks: teaching, learning and learning assistance measured by SET and SALG. Route A and B indicate the mechanisms of how learning occurs.*

Research design

A quantitative survey research method was used to provide insights into teaching and learning. One hundred eight courses were randomly selected from a school course list for the purposes of data generation. The instrument used was a modified version of SALG and SET, which had been piloted by two university instructors for its structure and question items. Data collection continued over three months, from November 2014 to February 2015 (after mid-term examinations). The entire process of data collection took approximately 20 minutes in each class using the well-designed instruments and well-prepared instructions.

Instruments for data collection

The current study used a modified version of SALG (Appendix A) along with SET (Appendix B). Both SALG and SET have been used in different contexts in various disciplines over a number of decades. The results of these studies have provided considerable and revealing insights, which formed the matrix upon which the integrated teaching and learning model in the current study was developed. SALG is taken to measure the aspects of learning and learning assistance, while SET is intended to provide data on the aspect of teaching (Figure 1). Twenty-two items in SALG measure the learning factor, and the other 26 measure the learning-assistance factor. Four constructs can be identified for the learning factor: (A) content knowledge, (B) skill development, (C) learning attitudes and (D) learning integration. Each construct has several corresponding question items.

The learning assistance factor has six constructs: (E) class overall, (F) class activities, (G) assessments, (H) class resources, (I) information and (J) assistance to develop learner autonomy. These six constructs are related to the guided process that the student goes through to acquire knowledge. Similarly, each construct also has several corresponding questions (Table 1 summarises the SALG). SALG has 48 questions, for each of which students were asked to select statements of agreement or disagreement on a five-point Likert scale reflecting their degree of learning and learning assistance. The original version of SALG was written in English; therefore, great care was taken to translate English into Chinese for reading convenience. Examples and explanations were supplied to make the terminology and concepts easier to comprehend and understand.

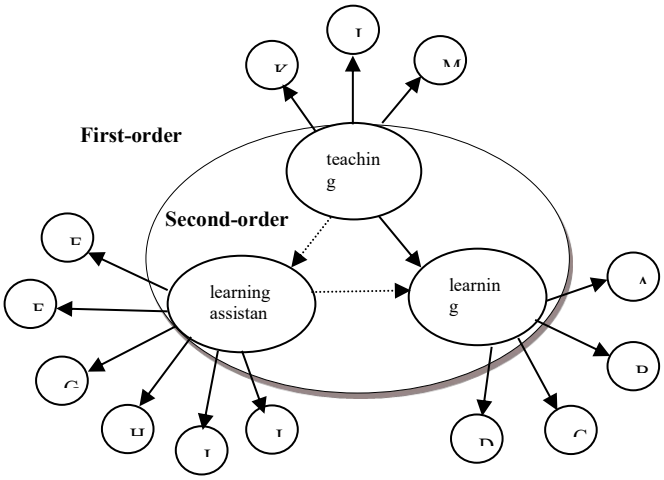
In contrast, SET is meant to evaluate teaching. Students are asked to evaluate whether the teacher has a serious attitude towards teaching, whether the teacher arranges the learning contents based on the course outline, whether the teacher is able to effectively deliver the course, and so on, using a five-point Likert scale. The student's role in SET is quite passive, as nearly all the questions are designed to evaluate teaching. Such questions are characteristic of the knowledge-transmission model. SET has three constructs: (K) teaching methods, (L) teaching attitudes and (M) teacher interaction with the student. Each construct also has several corresponding question items (Table 1 summarises the contents of SET).

Table 1. Overview of the construction of the modified questionnaire

	Constructs	*No. of question items*	*Content*
Learning	(A) content knowledge	5	Asking whether students agree that they have learned the fundamental concepts in the course.
	(B) skill development	7	Asking whether students agree that they have understood how to apply what they have learned from the course in the related field.
	(C) learning attitudes	6	Asking whether students agree that they have a positive learning attitude towards the course.
	(D) learning integration	4	Asking whether students agree that they have developed the ability to integrate knowledge learned from the course.
Learning assistance	(E) class overall	3	Asking whether the class is beneficial.
	(F) class activities	5	Asking whether class activities are helpful.
	(G) assessments	7	Asking whether the content and manner of assessments are instructive.
	(H) class resources	4	Asking whether the course resources (e.g., handouts, on-line information) are useful.
	(I) information	3	Asking whether students agree that their teacher provides information about how to use class resources.
	(J) assistance to develop learner autonomy	4	Asking whether students agree that their teacher supports the development of learner autonomy.

Teaching	(K) teaching methods	5	Asking about students' satisfaction with their teacher's teaching methods.
	(L) teaching attitudes	3	Asking whether the teacher has a positive attitude towards teaching.
	(M) teacher interaction with the student	2	Asking whether the teacher interacts with his or her students during the class.

Figure 2 shows the relationship among the three main blocks in the model's path: teaching, learning and learning assistance. This model is actually constructed based on the theoretical framework (Figure 1) underpinning this study. The meanings of the two routes, A and B, in Figure 2 are the same as in Figure 1. More importantly, Figure 2 also shows that the model is a hierarchical construct model, which contains two layer constructs. Researchers and theorists have positively evaluated the theoretical and empirical contributions of hierarchical construct models (see Hair, Ringle & Sarstedt 2011; Jarvis, MacKenzie & Podsakoff 2003; Petter, Straub & Rai 2007; Wetzels, Odekerken-Schröder & Van Oppen 2009). The model in this study includes two orders: first-order latent variables (constructs A-M) and second-order latent variables (constructs of teaching, learning and learning assistance). This means that the model of teaching and learning in this study is measured at two levels of abstraction.



Note: ⟶ route A; ⋯▶ route B

Figure 2. The hierarchical construct model of integrated teaching and learning. This path model demonstrates the construction of two orders of latent variables: first-order (constructs A to M) and second-order latent variables (teaching, learning assistance, and learning). Routes A and B indicate the learning mechanisms that occur.

Background information about the university

This study chose as its research object a large-scale national university located in central Taiwan, with approximately 8,000 students. One of the goals of the university is to provide quality teaching to equip learners with the subject knowledge required at their future workplaces or by their subject disciplines. The Teaching Development Centre at the university is responsible for the evaluation of teacher effectiveness each semester. The policy of evaluating teacher effectiveness dates to 1996,

and its purpose is to help the university understand teachers' performance, and then to make formative and summative decisions. SET has been used for these purposes since the policy was implemented. However, the university is prompted to make changes to its teacher-evaluation policy for two reasons: (1) an increasingly diverse student population, and (2) SET's lack of discriminatory power. The student population at the university is becoming increasingly diverse due to the effect of the multi-route promotion program for college-bound seniors discussed in the introduction and the increasing number of international students from various countries in Asia, including Malaysia, mainland China, Mongolia and Vietnam. This means that the traditional knowledge-transmission model might not be able to meet the learning needs and satisfy the learning preferences of the entire cohort of students. In the case of the latter, the average SET score reaches 92 (0-100; 0 is the lowest score and 100 the highest), which not only is unrealistic but also provides limited information for teachers seeking to further improve their teaching. However, before undertaking any important reforms regarding the evaluation system, there is a need to have a firm understanding of the teaching and learning mechanism.

The university itself is a typical university in Taiwan for three reasons. First, because of the multi-route promotion program for college-bound seniors, nearly all colleges and universities in Taiwan have diverse student populations. Second, due to Taiwan's low birth rate, many colleges and universities actively recruit international students. Third, according to Chang's (2005) research findings, up to 80% of colleges and universities in Taiwan (based on data from 36 national and 40 private colleges and universities) implement the SET system to evaluate teacher effectiveness. Thus, the selected university is representative of many in Taiwan, and consequently is worthy of investigation.

Research sample

The population sample consisted of 108 randomly selected courses. There were 2,313 full-time students involved in total, including freshmen, sophomores, juniors and seniors from various departments with different majors. Their ages ranged from 19 to 22. Due to the anonymous nature of the evaluation, no other demographic information was gathered. The participant population was required to rate the teaching, learning assistance and learning aspects of their courses.

Data analysis

The parameters of the hierarchical model were estimated by PLS (partial least squares) path modelling, as Wetzels et al. (2009) and Petter et al. (2007) indicated that PLS is suitable for use in assessing hierarchical construct models, even though the number of real applications currently is still limited. To reduce the influence of within-group variance on the measurement model, the mean score of each course was calculated before PLS path modelling was undertaken. The intent of PLS path modelling is to maximise the explained variance of the endogenous latent constructs. Therefore, it is particularly suitable for testing a confirmatory theory; this characteristic made it appropriate for this study. Scores on the 58 indicator variables (48 question items from SALG and 10 from SET) were used to compute proxy scores for the 13 latent constructs A to M. The PLS path model of integrated teaching and learning in this study is a reflective measurement model, as the 13 constructs of both SALG and SET cannot be directly gauged; however, they can be indirectly estimated via the indicator (observed) variables (i.e., 58 corresponding question items in the questionnaire). Put more directly, the indicator variables are reflections of the 13 constructs. The proxy scores of these constructs were computed based on the scores of the indicator variables. The PLS path model could then be constructed by calculating the interrelationship among indicator variables and latent constructs. According to Edwards (2001), the measurements of validity and reliability in a hierarchical construct model are particularly important. As Wetzels et al.

(2009, p. 179) noted, "as the heterogeneity of the dimensions of the multidimensional construct increase, the internal consistency of the summed dimension scores will eventually be reduced." Hair et al. (2011) proposed certain criteria for model evaluation (Table 2). Model evaluation involves two levels: measurement model evaluation (the outer circle in Figure 2) and structural model evaluation (the inner circle in Figure 2).

Table 2. Guidelines for model evaluation

Measurement Models
• Internal consistency reliability: Composite reliability (CR) > 0.70
• Indicator reliability: Indicator loadings > 0.70.
• Convergent validity: The average variance extracted (AVE) > 0.50.
• Discriminant validity: The AVE of each latent construct should be higher than the construct's highest squared correlation with any other latent construct. An indicator's loadings should be higher than all of its cross loadings.
Structural Model
• R^2 values > 0.75 → substantial; R^2 values > 0.50 → moderate
• Use bootstrapping to assess the path coefficients' significance. The minimum number of bootstrap samples is 5,000, and the number of cases should be equal to the number of observations in the original sample. Critical t-values for a two-tailed test > 1.65 (significance level).

Research findings

Table 3 gives the results of the reflective measurement model analysis. For the first-order constructs, the loading of each manifest variable was higher than 0.7. This reveals that the question items in the combined SALG and SET questionnaire are good indicators of teaching, learning and learning assistance. All the loadings reach significance level. The composite reliability (CR) exceeds 0.7, and the average variance extracted (AVE) of all measures is higher than the cut-off value of 0.5. Similarly, for the second-order constructs, the CR exceeds 0.7, and the AVE is higher than 0.5. Table 4 indicates that, for each construct, the square root of the AVE is higher than the intercorrelations of the construct with the other constructs in the model. This outcome provides sufficient evidence of the model's reliability and validity. For the structural model, the R^2 value is 0.794 (see Figure 3). This shows that the model performs well, substantially explaining the endogenous latent variables' variance. The path coefficients were assessed via bootstrapping. As shown in Table 5, the coefficient for the route between teaching and learning is 0.005, with t=0.0359. For the route between teaching and learning assistance, the coefficient is 0.7717, with t=18.6795. For the route between learning assistance and learning, the coefficient is 0.8849, with t=13.2732. The path coefficient of the first route (i.e., teaching→learning) does not reach significance level (t<1.65). Therefore, this route was deleted from the integrated model. This finding provides evidence of the existence of hypothesis 2: knowledge is constructed, and learning assistance plays the role of a complete mediator catalysing teaching and leading to learning.

Table 3. Psychometric properties of first-order and second-order constructs

First-order constructs							**Second-order constructs**
Constructs	Manifest variables	Outer loading	Composite reliability	AVE	Constructs	AVE	Composite reliability
(A) Content knowledge	A1	0.9398	0.9732	0.8789	Learning	0.7899	0.988
	A2	0.9493					
	A3	0.9576					
	A4	0.9335					
	A5	0.9064					
(B) Skill development	B1	0.9179	0.9715	0.8297			
	B2	0.9442					
	B3	0.9229					
	B4	0.9248					
	B5	0.9121					
	B6	0.8652					
	B7	0.8866					
(C) Learning attitudes	C1	0.9219	0.9718	0.8517			
	C2	0.8887					
	C3	0.9117					
	C4	0.956					
	C5	0.9389					
	C6	0.9186					
(D) Learning integration	D1	0.9549	0.9757	0.9093			
	D2	0.9623					
	D3	0.958					
	D4	0.939					
(E) Class overall	E1	0.9788	0.9822	0.9485	Learning assistance	0.7199	0.9852
	E2	0.9732					
	E3	0.9698					
(F) Class activities	F1	0.9171	0.9677	0.857			
	F2	0.9447					
	F3	0.9511					
	F4	0.9245					
	F5	0.8901					
(G) Assessments	G1	0.8494	0.9591	0.7701			
	G2	0.9088					
	G3	0.8564					
	G4	0.869					
	G5	0.8722					
	G6	0.8875					
	G7	0.898					
(H) Class resources	H1	0.8614	0.9493	0.8242			
	H2	0.9274					
	H3	0.9286					
	H4	0.9124					
(I) Information	I1	0.9704	0.979	0.9395			
	I2	0.9682					

	I3	0.9693					
(J) Assistance to develop learner autonomy	J1	0.9148	0.934	0.78			
	J2	0.9365					
	J3	0.8482					
	J4	0.8288					
(K) Teaching methods	K1	0.9377	0.9732	0.8792	Teaching	0.7898	0.974
	K2	0.9375					
	K3	0.9595					
	K4	0.939					
	K5	0.9182					
(L) Teaching attitudes	L1	0.884	0.935	0.8277			
	L2	0.889					
	L3	0.9547					
(M) Teaching interaction with the student	M 1	0.9701	0.9705	0.9426			
	M 2	0.9717					

Note: Outer loading, CR, AVE of first- and second-order constructs are presented.

Table 4. Intercorrelations of the latent variables for first-order constructs

Learning	A	B	C	D	Learning assistance	E	F	G	H	I	J	Teaching	K	L	M
A	0.937				E	0.973						K	0.937		
B	0.898	0.910			F	0.897	0.925					L	0.845	0.909	
C	0.907	0.831	0.922		G	0.801	0.824	0.877				M	0.834	0.845	0.97
D	0.927	0.868	0.893	0.953	H	0.806	0.839	0.743	0.907						
					I	0.896	0.892	0.813	0.895	0.969					
					J	0.846	0.878	0.789	0.791	0.850	0.883				

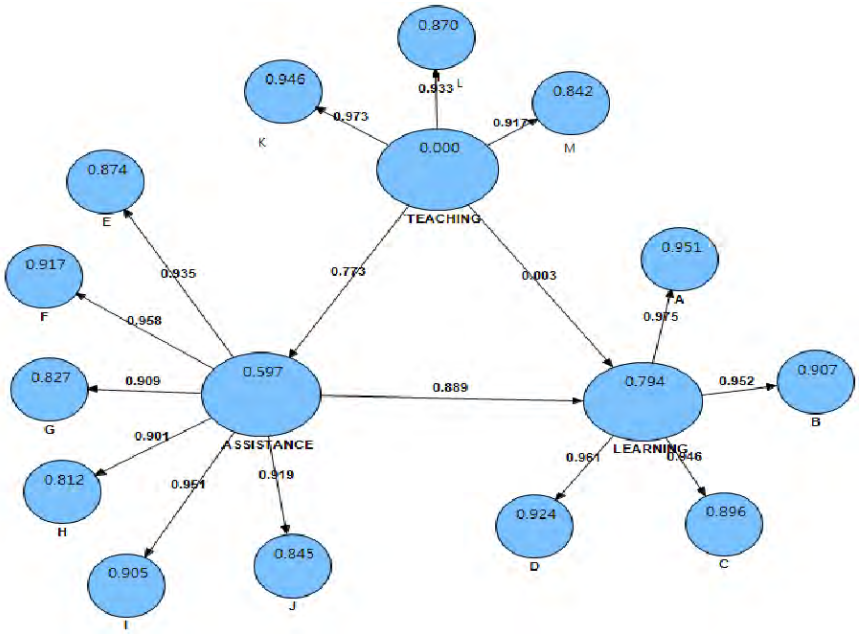


Figure 3. *Structural model of integrated teaching and learning. The R^2 value of each second-order variable (i.e., teaching, assistance, and learning) is presented.*

Table 5. Path bootstrap analysis of path coefficients

	Original sample (O)	Sample mean (M)	Standard error (STERR)	*t* statistics (| O/STERR |)
teaching→learning	0.0029	0.005	0.082	0.0359
teaching→learning assistance	0.773	0.7717	0.0414	18.6795
learning assistance→learning	0.8887	0.8849	0.067	13.2732

Note: The coefficient's significance with standard errors of the three routes between teaching and learning is presented.

Discussions

The results of this study raise issues regarding knowledge acquisition and the utility of SET ratings. The first issue is the research findings reveal that the participants learned new knowledge via Route B in Figure 1. This suggests that knowledge is constructed in the mind of the student, with the help of the different forms of scaffolding that more capable others use to support learning development. Therefore, it is important for instructors to create a supportive learning environment and design social-cultural learning activities in which the student is allowed to work collaboratively, share understanding and discover knowledge with their peers and teachers (Wanner 2015). Biggs (2003) emphasised that the key to designing learning activities is that they must truthfully reflect the intended learning outcomes. Other important components that should be aligned with learning activities include teaching methods and assessment tasks (the core concept of constructive alignment). In this case, the learner "finds it difficult to escape without learning what he or she is intended to learn". In addition, social-cultural activities, according to Prince

(2004), are core elements to prompt active learning and student engagement. These two are considered to be a prerequisite in achieving meaningful learning, critical thinking ability, reasoning skills and openness to differences, which are at the core of higher education (McLaughlin et al. 2014). In addition to social cultural activities, many teaching approaches have been discussed, such as a flipped classroom (McLaughlin et al. 2014), e-learning (Koohang, Paliszkiewicz, Gołuchowski & Nord 2016) and just-in-time teaching (Gavrin 2006; Wanner 2015), and these approaches are proved to be effective in prompting active learning and student engagement. The current study demonstrated that students prefer to learn through engaging in learning activities and that students construct knowledge in their mind with the teacher's assistance. Such results could be a legitimate force prompting the change of the shape of course structures in Taiwan's higher education.

The knowledge-construction route suggests that the knowledge-transmission route is not valid. However, the knowledge-transmission approach is popular in Taiwan and elsewhere. The belief that teaching is equal to learning is rooted in the mind of teachers. There are perhaps two reasons for this. First, giving lectures, compared to designing learning activities in which learners can actively discover and build up knowledge and understanding, is relatively uncomplicated, as it emphasises the unidirectional process of imparting information to the learner rather than the interaction and collaboration between the teacher and the student. The second reason is the belief that moving a body of practical or theoretical knowledge from the head of the lecturer or academic to the student's head is what teachers should do and ought to be their top priority. However, even though the dissemination of knowledge will fulfill certain goals of the course, it will surely not fulfill all of them. Allan (1996) noted that learning outcomes in higher education include much more than the mastery of content knowledge. Different forms of guided-learning activities have potential to serve other goals of the course. Therefore, what teachers should do is to provide various forms of social scaffolding, with which they can support learning development and promote a deep approach to learning (Jarvis & Woodrow 2001; Mascolo 2005).

The second issue is that SET is widely used for evaluating teacher effectiveness in Taiwan (Chang 2005). Taiwan's colleges and universities are inclined to assume that the teacher plays a crucial role in determining the success of student learning and that teacher performance is closely related to student performance. However, the finding of the current study reveals that there is no direct and causal relationship between teaching and learning. Human beings do not learn new things by being given information. It is problematic to solely use SET ratings to evaluate how much students have learned from the course and predict how well they will perform academically. Students express their opinions of how they feel about a teacher's teaching through SET. It thus provides limited information about learning. In other words, learning outcomes cannot be measured simply by viewing SET scores. More importantly, researchers and theorists are questioning the utility and the validity of SET. For example, Blackmore (2009) remarked that SET has been largely used as an indicator of internal quality assurance to satisfy a requirement of consumer satisfaction, making the measure of teaching quality merely a reflection of how much students' expectations have been met rather than how much students have learned from the course. Otani, Kim and Cho (2012) noted that many uncontrollable variables, such as class size, prior interests and expected grades, are not considered in routine SET ratings.

Pedagogical implications

Two pedagogical implications emerge from this study. First, teachers and students must understand how learning occurs and how knowledge is gained. For teachers, having such an understanding enables them to adjust their teaching approaches. It is unlikely that teachers will conceptually

change their teaching approaches if they have a limited understanding of how knowledge is constructed. For students, knowing this helps them understand how to learn in groups and how to be effective resource investigators. Second, simply using SET to measure teacher effectiveness for the purposes of promotion and employment fails to faithfully reflect the teaching and learning relationship. The amount of what a student has learned from one particular course cannot be assessed simply through viewing SET scores because, as the present research results demonstrate, there is no direct relationship between teaching and learning. SET should not be the only source of data in the evaluation system. It should be supplemented with SALG or other valid and reliable measurements to realise an integrated evaluation.

Despite the strength of the research findings, there are concerns about the accuracy of self-reported gains surveys. It is possible that students do not faithfully report what they believed when filling out the questionnaire and that students assume they have a firm understanding about the course subject, even if, in fact, they do not. Although the combined SET and SALG questionnaire may have some imperfections in relation to the current research, the key issue is whether such an integrated evaluation could advance the current evaluation system, which relies on limited information about teacher effectiveness.

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Appendix A

Student Assessment of Learning Gains (SALG)

	No help	A little help	Moderate help	Much help	Great help	N/A
Class overall						
1. The instructional approach taken in this class	☐	☐	☐	☐	☐	☐
2. How the class topics, activities, readings and assignments fit together	☐	☐	☐	☐	☐	☐
3. The pace of the class	☐	☐	☐	☐	☐	☐
Class activities						
1. Attending lectures	☐	☐	☐	☐	☐	☐
2. Participating in discussions during class	☐	☐	☐	☐	☐	☐
3. Listening to discussions during class	☐	☐	☐	☐	☐	☐
4. Participating in group work during class	☐	☐	☐	☐	☐	☐
5. Doing hands-on classroom activities	☐	☐	☐	☐	☐	☐
Assessments						
1. Graded assignments in this class	☐	☐	☐	☐	☐	☐
2. Opportunities for in-class review	☐	☐	☐	☐	☐	☐
3. The number and spacing of tests	☐	☐	☐	☐	☐	☐
4. The fit between class content and tests	☐	☐	☐	☐	☐	☐
5. The mental stretch that tests require	☐	☐	☐	☐	☐	☐
6. The way the grading system helped me understand what I needed to work on	☐	☐	☐	☐	☐	☐
7. The feedback on my work received after tests or assignments	☐	☐	☐	☐	☐	☐
Class resources						
1. Other reading materials	☐	☐	☐	☐	☐	☐
2. Online materials (other than teacher-provided online notes or presentations)	☐	☐	☐	☐	☐	☐
3. Online notes or presentations posted by instructor	☐	☐	☐	☐	☐	☐
4. Visual resources used in class (i.e., PowerPoint, slides, models and demonstrations)	☐	☐	☐	☐	☐	☐
Information						
1. Explanation of how the class activities, reading and assignments related to each other	☐	☐	☐	☐	☐	☐
2. Explanation given by instructor on how to learn or study the material	☐	☐	☐	☐	☐	☐
3. Explanation of why the class focused on the topics presented	☐	☐	☐	☐	☐	☐
Assistance to develop learner autonomy						
1. Interacting with the instructor during class	☐	☐	☐	☐	☐	☐
2. Interacting with the instructor during office hours	☐	☐	☐	☐	☐	☐
3. Working with peers during class	☐	☐	☐	☐	☐	☐
4. Working with peers outside of class	☐	☐	☐	☐	☐	☐
Content knowledge						
1. The main concepts explored in this class	☐	☐	☐	☐	☐	☐
2. The relationships between the main concepts	☐	☐	☐	☐	☐	☐
3. How ideas from this class related to ideas encountered in other classes within this subject area	☐	☐	☐	☐	☐	☐
4. How ideas from this class relate to ideas encountered in classes outside of this subject area	☐	☐	☐	☐	☐	☐
5. How studying this subject area helps you address real-world issues	☐	☐	☐	☐	☐	☐
Skill development						
1. Finding articles relevant to a particular problem in professional journals or elsewhere	☐	☐	☐	☐	☐	☐
2. Critically reading articles about issues raised in class	☐	☐	☐	☐	☐	☐
3. Identifying patterns in data	☐	☐	☐	☐	☐	☐
4. Recognising a sound argument and appropriate use of evidence	☐	☐	☐	☐	☐	☐
5. Developing a logical argument	☐	☐	☐	☐	☐	☐
6. Writing documents in discipline-appropriate style and format	☐	☐	☐	☐	☐	☐
7. Working effectively with others	☐	☐	☐	☐	☐	☐
Learning attitudes						
1. Enthusiasm for the subject	☐	☐	☐	☐	☐	☐
2. Interest in discussing the subject area with friends or family	☐	☐	☐	☐	☐	☐
3. Interest in taking or planning to take additional classes in this subject	☐	☐	☐	☐	☐	☐
4. Confidence that you understand the material	☐	☐	☐	☐	☐	☐
5. Confidence that you can do this subject area	☐	☐	☐	☐	☐	☐
6. My comfort level in working with complex ideas	☐	☐	☐	☐	☐	☐
Learning integration						
1. Connecting key class ideas with other knowledge	☐	☐	☐	☐	☐	☐
2. Applying what I learned in this class to other situations	☐	☐	☐	☐	☐	☐
3. Using systematic reasoning in my approach to problems	☐	☐	☐	☐	☐	☐
4. Using a critical approach to analysing data and arguments in my daily life	☐	☐	☐	☐	☐	☐

Appendix B

Student Evaluation of Teaching (SET)

	SA	A	NA	D	SD
Teaching methods					
1. The designed learning content accords with the course outline.	☐	☐	☐	☐	☐
2. Assessments reflect learning outcomes.	☐	☐	☐	☐	☐
3. The instructor meets the teaching schedule plan and effectively uses class hours.	☐	☐	☐	☐	☐
4. The instructor clearly delivers the course, making the learning content easy to understand and comprehend.	☐	☐	☐	☐	☐
5. This course is helpful.	☐	☐	☐	☐	☐
Teaching attitudes					
1. The instructor is never late to the course.	☐	☐	☐	☐	☐
2. The instructor marks the examination papers and assignments.	☐	☐	☐	☐	☐
3. The instructor has a serious attitude towards teaching and shows enthusiasm in teaching.	☐	☐	☐	☐	☐
Interaction with the student					
1. The instructor answers student questions during class.	☐	☐	☐	☐	☐
2. The teacher devotes his or her attention to the learning situation and the students' responses.	☐	☐	☐	☐	☐

Note: SA: strongly agree; A: agree; NA: not applicable; SD: strongly disagree; D: disagree