DEVELOPMENT AND VALIDATION OF AN INSTRUMENT TO MEASURE STUDENTS' PERCEPTIONS OF TECHNOLOGY-ENABLED ACTIVE LEARNING

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ABSTRACT

This article reports on the design, development, and validation of a new instrument, the Technology-Enabled Active Learning Inventory (TEAL), to measure students' perceptions of active learning in a technology-enabled learning context. By laying the theoretical foundation, a conceptual framework for technology-enabled active learning was developed. The conceptual framework formed the basis of the instrument development process including the design, development and validation of TEAL to measure students' perceptions of active learning in a technology-enabled learning context. The self-reporting questionnaire consisted of four scales: interactive engagement, problem-solving skills, interest and feedback.

All scales were assessed on a 7-point Likert scale. The survey items were designed to measure the four aspects of technology-enabled active learning and were verified by two panels using a formalized card sorting procedure as well as confirmatory factor analysis of a small-scale (n = 61) pilot survey. The TEAL questionnaire demonstrated internal consistency. Reliability as measured by Cronbach's coefficient alpha ranged from 0.83 to 0.88 indicating good reliability and internal consistency of the items. The resultant instrument is a valid and reliable instrument that can be used in future research to gather and represent data on students' perceptions of active learning in a technology-enabled learning context.

OBJECTIVE

The primary objective is to cover this gap by reporting on the development and validation of the Technology-Enabled Active Learning Inventory (TEAL) designed to measure students' active learning in a technology-enabled learning context and to test the validity and reliability of the newly developed instrument. The value of developing and validating an instrument is its potential for improved student performance – hence, there are various practical reasons for developing an instrument. Firstly, technology-enabled active learning strategies support intellectual development and higher-order competencies such as critical thinking and problem-solving skills in technology rich contexts.

One of the key goals of active learning is to enable students to use higher levels of cognitive functioning through cognitively deeper and richer learning experiences. Secondly, feedback from students as to the effectiveness of active learning in a technology-enabled learning context should allow for improvements in course design. Thirdly, development of an instrument may also inform future research regarding implications for theory and practice in active learning in technology-enabled learning contexts.

Definitions of active learning	Proponents	Field
"learning in which the learner uses opportunities to decide about aspects of the learning process."	(van Hout-Wolters, Simons, & Volet, 2000, p. 1)	Education
"the extent to which the learner is challenged to use his or her mental abilities while learning."	(van Hout-Wolters, et al., 2000, p. 1)	
"activities that involve the students in the learning process."	(Nagda, Gurin, & Lopez, 2003, p. 8)	Social psychology
"any instructional method that engages students in the learning process."	(Prince, 2004, p. 1)	Engineering education
"a philosophy of education based on the premise that students best internalize information when they are directly involved in their own learning."	(Greek, 1995, p. 2)	Criminal justice education
"engagement in meaningful tasks where students have ownership of the content."	(McCown, Driscoll, & Roop, 1996, p. 236)	Educational psychology
"an approach or methodology for learning that draws on, integrates and creatively synthesises numerous learning methods."	(Dewing, 2010, p. 274)	Nursing and healthcare
"instructional activities involving students in doing things and thinking about what they are doing; to be actively involved, students must engage in such higher order thinking tasks as analysis, synthesis, and evaluation."	(Bonwell & Eison, 1991, p. 2)	Higher education
"an educational process where high levels of learning interactions and mental involvement are initiated by the learner."	(Ren et al., 2015, p. 6)	Engineering

Domain	Active learning constructs	Dimensions of active learning	Technology-supported activities
Social	Interactive engagement (ITR)	Engagement/interaction	Interacting with the features of the technology in a responsive manner
		Human–computer interaction	Actively engaging with the user-interface in a way that promotes dialogue Interacting with peers through an engaging user interface Facilitating the exchange of information by engaging with content presented in diverse formats
Cognitive	Problem-solving skills (PRS)	Critical thinking	Generating ideas by contributing information from multiple viewpoints
		Analytic reasoning	Analysing information, formulating independent judgements Articulating reasoned arguments through review
Behavioural	Interest (INT)	Challenge	Engaging in thought-provoking dialogue with points of view that challenge perspectives
		Curiosity	Exploring various options when navigating the user interface Exerting effort in the face of difficulty by persisting at challenging tasks
Evaluative	Feedback (FEE)	Evaluative feedback	Receive timely feedback to improve performance Receiving inputs to keep track of performance Receiving feedback on progression

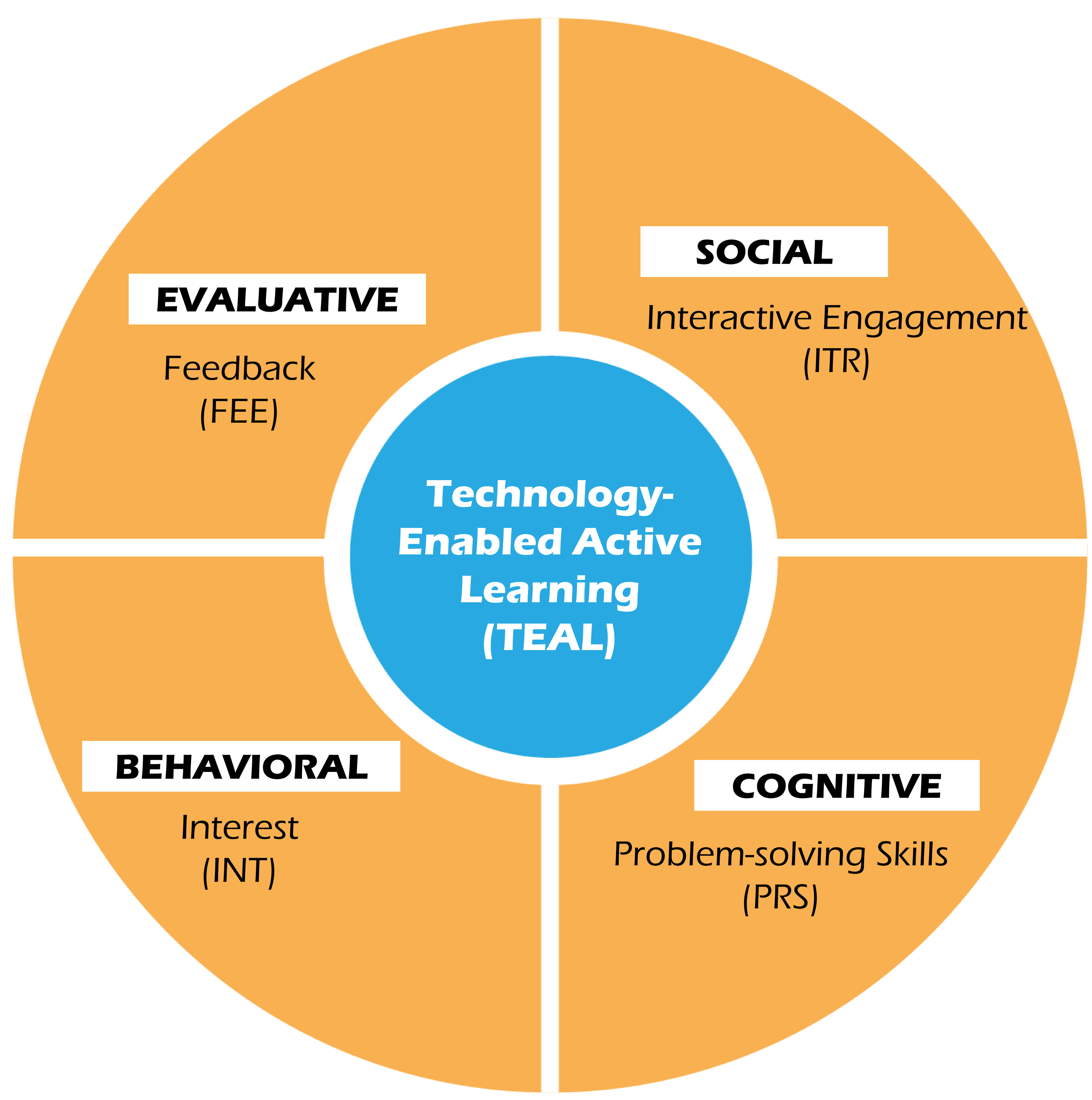

Figure 1. Active learning conceptual framework in a technology-enabled context

RESEARCH METHODOLOGY

Instrument Development

To provide a high degree of confidence in the constructs and item content as well as construct validity and reliability, the Moore and Benbasat (1991) instrument development process was carried out to create and test the survey instrument, since this instrument development process provides a high degree of confidence in the constructs and item content as well as construct validity and reliability. Based on Moore and Benbasat (1991), the following 3-stage development procedure helped clarify and refine the items and constructs of the survey instrument:

1. Item creation – creating a pool of items to match each construct definition. The objective of this stage was to ensure content validity.
2. Card sorting – using a total of four judges in multiple rounds to sort items into construct categories (scales) and consequently examining judges' inter-rater reliabilities and their consistency in labelling these scales.
3. Instrument testing – administering the survey instrument to a small-scale pilot sample with the objective of checking scale reliability.

The purpose of the pilot study was to test the instrument and to ensure that the respondents correctly understood the comprehensiveness of the survey instrument items. The pilot study finalised the development of the survey instrument by testing its validity and reliability (i.e., analysis of survey data).

Item creation

The goal of the item creation step was to ensure content validity of the measurement items in order to make sure that the instrument covered all the items to reflect the definition of the constructs that are proposed as part of the conceptual framework (Bohrnstedt, 1970). The items for the instrument were generated from the framework and literature described earlier. First, we generated an initial item pool for the various constructs. Then, items considered too narrow in focus and applicable only to a particular situation were removed. After the item pools were created, they were re-evaluated to eliminate those which appeared redundant or ambiguous (i.e., items which might load on more than one factor).

Card Sorting

In order to ensure construct validity, by knowing the extent to which the constructs may be ambiguous, a card sorting procedure was performed following Moore and Benbasat's (1991) development process. The objective of performing the two sorting rounds was to ensure construct validity, the first round being exploratory while the second was confirmatory.

Question	Constructs	Items	Factor loading
	Interactive engagement (ITR)		
	Using Kahoot!		
1	ITR1	allowed me respond expediently to my actions, resulting in a fully responsive interaction	.804
5	ITR2	enabled me to skilfully interact with the features in a responsive manner	.762
9	ITR3	allowed me to actively engage with the user-interface in a way that promotes dialogue	.748
13	ITR4	helped me to interact more effectively with peers through an engaging interface	.751
17	ITR5	facilitated the exchange of information by engaging with content presented in diverse formats	.749
	Problem-solving skills (PRS)		
	Using Kahoot!		
2	PRS1	allowed me to methodically generate ideas by contributing information from multiple viewpoints	.769
6	PRS2	enabled me to solve a problem systematically by taking into account different points of view	.712
10	PRS3	encouraged me to think critically about the broader concepts related to the problem	.822
14	PRS4	let me to analyse my own views and their wider contexts in order to draw firm conclusions	.669
18	PRS5	allowed me to define the problem systematically by viewing it from different angles in an effort to find possible solutions	.696
	Interest (INT)		
	Using Kahoot!		
3	INT1	Allowed me to engage in thought-provoking dialogue with points of view that challenged my perspectives	.699
7	INT2	encouraged me to explore a variety of different issues that I may not have otherwise considered	.775
11	INT3	piqued my curiosity by exploring various options when navigating the user interface	.627
15	INT4	held my attention by challenging me to look into issues that I may not have otherwise thought of	.663
19	INT5	encouraged me to exert effort in the face of difficulty by persisting at tasks I found challenging	.823
	Feedback (FEE)		
	Using Kahoot!		
4	FEE1	allowed me to receive timely feedback that helped me improve my performance	.740
8	FEE2	enabled me to receive inputs, so that I was able to keep track of my own performance	.792
12	FEE3	allowed me to receive prompt feedback, so that I was aware of my own progression towards knowledge acquisition	.632
16	FEE4	allowed me to receive prompt feedback, so that I was aware of my own progression towards mastery of my skills	.795
20	FEE5	enabled me to receive responses that allow further understanding	.746

RESULTS

The reliabilities of factors (for the items loading on each factor) were assessed using Cronbach's (1951) alpha. Exploratory factor analysis using a principal axis factor method was conducted to determine the factor structure. All items demonstrated high loadings which ranged from .627 to .823. Table 6 shows the items, constructs and factor loadings of TEAL for the sample of 61 students, using the individual student as the unit of analysis. The results of the CFA determined that the scales were not only reliable, but also valid for the factors under study.

To test the construct validity of the items in the survey instrument, both exploratory factor analysis and confirmatory factor analysis (CFA) were conducted. The reliabilities of factors (for the items loading on each factor) were assessed using Cronbach's (1951) alpha. Exploratory factor analysis using a principal axis factor method was conducted to determine the factor structure. All items demonstrated high loadings which ranged from .627 to .823. Table 6 shows the items, constructs and factor loadings of TEAL for the sample of 61 students, using the individual student as the unit of analysis. The results of the CFA determined that the scales were not only reliable, but also valid for the factors under study.

The constructs were analysed using Cronbach's (1951, 1970) alpha. All of the measures utilised in this study displayed excellent internal consistency, ranging from 0.83 to 0.88, thereby exceeding the reliability estimates ($\alpha = 0.70$) recommended by Nunnally (1967).

Construct	Items	Alpha
Interactive engagement (ITR)	5	.88
Problem-solving skills (PRS)	5	.83
Interest (INT)	5	.85
Feedback (FEE)	5	.86

CONCLUSION

The TEAL inventory and conceptual framework was developed based on the literature review. Each of the four scales exhibited comparatively strong factor structure, internal consistency and reliability. The most notable contribution is the creation of an overall instrument to gather and represent data on students' perceptions of active learning in a technology-enabled learning context. The instrument creation process included reviewing existing literature on active learning developed by other researchers, creating items and then undertaking an extensive scale development process. This was done by developing and verifying an instrument for measuring each of the four scales of the proposed model using a formalised procedure.

This study is of notable importance in that design, refinement and validation of the TEAL inventory provides us with a valid and reliable instrument for future research in assessing students' perceptions of active learning in a technology-enabled learning context on a much larger scale. Since active learning is an important educational strategy, a reliable and valid instrument to measure students' perceptions of active learning in a technology-enabled learning context is essential.

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Collaborating Partners

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