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Development and validation of an instrument for exploring Taiwanese undergraduates' approaches to Internet-based learning

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Abstract: Few studies have developed questionnaires that attempt to assess approaches to learning in the context of Internet-based learning. To obtain a better understanding of undergraduates' approaches to Internet-based learning, this study aimed to develop and validate the Approaches to Internet-based Learning (AIL) instrument which was created by referring to the qualitative results of Ellis' (2011) research and the structure of Lee et al.'s (2008) Approaches to Learning Science questionnaire. The AIL consists of the six factors of "deep motive," "criticism and evaluation", "reflection and integration," "surface motive," "collecting and summarizing," and "replicating information." In addition, the former three factors could be categorized as "Deep approaches to Internet-based learning" while the latter three could be grouped into "Surface approaches to Internet-based learning." To establish the reliability and validity of the AIL and to confirm its second-order structure as hypothesized in this study, exploratory factor analysis and second-order confirmatory factor analysis were conducted. A total of 598 undergraduates from seven Taiwanese universities participated in this study. The results support our hypothesized second-order structure of the AIL and indicate that the instrument items have good reliability and validity. We also found that the Taiwanese undergraduates tended to adopt deep approaches to Internet-based learning. The newly developed AIL could provide educators with a valid instrument to examine students' approaches to Internet-based learning.

Keywords: Approaches to Internet-based learning

1. Introduction

Following the advances in technology and associated innovations, Internet-based learning or online learning has been recognized as an effective way to enhance students' learning. In one study, 71% of students said that the Internet tended to be the major source of information for their school learning (Lenhart et al., 2001). Additionally, recent research has indicated that enrollment in online courses is growing at a rate approximately ten times that of traditional classroom-based instruction in higher education (Shea & Bidjerano, 2009). Due to the rapid development of Internet technology in education, numerous studies have investigated how students' characteristics contribute to learning in an Internet-based context. Some studies have attempted to investigate students' approaches to Internet-based learning. Ellis et al. (2011) investigated students' experiences of learning through research on the Internet, and identified four categories: "Critical focus and Evaluation," "Reflection and Integration," "Collecting and Summarizing," and "Replicating information." The four categories seem to reflect the various forms of students' strategies in the context of Internet-based learning. In addition, Marton and Säljö (1976) found that undergraduates' approaches to learning could be classified as 'surface approaches to learning' and 'deep approaches to learning.' In Ellis et al.'s (2011) study, the first two categories could be categorized as deep approaches while the latter two could be categorized as surface approaches.

In the area of learning approaches, several studies have used questionnaires to explore students' approaches to learning such as Kember et al. (2004) and Lee, Johanson and Tsai (2008). Kember et al.'s (2004) and Lee et al.'s (2008) questionnaires consisted of the four main factors of deep motive for learning, deep strategies for learning, surface motive for learning, and surface strategies for learning, which could also be grouped as deep approaches and surface approaches. However, few studies have

developed questionnaires that attempt to assess approaches to learning in the context of Internet-based learning.

A larger scale quantitative survey might obtain a better understanding of students' approaches to Internet-based learning. Moreover, second-order confirmatory factor analysis can be used to examine whether the motive for learning and strategies for learning can be framed by higher-order categorization such as surface and deep approaches. By referring to the four categories of Ellis et al. (2011) and the structure of Lee et al.'s (2008) instrument, the aim of this study was to develop and validate an instrument, namely the Approaches to Internet-based Learning (AIL) instrument, for exploring Taiwanese undergraduates' approaches to Internet-based learning.

2. Method

2.1 Participants

The participants consisted of a total of 598 undergraduates (261 male) from seven universities in Taiwan. All participants responded to the AIL instrument. The participants were then split into two subsets for the exploratory factor analysis (EFA) (n = 445) and the second-order confirmatory factor analysis (CFA) (n = 153).

2.2 Instrument assessing undergraduates' approaches to Internet-based learning (AIL)

The AIL instrument was created with reference to the qualitative results of Ellis' (2011) research and the structure of Lee et al.'s (2008) ALS (Approaches to Learning Science) questionnaire. The AIL consists of the six factors of "deep motive," "deep strategy A: criticism and evaluation", "deep strategy B: reflection and integration," "surface motive," "surface strategy A: collecting and summarizing," and "surface strategy B: replicating information." In addition, the former three factors could be categorized as "Deep approaches to Internet-based learning" and the latter three could be grouped into "Surface approaches to Internet-based learning."

Through consulting with four experts in this field for the content validity, this study constructed 5 items for each of the six factors, giving a total of 30 items presented in a five-point Likert mode, ranging from "strongly agree" to "strongly disagree." A detailed description of the six factors, with a sample item for each, is presented below:

- Deep motive (DM): The student has a deep motive (e.g., intrinsic interest) for Internet-based learning, e.g., When I learn in the context of Internet-based learning, I feel happy and contented.
- Criticism and Evaluation (CE): The student uses critical thinking and information evaluation in the context of Internet-based learning, e.g., When I am learning in the context of the Internet, I check different websites at the same time to judge information.
- Reflection and Integration (RI): Knowledge reflection and integration are used in the context of Internet-based learning, e.g., When I use the Internet for learning, I like to create a theory to help me put the fragmented content together.
- Surface motive (SM): The student uses Internet-based learning just to pass exams or meet the requirements of the course, e.g., I use the Internet for learning in order to get a good grade.
- Collecting and Summarizing (CS): Collecting and summarizing information are the main strategies adopted in the context of Internet-based learning, e.g., When I use the Internet for learning, irrelevant contents do not make sense to me.
- Replicating information (Rep): Replicating information is the main strategy used in Internet-based learning, e.g., When I use the Internet for learning, I think the best way to get a good grade is to memorize the answers to related questions.

2.3 Data analysis and procedure

The purpose of this study was to develop and validate an instrument, namely the Approaches to Internet-based Learning (AIL) instrument, for exploring Taiwanese undergraduates' approaches to Internet-based learning. In order to establish the reliability and validity of the AIL, both exploratory and

second-order confirmatory factor analyses were performed. The reduction of items of the AIL was based on two sets of evidence: an exploratory factor analysis, followed by the use of reliability statistics. In an EFA, only those items with a factor loading of at least 0.40 within their own factor should be retained (Stevenson, 1996). EFA was employed first and then the second-order confirmatory factor analysis (CFA) was performed to analyze the construct validity and structure of the AIL.

Accordingly, the validity and reliability of the AIL were evaluated. In addition, the participants were split into two subsets for the exploratory factor analysis (EFA) (n = 445) and for the second-order confirmatory factor analysis (CFA) (n = 153).

3. Results and Discussion

3.1 Exploratory factor analysis for the approaches to Internet-based learning (AIL) (n=445)

An exploratory factor analysis with a varimax rotation was performed to clarify the structure of the AIL. As a result, the 445 students' responses were grouped into the following six factors: Deep motive (DM), Criticism and Evaluation (CE), Reflection and Integration (RI), Surface Motive (SM), Collecting and Summarizing (CS), and Replicating information (Rep). The eigenvalues of the six factors from the principle component analysis were all larger than one, while six items with a factor loading of less than 0.40 were omitted from the instrument. As a result, a total of 24 items were retained in the final version of the AIL (as shown in Table 1), and the total variance explained is 65.62%.

Table 1: The exploratory factor analysis for the AIL factors (n = 445)

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Factor 1: Deep Motive (Mean = 3.48, SD = .65, α = .84)						
DM 1	.72					
DM 2	.81					
DM 3	.75					
DM 4	.71					
DM 5	.63					
Factor 2: Criticism and Evaluation (Mean = 3.84, SD = .65, α = .83)						
CE 7		.74				
CE 8		.68				
CE 10		.83				
CE 11		.64				
Factor 3: Reflection and Integration (Mean = 3.67, SD = .65, α = .81)						
RI 12			.53			
RI 13			.80			
RI 14			.77			
RI 15			.68			
RI 16			.67			
Factor 4: Surface Motive (Mean = 3.14, SD = .79, α = .68)						
SM 18				.68		
SM 20				.61		
SM 21				.68		
Factor 5: Collecting and Summarizing (Mean = 2.92, SD = .80, α = .81)						
CS 22					.80	
CS 23					.81	
CS 24					.81	
CS 25					.63	
Factor 6: Replicating information (Mean = 3.00, SD = .85, α =.79)						
Rep 28						.82
Rep 29						.78
Rep 30						.77

Total variance = 65.62%, overall α = 0.87

In addition, the reliability (Cronbach's alpha) coefficients respectively for these factors were 0.84, 0.83, 0.81, 0.68, 0.81, and 0.79, and the overall alpha was 0.87, suggesting that these factors had sufficient reliability in assessing the students' approaches to Internet-based learning.

3.2 Second-order confirmatory factor analysis for the AIL (n=153)

The CFA further confirmed the construct validity and the second-order structure of the 24 item version of the AIL through the 153 students' responses. In addition, the second-order factor analysis model of the AIL was hypothesized in this study. To examine whether the second-order structure of the AIL can be established, the first-order factors which converged to the second-order constructs were tested. Each factor of the AIL was a first-order construct (i.e., DM, CE, RI, SM, CS, and Rep). The deep and surface approaches to Internet-based learning served as the second-order constructs of the AIL. As shown in Table 2A, the factor loading values for the six factors are significant and larger than 0.4. The ratio of chi-square per degree of freedom = 1.46, RMSEA = 0.055, CFI = 0.95, GFI = 0.84, AGFI = 0.80. Moreover, the results shown in Table 2B support that the first-order factors converge to the second-order constructs. These results suggest an acceptable model fit which supports our hypothesized second-order structure of the AIL and indicates that the instrument items have good convergent and construct validity in this model.

Table 2: The Second-order Confirmatory factor analysis (CFA) for the AIL factors (n = 153)

A. Standardized CFA first-order loading

Factors	Number of item	Factor loading	*t*- value	CR
Deep motive (DM)	5	0.69 - 0.86	8.97* - 11.82*	0.88
Criticism and Evaluation (CE)	4	0.70 - 0.75	7.38* - 7.84*	0.81
Reflection and Integration (RI)	5	0.45 - 0.69	4.51* - 4.80*	0.74
Surface Motive (SM)	3	0.54 - 0.71	4.61* - 4.60*	0.66
Collecting and Summarizing (CS)	4	0.62 - 0.70	6.02* - 6.35*	0.76
Replicating information (Rep)	3	0.48 - 0.91	5.12* - 6.12*	0.75

B. Standardized CFA second-order loading

Second-order factor model	Loading value	*t*- value
Deep approaches		
DM	0.71	7.21*
CE	0.79	6.81*
RI	0.88	4.83*
Surface approaches		
SM	0.61	3.54*
CS	0.51	3.71*
Rep	0.68	4.67*

* $p < 0.05$; CR: Composite Reliability

3.3 Paired-t-test for the AIL (n = 598)

In order to understand students' learning motive and strategy in the context of Internet-based learning, this study calculated the mean values for deep strategy as combining CE and RI, and for surface strategy as combining CS and Rep. Then, a paired t-test was conducted to examine whether the students tended to use deep or surface approaches to learn in the context of Internet-based learning. As shown in Table 3, significant differences were found. The results seem to indicate that, rather than surface approaches, these Taiwanese undergraduates tended to have deep motives and adopt deep strategies to learn in the context of Internet-based learning.

Table 3: Differences between Deep AIL and Surface AIL (n = 598)

Deep AIL	Surface AIL (M, SD)	*t* value
Deep Motive (M, SD)	Surface Motive	
3.52 (0.67)	3.20 (0.79)	9.25***
Deep Strategy (M, SD)	Surface Strategy (M, SD)	
3.75(0.57)	2.97(0.69)	21.96***

*** $p < .001$.

In conclusion, the abovementioned results suggest that the newly developed AIL instrument has sufficient reliability and validity, and could serve as a valid instrument for evaluating undergraduates' approaches to Internet-based learning.

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