The structure of teaching practice, learning motivation and learning satisfaction scales at Taiwanese technological universities

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ABSTRACT: Reliable and valid measures are a cornerstone of empirical research across various disciplines. The main purpose of this study was to develop a comprehensive model and instrument for measuring technological universities' teachers and students. This research takes into account teachers at technological universities in Taiwan. The teachers' responses resulted in 391 questionnaires returned, and 1,742 students responded to their questionnaires. The psychometric properties of the measurement model were evaluated in terms of reliability and convergent validity; reliability and convergent validity of the factors were estimated by composite reliability and average variance was extracted. Data analysis through Structural Equation Modelling (SEM) was used to measure the theoretical model and goodness-of-fit analysis.

INTRODUCTION

The purpose of this study was to construct reliable and valid measures that are a cornerstone of empirical research among teachers' teaching practices, learning motivation, and learning satisfaction in Taiwanese technological universities. More specifically, the association of common classroom teaching practices was examined (e.g. teaching preparation, teaching implementation and teaching evaluation), along with students' learning motivation (e.g. value, expectation and emotion), and students' learning satisfaction (e.g. professional teaching, curriculum arrangement, learning environment, teaching equipment and learning outcome).

Simplicio has reported on the association of student learning motivation and satisfaction, which will be discussed below [1]. Nevertheless, the association of the impact of precise teaching practices on learning motivation and satisfaction lacks an adequate description of specificity and duration. Additionally, we are unaware of a valid and reliable instrument with which to diagnose and recommend specific classroom practices, duration of those practices, and the corresponding association with learning motivation and satisfaction.

This paper is based on a theoretical review of teacher education research, analysis of general concepts of teachers' teaching practice, and students' learning motivation and satisfaction. Results are from students and teachers surveyed by questionnaires, which were analysed for validity and reliability using Structure Equation Modelling (SEM).

LITERATURE REVIEW

Teaching Practice

Teaching practice means any incident or activity related to teaching presented via classroom instruction by a teacher [2][3]. Cardinal and Kosma further pointed out that it includes activities that can encourage students to think and to make policy in teaching practice, as well as promoting learning motivation and the learning of knowledge and skills [4].

O'Neill proposed 20 of the most important factors for a practical course of teaching [5]. These results are according to O'Neill, Hill, Marsh and Bailey, and Moneys [5-8]. The top three are:

1. Teaching Preparation: teaching plan, teacher's knowledge, teacher issues, course teaching material.
2. Teaching Implementation: teacher's expectations, teacher's zeal, classroom atmosphere, teaching management, advance organisation, teaching model, question level, direct instruction and teaching process.
3. Teaching Evaluation: teaching feedback, criticism and appreciation.

Student's Learning Motivation

Matthews has said that many parameters will directly influence students' learning motivation in the classroom [9]; these parameters include organisation of classroom and learning atmosphere of the classroom. McCown, Driscoll, and Roop pointed out that students' learning motivation is structured by very complicated psychological factors [10]. They have stated that students' learning may be influenced by personal goal, belief, self-concept, environment, others' expectations and social values.

This study considered Alderman; Pintrich, Smith, Garcia, and McKeachie; and Matthew and Roslin's research. We divided learning motivation into three factors: value, expectation and emotion [11-13].

1. Value: Students reach precise and familiar learning on their own and challenge themselves in intensity in the learning courses; in order to reach the learning goal, the student makes the effort to obtain the best achievement scores.
2. Expectation: Includes students' learning result and ability, which are influenced by students' learning skills and beliefs. Among contemporary motivational theories, ability beliefs and adequate incentives for behaviours have been postulated to directly influence decisions individuals make about whether they would not participate in a task or continue to engage in a task following failure [14][15]. Exceptions come from the expectancy-value model of achievement choice and Bandura's self-efficacy theory [16][17]. They are two major constructs to have emerged as being strongly predictive of individuals' achievement behaviours and have been extensively applied in physical education achievement contexts [18-20].
3. Emotion: Includes anxiety towards testing that students may experience during or prior to testing and may cause a fear to perform, along with other uncomfortable feelings.

Learning Satisfaction

Learning satisfaction is a critical component in improving learning achievement in the traditional classroom. Many researchers have examined the factors that influence learning satisfaction in education [21][22]. Researchers believe learning satisfaction, which is reflected in an attitude toward learning, should be studied and improved upon by all educators [23]. Moore stated that social interaction, prompted by the instructor, and timely instructor feedback, were linked to increased learning satisfaction within a course [24]. The most significant contributor to perceived learning in courses was the interaction between instructor and learning.

As education has advanced, the role of interaction changed considerably, along with the development of pedagogical approaches and methodologies. Even though the degree of interaction varies between traditional and distance settings, research on the implications of interaction on learning has identified that interaction positively affects abilities to learn. Conversely, lack of interaction makes learning boring and difficult. Therefore, further research focusing on the specific implications of interaction on learning satisfaction should increase understanding of how to integrate interaction most effectively in distance education settings, to maximise abilities to learn.

In research summed up by Jaeger; Field and Gill; and Chien found that learning satisfaction had five aspects [25-27]: professional teaching, curriculum arrangement, learning environment, teaching equipment, and learning outcomes, summarised as:

1. Professional Teaching: The attitude and care shown to students that inspires student thinking, etc. This includes the teacher's professional knowledge, solving learning-problem ability, preparation of curriculum and teaching in a way that advances students' studying, therefore increasing levels of satisfaction.
2. Curriculum Arrangement: The curriculum content, students' demand, and effective teaching goal. Through implementing educational activities in teaching course material, the teacher can effectively reach the teaching goal and then students' level of learning satisfaction increases.
3. Learning Environment: School is the main place that offers students a place to receive learning; it includes environmental hardware facilities and transportation.
4. Teaching equipment: Materials used for reaching a teaching goal include relevant facilities, such as personnel, factory building, machines, apparatus and other materials.
5. Learning Outcome: The learner is developed to his/her own working skill level and intelligence. If achieved, the student is satisfied.

METHOD

Participants

Research participants in this study were teachers at technological universities in Taiwan. The teachers responded to the questionnaire pertaining to their teaching beliefs and teaching practices. Nine hundred questionnaires were sent out (to 30 schools and every school received 30 questionnaires). However, only 391 questionnaires were completed and returned. The composition of the participants is shown in Table 1.

From the 30 technological universities and the students' samples, 5 students' questionnaires were randomly drawn from the teachers' classes. Of the student questionnaires, 4,500 were sent to students at technological universities, including the learning motivation questionnaire and the learning satisfaction questionnaire, and 2,367 questionnaires were returned. The effective rate was 52.60%, after rejecting invalid questionnaires and questionnaires that could not be matched (students' questionnaires and teachers' questionnaires were unable to be matched). Total student questionnaires were 1,742. Composition of the participants is shown in Table 2.

Instrumentation

Questionnaire: Confirmatory Factor Analysis (CFA)

The psychometric properties of the measurement model in terms of reliability, and convergent validity, were evaluated. Reliability and convergent validity of the factors were estimated by composite reliability (CR) and the average variance extracted (AVE). Interpretation of the composite reliability is similar to that of Cronbach's alpha, except that it also takes into account actual factor loadings, rather than assuming each item is equally weighted in the composite load determination.

Table 1: Technological university teachers' background characteristics.

Background characteristics	Items	Numbers	Percentage (%)
Sex	Male	239	61.13
	Female	152	38.87
Education	Bachelor	13	3.32
	Master	156	39.90
	doctorate student	68	17.39
	Doctor	154	39.39
Professional position	Assistant teacher	5	1.28
	Lecturer	188	48.08
	Assistant professor	95	24.30
	Associate professor	86	21.99
	Professor	17	4.35
School location	North of Taiwan	176	45.01
	Middle of Taiwan	130	33.25
	South of Taiwan	54	13.81
	East of Taiwan	31	7.93

N =391

Table 2: Technological university students' background characteristics.

Background characteristics	Project	Number of times	Percentage (%)
Sex	Male	908	52.12
	Female	834	47.88
School properties	Public	341	19.58
	Private	1401	80.42
School location	North of Taiwan	739	42.42
	Middle of Taiwan	387	22.22
	South of Taiwan	464	26.64
	East of Taiwan	152	8.73
Learning group	Industry group	521	29.91
	Commercial management group	844	48.45
	Nursing group	58	3.33
	Designing group	74	4.25
	Language group	181	10.39
	Housekeeping group	32	1.84
	Agricultural group	32	1.84

N =1742

Composite reliability for all factors in the measurement model was above 0.70. The average extracted variances were all above the recommended 0.50 level [28], which meant that more than one-half of the variances observed in the items were accounted for by their hypothesised factors. Convergent validity was also evaluated by examining the factor loadings and squared multiple correlations (SMC) from the confirmatory factor analysis (CFA). According to the Hair et al recommendation [28], factor loadings greater than 0.50 are considered very significant. All factor loadings of the items in the research model were greater than 0.60. Also, SMC between the individual items and their factors were high (above 0.50 in all cases). Accordingly, all factors in the measurement model had adequate reliability and convergent validity.

Teachers' Practice Questionnaire

This teachers' practice questionnaire (TPQ) references Brousseau and Freeman's research literature [29]. The questionnaire in this study is composed of three sections, including teaching preparation, teaching implementation, and teaching evaluation. The questionnaire is a 6-point Likert-type response, with a Cronbach's alpha coefficient of 0.954.

The item loadings structure was consistent with the intended theoretical constructs by CFA. Their Composite Reliability (CR) was 0.876, and Variance Extracted (VE) was 0.702. The CR and VE of TPQ are shown in Table 3. The TPQ by CFA was applied to test the remaining 18-item three-factor model fitness, as shown in Table 4.

Learning Motivation Questionnaire

This learning motivation questionnaire (LMQ) references Pintrich, Smith, Garcia and McKeachie's research literature [12]. The questionnaire in this study was composed of three dimensions, including value, expectation, and emotion. The questionnaire is a 6-point Likert-type response with a Cronbach's alpha coefficient of 0.816.

The structure of item loadings was consistent with the intended theoretical constructs by CFA. Their Composite Reliability (CR) was 0.892, and Variance Extracted (VE) was 0.734. The CR and VE of TBQ are shown in Table 3. The LMQ by CFA was applied to test the remaining 11-item three-factor model fitness, as shown in Table 4.

Learning Satisfaction Questionnaire

This learning satisfaction questionnaire (LSQ) references Field and Gill's; Behuniak and Gable's; Howard and Schmeck's; and Liegler's research [26][30][31]. The questionnaire was composed of five dimensions, including professional teaching, curriculum arrangement, learning environment, teaching equipment and learning outcome. The questionnaire is a 6-point Likert-type response with a Cronbach's alpha coefficient of 0.909.

The structure of item loadings was consistent with the intended theoretical constructs by CFA. Their Composite Reliability (CR) was 0.912, and Variance Extracted (VE) was 0.678. The CR and VE of TBQ are shown in Table 3. The LMQ by CFA was applied to test the remaining 21-item five-factor model fitness, as shown in Table 4.

Table 3: Measurement model of the reliability and validity of the Questionnaires.

Questionnaire	Reliability of the item				Composite Reliability	Variance Extracted
	Measure variable	Factor loading	Standard deviation	SMC		
TPQ	Teaching preparation	0.883	0.220	0.780	0.876	0.702
	Teaching implementation	0.856	0.267	0.733		
	Teaching evaluation	0.771	0.406	0.594		
LMQ	Value	0.860	0.260	0.740	0.892	0.734
	Expectation	0.823	0.323	0.677		
	Emotion	0.886	0.215	0.785		
LSQ	Professional teaching	0.828	0.314	0.686	0.912	0.678
	Curriculum arrangement	0.949	0.099	0.901		
	Learning environment	0.741	0.451	0.549		
	Teaching equipment	0.724	0.476	0.524		
	Learning outcome	0.854	0.271	0.729		

Table 4: The fitness indices of two-order CFA model on TPQ, LMQ and LSQ.

Questionnaires	χ^2	df	$\chi^2\diagup$df	GFI	AGFI	CFI	NFI	RMSEA
TPQ	355.514	129	2.756	0.910	0.881	0.947	0.919	0.067
LMQ	199.781	41	4.873	0.909	0.854	0.937	0.922	0.099
LSQ	558.752	305	1.832	0.906	0.883	0.973	0.943	0.046
Recommend value			<5	>0.8	>0.8	>0.9	>0.9	<0.10

Data Analysis

This research, through Structural Equation Modelling (SEM), applied theoretical model and goodness-of-fit analysis. First, the focus was placed on the Measurement Model and a validity test was performed. Second, through the Structure Model, which was constructed using the literature, the measurement model of questionnaires' reliability and validity by SEM was determined. This study utilised statistical software AMOS 7.0 and SPSS 12.0.

Measurement Model

A CFA using AMOS 7.0 was conducted to test the measurement model. Six common model-fit measures were used to assess the model's overall goodness of fit: the ratio of χ^2 degrees of freedom (DF), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), normalised fit index (NFI), and root mean square error of approximation (RMSEA) [32-36].

As shown in Table 4, all model-fit indices exceeded their respective common acceptance levels suggested by previous research, thus demonstrating that the measurement model exhibited a fairly good fit with the data collected. Therefore, the psychometric properties of the measurement model were evaluated, in terms of reliability and convergent validity. Reliability and convergent validity of the factors were estimated by composite reliability, and average variance was extracted. The interpretation of the composite reliability is similar to that of Cronbach's alpha, except that it also takes into account the actual factor loadings rather than assuming that each item is equally weighted in composite load determination.

Composite reliability for all factors in our measurement model was above 0.70. The average extracted variances were all above the recommended 0.50 level [28], which meant that more than one-half of the variances observed in the items were accounted for by their hypothesised factors. Convergent validity can also be evaluated by examining the factor loadings and squared multiple correlations from the CFA.

Following Fornell and Larcker, and Hair et al recommendations, factor loadings greater than 0.50 were considered very significant [34][28]. All factor loadings of items in the research model were greater than 0.70. Also, squared multiple correlations between the individual items and their factors were high (above 0.50 in all cases). Accordingly, all factors in the measurement model had adequate reliability and convergent validity.

Implementation and Research Limitation

This research is based on teachers' teaching practice theory, testing of the reliability and validity of the questionnaire by CFA and contracture structural model for teaching practice, learning motivation, and learning satisfaction in teachers and students. Researchers' results were good, but some limitations existed in the research. The research was based on objective factors, with limitations as shown below:

- First, this research of teachers' practices cannot be completed within a short time. Subsequent research is being proposed to investigate more groups.
- Second, the researchers utilised the SEM method to analyse data and analysed the sample with Maximum Likelihood Estimate (MLE). But MLE will increase with sample size, making the model too sensitive. The number of samples collected was 391, but still there were too few to analyse as a group model. In order to construct a more-appropriate model of teaching practice, learning motivation and learning satisfaction, a larger group model is necessary.
- Third, the study samples of five corresponding students were not matched to a teacher, so it was assumed that the student sample was random.

Future research should continue to explore the relationships between teachers' teaching beliefs and teaching practice and examine the relationships among students' learning motivational characteristics, self-efficacy and learning outcomes in school situations. Moreover, future work should include more direct measures of student achievement, as well as measures of prior content knowledge, in order to fully understand the relationships between students' motivational characteristics and their learning satisfaction.

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