

The influences of interest in learning and learning hours on learning outcomes of vocational college students in Taiwan: using a teacher's instructional attitude as the moderator

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ABSTRACT: The major purpose of this study is to verify by means of Confirmatory Factor Analysis (CFA) how a teacher's instructional attitude affects student learning outcomes through interaction with either students' interest in learning or the number of their learning hours. While convenience sampling was used to yield knowledge from the population of students and lecturers (or teaching staff of higher levels) at Taiwanese vocational colleges, the linear Structural Equation Modelling (SEM) was adopted to verify the goodness-of-fit effects among the overall model, structural model and measurement model. Findings from this study show that when Taiwanese vocational college students have a satisfied attitude towards their teachers, both interest in learning and learning hours have a positive and significant interactive influence on the learning outcomes.

Keywords: Interest in learning, learning hours, learning outcomes, teacher's instructional attitude

INTRODUCTION

Motives of Research

A *United Daily News* report dated 29 June 2011 mentioned some perplexing issues about vocational college students in Taiwan. These issues revolved around a lack of enthusiasm about knowledge, disappointing behaviour in class (e.g. sleeping, becoming distracted, chit-chatting, passing notes and eating) and a pathetic lack of common sense that keeps them up all night doing everything from browsing the Internet to checking out Facebook messages, and a general disinclination to study.

While boys go to school in thong sandals, Taiwanese blue-and-white sandals or tank tops, girls wear pants that are too short to even hide their underwear, and they expose or even flaunt their cleavage under camisole tops. Some even wear heavy makeup. Without any lifetime goal, most of the vocational college students have no plans for the future and do not even bother to come up with one.

They are counting on parents to meet their living costs and, therefore, they do not mind staying unemployed after graduation. Apart from the teachers' tolerance for such unsavoury behaviour in order to maintain *harmony*, the absence of quality control and disqualification policies at Taiwanese colleges have left a considerable number of college graduates devoid of a sense of commitment, discipline, independence, aim or reality. This is an aftermath of the infamous Taiwanese educational reform now embarrassing Taiwan's higher education facilities [1].

Despite the noticeable decline in college enrolment due to a lower birth rate, the number of colleges in Taiwan has surged in recent years, leading to an imbalance between the supply of, and demand for, higher education. This imbalance prompted some colleges to conduct the initially well-intended *teaching assessment programme* on their faculty members, which has nevertheless become a convenient tool for a college to discharge teachers, with or without severance payment.

On the other hand, teachers seeking *survival* are forced to work in an all-purpose manner wearing many hats as *instructor*, *counsellor*, *researcher* and *servicer*, paying attention to every detail every day lest they should lose their teaching job. Among other things, the college faculty tend to focus on corporate-sponsored academic programmes and

research projects, so many teachers spend every waking moment over-working, leading to their inevitably questionable attitude toward teaching. Such a predicament, nevertheless, underscores the extreme importance of solving these educational problems.

Sparkling students' interest in learning and encouraging them to spend more time on school work is currently a problem faced by all teachers. A teacher's good attitude, in particular, plays an integral part in the effort to improve learning outcomes or teaching efficacy when students are unwilling to participate in class. Learning outcomes, or teaching efficacy, refer to a teacher's capability of eliciting outstanding performance from students either, learning-wise or behaviour-wise in all the four aspects of education objectives, namely class management, teaching patterns, teaching strategies and teacher's expectations [2].

A teacher develops teaching efficacy over a period under the influence of many factors, with that influence being a complicated process of interaction [3]. Most of the studies concerning teaching efficacy published worldwide have focused on self-efficacy and the teacher's beliefs, a sign that teachers not only play a pivotal role in education but also exert greater influence on students than any other factor.

A multicultural environment enables teachers to provide effective instruction from the perspective of multicultural education and, subsequently, to bolster the quality of education to accomplish the educational objectives/purposes. Since it takes a teacher and his/her wisdom to carry out a perfectly designed curriculum effectively, teaching staff are crucial to successful execution of a comprehensive curriculum. Another major concern over curriculum implementation is whether the teacher is equipped with satisfactory teaching-related beliefs, expertise and competencies, and uses these to complete such implementation, to convey to learners effectively the content of a curriculum and, eventually, to enhance the students' learning outcomes, or teaching efficacy [4].

As a result, the link between students' interest in learning and their learning hours and learning outcomes is worthy of discussion. This is what motivated the authors of this study to delve further into this area of research. With its focus on students and lecturers (or teaching staff of higher levels) at Taiwanese colleges, this study explores the influence of both interest in learning and learning hours on student learning outcomes, with a teacher's instructional attitude being the extraneous variable.

The major purpose of this study is to use Confirmatory Factor Analysis (CFA) to obtain a picture of how the interest in learning and learning hours of vocational college students in Taiwan interact, respectively, with the influence of teacher instructional attitudes on learning outcomes. To conclude this study, suggestions based on the findings are proposed to provide references for decision makers at educational facilities. The purposes of the present study are as follows:

1. To verify and understand whether students' interest in learning in Taiwanese colleges has a positive and significant influence on learning outcomes;
2. To verify and understand whether students' learning hours in Taiwanese colleges have a positive and significant influence on learning outcomes;
3. To verify and understand whether a teacher's instructional attitude has a positively significant influence on the students' learning outcomes in Taiwanese colleges;
4. To verify and understand whether students' interest in learning in Taiwanese colleges and a teacher's instructional attitude exert a significant interactive influence on learning outcomes;
5. To verify and understand whether students' learning hours in Taiwanese colleges and teacher's instructional attitude exert a significant interactive influence on learning outcomes.

LITERATURE REVIEW

The following passages present an overview of previous research, examining the literature pertaining to each aspect of this study.

The Conceptual and Operational Definitions of Interest in Learning.

Li proposed two hypotheses about the important role of the *interest in learning* process. In a classroom setting, interest is required to meet students' intellectual as well as emotional needs; interest can never be imposed on an individual by external forces, but a teacher can help increase the learners' interest [5].

From a psychological point of view, Chang said the term *interest* has a two-ply meaning that involves, first, an individual's internal orientation when he/she expresses the choice of someone or something and, second, the small difference between interest and motives as both of them are the internal causes of an individual's behaviour [6].

Chiu said interest is inherent and yet can be improved by external forces [7]. Chen addressed interest in learning in three categories: individual interest, which is a personal quality that is quite stable and fluctuates little; situational interest, which is an emotional state elicited by amusing mathematics-related activities or the content of teaching materials; and interest-induced psychological state that occurs when an individual is showing intense interest in something and he/she

focuses all attention on what sparks that interest, while ignoring anything else in the surroundings [8]. She also said interest can be generated in a classroom setting to offer meaningful options to students by: selecting well-compiled teaching materials; selecting teaching materials that are full of variation and also liveliness; selecting teaching materials that students have prerequisite knowledge of; encouraging students to be active participating learners; giving hints/reminders immediately relevant to students; putting to use ideas of novelty and variation; and helping the teacher set an example by showing passion and interest about what is being taught.

Lai defined interest in learning as personal preferences with regard to learning, which sometimes means what an individual chooses one thing rather than other things and sometimes a positive psychological state occurs during his/her interaction with the circumstances that engenders further learning motives [9].

Krapp, Hidi and Renninger proposed a conceptual framework that divides the interest in learning into individual interest and situational interest [10].

As noted by Schraw and Dennison, an individual possesses autonomy over a learning task and, therefore, is able to strengthen his/her internal motives to increase active participation when it comes to self-decision and control-oriented tasks [11].

Schraw and Lehman categorised interest and presented five core themes pertaining to individual interest and/or situational interest, namely: latent interest; actualised interest; text-based interest; task-based interest; and knowledge-based interest [12][9].

In their research project, Schraw, Flowerday and Lehman found that a reader shows little interest in reading materials about which he/she lacks relevant intellectual experience [13].

Hsueh noted in an empirical study how strongly and consistently text-based interest is linked to situational interest, although the connection between inductivity and situational interest is not supported with sufficient evidence [14].

Lai identified the factors behind task-based interest: Encoding-task manipulation: a method to improve an individual's interest in learning by changing his/her learning objectives or strategies; and Change-of-text manipulation: By emphasising certain parts of the text, this method helps remove redundancy from the structure of learning content or enhance the logical connection throughout the textual content and, consequently, impels the individual to become more interested in learning [9]. That is, most learners will increase interest in learning if they are able to understand easily the textual content.

To sum up the studies mentioned above, the present study proposed a conceptual definition of *interest in learning*: a situational interest sensed by students in class because of the teacher's enthusiasm for what is being taught, and an individual interest that prompts the individual to learn eagerly with a focus on his/her prerequisite knowledge and emotions.

Among the impressive amount of literature mentioned above, a majority of studies cited the categories of interests in learning presented by Schraw and Lehman [12]. Since the *five core themes* model in that categorisation method remains widely accepted till this day, the present study determined the *interest in learning* variables according to the categorisation approach adopted by Schraw and Lehman. The operational definition stated below is based on how the two scholars categorised/defined those variables:

- Latent interest: the long-term interest of an individual in learning a specific topic or discipline. It is an internal inclination that guides an individual through cognitive activities, including interests (in learning) related to all senses and values. In other words, the latent interest occurs when an individual reinforces his/her emotional attitude toward the task of learning he/she is engaged in, and an individual's value-related beliefs of knowledge/tasks are probably a critical part of his/her goals in a long-term learning process.
- Actualised interest: the motive to learn a specific topic or discipline. Compared to the latent interest, the actualised interest involves specific content that is more precise and clearly defined and, therefore, refers to the degree of an individual's participation in a certain task of learning.
- Text-based interest: the text-induced interest in learning is characterised by inductivity, vehemence and consistency. It also refers to the interest sparked by a text an individual plans to learn.
- Task-based interest: the interest elicited from altered teaching materials that an individual is exposed to. For instance, an individual's interest in learning may be affected by altered objectives/text (of learning) which, in turn, vary depending on the task of learning assigned.
- Knowledge-based interest: the influence of prerequisite knowledge and experiences on an individual's current task of learning.

Literature Concerning Learning Hours

In an attempt to extend Carroll's theory concerning learning hours, Bloom noted the approximately normal distribution of academic performances of students receiving non-specific instruction, which led to the conventional practice of

offering all students the same instruction and, consequently, the normal distribution of learning results [15]. If a group of students has enough learning hours, they are supposed to achieve the same level of results. Bloom defined time as the duration a student devotes solely to school work, rather than the physical sense of time or the natural course of passing time [15][16].

According to Yen, there is never a substantial amount of time, which is an abstract that nevertheless is omnipresent in a student's everyday experiences [17]. Although students use time one way or another around the clock, they often face difficulties when learning about the concept of time. Given the impossibility of a student acquiring knowledge of time by spending time, time-related concepts can be highly abstract. Not only is it imperative that such concepts be learned on a foundation of how everyday occurrences are perceived, the concept of time is also built by comparing the priority of occurrences in everyday life. Since a correct understanding of time is unlikely without an individual's ability to grasp and sense the physical time, as well as inner time, the concept of time is developed, just like any other concept, in a progressive rather than abrupt manner and matures as one grows older [18]. Therefore, an instructor is required to understand students' developmental levels regarding the concept of time, so as to have a hold on the highlights of teaching materials [17][19][20].

From the literature above, this study derived a conceptual definition of learning hours: with the ability to grasp and sense the physical, as well as inner time, an individual inspired by the teacher's instructional attitude that students find satisfying, develops a correct idea of time and/or willingness to spend more time on learning, based on individual and situational interests [18]. In this study, the concept of learning hours is addressed in the two dimensions proposed by Lai, namely: *learning hours related to individual interest* and *learning hours related to situational interest*, the former being an individual's focus, driven by personal interest, on a basis of prerequisite knowledge combined with emotions, and the subsequent willingness to spend more time on learning eagerly [9]. The latter involves a student's decision to spend more time on learning because of the teacher's enthusiasm about what is taught.

Literature concerning the teacher's instructional attitude

The six components of a teacher's instructional attitude, according to Frey, are: the assessment of student assignments; how the teaching materials are organised; how the teaching materials are presented; how receptive a teacher is to students' opinions; scoring; and how a teacher contributes to student achievement [21].

Bunting cited the four aspects of a teacher's instructional attitude (i.e. affections, perception, discipline and interpretation) to explain the factors of emotional development, the guidance for a teacher's instruction, the teacher's authoritative attitude displayed in a classroom, and the teacher's responses that reflect his/her attitude toward students' learning process [22].

Chen noted in a study that a teacher's instructional attitude involves his/her attitude toward a student's conformity/resistance to authority; his/her attitude towards school discipline staff; his/her understanding of students' psychological development; his/her understanding of the principles of disciplinary education; and his/her personal responses [23].

Su identified the three aspects of a teacher's instructional attitude, namely: the teacher-student relationship: whether or not the teacher interacts with students well; the teacher's professionalism: which involves the two aspects of *teaching skills* and *teaching materials, beliefs about teaching and values*; and the teacher's duties: which can be divided into the three aspects of *work environment, job satisfaction and concerns over workload and tools* [24].

As Chen noted, the teacher's instructional attitude can be discussed in three aspects: the teacher's receptivity to students' feelings, which involves an interactive relationship through which a teacher encourages students and consequently becomes receptive to their feelings; the teacher's instructional attitude as an education professional, which involves teaching skills, instruction-related beliefs and how well he/she understands the principles of education, the students' psychological status and behaviours; and the teacher's instructional attitude toward his/her role and duties, which involves the work environment, job satisfaction, workload and job-related concerns [25].

Ciu defined a teacher's instructional attitude as the explicit actions taken by a teacher on the basis of various thoughts when providing instruction [26]. Those thoughts include a sense of self-commitment, educational philosophy, the approach to managing teacher-student relationship and perceptions of the surroundings.

Chang defined the teacher's instructional attitude as something that affects a student's behaviour in the process of teacher-student interactions [27].

Li noted an instructor's attitude is similar to a teacher's instructional attitude and refers, in a strict sense, to a teacher's instructional attitude toward the job of providing instruction [4]. In a broader sense, however, an instructor's attitude refers to the instructional objectives, content of instruction, teaching methods and the environment where that instruction is given.

The present study derived a conceptual definition of a teacher's instructional attitude from the above-mentioned literature: how a teacher interacts with students in a classroom setting, conveys knowledge, triggers students' motives to learn, inspires academic achievement, and lives up to his/her educational philosophy. These components of the teacher's instructional attitude are determined in accordance with the categorisation method proposed by Chen [25].

Learning Outcomes

The numerous factors that affect learning outcomes have led to a controversy among scholars of varying purposes and standpoints, who have named the term: *learning outcomes* in many other ways. From a teacher's point of view, for instance, the term is also known as *teaching efficacy* [28], *teacher's efficacy* [29], *teacher's self-efficacy* [30], and *teacher's sense of self-efficacy* [31], among others [4].

Piccoli, Ahmad and Ives defined learning outcomes as the changes in a learner's knowledge, skills and attitude after receiving instruction [32]. As noted by Jones, the learning outcomes are affected by factors such as the learning style, curriculum design and how instruction is provided [33].

Likewise, Loo argued that learning performance is affected by the learning style, curriculum design and how instruction is provided [34]. Learning outcomes are directly evaluated using students' academic records at school, the ability to obtain occupational certificates and results of exams taken outside school. From a student's viewpoint, the present study adopts the three explicit variables (i.e. a student's academic achievements at school, observable professional skills and the proficiency displayed in external tests). Such an operational definition is briefly described as follows:

1. Academic achievements at school: the test results a student achieved after completing in a school-based learning process;
2. Total occupational certificates earned: the total number of occupational certificates a student earns after completing a training process, school-initiated or not, to validate the occupational proficiencies;
3. External examinations: a student's process of taking occupational competency tests outside the school after completing a school-based or occupational training programme.

The Influence of Interest in Learning and Learning Outcomes

According to a study by Huang, students showed an increased interest in learning after receiving mathematics instruction intervened with creative games [36]. In the result-retaining stage, all the students surveyed were able to keep their test scores at the level achieved in intervening stages.

Yang studied students from seven countries and found those who have both confidence and interest in learning science always showed positive achievements in the area of science [37]. That is, students with higher levels of interest in science performed better in science than those with mid- and low-level interest.

Yang argued that, when student placement is based on the normal distribution, there is a positive relation between academic achievements and interest in learning [38].

As Lin noted, female students with experience in learning a musical instrument and music club participation report relatively better music-learning outcomes [39].

Xu said in one study that after instruction was provided using cooperative learning strategies, students in the experimental group showed more interest in learning English than those in the control group [40]. In other words, the implementation of such a cooperation-based instructional method enhanced the students' interest in learning English.

Qiu argues that enhanced interest/focus in reading, combined with changes in concept learning, ensures a reader's greater concentration on the focus and subsequently facilitates concept learning in science [41].

The Influence of Learning Hours and Learning Outcomes

Gu found that, first, students who spend relatively long hours learning on-line report better on-line learning outcomes than those who do not; second, there is a correlation between the *learning hours* factor and *learning attitude* factor [42].

In a study on the correlation between the pattern of learning hours and students' achievements in a non-synchronised distance-learning environment, Wang derived three findings. First, students who are used to hasty cramming are those who do not show an enormous difference in academic achievements; second, all of the students surveyed who practised time management reported mid-to high-level academic achievements; and third, a majority of the students with high-level achievements practised time management [16].

Yen mentioned in her study that, students who learned through *a system of on-line tests and on-line remedial instruction* showed significant difference in both the concept of *time* and test results compared to those who did not [17]. That is, the on-line system generates significant learning outcomes.

Lai said junior high school teachers in Taoyuan County, who incorporated information technologies in their instruction showed significantly varying teaching efficacy depending on a range of factors. These included gender, age, the highest academic degree earned, discipline(s) of expertise, seniority, total hours spent on information-technology training, school size, whether or not the school is an information-technology seed school, and whether or not the instructions were given at a location with Internet access [43].

The Influence of Learning Attitude and Learning Outcomes

Gu said there was only an insignificant difference between students with a higher level of learning attitude and those with a lower one in on-line learning outcomes [42].

Li pointed out the significantly positive correlation between the attitude of elementary-school Physical Education (PE) teachers and the teaching efficacy in PE [44].

As Chen argued, the instructional method that draws the greatest student attention is one based on group competition with novelty, diversity and fun incorporated into it [35]. Such a method also helps elicit a sense of honour and loyalty to the class from the students. Meanwhile, efforts in parent-teacher communications, partnership seeking and an appropriate amount of videotaping/instructional demonstrations all prove helpful in improving the teacher's expertise. In a pleasant and safe setting, group-based cooperative projects provide the most effective approach to eliciting students multifaceted thinking, a sense of participation, bolstered learning motives, a different learning attitude, as well as enhanced writing skills.

According to Lai, the attitude of teachers who incorporated information technologies in instruction is significantly and positively linked to the teaching efficacy [43].

In a study on elementary school teachers in Kaohsiung City, Li said that, in a multicultural education programme, the teacher's instructional attitude is not only significantly and positively related to teaching efficacy, it also serves as an effective tool to predict and affect that efficacy [4].

Li believed a mother tongue teacher's instructional attitude has a significantly positive relationship with his/her sense of self-efficacy [45].

Although most of the literature reviewed differs from this study in terms of samples selected and the purposes of research and methodology, the following hypotheses are presented (based on the literature review):

- Hypothesis 1 (H1): Students' interest in learning has a positive and significant influence on learning outcomes in Taiwanese colleges;
- Hypothesis 2 (H2): Students' learning hours in Taiwanese colleges affect learning outcomes in a positive and significant manner;
- Hypothesis 3 (H3): Satisfaction with a teacher's instructional attitude has a significantly positive influence on learning outcomes in Taiwanese colleges;
- Hypothesis 4 (H4): Students' interest in learning and their satisfaction with a teacher's instructional attitude exert a significant interactive influence on learning outcomes in Taiwanese colleges.
- Hypothesis 5 (H5): Students' learning hours and their satisfaction with a teacher's instructional attitude exert a significant interactive influence on learning outcomes in Taiwanese colleges.

RESEARCH METHOD

Based on the research motives, purposes and literature reviews described above, the research hypotheses and established a conceptual research framework were derived, as shown in Figure 1.

Designing the Questionnaire

The questionnaire in this study was designed on the basis of Multi-Dimension Measurement according to each observable dimension. It uses a 7-point Likert Scale to measure each answer, with 7 being *strongly agree* and 1 being *strongly disagree*. A higher point represents a higher degree of agreement, and vice versa. Data collected from the samples were *centralised*, so the sum of scores given to all questionnaire items after deducting the average was zero.

In this way, the multi-colinearity between independent and extraneous variables will be erased to provide a better test of the interactive influence of independent variables on the extraneous variable. The following mathematical equation illustrates the *centralisation* concept:

$$\Sigma (X_i - \bar{x}) = \Sigma Y_i = 0 \quad (1)$$

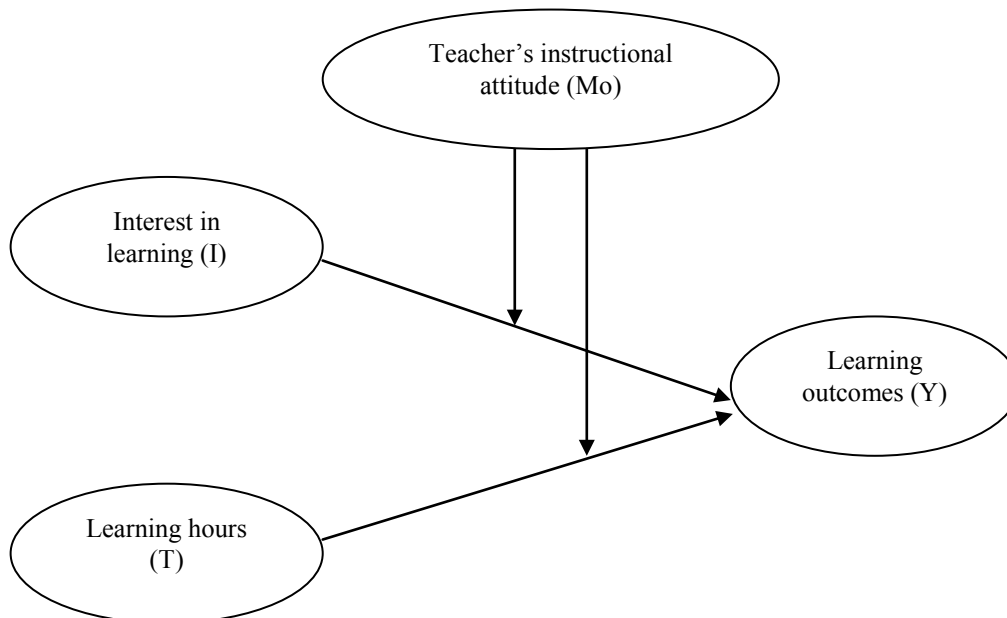


Figure 1: Conceptual framework in this study.

The questionnaire of interest in learning was patterned after the ones proposed by Schraw and Lehman and Lai, with the *latent interest*, *actualised interest*, *text-based interest*, *task-based interest* and *knowledge-based interest* being the five variables [9][12]. Designed on the basis of Multi-Dimension Measurement, the questionnaire contains 20 items in total, with four items placed under each variable.

The questionnaire of learning hours was patterned after the ones proposed by Lai [9] and Piaget [18], with the *learning hours related to situational interest* and *learning hours related to individual interest* being the two variables. Designed on the basis of Multi-Dimension Measurement, the questionnaire contains eight items in total, with four items placed under each variable.

The questionnaire of teacher's instructional attitude was patterned after the one proposed by Chen, with *the teacher's receptivity to students' feelings*, *the teacher's instructional attitude as an educational professional* and *the teacher's instructional attitude toward his/her role and duties* being the three variables [25]. Designed on the basis of Multi-Dimension Measurement, the questionnaire contains 12 items in total, with four items placed under each variable.

The questionnaire of learning outcomes was patterned after the ones proposed by Loo [34] and Jones [33], with *academic achievements at school*, *total occupational certificates earned* and *external examinations* being the three variables. Designed on the basis of Multi-Dimension Measurement, the questionnaire contains 12 items in total, with 4 items placed under each variable.

Sampling Method

This study conducted a questionnaire-based survey on the students and lecturers (or teaching staff of higher levels) at Taiwanese colleges, selected using convenience sampling. 50 copies of expert questionnaire were given out in a pilot-test. A post-test was conducted after modifying the questionnaire in accordance with experts' suggestions. Three-hundred copies of the official questionnaire were given out, with 235 valid copies returned at a return rate of 78.3%.

Data Obtained from the Questionnaire and the Measurement Model

To verify the research framework proposed, a linear Structural Equation Model (SEM) was applied to the Confirmatory Factor Analysis (CFA) of the research model's framework. The questionnaire was divided into four latent variables (i.e. interest in learning, learning hours, teacher's instructional attitude and learning outcomes), each containing several observable/explicit variables.

The survey was conducted using these observable/explicit variables, with several questionnaire items categorised under each variable. After processing data collected in the survey, files were created for the primary data. Although the questionnaire design was based on Multi-Dimension Measurement, either *Dual Measurement* or *Single Measurement* was adopted to make sure the computer software-aided data processing would go as expected [46].

Table 1 shows the number of questionnaire items under implicit and explicit variables in this study, along with their reference resources.

Table 1: Number of questionnaire items for *implicit variables* and *observable variables*.

Implicit Variables	Explicit Variables	Total Number of Questionnaire Items	References for Questionnaire
Interest in learning (I)	Latent interest	4	Lai [9], Schraw and Lehman [12]
	Actualised interest	4	
	Text-based interest	4	
	Task-based interest	4	
	Knowledge-based interest	4	
Learning hours (T)	Learning hours related to situational interest	4	Lai [9], Piaget [18]
	Learning hours related to individual interest	4	
Teacher's instructional attitude (Mo)	The teacher's receptivity to students' feelings	4	Chen [25]
	The teacher's instructional attitude as an educational professional	4	
	The teacher's instructional attitude toward his/her role and duties	4	
Learning outcomes (Y)	Academic achievements at school	4	Loo [34], Jones [33]
	Total occupational certificates earned	4	
	External examinations	4	

RESULTS AND ANALYSIS

Linear Structure Model Analysis

The CFA is an analytical approach opposite to the Exploratory Factor Analysis (EFA). This study conducted a CFA of four unobservable/implicit variables (i.e. interest in learning, learning hours, teacher's instructional attitude and learning outcomes). Consisting of the Structural Model and Measurement Model, a SEM provides an effective solution to the cause-effect relation between implicit/latent variables. The models verified in this study are divided into three parts: 1) verifying the goodness-of-fit of Measurement Model; 2) verifying the goodness-of-fit of Structural Model; 3) verifying the overall model's goodness-of-fit to make sure it conforms to the goodness-of-fit indices. That is, the goodness-of-fit of the overall SEM was judged with related goodness-of-fit indices [47].

Analysing Fit of Measurement Model

The factor loading of latent/implicit variables and manifest/explicit variables mainly measures the intensity of linear correlation between explicit and implicit variables. A factor loading close to 1 indicates the explicit variable is relatively capable of measuring the implicit one. In this study, all explicit variables' factor loadings are between 0.7 and 0.9, hence, the satisfying reliability. Consequently, all explicit/manifest variables in the model's measurement system are capable of appropriately measuring the implicit/latent variables. Moreover, the Average Variance Extracted (AVE) is used to calculate the explanatory power of variance between implicit/latent variables versus explicit/manifest ones; the higher the VE value, the greater reliability and convergent validity of the latent/implicit variables. Usually, the VE value must be larger than 0.5 to indicate the explanatory variance of explicit variables is larger than measurement error [48]. In this study, all AVEs are larger than 0.5, hence, the explicit variables' excellent reliability and convergent validity (see Table 2 and Figure 2).

Table 2: Judgment indicators of measurement system in the model.

Unobservable/Implicit Variables	Observable Variables: Centralised Dual Measurement	Factor loading	Variance Extracted (VE)
Interest in learning (I)	X1C	0.83	0.63
	X2C	0.84	0.62
Learning hours (T)	X3C	0.82	0.64
	X4C	0.83	0.63
Teacher's instructional attitude (Mo)	Z1C	0.86	0.66
	Z2C	0.85	0.67

I*Mo	X1Z1C	0.76	0.61
	X2Z2C	0.77	0.62
T*Mo	X3Z1C	0.76	0.62
	X4Z2C	0.78	0.63
Learning outcomes (Y)	M1C	0.84	0.68
	M2C	0.85	0.69

Analysing Fit of Structure Model

Path Analysis Results of Structure Model

After the overall model passed the goodness-of-fit test, Table 3 shows such results as the parameter estimates, SE and Critical Ratio (CR) between implicit variables. In Taiwanese colleges, students' interest in learning and a teacher's instructional attitude both have a significant interactive influence on learning outcomes. Likewise, vocational college students' learning hours and a teacher's instructional attitude both have a significant interactive influence on learning outcomes. That is to say, a teacher's instructional attitude exerts a positive extraneous effect that helps the learning outcomes achieve synergy.

Table 3: Path analysis results of the structural model.

Path Coefficients between Implicit Variables		Estimate	SE	CR	P	Label
Interest in learning (I)	→ Learning outcomes (Y)	0.462	0.091	5.077	***	a
Learning hours (T)	→ Learning outcomes (Y)	0.451	0.092	4.902	***	b
Teacher's instructional attitude (Mo)	→ Learning outcomes (Y)	0.442	0.023	19.217	***	c
I*Mo	→ Learning outcomes (Y)	0.691	0.022	31.409	***	d
T*Mo	→ Learning outcomes (Y)	0.672	0.023	29.217	***	e

Note: * indicates $P < 0.05$; ** indicates $P < 0.01$; *** indicates $P < 0.001$

Coefficient of Determination

Also known as Squared Multiple Correlation (SMC), the Coefficient of Determination is the degree of explanatory power of an *independent variable* with respect to a *dependent variable* under each implicit variable. In other words, the R^2 values shown in Table 4a and Table 4b indicate that the implicit independent variable has adequate explaining ability on the implicit dependent variable respectively.

Table 4: Path coefficient of determination.

Table 4a: Coefficients (hierarchical regression).

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.867 ^a	0.752	0.746	0.916	0.006	169.218	2	97	0.000
2	0.875 ^b	0.766	0.753	0.711	0.013	17.024	1	96	0.003

a. Predictors: (Constant), Mo, I and T

b. Predictors: (Constant), Mo, I, T, I*Mo and T*Mo

Table 4(2) was derived from Table 4(1):

Table 4b: Coefficients.

Coefficients of Determination	Adjusted R^2
Interest in learning (I), Learning hours (T) and Teacher's instructional attitude (Mo) versus Learning outcomes (Y)	0.746
Interest in learning (I), Learning hours(T), Teacher's instructional attitude (Mo), I*Mo and T*Mo versus Learning outcomes (Y)	0.753

The Indices of Fit of the Overall Model

The purpose of adopting SEM in the modelling phase of this study is to explore the relationship between unobservable variables within the Structural Model, to examine whether the Measurement Model has measurement reliability or not,

and also to measure the overall goodness-of-fit effects of this study using such indices as χ^2 , d.f., GFI, AGFI, NFI, CFI, RMR and RMSEA. In most cases, it is required that $\chi^2/DF < 5$, $1 > GFI > 0.9$, $1 > NFI > 0.9$, $1 > CFI > 0.9$, $RMR < 0.05$ and $RMSEA < 0.05$. The goodness-of-fit of the overall model in this study is satisfying, given the fact that $\chi^2/DF < 5$ and GFI, AGFI and NFI are all larger than 0.90, with the RMR value smaller than 0.05, as shown in Table 5.

Figure 2 indicates the result of computer-aided standardisation of the model's overall framework.

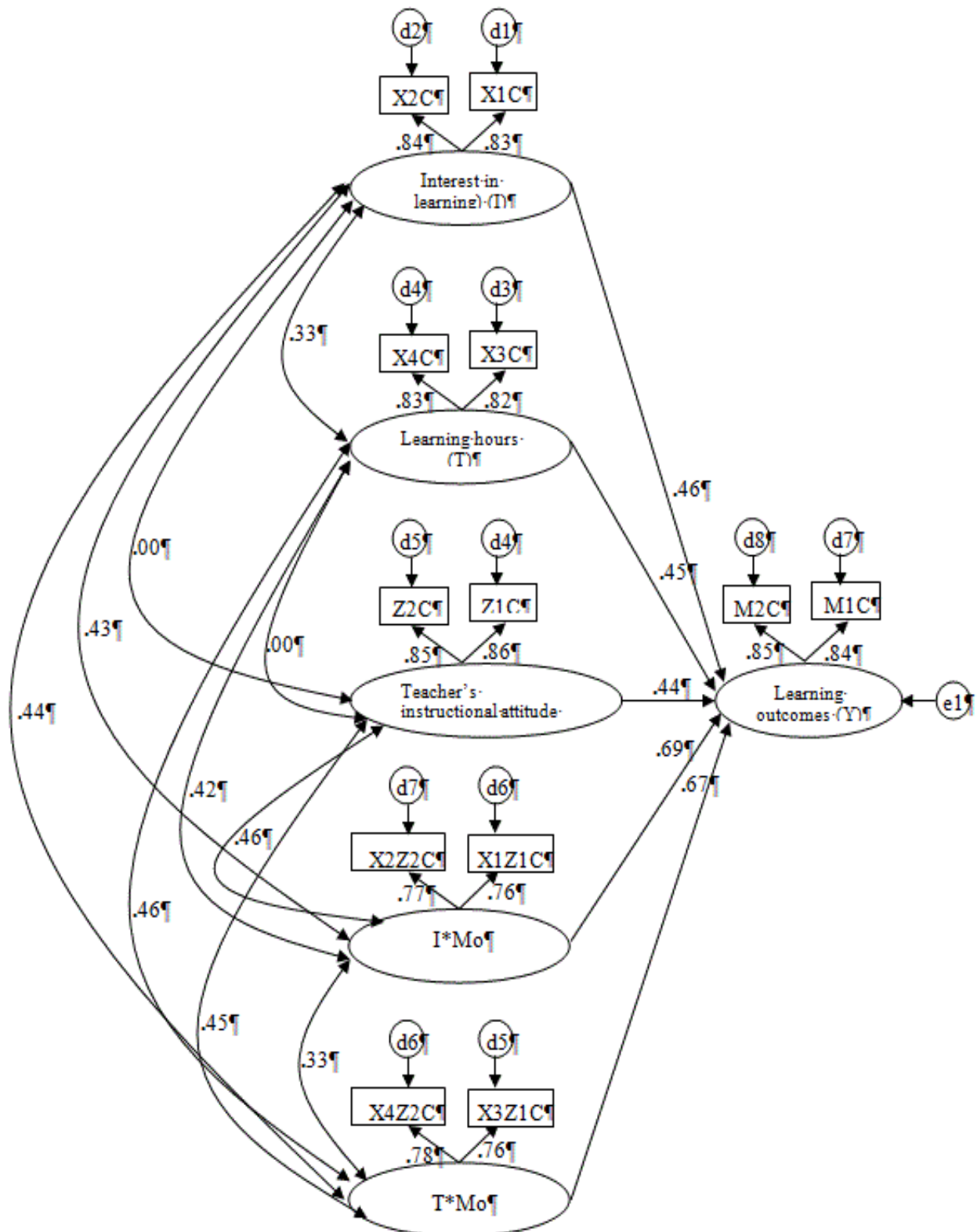


Figure 2: Standardised results of SEM analysis.

Table 5: Assessment of fit of the overall model.

Determination index	χ^2	DF	GFI	AGFI	NFI	CFI	RMR	RMSEA
Fit value	46.918	39	0.917	0.903	0.911	0.912	0.023	0.022

In order to test the extraneous variable, this study performed a hierarchical regression analysis (see Table 4a), followed by centralised hierarchical regression analyses and *t*-tests of Y versus I, T, Mo, I*Mo and T*Mo. These analyses were intended to test whether the significance of regression coefficient *c* was substantiated (i.e. whether *c* is zero or not). The test results are shown in Table 6.

Table 6: Coefficients.

Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig
	B	Std. Error	Beta		
1 (Constant)	27.709	0.873	0.621	31.740	0.000
I	12.020	0.919	0.462	13.079	0.000
T	11.621	0.928	0.371	12.523	0.000
Mo	10.985	0.410	0.432	26.793	0.000
I*Mo	23.407	0.531	0.681	44.080	0.000
T*Mo	23.426	0.536	0.631	43.705	0.000

a. Dependent Variable: Learning outcomes (Y)

From Table 3, it is known that the Path Coefficient of I*Mo versus Y is 0.691 and that of T*Mo versus Y is 0.672, indicating the extraneous effect of I*Mo and T*MO on Y. The above-mentioned analysis generated the following verified results:

1. Students' interest in learning exerts a positive and significant effect on learning outcomes in Taiwanese colleges with a 0.46 standardised path coefficient that supports H 1 (Hypothesis substantiated);
2. Students' learning hours exerts a positive and significant effect on learning outcomes in Taiwanese colleges with a 0.45 standardised path coefficient that supports H2 (Hypothesis substantiated);
3. Teacher's instructional attitude exerts a significantly positive effect on learning outcomes in Taiwanese colleges with a 0.44 standardised path coefficient that supports H3 (Hypothesis substantiated);
4. Students' interest in learning and teacher's instructional attitude both have a positive and significant interactive influence on the learning outcomes in Taiwanese colleges, with a 0.69 standardised path coefficient that supports H4 (Hypothesis substantiated);
5. Students' learning hours and teacher's instructional attitude both have a positive and significant interactive influence on learning outcomes in Taiwanese colleges, with a 0.67 standardised path coefficient that supports H5 (Hypothesis substantiated).

CONCLUSIONS AND SUGGESTIONS

Conclusions

The following specific conclusions have been derived from the aforementioned data analyses and results:

- As for SEM verification, the SEM established in this study has a satisfying goodness-of-fit in terms of the Measurement Model, Structural Model and the overall structure, hence, a good model fitting.
- Conclusions with regard to the verification of practices at Taiwanese colleges:
 - Students' interest in learning and a teacher's instructional attitude both have a significant interactive influence on the learning outcomes in Taiwanese colleges;
 - Students' learning hours and a teacher's instructional attitude both have a significant interactive influence on learning outcomes in Taiwanese colleges.

The researchers learnt that when a teacher's instructional attitude exerts a positive extraneous effect, H1, H2 and H3 appear relatively insignificant, compared with the increased significance of H4 and H5 statistically [46].

Contributions of this Study

Innovative Applications of Methodology: The previous literature pertaining to vocational college students in Taiwan has usually involved exploratory research using the multi-regression analysis and rarely used the CFA-based research framework that takes into consideration the implicit variables' extraneous effect. But since the chief dimensions of this

present study are implicit variables, CFA and linear SEM appear suitable as the measurement tool and model framework, respectively. That explains why this study is relatively innovative in terms of methodology.

Contributions to Practices at Taiwanese Colleges: While previous studies of vocational college students in Taiwan have tended to focus on EFA, this study performed modelling on the summarised results of previous literature in related fields. It also verified the model's goodness-of-fit to find out, if this model has fit-of-goodness effects satisfied. Consequently, this study is a CFA-based one that addresses a crucial topic regarding school practices. Not only is that topic worth further research in relevant fields, the research results also provide a reference for decision makers at Taiwanese colleges in terms of sustainable school operations. This explains why this present study can serve as an extremely valuable reference.

Limitations and Suggestions

1. Given the limited research resources available, this study adopted the non-probability, convenience sampling method for convenience purposes, with samples selected only on the *proximity* and *easy-to-measure* bases. This, however, resulted in a substantial sampling bias and a reduced reliability. Therefore, future studies are advised to use simple random sampling or stratified random sampling instead;
2. During the model-building process, this CFA-based study should ensure the verification model is as simple as possible and avoid complicated ones with a poor goodness-of-fit [46]. That is why this study focuses only on how the students' interest in learning and their learning hours affect learning outcomes, with teacher's instructional attitude being the extraneous variable.
3. As this study focuses solely on the CFA of Taiwanese colleges, future studies may consider either extending the scope of research or verifying the goodness-of-fit of companies in various other industries, so as to find out if the goodness-of-fit varies among industries in the same model.

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