Effects of Flipped Teaching and MOOCs on Learning Effectiveness: Using Learning Satisfaction as a Dual Mediator?

I-Chao Lee, Kao Yuan University, Taiwan

ABSTRACT

At present, many technical colleges in Taiwan are implementing flipped education and MOOCs. The former is made possible by the Internet and information technology, where instructor's teaching and student's learning have undergone a revolutionary change; the latter, Massive Open Online Courses (MOOCs) is a large-scale free online open course scheme recently launched by domestic and international universities.

The primary objective of this study is to verify and to learn the effects of flipped teaching and MOOCs on learning effectiveness with learning satisfaction as a dual intervening variable. The research population of this study is the instructors of lecturer level, or above, of the technical & vocational colleges in Taiwan and their students. The Purposive Sampling method is used to select the population, while Structural Equation Modeling (SEM) is used to verify the overall research model and the fitting effect of its Structural Model and Measurement Model. The findings of this study show that: (1) both the instructors and students of technical & vocational colleges in Taiwan believe that flipped teaching has a positive effect on learning satisfaction, but that it is not significant; (2) while the students of technical & vocational colleges in Taiwan believe that flipped teaching has an impact on learning satisfaction, but that it is not significant; (3) both the instructors and students of technical & vocational colleges in Taiwan believe that flipped teaching has a positive effect on learning effectiveness, but that it is not significant;(4) both the instructors and students of technical & vocational colleges in Taiwan believe that learning satisfaction has a significant positive effect on learning effectiveness; and (5) the instructors and students of technical & vocational colleges in Taiwan believe that MOOCs has a negative effect on learning effectiveness, but that it is not significant.

As observed from the above, learning satisfaction has only a "partial" dual intervening effect. The results of this study can help to provide educational decision makers with an understanding of the importance of flipped classroom, MOOCs, learning satisfaction, and learning effectiveness, and the impact that these variables have on current educational reform.

Keywords: *Flipped Teaching, MOOCs, Learning Effectiveness, Learning Satisfaction*

INTRODUCTION

Flipped education is one of the most important educational topics in the world. Thanks to the internet and information technology, revolutionary changes are happening to the way instructors teach and students learn. Teachers are breaking away from the role of being a knowledge provider to becoming a facilitator and coordinator of the students' learning process; and students' learning model is moving to a more self-initiating learner model. Digital teaching materials, Massive Open Online Courses (MOOCs) and SPOCs (Small Private Online Course) are all independent learning materials for students; while

classroom discussion has become the catalyst for effective learning outcomes (Yang, 2015). However, when the teachers in the school are poised to implement the flipped teaching method, are students willing to accept the self-initiated learning? One of the most important elements of successfully implementing the flip learning method is the willingness of students to take initiative in learning. Under the impact of a low-birth rate, many schools in Taiwan are facing the challenge of recruiting students. Some schools are nearly closed down, while in some schools, for the sake of maintaining sustainability, the acceptable student-quality is affected. It is not clear if some of these students go to school for learning or for other purposes.

Bergmann & Sams (2012) argued that the success of a flipped classroom is closely related to students' enthusiasm in learning, and instructors should provide more opportunities for students to choose so as to maintain or nurture learning enthusiasm. Lastly, just like the traditional teaching, instructors should design a complete mechanism to ensure the quality of group discussion, and design lesson-preparation content that is interesting, while being appropriate to the student's level. All of these factors are key elements in the success of a flipped classroom.

Moreover, learning satisfaction and learning effectiveness are both critical factors in the measurement of learning effectiveness. There are many factors that can affect students' learning satisfaction and learning effectiveness; apart from students' individual factors, instructors, curriculum, and learning environment are all possible factors. Researchers may focus on any one particular factor due to research objectives, or research environments. Lynch, Woelfl, and Steele (1998) have studied, specifically, medical school students, the effects and the relationship between learning patterns and learning performance. Jones (1996) also discussed, in his essay, the effects of capability, self-efficacy, and personal goals on performance, and finds that a number of different personal traits can indeed affect learning performance. Overall, learning satisfaction and learning effectiveness dimensions may be slightly different in various research discussions due to the differences in research topics; however, the dimensions they cover include no more than the following six items: learning environment, administration, instructors, curriculum, learning outcomes and interpersonal relationships. However, the constant updating of teaching methods, the persistent presence of the emphasis on students' learning satisfaction, and the effective development of learning effectiveness can bring forth the basis of effectiveness between teaching and learning for teachers and students in the school, and enhance learning willingness and learning effectiveness. Therefore, this study is attempting to verify and to understand the effects of implementing flipped teaching and MOOCs on the learning effectiveness in technical & vocational colleges in Taiwan, while using learning satisfaction as the intervening variable. Specific research objectives can be summarized as the following items.

To learn and then verify whether or not the instructors and students of technical & vocational colleges in Taiwan believe that:

(1) Flipped teaching has a significant positive effect on learning satisfaction (H_1);
(2) MOOCs also have a significant positive effect on learning satisfaction (H_2);
(3) Flipped teaching has a positive and significant effect on learning effectiveness (H_3);
(4) learning satisfaction has a positive and significant effect on learning effectiveness (H_4); and
(5) MOOCs have a positive and significant effect on learning effectiveness (H_5).

LITERATURE REVIEW

Flipped Teaching

The conceptual definition of flipped teaching in this study is "a learning model that is centered on students, where students learn the online course materials first, then have their questions answered by the instructor, and participate in the guided discussion and experiments during the classroom hour. Thus, it is also called flipped classroom." This study integrated the ideas proposed by Cai (2016) as the sub-dimensions for flipped teaching: (1) independent learning; and (2) two-way interactive learning in the classroom, and performed verification respectively. The above mentioned conceptual definition concerning flipped teaching is summarized from the following literature review.

Hwang (2014) mentioned that the term, flipped classroom, has not been universally adopted. Terms such as flipping class, flipped approach, flipping model, reverse instruction, flipped learning, inverted classroom, and backwards classroom, are being used by some, while others call it: the blended learning model, due to the fact that it is a blend of online instruction and offline learning.

Liu (2013) argued that the flipped classroom is a student-centered learning model, where the learning sequence is as follows: self-study before class, classroom interaction, after-class club activities or other such extended learning. The self-study formats include: watching instruction videos, listening to instruction podcasts, studying advanced versions of e-book contents, and collaborating with peers for the online learning activities. Students can take control of the contents of learning materials, the pace and style of learning, while teachers transform the role of information "instructor" to learning "guide". This model combines hybrid learning, exploratory learning, and problem-oriented learning (PBL), and allows students to communicate and interact in the form of practical and cooperative learning, and even propose feasible solutions to real problems, so that students can have a deeper understanding and apply the subject contents to help achieve the purpose of the learning transfer.

Acedo (2013) believed that flipped classroom refers to the reversal of the traditional instruction model, where now, students are the center of the learning environment. The classroom time is allocated for students' learning, rather than instructor's lectures, allowing students to master learning skills through collaboration and discussion, thus improving learning efficiency and achievements.

Hoffman (2014) also proposed that the reform model of flipped classrooms, should not be limited to the flipping of instructors' lectures and homework assignment methods, but should also extend to the pursuit of changes in teaching methods.

Chang (2015) pointed out that students play the leading role in a flipped classroom, and that the progression rate is based on students' information absorption guidance. The classroom is no longer the venue for teacher's lectures, but a place for interaction between teachers and students, students and students, and students and information.

Cai (2016) deduced four critical aspects of flipped teaching: the breakdown of curriculum contents and suggestions, the conversion of one-way independent learning, the assistance and records provided by digital platforms, and the arrangement of two-way interactive learning activities in classrooms.

Wang (2018) pointed out that flipped teaching must have the following course design elements and procedures: instructor designs and provides students with pre-class learning materials, students self-study before the class, group discussions in the classroom, and teacher-student exchange and peer feedback. Such a method of stepped process is the essence of flipped teaching. Wang also proposes that flipped teaching is composed of four aspects: "independent learning, exchange and feedback, technology assistance, diversified evaluation". In each of the aspects, a higher score implies a higher degree of flipped teaching; a lower score implies a lesser degree of flipped teaching.

MOOCs

MOOCs is the abbreviation of Massive Open Online Courses, also known as "large-scale open online courses". As the name implies, it is a teaching process open to the participation of online users via internet.

This study integrates the views of the following scholars and defines the concept of "MOOCs" as "a learning method that uses information technology to transmit and retrieve information for learning, and promotes self-regulation and individuation through the provided digital learning content and situations, so as to achieve learning goals." In this study, the sub-dimensions of MOOCs are based on the concepts of Tabaa & Medouri (2013) and Chen (2016): (1) digital learning contents; and (2) online peer collaboration learning and discussion, which are respectively verified. The conceptual definition described above, concerning MOOCs, is derived from referring to the following literature.

The system of MOOCs consists of five elements: (1) Instructors: Simplify the learning process by producing appropriate instruction materials to trigger communication between learners, and manage evaluations of expected learning outcomes. (2) Learners: Anyone who wants to learn about a certain subject is authorized to register. Learners can pursue the formal degrees or credits offered by some courses, or only access specific content. (3) Topics: Topics brought in by learners, instructors, textbooks and situations are introduced throughout the entire system, they may be content limited, but are broad enough to cover various fields. (4) Material: It exists on various websites in various modes, and is accessible through various technical solutions. And (5) Context: It refers to various elements that make up a course environment. Each course can be constructed by combining online social networks, common information sources, various types of information delivery methods, communication systems, expected learning outcomes and forming groups (Tabaa & Medouri, 2013; Chen, 2016).

Wu (2013) defined MOOCs as native digitally-born classrooms with video instruction materials as its core elements. Such teaching materials are produced with an instructor giving instructions in front of a camera, while incorporating presentation software or animations. Questions for practice may be interspersed in the video, and sometimes the designed video contents may include conversations with experts.

Hsiao (2016) proposed that massive open online courses (MOOCs) are designed to return the autonomy and the rhythm of learning back to students. Students can schedule courses and time according to their desires, so that they can have more time and convenient learning opportunities.

The research of National Cheng Kung University (2019) pointed out that MOOCs (Massive Open Online Courses) are large-scale free online open courses that have emerged recently and are generally launched by universities at home and abroad. The courses usually consist of small units in 5- to 10-minute segmented videos, that incorporate between these units, real-time online discussions and feedback, online peer collaboration in learning and discussion, virtual online experiments and online practice and evaluation. Students can gear the learning progress to fit their own learning pace.

Learning Satisfaction

Learning satisfaction is one of the major items used for measuring learning results. In addition to students' individual issues, instructors, curriculum, and learning environment are possible factors that can affect students' learning satisfaction. Summarizing the perspectives of the following scholars, the conceptual definition of "learning satisfaction" adopted by this study is “the degree of students' satisfaction with their wishes and needs as provided by the learning process." The dimensions of learning satisfaction are based on the concepts proposed by Wu (2012): (1) instructor’s teaching; (2) curriculum

and learning environment; and (3) school administration. The conceptual definition and dimensions of learning satisfaction, as mentioned above, are derived from reference with the following literature.

Cheng (2008) proposed that the definition of learning satisfaction refers to "the feeling and attitude that a student has about the learning activity. The formation of such a feeling or attitude is attributed to a student's enjoyment of the learning activity, or to the student's aspirations and needs being achieved at a satisfactory level during the learning process."

Shen (2010) pointed out that levels of learning satisfaction refer to the gap between what the learner expects to learn and what he/she actually learns. If satisfaction is met in this learning process, the learner is satisfied. Learning satisfaction is also a measure of the student's attitude and feelings towards the overall learning situation. When students are satisfied with the learning process, and their own needs are met, the learning satisfaction is high; otherwise, the degree of satisfaction is low.

Huang & Lin (2015) proposed that it is a kind of feeling or perception, reflecting the degree of a learner's love for particular learning activities, or the degree of meeting their needs and fulfilling their wishes through such learning.

Wang (2019) suggests that learning satisfaction refers to the degree to which learners are satisfied with the course of learning activities. Because individuals' subjective feelings are different, whether factors such as positive attitudes, personal wishes and needs can be achieved, are highly dependent on the degree of differences between learners' expectations, needs and actual achievements of the course.

Wu (2019) believed that learning satisfaction should be based on students' subjective perception of learning satisfaction, rather than scores, to reflect students' true effectiveness indicators in learning.

Concerning the method for measuring learning satisfaction, scholars have derived a variety of perspectives and research findings.

Corts, Lounsbury, Saudargas & Tatum (2000) adopted five environmental factors to study their impact on student satisfaction. Their research findings show: career preparation and course offerings have the biggest impact on student satisfaction; while advising also has a positive effect on student satisfaction.

Teng (2006) proposed that there are six aspects in learning satisfaction: curriculum, equipment and environment, teaching and achievement, internship planning, internship employers and career guidance.

Wu (2012) divides learning satisfaction into three aspects: instructor teaching, curriculum and learning environment, and school administration.

Learning Effectiveness (the study effect of students)

In 2006, the American Society for Training & Development (ASTD) proposes an assessment of learning effectiveness to confirm whether the content of the course allows learners to reach the required state or standards, and determine whether such a course plan is meaningful, so as to adjust and improve inadequate course content (Chang & Chou, 2015). In this study, the conceptual definition of "learning effectiveness" is "the change of knowledge, skills and attitude after completing learning activities, and the behavioral abilities exhibited by learners". The "dimensions of learning satisfaction" is based on the concepts proposed by Huang (2007); Chiu & Lin (2009); Chang (2018), as follows: (1) reaction level; (2) learning level; and (3) behavior level. The conceptual definition and dimensions of learning effectiveness, as mentioned above, are derived from reference with the following literature.

Gangne (1985) proposed that learning refers to a person's change in mental tendencies and abilities. This change lasts for a period of time, and cannot be simply attributed to the growth process.

Hong (1999) believed that there are two factors in learning effectiveness: they are subjective and objective learning attainments. Subjective learning attainments have three components: learning

satisfaction, learning achievements, and learning preferences; objective learning attainments are test scores, progress completion time, and semester scores.

Xu (2009) believed that learning effectiveness refers to the changes of knowledge, skill and attitude of students after the course is completed; such changes are used as the basis for evaluating whether the learning effectiveness is achieved. The purpose of evaluating learning effectiveness is to allow teachers and students to have a basis for adjusting course content, as required.

Chen (2015) argued that the definition of learning effectiveness refers to "a student's demonstrated ability after various possible forms of assessment tests are conducted on the student at the end of the learning activity."

Concerning the methods for measuring learning effectiveness, scholars have derived a variety of perspectives and research findings.

Wu (2016) that learning effectiveness is the observed changes in students' learning attitudes, learning strategies concerning their learning objectives after their learning experience, and their satisfaction with learning outcomes.

Kirkpatrick, a professor at the University of Wisconsin, proposes "techniques for evaluation training programs" in 1994. According to the hierarchical structure of the evaluation program, there are four sequential steps: reaction, learning, behavior and results, in the contents of this hierarchical structure. It is a method of evaluating whether a training is effective. Each level is important in itself: (1) Reaction Level: refers to the degree of love and satisfaction of learners with the education and training courses. It primarily measures learners' feelings about all aspects of the curriculum, including teachers, teaching materials, curriculum arrangements, education and training, but does not include measurement of any knowledge or skills thus learned. This level is basically a measure of satisfaction; (2) Learning Level: This level refers to the level of learners' absorption of educational content, including principles, facts, skills and attitudes. This level is to assess learners' learning status, and to see if learning effectiveness is achieved; (3) Behavior Level: refers to the degree to which learners change their work behavior due to this education. It mainly measures whether learners apply what they have learned to their disciplines. The difference in behavior, before and after learning, is used to determine learning effectiveness, which is usually evaluated after a period of education; and (4) Result Level: refers to the final results of the influence of the education and training program on the process, such as productivity improvement, quality improvement, and others. This level is used to measure the final results and impact of organizational changes (Huang, 2007; Chiu & Lin, 2009; Chang, 2018).

The Relationship of Pair wise Dimensions

Flipped Teaching and Learning Satisfaction

The research of Feng, Zhen & Xie (2015) indicated that adopting the method of micro-lesson teaching practice by students, along with the help of the new flipped-classroom ideas, in the instruction design of their "Instruction Design" course, produces the results showing that students' learning satisfaction is higher when this method is implemented.

Lin (2017) pointed out that implementing flipped teaching has a positive and significant impact on learning satisfaction.

Summarizing the above, following hypothesis is deduced in this study:

H_1: *Flipped teaching has a significant positive effect on students' learning satisfaction.*

MOOCs and Learning Satisfaction

The research findings of Lai (2016) showed that MOOCs learning model successfully and effectively promoted a cross-strait curriculum to be spread in Chinese society, and provided a more satisfactory learning experience with the support of cross-platform and cross-school partnerships.

H_2: *MOOCs has a significant and positive effect on students' learning satisfaction.*

Flipped Teaching and Learning Effectiveness

New teaching model: It has been confirmed by many studies abroad that flipped teaching is helpful in enhancing learning effectiveness.

Wu (2013) studied that students who accepted flipped teaching method in their English course, in which the experimental group students' English learning performance is significantly better than those in the control group.

The research results of Hung (2015) showed that learning motivation, interaction and self-efficacy in a flipped classroom environment have a significant impact on learning effectiveness, and that learning effectiveness also has a significant impact on satisfaction.

The research of Leou (2015) indicated that intelligence evaluation helps students to have a positive learning attitude, and improves students' learning effectiveness and their extent of immersion.

Lin (2017) pointed out that implementing flipped teaching has a positive impact on learning effectiveness.

Summarizing the above, following hypothesis is deduced in this study:

H_3: *adopting flipped teaching by instructors in technical & vocational colleges in Taiwan has a significant positive effect on learning effectiveness*

Learning Satisfaction and Learning Effectiveness

Chenn (2002) believed that goal orientation and learning satisfaction have significant positive effects on learning performance.

Tsao, Chang & Chen (2007) pointed out that there is a significant positive correlation between learning satisfaction and learning effectiveness.

Wu (2012) believed that students with a higher learning satisfaction will exhibit more significant learning effectiveness with positive effects.

Yeh (2016) pointed out that learning satisfaction has a significant positive effect on learning effectiveness.

The research of Tu (2018) indicated that the overall learning satisfaction and overall learning effectiveness, via a study of learning satisfaction and learning effectiveness of an elementary school children's physical education program in New Taipei City, are positively correlated.

Summarizing the above, following hypothesis is deduced in this study:

H_4: *The learning satisfaction of students of technical & vocational colleges in Taiwan has a significant positive effect on their learning effectiveness.*

MOOCs and Learning Effectiveness

The research results of Liu (2016) showed that students receiving flipped teaching combined with MOOCs and game-based learning can improve learning motivation and learning effectiveness.

H_5: *MOOCs learning for students in technical & vocational colleges in Taiwan has a significant positive effect on their learning effectiveness.*

Based on the above research purposes, and literature review, this study constructs a conceptual research framework, as shown in Figure1:

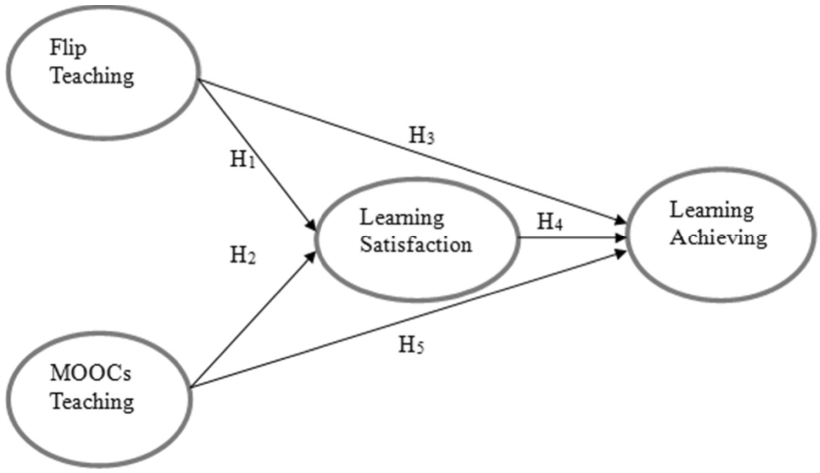

Figure 1: Research Framework

RESEARCH METHODOLOGY

Sampling Method

This study applied Purposive Sampling method on the research population, and targeted, for the questionnaire survey, instructors at least at the lecturer level and students of the technical & vocational colleges in Taiwan. This study distributed 40 copies of questionnaire to experts as the Pilot-test, then modified the questionnaire in accordance with experts' feedback recommendations, and performed official Post-test with 350 copies of questionnaire distributed. There are 241 valid questionnaire samples, at a sample-return rate of 68.8%.

Designing the Questionnaire

The questionnaire in this study was compiled on the basis of Itemization Survey method and the afore-mentioned observable dimensions. On a 7-point Likert Scale, the answers were measured with 7 denoting Strongly Agree and 1 denoting Strongly Disagree. A higher score represents a greater level of agreement, and vice versa.

The questionnaire design relating to flipped teaching in this study integrates the dimensions as proposed by Cai (2016), with other added improvements, resulting in a total of 4 questions.

The questionnaire design about MOOCs is derived from the dimensions as proposed by Tabaa & Medouri (2013) and Chen (2016) with added improvements, resulting in a total of 6 questions.

Additionally, in this study, the dimensions as proposed by Wu (2012) are adopted for the questionnaire design about learning satisfaction, and along with some improvements are added to create a total of 9 questions.

The questionnaire design relating to learning effectiveness in this study integrates the studies as proposed by Huang (2007), Chiu & Lin (2009); Chang (2018) and along with other added improvement, results in a total of 6 questions.

The Data Obtained from Questionnaire and Measurement Model

This study's author adopted SEM in a Confirmatory Factor Analysis (CFA) of the research framework, and based the questionnaire design on three latent variables (i.e., flipped teaching, learning satisfaction and learning effectiveness), each of which was divided into observable/explicit sub-variables containing several questions, as shown in the table below. After processing the collected data, the author created a primary file that preceded the design of questionnaire, using Itemization Survey method for the construction of this study's measurement system. Although Itemization Survey method is applied to the design of the questionnaire, Dual Measurement was adopted to ensure the computer software efficiently handled and/or measured all data (Chen, 2010). Table 1 shows the number of questions under each implicit or explicit variable, as well as the referential sources.

Table 1: Number of Questionnaire Items under each 'Implicit Variable' and 'Explicit Variable'

Implicit Variables	Explicit Variables	No. of questions	Reference
Flipped Teaching	Independent Learning	2	Cai (2016)
	Two-way interactive learning in the classroom	2	
MOOCs	Digital Learning Content	3	Chen (2016)
	Online peer collaboration learning and discussion	3	
Learning Satisfaction	Instructor's teaching	3	Wu (2012)
	Curriculum and learning environment	3	
	School Administration	3	
Learning Effectiveness	Reaction Level	2	Huang (2007); Chiu & Lin (2009), Chang (2018)
	Learning Level	2	
	Behavior Level	2	

RESULTS AND DISCUSSION

Linear Structure Model Analysis

This study includes a CFA, an analytical method contrary to the Exploratory Factor Analysis (EFA), on the four unobservable/latent variables of flipped teaching, MOOCs, learning satisfaction and learning effectiveness. SEM is made up of structural and measurement models to efficiently tackle the cause-effect relations among implicit/latent variables. The three parts of model-testing in this study are: (1) goodness-of-fit of the measurement model; (2) goodness-of-fit of the structural model; and (3) the overall model's conformity with goodness-of-fit indicators. In other words, goodness-of-fit indictors were applied to a test of the overall goodness-of-fit effect of SEM (Diamantopoulos & Siguaw, 2000).

Analyzing Fit of the Measurement Model

To a large extent, factor loading is intended to measure the intensity of linear correlation between each latent/implicit variable and a manifest/explicit one. The closer the factor loading is to 1, the better an observable variable is in measuring latent variables. Since this study's reliability is supported by the fact that factor loadings for all observable variables range between 0.7 and 0.8, all observable/explicit variables in the measurement model appropriately gauged the latent/implicit ones. The Average Variance Extracted (AVE), on the other hand, gauges an unobservable/implicit variable's explanatory power of variance with regard to an observable one, with the AVE value growing in proportion to the reliability and convergent validity of that particular implicit/latent variable. As a rule, AVE must be larger than 0.5 for an observable variable's explainable variance to exceed the measurement error (Fornell & Larcker, 1981). As Table 2 and Figure 2 show that all AVEs in this study exceed 0.5, the explicit variables have excellent reliability and convergent validity.

Table 2: Judgment Indicators for the Measurement Model

Implicit Variables	Explicit Variables	Factor loading	Variance Extracted, VE
Flipped Teaching (X_1)	X_{1a}	.731	.532
	X_{1b}	.752	.554
MOOCs (X_2)	X_{2a}	.721	.523
	X_{2b}	.744	.541
Learning Satisfaction (ME)	ME_1	.732	.533
	ME_2	.741	.545
Learning Effectiveness (Y)	Y_1	.753	.554
	Y_2	.771	.581

Analyzing Fit of Structure Model

Path analysis results of structure model

After the group model of this study has passed the goodness-of-fit test, the parameter Estimates, Standard Errors (S.E.) and Critical Ratio (C.R.) among latent variables were calculated (as shown in Table 3).

Table 3: Path analysis results of structure model

Path Coefficients between Implicit Variables			Estimate	S.E.	C.R.	P	Label
Flipped Teaching (X_1)	→	Learning Satification (ME)	.132	.098	1.347		H_1
MOOCs (X_2)	→	Learning Satification (ME)	.133	.092	1.446		H_2
Flipped Teaching (X_1)	→	Learning Effectiveness (Y)	.142	.091	1.560		H_3
Learning Satification (ME)	→	Learning Effectiveness (Y)	.563	.021	26.810	***	H_4
MOOCs (X_2)	→	Learning Effectiveness (Y)	-.141	.082	-1.720		H_5

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

Coefficient of Determination

The explaining level of each implicit independent variable to each implicit dependent variable is the R^2 value (Squared Multiple Correlation, SMC). Therefore, the R^2 value shown in Table 4 indicates that the implicit independent variable has adequate explaining ability on the implicit dependent variable, respectively.

Table 4: Path Coefficient of Determination

Coefficients of Determination	R^2
Flipped Teaching → Learning Satisfaction	.721
MOOCs → Learning Satisfaction	.732
Flipped Teaching → Learning Effectiveness	.702
Learning Satisfaction → Learning Effectiveness	.781
MOOCs →Learning Effectiveness	.711

Indices of Fit of the Overall Model

The purpose of adopting SEM in the modeling phase of this study is to explore how unobservable variables are interconnected within the structural model, to determine if the measurement model has measurement reliability, and also to measure this study's overall goodness-of-fit effect using such indices as χ^2, d.f., GFI, AGFI, NFI, CFI, RMR and RMSEA. In most cases, it is required that χ^2/d.f. <5, 1>GFI>0.9, 1>NFI>0.9, 1>CFI>0.9, RMR<0.05 and RMSEA<0.05 (Bagozzi & Yi, 1988). The goodness-

of-fit of the overall model proved satisfactory because χ^2/d.f. <5 and GFI, AGFI and NFI all exceed 0.90, with the RMR smaller than 0.05 (see Table 5).

Table 5: The Fitting Evaluation Table of the Overall Group Model

Determination index	χ^2	DF	GFI	NFI	AGFI	CFI	RMR	RMSEA
Fit value	35.970	10	0.902	0.933	0.902	0.931	0.023	0.021

Standardized results of SEM analysis

The computerized standardized results of the overall framework are shown in Figure 2.

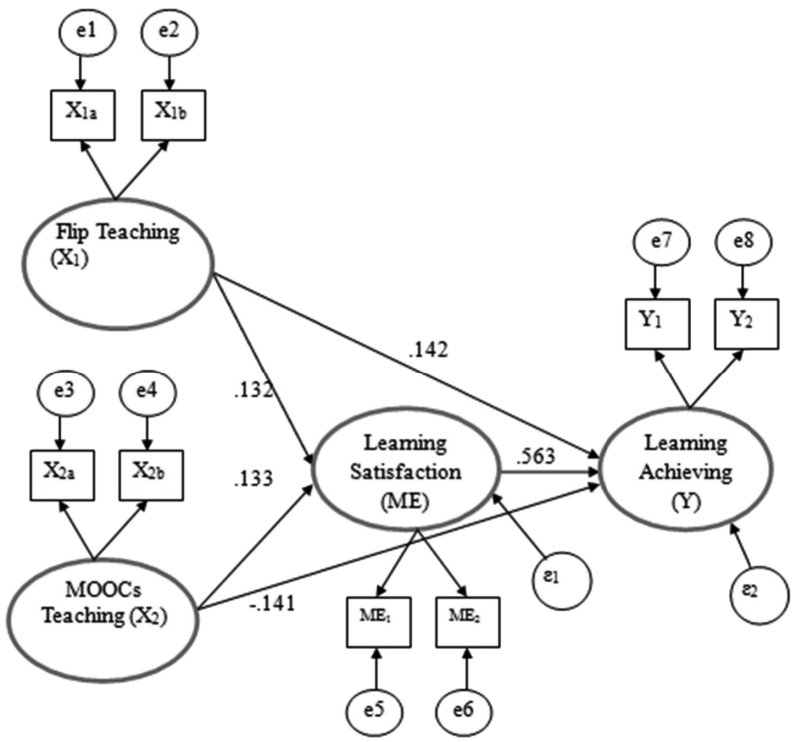

Figure 2: Standardized results of SEM analysis

Path Effect Analysis & Tests of Inner Model

The Bayesian Estimation is adopted for an analytical test, with specific focus on the path coefficients between implicit (unobservable) variables of the inner model, to analyze and verify the group inner model's path effect, using students' learning satisfaction (ME) as the dual intervening variable. Table 6 shows:

(1) The path coefficient of flipped teaching (X_1) to learning satisfaction (ME) is H1 = .132, and the 95% confidence interval is (.114, .256), which shows a positive effect but is not significant.

(2) The path coefficient of MOOCs (X_2) to learning satisfaction (ME) is H2 = .133, and the 95% confidence interval is (.121, .245), which shows that it has an impact, but it is not significant.

(3) The path coefficient of flipped teaching (X_1) to learning effectiveness (Y) is H3 = .142, and the 95% confidence interval is (.091,1.560), which shows a positive effect but is not significant.

(4) The path coefficient of learning satisfaction (ME) to learning effectiveness (Y) is H4 = .563, and the 95% confidence interval is (.437, .674), which shows a positive and significant impact.

(5) The path coefficient of MOOCs (X_1) to learning effectiveness (Y) is H5 = -.141, and the 95% confidence interval is (-.164, -.116), which shows a negative impact but is not significant.

Table 6: Bayesian Estimation

Regression weights	Mean	S.D.	95% Lower bound	95% Upper bound	Name
Flipped Teaching (X_1) → Learning Satisfaction (ME)	.132	.098	.114	.254	H_1
MOOCs (X_2) → Learning Satisfaction (ME)	.133	.092	.121	.245	H_2
Flipped Teaching (X_1) → Learning Effectiveness (Y)	.142	.091	.051	.233	H_3
Learning Satisfaction (ME) → Learning Effectiveness (Y)	.563	.021	.437	.674	H_4
MOOCs (X_2) → Learning Effectiveness (Y)	-.141	.082	-.164	-.116	H_5

According to the analysis above, the following verification results are obtained in this study:

(1) Flipped teaching in Taiwan's technical & vocational colleges has a positive effect on students' learning satisfaction, thus H_1 is partially supported (Hypothesis 1 H1 is partially substantiated);

(2) MOOCs has an impact on students' learning satisfaction in Taiwan's technical & vocational colleges, but it is not significant, thus Hypothesis 2 (H2) is partially substantiated;

(3) Flipped teaching has a positive effect on students' learning effectiveness in Taiwan's technical & vocational colleges, but it is not significant, thus Hypothesis 3 (H3) is partially substantiated;

(4) The learning satisfaction of students in Taiwan's technical & vocational colleges has a significant positive effect on their learning effectiveness, thus Hypothesis 4 (H4) is substantiated; and

(5) MOOCs learning for students in technical & vocational colleges in Taiwan has a negative effect on their learning effectiveness, but it is not significant; thus Hypothesis 5 (H5) is not substantiated.

As learned from the above, learning satisfaction has only a "partial" dual intervening effect

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The following conclusions are obtained from summarizing the above mentioned results and analysis:

1. In terms of validating Structural Equation Modeling (SEM), the structures of the Measurement Model, Structure Model, and overall group model of the SEM in this study have goodness-of-fit, showing good fitting effects. However, learning satisfaction only exhibits a "partial" dual intervening effect, not the complete dual mediating effect. This phenomenon may be a result of the selected sampling method and the characteristics of the samples themselves.
2. From the practical verification perspective:
   (1) Teachers and students in technical & vocational colleges in Taiwan believe that flipped teaching has a positive effect on learning satisfaction, but it is not significant. This phenomenon may be related to the learning quality of students. Students with good learning qualities are more at ease with the flipped teaching method; vice versa.
   (2) Students in technical & vocational colleges in Taiwan believe that MOOCs has an impact on learning satisfaction, but that it is not significant. This phenomenon may also be related to the learning quality of students. Students with good learning quality are more at ease with MOOCs learning methods; vice versa.
   (3) Teachers and students in technical & vocational colleges in Taiwan believe that flipped teaching has a positive effect on learning effectiveness, but that it is not significant. This shows that flipped

teaching is different from traditional teaching and that it is an innovative learning method. However, the ability to fully demonstrate the effect of flipped teaching may lie in students' motivation for independent learning and their basic Prior Knowledge for taking the course.

(4) Teachers and students in technical & vocational colleges in Taiwan believe that learning satisfaction has a significant positive effect on learning effectiveness, which indicates that only with positive satisfactory learning, can satisfactory learning effectiveness be achieved.

(5) Teachers and students in technical & vocational colleges in Taiwan believe that MOOCs has a negative impact on learning effectiveness, but that it is not significant. The reason may be that MOOCs learning is very different from traditional learning methods. Although it is an innovative learning method, students taking the course, with a poor preparatory foundation, or without motivation for independent learning, are a heavy burden on teacher's response and training time.

Recommendations

Flipped classroom and MOOCs are currently some of the most talk-about teaching strategies. They are highly valued, and many schools are attempting to gradually implement them in to their curriculum. When implementing the two innovative teaching methods mentioned above separately, the prerequisites for flipped teaching (the former) to be effective are that students taking the courses must have the motivation to learn independently and have the basic Prior Knowledge; While for MOOCs (the latter) to be effective, instructors must spend more time and effort on responding to students' questions, in addition to cultivating students' motivation to learn independently.

From the above research results, we recognize that school teaching must adapt to the needs of social development. Particularly in response to the COVID19 epidemic, many schools are adopting "distance learning", investing in modern cloud technology, and designing sets of "user-friendly interface" sites for online learning to help solve current learning issues. Therefore, how to promote teachers' creativity, improve students' learning satisfaction, and then enhance students' learning effectiveness, are important research topics worthy of further discussion.

REFERENCES

Bagozzi, R. P. & Yi, Y. (1988). On the evaluation of structural equation models. *Academy of Marketing Science Journal.* 16(1), 74-94.

Bergmann, J. & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day.* Washington, DC: International Society for Technology in Education.

Cai, P. J. (2016). *The Effects of Applying Flipped Learning to a Chinese Language Course on Listening and Reading Learning Effectiveness on Foreign College Students.* Taiwan: Master's degree thesis, Technical and Vocational Education, National Taipei University of Technology.

Chang, C. N. (2015). *Study of Flipped Classroom in Mathematics Teaching.* Taiwan: Master's degree thesis, National Taiwan Normal University.

Chang, L. H. (2018). *A Study on Learning Attitude, Learning Performance, and Learning Satisfaction for the Students of the Cooperative Technique Education Program in Junior High Schools.* Taiwan: Master's degree thesis, Department of Tourism Management, National Kaohsiung University of Applied Sciences.

Chang, N. C. & Chou, T. (2015). Evaluating Learning Effectiveness of an Information Law Course in a Blended Learning Environment Based on the Kirkpatrick Model. *Taiwan: Journal of Educational Media & Library Sciences,* 52(4), 417-450.

Chen, H. F. (2015). *The Learning Effectiveness and Learning Retention Involved in Elementary Mathematics Studies by Using E-*

Textbook. Taiwan: Master's degree thesis, Department of Business Management, Kao Yuan University.

Chen, S. L. (2002). *The Study of the Relationship between Goal Orientation, Learning Satisfaction and Learning Performance-Using Kaohsiung Learning Center of National Open University as an Example*. Taiwan: Master's degree thesis, Institute of Human Resource Management, National Sun Yat-sen University.

Chen, S. Y. (2010). *Structural Equation Modeling.* Taiwan: Psychology Publishing.

Chen, Y. X. (2016). *An Analysis Framework for MOOCs Learning-A Case Study of OpenEdu.* Taiwan: Master's degree thesis, Department of Information Engineering & Computer Science, Feng Chia University.

Cheng, T. Y. (2008). *A Study of the Relationships among Learning Motivation and Learning Satisfaction in Social Studies of Elementary school Students.* Taiwan: Master's degree thesis, Department of Social Development, National Pingtung University of Education.

Chiu, T. S. & Lin, Z. H. (2009). A Study of Relationships between Learning Motivation, Learning Satisfaction and Learning Performance of Taiwan Hospitality & Tourism College Students. *Taiwan: Taiwan Hospitality & Tourism Journal,* 6, 75-93.

Corts, Daniel P., John W. Lounsbury, Richard A. Saudargas, and Holly E. Tatum (2000). Assessing Undergraduate Satisfaction with an Academic Department: A Method and Case Study. *College Student Journal,* 34(3), 399-408.

Diamantopoulos, Adamantios and Judy A. Siguaw (2000). *Introducing LISREL: A Guide for them.* Uninitiated. London: Sage Publications.

Feng, L. Y., Zhen, Z. W. & Xie, B. (2015). A Study on Mixed Learning Design of "Instructional Design" Courses for Primary Education Majors. China: Education Research, 3, 2015. http://www.cnki.com.cn/Article/CJFDTotal-DHJY201503016.htm

Fornell. C. & Larcker, D. F. (1981). Evaluating structural equation models with un-observables and measurement error. *Journal of Marketing Research*, 18, 39-50.

Gangne, R. M. (1985). The Conditions of Learning. New York: CBS College Publishing.

Hoffman, E. S. (2014). Beyond the flipped classroom: Redesigning a research methods course for e3 instruction. *Contemporary Issues in Education Research,* 7(1), 51-62.

Hong, M. Z. (1999). *The Effect of Curriculum Design of Web-based Education on Learning Effectiveness.* Taiwan: Thesis for The Systematic Curriculum Design for Distance Learning International Seminar.

Hsiao, N. F. (2016). *Mobile Assisted Learning for MOOCs: A Learning Assistant on edX.* Taiwan: Department of Information Engineering & Computer Science, Feng Chia University.

Huang, L. Y. (2007). *Related Research in Learning Motivation, Learning Satisfaction and Learning Performance of Continuing Education for In-service Personage: Taking In-service Master Program of NCKU as the Example.* Taiwan: Master's degree thesis, Department of Industrial and Information Management, National Cheng Kung University.

Huang, S. L. & Lin, K. H. (2015). The relationships between learning motivation, sport constraints, and learning satisfaction-taking volleyball as an example. *Taiwan: Journal of Physical Education, National Kaohsiung University of Science and Technology Physical Education,* 14, 95-113.

Hung, T. C. (2015). *Understanding the Factors Influencing Learning Outcomes in the Flipped Classroom Model.* Taiwan: Master's degree thesis, National Formosa University.

Hwang, J. J. (2014). The Flipped Classroom and Its Concepts, Problems, and Perspectives. *Taiwan: Taiwan Educational Review Monthly*, 3(12)，161-186.

Jones, Barbara Lynn (1996). Self-Efficacy and Personal Goals In Classroom Performance: The Effect of Task Experience. A Dissertation Submitted to the Kent State University Graduate School of Management in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Lai, Y. C. (2016). *A Study of Learning Effectiveness of the MOOC Innovative Instructional Mode: Using the Cross-strait Courses of the Tsing Hua Universities as an Example.* Taiwan: Master's degree thesis, Institute of Learning Sciences and Technologies, National Tsing Hua University.

Leou, C. H. (2015). *Effectiveness of smart evaluation on improving students' learning performance in MOOCs: Using Junyi*

Academy as an Example. Taiwan: Master's degree thesis, Department of Computer Science & Information Engineering, National Central University.

Lin, P. C. (2017). *The Effects of Incorporating Information Technology into Managerial Agenda Teaching and Adopting Flipped Teaching on Learning Effectiveness: Using Learning Satisfaction as the Dual Mediators*. Taiwan: Doctoral Dissertation, Department of Management Science, Tamkang University.

Liu, J. Y. (2016). *Effects of Flipped Classrooms Integrated with MOOCs and Gamed-Based Learning on Learning Motivation and Outcomes of Students from Different Backgrounds: The Case of Mathematics Courses in Junior High School*. Taiwan: Master's degree thesis, Department of Applied Mathematics, National Chiao Tung University.

Liu, Y. F. (2013). Flipping the Classroom-Implementing the educational improvement approach that centers on students and enhances employability. *Taiwan: Evaluation Bimonthly,* 41 (January 2013), 1-10.

Lynch, T.G., Woelfl, N.N. and Steele, D.J. (1998). Learning Style Influences Student Examination Performance. *The American Journal of Surgery*, 176, 62-66.

Mike Acedo (2013). Pros And Cons Of A Flipped Classroom. Retrieved from http://www.teachthought.com/trends/10-pros-cons-flipped-classroom/

National Cheng Kung University (2019). URL: http://eserver.lib.ncku.edu.tw/moocs/

Shen, J. T. (2010). *A Study of the Relationships Between Satisfaction and Performance of Web-based Learning Courses for K-12 Teachers' In-Service Education at the Digital School in Taipei Country.* Taiwan: Master's degree thesis, Graduate School of Curriculum and Instructional Communications Technology, National Taipei University of Education.

Tabaa, Y. & Medouri, A. (2013). LASyM: A Learning Analytics System for MOOCs. *Advanced Computer Science and Applications,* 113-119.

Teng, C. C. (2006). What do They Really Think? A Study of Hospitality Students' Learning Satisfaction in Taiwan. *Taiwan: Journal of Hospitality and Home Economics,* 3(2), 158-167.

Tsao, C. C., Chang, S. T. & Chen, W. C. (2007). The Investigation of Students' Learning Satisfaction and Learning Results of a Physical Education Course in Chung-Yuan Christian University. *Taiwan: TPEC Press,* 15, 322-333.

Tu, I. A. (2018). *The Study on Learning Satisfaction and Learning Efficiency of the Physical Education Classes in Primary Schools in New Taipei City.* Taiwan: Master's degree thesis, Physical Education Department, University of Taipei.

Wang, I. W. (2018). *A Study on the Relationship Between Flipped Instruction and Innovative Teaching Effectiveness in Junior High Schools in Taipei City.* Taiwan: Master's degree thesis, Institute of Educational Administration and Evaluation, University of Taipei.

Wang, Y. L. (2019). *A Study of the Impact of Incorporating Diabolo with Performing Arts Courses on Learning Satisfaction-A Case Study of the Fifth Graders of a Certain Elementary School in Taipei.* Taiwan: Master's degree thesis, Performing Arts Education, National Taiwan University of Arts.

Wu, H. L. (2013). *The Effect of Flipped Classroom on English Self-directed Learning and Learning Performance of Low Achievers.* Taiwan: Master's degree thesis, Graduate Institute of Digital Learning and Education, National Taiwan University of Science and Technology

Wu, I. T. (2012). *A Study on the Relationships between Learning Motivation, Learning Satisfaction and Learning Achievement-Using Students of Vocational High School in Central Taiwan As an Example.* Taiwan: Master's degree thesis, Nanhua University.

Wu, K. (2013). Academic libraries in the age of MOOCs. *Reference Services Review,* 41(3), 576-587.

Wu, T. H. (2019). *A Study on Learning Motivation and Satisfaction in Mathematics-A Case of K Vocational High School of Taipei City.* Taiwan: Master's degree thesis, Graduate School of Education, Ming Chuan University.

Wu, T. J. (2016). *The Study of the Relationships Between Learning Leadership, Learning Environment and Learning Outcomes in Junior High School.* Taiwan: Master's degree thesis, Department of Business Management, National Taipei University of Education.

Xu, L. Z. (2009). *A Study of Skill Competitor' Involvement, Learning Motivation and Learning Effectiveness - A Case Study of Textual Skill Processing for High School.* Taiwan: Master's degree thesis, Department of Leisure, Recreation, and Tourism Management, Chao Yang University of Technology.

Yang, C. X. (2015). *Taiwan and Hong Kong University Presidents: A Talk on Flip Education.* Taiwan: Merit Times, 04/09/2015, 9th Edition.

Yeh, S. T. (2016). A Study on the Relationships between Learning Motivation, Learning Attitudes, Learning Satisfaction and Learning Achievement--An Example of Students in Eyelashes Beautification Courses. Taiwan: Master's degree thesis, Department of Business Administration, Nanhua University.