

# The Impact of Distance Teaching and Physical Teaching on Learning Achievement During COVID-19 Pandemic: A Case Study

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**ABSTRACT:** *The worldwide outbreak of COVID-19, coupled with the rampant mutant virus, has changed the way people are used to living. With the significant impacts of the pandemic on the world's politics, economy, and even society, and when viewed from the perspective of education, the government has to change from the physical teaching paradigm to a distance learning scheme, in order to protect the rights and lives of students. The main purpose of this study is to investigate whether distance learning and physical teaching have significant effects on learning achievement, and to find out which of the two is more significant. In this study, a university of science and technology in Taiwan was selected as a case study, and after sampling the population with the purposive sampling method, an online questionnaire was then used to interview the samples. In addition, this study adopted the Structural Equation Modeling (SEM) method to validate the established model to see if the constructed model has a good fit and whether or not the hypothesis is valid. This study found that: (1) distance learning has a positive and significant effect on learning achievement; and (2) physical teaching has a positive and significant effect on learning achievement, of which the latter (2) is more significant. The findings of this study can be used as a reference for educational authorities and schools to help formulate educational policies.*

**KEY WORD:** COVID-19, Distance Teaching/Learning, Physical Teaching/Learning, Learning Achievement

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Date of Submission: 04-11-2021

Date of Acceptance: 18-11-2021

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## I. INTRODUCTION

As the pandemic continues to spread around the world, schools have announced closures in order to avoid further aggravating pandemic damages as caused by cluster spreading, thus forcing the established educational paradigm to change from the traditional physical classroom learning, or Blended Learning model, to the online learning method.

Taiwan declared "Severe Pneumonia with Novel Pathogens" (COVID-19) as a Class V statutory infectious disease on January 15, 2020, and confirmed the first imported case and the first local case in the same month. The Ministry of Education announced on February 10 that "schools at all levels are suspending the entry of Hong Kong and Macao residents to Taiwan in response to the novel corona virus pneumonia pandemic, and are initiating measures for safe schooling." In order to take into account the rights of students and the specificity of each case, the universities immediately started planning and implementing related work, and campus health protection was also actively and strictly enforced (Lee, 2021).

As information technology rapidly advances, traditional classroom teaching is being gradually integrated with the Internet, and distance learning is becoming a viable new learning trend, and it also provides students with more personalized learning. In a distance learning environment, students have to be able to study on their own, hence their self-disciplined learning skills should not be neglected. However, existing studies on self-disciplined learning found that learners are mostly on their own, and when they have psychological and theoretical confusion issues, they are unable to get help and support from the available learning process, and thus gradually lose their learning momentum and goal attainments, resulting in reduced learning achievement. Therefore, determining how the learners can receive peer support and assistance in the learning process, so as to focus on the learning materials with mutual support, thereby improving learning achievement, is a key issue in distance learning (Chuang, 2021).

Flipped teaching 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 teachers 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; while students are also getting away from the learning model to self-initiating learner model. Digital teaching materials, Massive Open Online Courses (MOOCs) and Small Private Online Course (SPOCS) are all self-learning materials for students; while classroom discussion has become the catalyst for effective learning outcomes (Yung, 2015)

The biggest difference between distance learning and traditional teaching is that the instructor and learners are not face-to-face, and the learning methods are not limited by time and space. Learners are not required to come to school to attend classes, which saves them the time and expenses required for traveling to and from school. Moreover, the diversity of available learning styles allows learners the flexibility and independence required to adjust the learning modes according to their needs, thus providing the best learning options for learners of continuing education and lifelong learners. Distance learning is a teaching process that uses communications media and computer technology to deliver systematically designed materials to learners. Since the Internet is not limited by time and space, learners can learn online at any time and any place, and can also interact and communicate with instructors and peers in real time during the learning process. With the advent of the information age and the rapid changes in technology, the world is changing, and education is changing with it. However, in a teaching environment where technology is adopted, how can we best use the features of technology to enhance the learning process and to make learning more efficient? "Distance learning" is an inevitable trend of the future. The widespread use of the Internet has made it possible for nearly everyone to find the information they need quickly and easily, which means that for many Internet users, the Internet has become their best helper for thinking and learning. It is also because of the popularity of the Internet that allows distance learning to be more effective, and thus makes the development of future learning modes possible (Chang, 2015).

In the past, distance learning mainly played a supplementary role in education, but with the growing importance of continuing education and the latest developments in computer and internet technologies, distance learning has become a major alternative method of education, in addition to more traditional forms of education. Therefore, under the severe impact of the pandemic and to help students to "continue learning with the suspension of schools", can the implementation of distance learning provide schools and students a relatively effective basis between teaching and learning, while enhancing students' desire for and achievement in learning?

Summarizing the above, the main purpose of this study is to investigate whether distance learning and physical teaching have significant effects on learning achievement, and to find out which of the two is more significant. In this study, a university of science and technology in Taiwan was selected as a case study, and after sampling the population with the purposive sampling method, an online questionnaire was then used to interview the samples. In addition, this study adopted the Structural Equation Modeling (SEM) method to validate the established model to see if the constructed model has a good fit and whether or not the hypothesis is valid.

## **II. LITERATURE REVIEW**

### **2.1. The Conceptual Definition of Distance Teaching/Learning**

The conceptual definition of "distance learning" in this study is that "it includes Online Learning and Massive Open Online Courses (MOOCs). The distance learning system can be divided into two modes: synchronous and asynchronous. The Synchronous method refers to where teachers and students are at different locations, but on the same time when the teaching is conducted; while the asynchronous method refers to that, where the course content is placed on the Internet and students can choose to study at any time." This conceptual definition is a summarization of the following literature.

According to Portway & Lane (1994), distance learning is defined as teaching and learning activities conducted between teachers and students at different locations by using communication devices for transmission.

Liu (2001) proposed that distance learning systems can be divided into synchronous and non-synchronous. Synchronous method refers to where teachers and students can be at different locations, but on the same time, when the teaching is conducted, while asynchronous method refers to that where the course content is placed on the Internet and students can choose to study at any time.

Huang, Su and Chen (2015) proposed that the process of teaching and learning various knowledge and skills in digital classrooms through the medium of computers and internet devices is the narrow definition of e-learning. Recently, the UK defines e-learning as the use of Information & Communication Technology (ICT) to assist learning activities, meaning that learners use ICT to achieve the goal of face-to-face learning, so that learners have the flexibility of time, place and learning style (Chou and Lu, 2014). Therefore, in a broad sense, all teaching and learning activities that are conducted in an electronic-based method, such as using network devices, or information communication technologies, are considered e-learning, which includes online learning (Lin, 2020).

National Cheng Kung University (Web) (2019) pointed out, on an open learning website, that MOOCs (Massive Open Online Courses) are large-scale free online open courses, that emerged recently and are launched by universities at home and abroad. The courses typically include small units of 5- to 10-minute segmented videos, and incorporated between these units are real-time online discussions and feedback, online peer collaboration learning and discussions, virtual online experiments and online practice and evaluation. Students can schedule their learning progress according to their own pace

The system of MOOCs consists of five elements: (1) Instructors: Simplify the learning process by producing appropriate instruction materials to initiate 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 formal degrees or credits provided by some courses, or only access specific content. (3) Topics: Topics brought in by learners, teachers, textbooks and situations are introduced through the entire system, and may be limited in scope but are broad enough to cover various fields. (4) Material: It exists on various websites in various forms, 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 groups (Tabaa & Medouri, 2013; Chen, 2016).

## **2.2. The Conceptual Definition of Physical Teaching/Learning**

The conceptual definition of "Physical Teaching" of this study is that "it includes three types of methods: traditional teaching, communicative language teaching, and flipped teaching: (1) Traditional teaching is didactic instruction, with the teachers lecturing and the students listening in the classroom. It is the teaching activity with a blackboard as the basic media.; (2) Communicative Language Teaching (CLT) is a communication process of learning that occurs between teachers and students, between students, and between students and teaching materials. It is the learning process centered on students with an emphasis on individuality. Instructors can systematically guide students through key concepts and get students involved in the learning process with interactive activities. Active discussions in the classroom help students to explain and present their solutions. This method fosters the self-construction of deeper understanding and reflection.; and (3) Flipped teaching is a model in which students learn online materials on their own, and then the teacher clarifies and guides discussions and practical work in the classroom, reversing the traditional format of teachers lecturing in the classroom and students working on assignments at home, hence it is also called flipped classroom." This conceptual definition is based on a summary of the following literature.

Lin and Nien (2000) argued that traditional education is general education, with no need to factor into individual differences of learners. Teaching comes first, followed by learning. Curricula are usually determined by teachers and students are less able to learn independently. Due to a lack of comprehensive and appropriate teaching materials and media, traditional teaching is often delivered with didactic instruction in the classroom. It is the most conventional, representative, and widely accepted teaching method. This method is done with teachers giving systematic and organized verbal instruction on a topic (Tsai, 2009).

Chen (2011) believed that communicative Language Teaching (CLT) or interactive teaching is the exchange process between teachers and students, between students and students, and between students and teaching materials. It is the learning process centered on students with an emphasis on individuality. Teachers can systematically guide students through key concepts and get students involved in the learning process with interactive activities. Active discussions in the classroom help students to explain and present their solutions. This method fosters the self-construction of deeper understanding and reflection.

Wang (2013) thought that traditional teaching is didactic instruction, with the teachers lecturing and the students listening in the classroom. It is the teaching activity with a blackboard as the basic media.

Liao (2017) pointed out that the flipped teaching model is a student-centered instructional design, with the intention of stimulating students' independent learning, which differs from the "teacher speaks, students listen" teaching model. There are a variety of teaching activities in the classroom, and through raising questions, students can develop critical thinking skills and higher-level abilities to internalize the information they learned. Teachers make good use of face-to-face classroom time with students, thus building a good interactive relationship with them. The designs of flipped teaching activities can be divided into three stages: (1) before, (2) during and (3) after the class. The key to a successful implementation of flipped teaching is that both the teachers and the students perform their defined, but different roles in the classroom activities.

According to Lai (2018), flipped teaching is a teaching model that draws on the concept of the learning community. Through teachers' joint preparations of curriculum and the grouping of students heterogeneously, with teachers asking questions to help students learn by way of discussions, this model helps students to reconstruct new knowledge and new abilities from their old experiences.

### **2.3. The Conceptual Definition of Learning Achievement**

The conceptual definition of "learning achievement" of this study is "the change of knowledge, skills and attitude after completing learning activities, and the resulting behavioral abilities exhibited by learners. The measurement of learning achievement in this study is based on the academic grades students received for the courses they took in that semester." This conceptual definition is based on a summary of the following literature.

According to Ou (2004), learning achievement refers to the knowledge and skills that students learn in school through a certain curriculum and materials, which is usually represented by school test scores or scores earned on academic tests.

Lee (2010) indicated that learning achievement is the results shown in assessment tests for research subjects after learning by experiment. In general, the higher the score, the better the learning achievement. The lower the score, the worse the learning achievement.

Wu (2016) pointed out that learning achievement is, after experiencing a learning process, the changes in students' learning attitudes and learning strategies concerning their learning objectives, and their satisfaction with learning outcomes.

Huang (2018) defined learning achievement as the learning outcome achieved during or after the participation of learning activities. As far as teaching venues are concerned, learning achievement is the learning outcome shown in the tests on students via a diversity of assessment methods. It consists of three elements, i.e. cognition, skills, and affections, as stated in teaching goals and manifested through students' involvements in learning activities.

### **2.4. Distance Learning and Learning Achievement**

The online learning method of distance learning can be very flexible in terms of time and space, but learners need to be very self-disciplined, and must understand the purpose, needs, motivation, and self-efficacy of learning in order to increase learning outcomes (Chiu, Lin, and Shih, 2007).

The research of Lin (2015) found that distance learning achievement is moderately high, and may vary due to the differences in age and training expertise. The acceptance of IT learning systems is positively correlated with the learning achievement of distance learning, and the highest correlation is between cognitive domain and perceived usefulness.

The research of Cheng & Chen (2015) pointed out that the implementation of MOOCs e-learning model for computer graphics design courses provides significant benefits on students' learning attitudes and learning achievements.

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

The research of Wang (2018) concludes that distance learning materials that are designed in accordance with learning styles could benefit the learning achievement of reflective learners. This result can provide teachers with a reference for distance learning and learning style applications.

Chen (2019) argued that task-technology fit exhibits positive and significant influence on learning achievement, but teachers' capability's influence is not statistically significant. This suggests that technology plays a bigger role than teachers in the interactive teaching environment.

The research results of Liu (2020) showed a significant relationship between self-directed learning, online learning behaviors, and learning outcomes.

In summarizing the aforementioned literature, following hypotheses are deduced in this study:

Hypothesis 1 (H<sub>1</sub>): Distance learning has a positive and significant impact on learning achievement.

H<sub>1.1</sub>: Online learning has a positive and significant impact on learning achievement.

H<sub>1.2</sub>: MOOCs teaching has a positive and significant impact on learning achievement.

### **2.5. Physical Teaching and Learning Achievement**

According to Wang (2013), traditional teaching is didactic instruction, with the teachers lecturing and the students listening in the classroom. It is the teaching activity with a blackboard as the basic media..

The research of Leou (2015) indicated that Intelligence evaluation helps students to have a positive learning attitude, and improve students' learning achievement and the extent of immersion.

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

Wang (2018) pointed out that flipped teaching must have the following course design elements and procedures: teacher designs and provides students with pre-class learning materials, students self-study before the class, group discussions in the classroom, and teacher-student exchanges and peer feedback. Such a method of stepped process is the essence of flipped teaching. Wang also proposed 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.

In summarizing the aforementioned literature, following hypotheses are deduced in this study:

Hypothesis 2 ( $H_2$ ): Physical Teaching has a positive and significant impact on learning achievement.

$H_{2-1}$ : Traditional teaching has a positive and significant impact on learning achievement.

$H_{2-2}$ : Communicative Language Teaching (CLT) has a positive and significant impact on learning achievement.

$H_{2-3}$ : Flipped teaching has a positive and significant impact on learning achievement.

### 2.6. Research Framework Diagram

The following research framework diagram is drawn on the above research motivation, purpose, literature review and hypothesis, as shown in Figure 1.

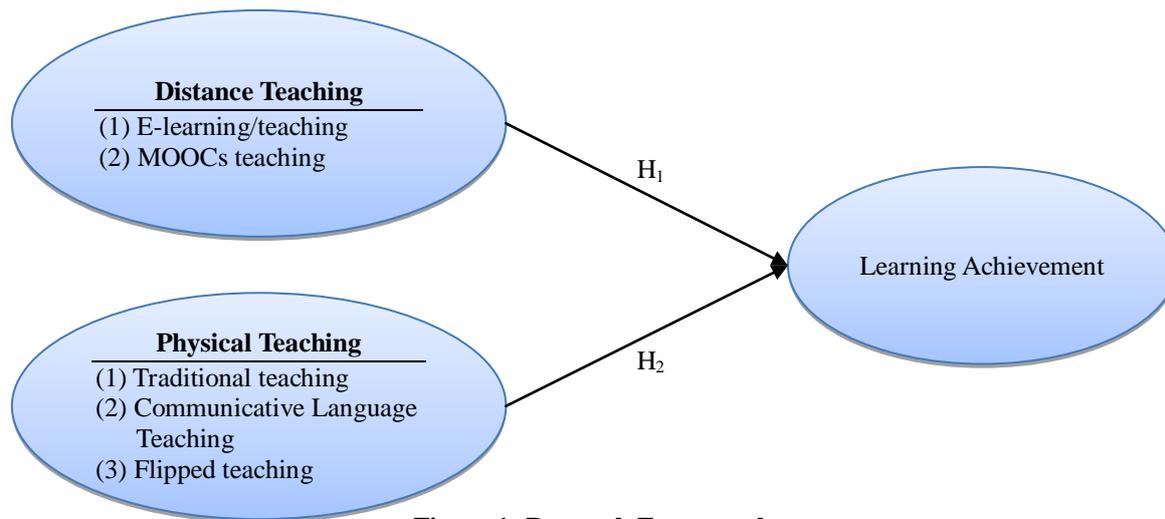


Figure 1: Research Framework

## III. RESEARCH METHODOLOGY

### 3.1 Sampling method

In this study, teachers and students from a university of science and technology in Taiwan were used as the research population, and after sampling the population using the Purposive Sampling method, an online questionnaire was used to survey the samples. Firstly, 30 expert questionnaires were distributed as a pilot-test, and then the questionnaires were revised according to the improvement suggestions made by the academic experts, and then the post-test was conducted. 1600 questionnaires (i.e., 250 for teachers and 1350 for students) were officially distributed, and the total valid sample was 301 (103 for teachers and 198 for students). The recovery rate was 18.81% in total.

### 3.2 Questionnaire Design

In this study, the questionnaire design was based on each observable aspect, although the questionnaire design adopted the "itemized measurement" approach. The questionnaire design was divided into (1) a "Distance Learning" section that included (A) Online Learning; (B) Massive Open Online Courses (MOOCs); (2) an Physical Teaching section that included (A) Traditional Teaching; (B) Communicative Language Teaching; and (C) Flipped teaching; and (3) a Learning Achievement section. The measurement of learning achievement in this study was based on the academic grades students received for the courses they took in that semester.

The questionnaire was measured on a 7-point Likert scale, with scores ranging from 7 to 1 depending on the degree of agreement and disagreement. 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.

(1) For the distance learning portion of the questionnaire:

(A) The questionnaire on online learning is based on the dimensions as proposed by Huang, Su and Chen (2015), with some improvements, resulting in a total of 3 questions.

(B) The questionnaire on Massive Open Online Courses (MOOCs) is based on the dimensions as proposed by Chen (2016), with some improvements, resulting in a total of 3 questions.

(2) For the physical teaching portion of the questionnaire:

(A) The questionnaire design on the traditional teaching is based on the dimensions as proposed by Lin & Nien (2000), with some improvements, resulting in a total of 3 questions.

(B) The questionnaire design on Communicative Language Teaching is based on the dimensions as proposed by Chen (2011), with some improvements, resulting in a total of 3 questions.

(C) The questionnaire design on flipped teaching is based on the dimensions as proposed by Liao (2017), with some improvements, resulting in a total of 3 questions.

(3) For the learning achievement dimension of the questionnaire design:

The design is based on the dimensions, as proposed by Lee, Lung-Chen (2010), with some improvements. The measurement of this dimension is based on the academic grades students received for the courses they took in that semester. (As shown in Table 1)

### 3.3 Questionnaire Data and Measurement System

In order to validate the research framework proposed by this research, a Structural Equation Modeling (SEM) is used to perform Confirmatory Factor Analysis (CFA) on the research model framework. This study's questionnaire is design on six latent variables (i.e., (1)Online Learning (2) MOOCs (3) traditional teaching (4) Communicative Language Teaching (5) flipped teaching, (6) learning achievement), each of which was divided into observable/explicit variables containing at least one or several questions to research. After processing the collected data, the study created a primary file. For the construction of this study's measurement system, although the Itemization Survey method is applied to the design of the questionnaire, Dual Measurement was adopted to ensure the computer software efficiently handled 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 Questions under each 'Implicit Variable' and 'Explicit Variable'**

Implicit Variables	Explicit variables	No. of questions	Questionnaire Reference
Online learning	E-Learning Content	3	Huang, Su and Chen (2015)
	Learning Attitude		
MOOCs	E-Learning Content	3	Chen (2016)
	Online peer collaboration and learning and discussions with teacher		
Traditional teaching	Learning atmosphere	3	Lin and Nien (2000)
	Learning Motivation		
	Interest In Learning		
Communicative language teaching, CLT	Level of student	3	Chen (2011)
	Interest In Learning		
	Material		
Flipped teaching	Degree of learning	3	Liao (2017)
	Learning Attitude		
Learning achievement	School Grades	2	Lee (2010)

## IV. RESULTS AND DISCUSSION

### 4.1 Linear structure model analysis

Confirmatory Factor Analysis (CFA) is an analysis technique in contrast with Exploratory Factor Analysis (EFA). This study conducts a survey via purposive sampling on the population, i.e. teachers (lecturers and above) and students of a university of science and technology in Taiwan. Structural Equation Modeling (SEM) is used to validate the goodness-of-fit for the whole model, i.e. structural model and measurement model.

This study includes a CFA, on the six unobservable/latent variables of online learning, MOOCs, traditional teaching, communicative language teaching, flipped teaching, learning achievement. 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; (3) the overall model's conformity with goodness-of-fit indicators. In other words, goodness-of-fit indicators were applied to a test of the overall goodness-of-fit effect of SEM (Diamantopoulos & Siguaw, 2000).

#### 4.2 Analyzing fit of Measurement Model

To a large extent, factor loading of each latent/implicit variable and manifest/ explicit variable is intended to measure the intensity of linear correlation between each explicit and implicit variable. 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 and Larcker, 1981). As Table 2&3 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
Online teaching (X <sub>1-1</sub> )	X <sub>1-1a</sub>	.723	.541
	X <sub>1-1b</sub>	.732	.543
MOOCs teaching (X <sub>1-2</sub> )	X <sub>1-2a</sub>	.731	.542
	X <sub>1-2b</sub>	.743	.551
Traditional teaching (X <sub>2-1</sub> )	X <sub>2-1a</sub>	.732	.543
	X <sub>2-1b</sub>	.742	.550
Communicative Language Teaching, CLT (X <sub>2-2</sub> )	X <sub>2-2a</sub>	.721	.524
	X <sub>2-2b</sub>	.734	.544
Flipped teaching (X <sub>2-3</sub> )	X <sub>2-3a</sub>	.732	.543
	X <sub>2-3b</sub>	.711	.513

#### 4.3 Analyzing fit of Structure Model

##### 4.3.1 Path analysis results of structure model

After the 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
Online teaching (X <sub>1-1</sub> )	→ Learning achievement(Y <sub>1</sub> )	.42	.16	2.63	**	H <sub>1-1</sub>
MOOCs teaching (X <sub>1-2</sub> )	→ Learning achievement(Y <sub>1</sub> )	.48	.14	3.43	**	H <sub>1-2</sub>
Traditional teaching (X <sub>2-1</sub> )	→ Learning achievement(Y <sub>1</sub> )	.61	.12	5.08	**	H <sub>2-1</sub>
CLT (X <sub>2-2</sub> )	→ Learning achievement(Y <sub>1</sub> )	.72	.12	6.00	**	H <sub>2-2</sub>
Flipped teaching(X <sub>2-3</sub> )	→ Learning achievement(Y <sub>1</sub> )	.65	.13	5.00	**	H <sub>2-3</sub>

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

##### 4.3.2 Coefficient of Determination

The explaining level of each implicit independent variable to each implicit dependent variable is the R<sup>2</sup> value (Squared Multiple Correlation, SMC). Therefore, the R<sup>2</sup> value shown in Table 6 and 7 indicate 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 <sup>2</sup>
Online teaching (X <sub>1-1</sub> )	→ Learning achievement(Y <sub>1</sub> )	0.71
MOOCs teaching (X <sub>1-2</sub> )	→ Learning achievement(Y <sub>1</sub> )	0.73
Traditional teaching (X <sub>2-1</sub> )	→ Learning achievement(Y <sub>1</sub> )	0.72
CLT (X <sub>2-2</sub> )	→ Learning achievement(Y <sub>1</sub> )	0.71
Flipped teaching(X <sub>2-3</sub> )	→ Learning achievement(Y <sub>1</sub> )	0.73

#### 4.4 The 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  $\chi^2$ , d.f., GFI, AGFI, NFI, CFI, RMR and RMSEA. In most cases, it is required that  $\chi^2/d.f. < 5$ ,  $1 > GFI > 0.9$ ,

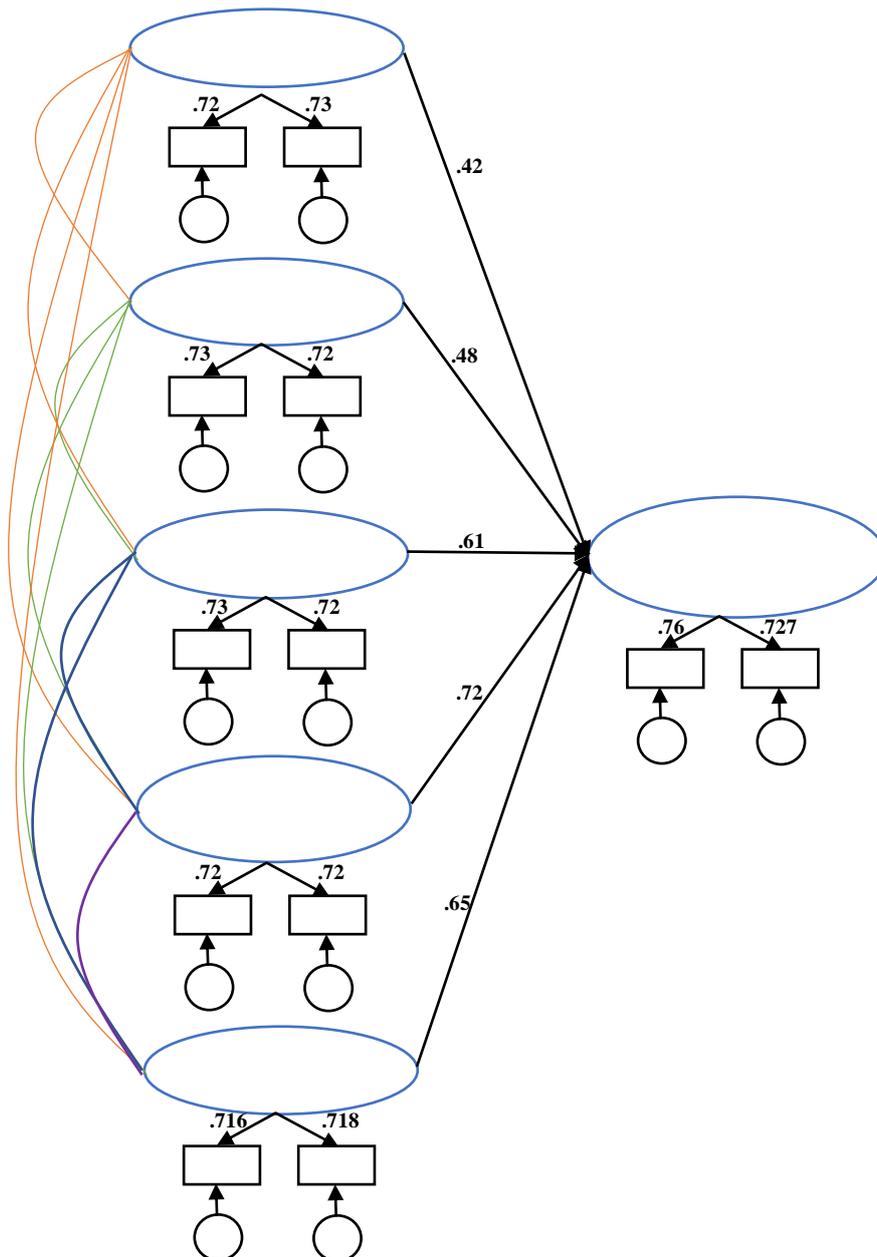
$1 > NFI > 0.9$ ,  $1 > CFI > 0.9$ ,  $RMR < 0.05$  and  $RMSEA < 0.05$  (Bagozzi & Yi, 1988). The goodness-of-fit of the overall group model proved satisfactory because  $\chi^2/d.f. < 5$  and GFI, AGFI and NFI all exceed 0.90, with the RMR smaller than 0.05 (see Table 5).

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

Determination index	$\chi^2$	DF	GFI	NFI	AGFI	CFI	RMR	RMSEA
Fit value	18.237	7	0.902	0.931	0.902	0.933	0.022	0.021

**4.5 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**

By studying the data in Figure 2, we derive the results of the hypothesis of this study, as shown in Table 6.

**Table 6: Research Hypotheses and Test Results**

Hypothesis	Items	Result
H <sub>1</sub>	Distance learning has a positive and significant impact on learning achievement	Full support
H <sub>1-1</sub>	Online learning has a positive and significant impact on learning achievement	Full support
H <sub>1-2</sub>	MOOCs teaching has a positive and significant impact on learning achievement	Full support
H <sub>2</sub>	Physical teaching has a positive and significant impact on learning achievement	Full support
H <sub>2-1</sub>	Traditional teaching has a positive and significant impact on learning achievement	Full support
H <sub>2-2</sub>	Communicative Language Teaching (CLT) has a positive and significant impact on learning achievement	Full support
H <sub>2-3</sub>	Flipped teaching has a positive and significant impact on learning achievement	Full support

## V. CONCLUSION AND SUGGESTION

### 5.1 Conclusions

The following conclusions are obtained from 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.

(2) In terms of practical validation, the following validation results are derived from the findings of this study, which are summarized below:

(A) Hypothesis 1 (H<sub>1</sub>): Distance learning has a positive and significant impact on learning achievement.

(a) H<sub>1-1</sub>: Online learning has a positive and significant impact on learning achievement (Path coefficient = 0.42).

(b) H<sub>1-2</sub>: MOOCs teaching has a positive and significant impact on learning achievement (Path coefficient = 0.48).

(B) Hypothesis 2 (H<sub>2</sub>): Physical Teaching has a positive and significant impact on learning achievement.

(a) H<sub>2-1</sub>: Traditional teaching has a positive and significant impact on learning achievement (Path coefficient = 0.61).

(b) H<sub>2-2</sub>: Communicative Language Teaching (CLT) has a positive and significant impact on learning achievement (Path coefficient = 0.72).

(c) H<sub>2-3</sub>: Flipped teaching has a positive and significant impact on learning achievement (Path coefficient = 0.65).

By studying aforementioned data, it shows that Communicative Language Teaching method has the greatest impact on learning achievement, followed by flipped teaching, traditional teaching, and MOOCs teaching, whereas online learning has the least impact on learning achievement. In conclusion, both distance learning and physical teaching have a positive and significant impact on learning achievement, but the latter (physical teaching) has a more significant impact (on learning achievement).

### 5.2 Recommendations

Under the COVID-19 pandemic, (1) When the pandemic slows down, implementing the physical teaching method is recommended. Particularly, the face-to-face communicative language teaching method, since it is conducive to improving interpersonal communications and learning outcomes, in addition to providing students with a sense of learning presence. (2) When the pandemic is severe, for the sake of pandemic prevention, while preventing students from neglecting their studies, distance learning, including online learning and MOOCs, should be adopted. (3) When the pandemic is over, it is appropriate to adopt physical teaching, in which the "Communicative Language Teaching" method (or "interactive teaching method") has the greatest impact on learning achievement.

## References

- [1]. Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Academy of Marketing Science. Journal.* 16(1), 74-94.
- [2]. Chang, Yi-Ling (2015), "Analysis and Comparison of Learning Results between On-line and Physical Classes", Taiwan: Taiwan: Master's degree thesis, E-Commerce In-Service Program, Feng Chia University.
- [3]. Chen Yang-Xuan (2016), "An Analysis Framework for MOOCs Learning-A Case Study in OpenEdu", Taiwan: Master's degree thesis, Department of Information Engineering & Computer Science, Feng Chia University. .
- [4]. Chen, Hui-Lun (2019). "A Study on Effects of Interactive Teaching System on Learning Outcomes and Satisfaction - The Case of Corporate Finance Course", Taiwan: Master's degree thesis, Department of Business Administration, National Taiwan University of Science and Technology
- [5]. Chen, Pei-Chi (2011). "The Effect of Interactive Teaching of IWB and Cognitive Style on Fifth Graders' English Learning Results", Taiwan: Master's degree thesis, Master Program of Professional Development for In-Service Teachers, National Chung Cheng University
- [6]. Chen, Shun-yu (2010). "Structural Equation Modeling", Taiwan: Psychological Publishing.
- [7]. Cheng, R. L. and Chen, T. Y. (2015). Exploring the Influence of Massive Open Online Courses in Computer-Aided Design and Drafting Courses. *Journal of the Hwa Gang Textile*, 22 (5).
- [8]. Chiu, Yuh-Wen; Lin, Yi-Min; and Shih, Dong-Her (2007), "The Effects of Technology Characteristics, Task Characteristics and Computer Self-efficacy on Behavioral Intention of Electronic Learning", Taiwan: *Journal of E-Business*, 9(2): 235-266.

- [9]. Chou, Chun-Yi and Lu, Luo (2014), "Exploring the Attitude Differentiation on E-Learning Systems Based on TAM: The Strength of Growth Need as a Moderator (e-edition)", Taiwan: Journal of Information Management, 21(1), 83-106.
- [10]. Chuang, Bo-Yue (2021). The Influence of Distance Education and Peer Self-Regulated Learning Mechanism on Learning Effectiveness, Learning Motivation, Self-Efficacy, Reflective Ability and Cognitive Load, Taiwan: Master's degree thesis, Department of Information Management, Soochow University.
- [11]. Diamantopoulos, Adamantios and Judy A. Sigauw (2000), "Introducing LISREL: A Guide for the uninitiated", London: Sage Publications.
- [12]. Fornell. C., & Larcker, D. F. (1981), "Evaluating structural equation models with un-observables and measurement error", Journal of Marketing Research, 18: 39-50.
- [13]. Huang Guo-Zhen, Su Jun-Ming, Chen Nian-Xing (2015), "Introduction and Practice of Digital Learning", Taiwan: DrMaster Press Co., Ltd.
- [14]. Huang, Chi-Liang (2018). "The Relationship among Growth Mindset, Learning Motivation and Learning Effectiveness: A Case Study of Sixth Grade Students in an Elementary School at Tainan", Taiwan: Master's degree thesis, Southern Taiwan University of Science and Technology
- [15]. Lai, Siou-Jhen (2018), "A Study of Flipped Teaching and Learning Facilitation-From the Perspective of a Primary School Counselor of National Education Counseling Group in Yilan County", Taiwan: Master's degree thesis, Department of Public Affairs, Fo Guang University.
- [16]. Lee, Chieh-Mei (2021), "A Study on Job Insecurity, Work Stress and Organization Commitment of Administrators in Universities and Colleges Under the COVID-19 Pandemic", Taiwan: Master's degree thesis, Educational Administration In-Service Program, Graduate Institute of Educational Administration, National Pingtung University.
- [17]. Lee, Lung-Chen (2010). "Investigating the learning achievement between multimedia-mediate instruction and traditional instruction-a study of time concept on third grade elementary", Taiwan: Master's degree thesis, Department of Information Management, National Formosa University
- [18]. Leou, Chia-hua (2015), "Effectiveness of smart evaluation on improving students' learning performance in MOOCs: A Case Study of Junyi Academy", Taiwan: Master's degree thesis, National Central University.
- [19]. Liao, Miao-Hsiu (2017), "An investigation of the effectiveness of flipped instruction in a high school hospitality program – An example of beverage knowledge course", Taiwan: Master's degree thesis, Graduate Institute of Hospitality, National Kaohsiung University of Hospitality and Tourism.
- [20]. Lin, Han-Ping (2015), "Research and Investigate the Benefit of Long Distance Learning by Using Information Technology Learning System", Taiwan: Master's degree thesis, Master In-Service Program of Applied Information Technology, Department of Computer Science and Information Engineering, China University of Technology.
- [21]. Lin, Pao-Ching (2017), "The Effects of Incorporating Information Technology into Managerial Area Teaching and Adopting Flipped Teaching on Learning Effectiveness: Using Learning Satisfaction as the Dual Mediators", Taiwan: Doctoral Dissertation, Department of Management Science, Tamkang University.
- [22]. Lin, Ping-Chen (2020), "Analyzing the Marketing of Online Learning Platforms by Using Social Media and Micro Moments Strategies", Taiwan: Master's degree thesis, Digital Marketing In-Service Program, Department of Marketing and Distribution Management, National Pingtung University
- [23]. Lin, Yeong & Nien, Chin-Cheng (2000). "Competency-Based Education vs. Traditional Education", Taiwan: Journal of Training and Development, 2, 20-24
- [24]. Liu, Hsien-Hsiang (2001), "The Reach of the Teaching Contents of Physical Education and Sports Website in Taiwan", Taiwan: Physical Education Journal, (30), 121-130.
- [25]. Liu, Jia-Yin (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.
- [26]. Liu, Kuan-Yi (2020), "Exploring the Relationship Between Students' Cognitive Load, Self-directed Learning, Online Learning Behaviors and Learning Outcomes in an E-book Learning System-The Case of Calculus Courses in a Management College", Taiwan: Master's degree thesis, Department of Mathematics, National Central University.
- [27]. NCKU (2019) · 網址 : <http://eserver.lib.ncku.edu.tw/moocs/>  
National Cheng Kung University (2019), URL: <http://eserver.lib.ncku.edu.tw/moocs/>
- [28]. Ou, Jen-Jung (2004), "A Study on the Influence of Family Environment and Family Structure on Academic Achievement of Vocational High School Students: A Case Study of Tainan City Senior Vocational School", Taiwan: Master's degree thesis, Department of Criminology, National Chung Cheng University.
- [29]. Portway, P. S., & Lane, C. (1994), Guide to teleconferencing and distance learning. Applied Business.
- [30]. Tabaa, Y. and Medour, A. (2013). LASYM: A Learning Analytics System for MOOCs. Advanced Computer Science and Applications, 113-119.
- [31]. Tsai, Jia-Jiun (2009). "U-learning compares with traditional teaching --- Using looking for the counted law unit in the fifth grade as an example ", Taiwan: Master's degree thesis, Department of Computer Science & Information Engineering, Asia University
- [32]. Wang, Hui-Sheng (2013). "Comparison of Interactive Teaching on Whiteboards, Collaborative Learning and Traditional Teaching in Terms of Learning Effective in Biology – Junior High School Curriculum on Reproductive Organs as an Example", Taiwan: Master's degree thesis, Graduate Institute of Information Management, Yu Da University of Science & Technology
- [33]. Wang, I-Wen (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, Educational Administration In-Service Program, Institute of Educational Administration and Evaluation, University of Taipei.
- [34]. Wei-Hang Wang (2018), "Study on Learning Material Arrangements of a Distance Learning Course to the Learning Effects of Students with Different Learning Styles-Example of Production Planning and Control", Taiwan: Master's degree thesis, Department of Industrial and System Engineering, Chung Yuan Christian University.
- [35]. Wu, Tang-Jung (2016), "The Study of the Relationships Among 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.
- [36]. Yung, Chaur-Shin (2015), "National Twelve-year Basic Education: Policy Dispute and Corresponding Strategies", Taiwan: Education Information and Research, 115, 1-26.