Deterministic Factors Influencing Learners' Learning Behaviors and Outcomes by Applying Information Technology-assisted Music Curriculum

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Abstract: Due to the tendency of complex relationship between learners' learning behaviors and learning outcomes, this research applies Fuzzy Delphi method and ISM with Fuzzy MICMAC to further understand deterministic factors influencing learners' learning behaviors and outcomes by applying information technology-assisted music curriculum. The results show that applying information technology-assisted music curriculum will affect learners' learning behaviors, such as online learning attitude, music learning motivation and learning engagement, as well as learning outcome factors such as learning satisfaction and learning effectiveness. In addition, self-directed learning is the crucial factor of learning behaviors and learning outcomes, and learning behaviors will affect learning outcome factors, such as learning effectiveness and learning satisfaction.

1 INTRODUCTION

The university music curriculum is a combination of music theory, music art and performance skills (learning by doing). It is difficult to use one single type of information technology to integrate all music teaching content and methods into the digital learning system, but to develop music teaching system with different information technology according to the needs of different teaching content and methods. Therefore, most of the research literature on applying information technology-assisted teaching systems studies applying information technology for music teaching based on case studies or a single teaching method. In the past, the literature has been less explored from a systematic integration perspective of music teaching (Tseng, 2009) and implemented music knowledge content into online teaching courses, such as music appreciation, music analysis, and music history (Ho, 2007). Therefore, this research takes the integrated music teaching system as the research target of applying information technology for music teaching.

Learner's learning behavior is a complex, multidimensional and uncertain concept, and many researchers have developed different measuring methods to evaluate learners' learning behavior. However, there is no consistent conclusion, because learners' learning behavior has many indicators, it is difficult to evaluate from a single point of view. So measuring learners' learning behavior needs to consider a variety of quantitative and qualitative criteria. In addition, learning outcomes are measured by subjective learning gains and objective learning outcomes (Tu, Huang, & Chang, 2010). In order to understand the relationship between learners' complex learning behaviors and learning outcomes in information technology-assisted teaching, this research takes the integration of information technology into music curriculum in universities in Tianjin and Beijing in China, and in universities in Taichung and Changhua in Taiwan, as the subject of research. By Fuzzy Delphi method, scholars and experts on learning behaviors and outcomes are surveyed to obtain the indicator for applying information technology for music teaching, learning

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behaviors and learning outcomes, and to establish the structure of the influence of applying information technology for music teaching on learners' learning behaviors and learning outcomes. By using ISM (Interpretive Structural Modelling) with Fuzzy MICMAC (Matriced' Impacts Croisés Multiplication Appliquée á un Classement), this research analyzes the relationship between dimensions/criteria influencing learners' learning behaviors and learning outcomes, and identifies deterministic factors to provide teaching strategies and curriculum design and planning references for educational institutions and schools to apply information technology for music teaching or to make improvement. At the same time, this research constructs a causality model between learners' learning behaviors and learning outcomes, which can be further explored in academic circles the complex relationship between learning behaviors and learning outcomes of online learners.

2 LITERATURE REVIEW

2.1 Applying Information Technology for Music Teaching

The connotation of IT integration into teaching is the innovation of educational idea and teaching method. Teachers use information technology to develop multidimensional and creative teaching activities to promote learners' active learning and cultivate the knowledge of learners' information technology application (Wang, 2010), to motivate learning behaviors such as learning attitudes (Wang & Liao, 2008), learning motivation (Ho, 2007) and learning engagement (Riordain, Johnston, & Walshe, 2016), and improve learning outcomes (Chen & Tsai, 2009).

Applying information technology for music teaching in this research means that teachers use information technology tools to assist the teaching of relevant music curriculum. Music curriculum can be divided into two categories: music knowledge, such as music theory, music appreciation, music research, and music skills, such as music composition recording, music performance, musical instrument teaching. Applying information technology for music teaching can be used in music theory, music creation, music composition recording, music performance, musical instrument teaching, music appreciation, and music research (Tseng, 2009), and the music teaching system and music curriculum used by the research objects in this research include the above seven online courses.

2.2 Learning Behaviors

In recent years, more and more attention has been paid to self-directed learning in the higher education environment (Shen, Chen, & Hu, 2014). The characteristic of self-directed learners is active learning, love of learning, fearless of difficulties, and using resources to achieve learning goals (Guglielmino, 1977). In addition, Knowles (1975) believes that self-directed learning is the process by which individuals actively diagnose learning needs without or with the help of others, to plan learning goals, to seek the human or material resources they need, and to implement appropriate learning strategies to evaluate learning outcomes. Therefore, in this research, self-directed learning is a kind of ability, which means the learner can trigger learning on his own, and can carry out independently and continuously. He has the ability of self-training, a strong desire and confidence to learn, can use basic learning skills, arrange appropriate learning steps, develop learning plans, and use time to carry out. And learners' self-directed learning affects their learning motivation (Saranraj & Shahila, 2016), learning attitudes (Zhang, Zeng, Chen, & Li, 2012), and learning effectiveness (Tucker, 2018).

Learning attitudes are gradually formed in the learner's learning activity process through interaction with the surrounding environment, so the factors affecting the learner's learning attitude are quite complex (Huang, 2003). Learning attitudes refer to the attitude of learners towards the interaction of their learning environment, and, depending on their ability and experience, learners' persistent positive or negative behavioral tendency or inner state for learning various matters (Liu, Ting, & Cheng, 2010). Online education is an important delivery method of teaching in a variety of educational settings (Ku & Lohr, 2003). Computers and the Internet designed for education have fundamentally changed the university education (Liaw & Huang, 2011). Learners' learning attitudes affect not only online teaching (Chang, 2000), but also learners' learning attitudes, learning satisfaction (Wang and Liao, 2008) and learning effectiveness (Masgoret & Gardner, 2003). Some other scholars believe that learning attitudes can affect learning motivation in learning behaviors (Maclntyre, Potter, & Burns, 2012) or self-directed learning (Khodabandehlou, Jahandar, Seyedi, & Abadi, 2012).

Learning motivation is the fundamental driving force of learning behavior, which enables learners to gain motive power to learn (Wu, 2016). Learning motivation refers to the internal psychological process that causes students to learn, maintain learning activities, and guide them toward the goals set by teachers (Chen, 2007). And learners' learning motivation not only affects learning behavior of learning engagement (Wei & Huang, 2001), but also affects their learning outcomes including learning effectiveness (Takaloo & Ahmadj, 2017) and learning satisfaction (Wang & Liao, 2008). Other scholars believe that in learning behavior, learning motivation can affect learning attitudes (Liu, 2009) or self-directed learning (Hung, Chen, & Tsai, 2016).

Learning engagement is the behavioral, cognitive and emotional engagement components which learners reflect in the learning process because of experience and feeling (Fredricks, Blumenfeld, & Paris, 2004). Learning engagement is an important indicator of the learning situation of college students, and many studies agree that the degree of learning engagement affects their ability to acquire knowledge and the result of cognitive development (Pascarella & Terenzini, 2005). Glanville and Wildhagen (2007) believe that learning engagement refers to the behavior and psychological involvement of learners in the school curriculum, and that the breadth of the engagement can make it a powerful concept for understanding the educational outcomes of students.

2.3 Learning Outcomes

Since learning outcomes are not limited to academic achievement in learning effectiveness (Tu, Huang, & Chang, 2010), but also include skills (Hsieh, Lee, & Sung, 2017), application and creation (Chen & Liu, 2015), and learning satisfaction (Tu, Huang, & Chang, 2010). Therefore, learning outcomes are measured by subjective learning gains (e.g. learning satisfaction) and objective learning outcomes (e.g. learning effectiveness) (Tu, Huang, & Chang, 2010).

Learning satisfaction is a feeling or attitude towards learning activities. A feeling of being happy or having a positive attitude is satisfaction, a feeling of being not happy, or having a negative attitude is dissatisfaction (Long, 1985). This feeling or attitude is formed because learners have a fondness for learning activities and a desire to learn, or, in the learning process, achieve their desires, needs, or learning goals, and generate a positive attitude or a sense of satisfaction (Chi, Lee, Liu, & Hsu, 2007). And learners' learning satisfaction affects their learning effectiveness (Lee & Huang, 2007). Therefore, learning satisfaction in this research refers to the learning behavior generated by the learner's learning desire and needs, and the subjective feeling of whether the learner is happy with the learning activity, and whether the learning effectiveness can make the learner feel that his needs are being met.

Learning Effectiveness is a student's achievement in knowledge or skills after learning (Hsieh, Lee, & Sung, 2017); Tu, Huang and Chang (2010) believe that learning effectiveness refers to the level to which a learner acquires certain knowledge, skills, or affection through learning or training in a particular field at a specific time. This research is about the effectiveness of music learning. Effectiveness of music learning refers to the level of knowledge, skills and affection reached. Hsieh, Lee, and Sung (2017) point out in the research that learning effectiveness includes musical skills and cultivation of affection. Chen and Liu (2015) indicate in the research that learning effectiveness includes memory and comprehension ability, application and analysis ability, evaluation ability and creativity.

3 METHODOLOGY AND MODEL DEVELOPMENT

3.1 Research Framework

The design and framework of this research will be divided into two stages for data collection and analysis, in order to construct the evaluation dimensions and criteria. First of all, the first stage is based on the review of the relevant literature, we compile the views of scholars, summarize the influence of applying information technology for music teaching on the learning behavior of learners, a total of 7 dimensions and 41 criteria. Then we use Fuzzy Delphi Method to make group decisions on scholars and experts on applying information technology for music teaching, to reach a consensus of the vagueness of the influence of applying information technology for music teaching on learners' learning behavior. Therefore, taking advantage of the knowledge and experience of experts and scholars through their feedback, the dimensions and criteria converge into a consistent and reliable structure to screen out the relatively important criteria and prepare a questionnaire. The second stage is the questionnaire survey, which is developed using ISM. Main respondents of the survey are experts and teachers of online music curriculum in universities in Tianjin and Beijing in China, and in universities in Taichung and Changhua in Taiwan. We construct the reachability matrix between dimensions and criteria using ISM with MICMAC, create the cause and effect diagram and draw the driving power and dependence graph, then find out the deterministic factors influencing learners' learning behaviors by applying information technology for music teaching, and construct the causal relationship between the deterministic factors of technological innovation ability, as the research structure of this research as a whole.

3.2 The Operation and Steps of Fuzzy Delphi Method

This research uses fuzzy Delphi method to screen out relatively important items in the dimensions and criteria of learners' learning behaviors and outcomes. The steps of fuzzy Delphi method (Liang, Lee, & Huang, 2010) are as follows.

Step 1: Collecting the opinions of the decision-making group; Step 2: Establishing triangular fuzzy number; Step 3: Defuzzification; Step 4: Screening evaluation criteria.

In the part of screening evaluation criteria, it is necessary to establish the threshold value and statistical judgment standard for the consensus of expert opinions (Yeh, Pai, & Peng, 2017), and select appropriate criteria from numerous criteria by threshold value. Generally, the standard adopted is 60% to 80% of the maximum value (Liang, Lee, & Huang, 2010). In this research we use 65% as the threshold value.

3.3 Questionnaire Design and Object

After compiling the data collected through literature review, 7 dimensions are sorted out: Applying information technology in music teaching (D_1), Self-directed learning (D_2), Online learning attitudes (D_3), Music learning motivation (D_4), Learning engagement (D_5), Learning Satisfaction (D_6) and Learning Effectiveness (D_7) then the 7 dimensions and 41 criteria are screened by fuzzy Delphi method. The questionnaire was distributed to 20 scholars and experts in applying information technology in music teaching, and they judged whether to retain the dimension based on their knowledge and experience. The threshold value used in this research is 65%, which means that a dimension should be retained if more than 65% (13 scholars) agreed to retain it. As for the 7 dimensions and 41 criteria compiled in this research, more than 65% of experts and scholars agreed on each of them, so all dimensions were retained. Finally, the 41 criteria are as follows: Music theory (M_1), Music composition creation (M_2), Music composition recording (M_3), Music performance (M_4), Musical instrument teaching (M_5), Music appreciation (M_6), Music research (M_7), Self-learning (S_1), Continuous learning (S_2), Efficiency learning (S_3), Independent learning (S_4), Self-understanding (S_5), Planning learning)(S_6), Favorite learning (S_7), Computer and network confidence (O_1), Network use (O_2), Online learning (O_3), Computer / smart phone use (O_4), Computer / smart phone preferences (O_5), Cognitive interest (L_1), Self-growth (L_2), Interpersonal facilitation (L_3), Professional advancement) (L_4), Social conformity (L_5), Transforming monotonous life (L_6), Skills engagement (E_1), Emotional engagement (E_2), Performance engagement (E_3), Attitudes engagement (E_4), Interaction engagement (E_5), Instructor's teaching ability) (A_1), Learning content and teaching materials (A_2), Interpersonal interaction (A_3), Teaching website learning environment (A_4), Administrative services (A_5), Academic achievement (F_1), Music skills (F_2), Cultivation of affection (F_3), Ability to remember and to understand (F_4), Application and analysis ability (F_5), Evaluation and creativity (F_6).

3.4 The Operation and Steps of ISM with Fuzzy MICMAC

3.4.1 ISM Analysis

This research uses the interpretive structure model (ISM) to explore the relationship between dimensions/criteria of learners' learning behaviors and learning outcomes influenced by information-assisted music teaching. The establishment of an ISM involves a number of steps, which are well documented in the literature (Farris & Sage, 1975): Step 1: Defining a set of variables affecting the system; Step 2: Developing Self-Structural Interaction Matrix and establishing a contextual relationship between these variables (obtained in the content analysis); Step 3: Developing a Reachability Matrix, and checking the matrix for transitivity; Step 4: Partitioning the Reachability Matrix into different levels; Step 5: Forming a canonical form of matrix; Step 6: Drawing a directed graph and removing the transitive links; Step 7: Converting the resultant digraph into an ISM by replacing variable nodes with statements.

The use of ISM helps to explore the relationship between dimensions/criteria of learners' learning behaviors and learning outcomes influenced by information-assisted music teaching. The Details of the development of the structural models for each of the clusters are provided in the results section.

3.4.2 MICMAC Analysis

Developed by Duperrin and Godet (1973), MICMAC is a systematic analysis tool for categorizing variables based on hidden and indirect relationships, as well as for assessing the extent to which they influence each other (Hu, Shao, Chiu, & Yen, 2009). Mandal and Deshmukh (1994) claim that the primary goal of MICMAC analysis is to analyze the driving power and dependence of each variable. "Driving power" refers to the degree of influence that one variable has exceeded another, and "dependence" is defined as the extent to which one variable is influenced by others (Arcade, Godet, Meunier, & Roubelat, 1999). Based on driving power and dependence, a 2D driver-dependence diagram can be created, with the horizontal axis representing the extent of dependence and the vertical axis representing the extent of the driver (Lee, Chao, & Lin, 2010).

The establishment of a Fuzzy MICMAC involves a number of steps, which are well documented in the literature (Katiyar, Barua, & Meena, 2017): Step 1: Developing fuzzy direct relationship matrix; Step 2: Fuzzy indirect relationship analysis; Step 3: Stabilizing fuzzy matrix; Step 4: Drawing driving-dependence power graph.

4 ISM WITH FUZZY MICMAC ANALYSIS

4.1 Analysis of Dimensions

4.1.1 Developing the Conical Matrix

After the first to fourth steps of the ISM, perform the conical matrix step. The conical matrix is computed by clubbing all dimensions based on their levels across the columns and rows of the final reachability matrix. Later, the conical matrix is used to develop the final digraph and structural model. For example, the dimension D_7 is found at the level 1, D_3 and D_6 at the level 2, D_5 at the level 3, D_4 at the level 4 and D_1 and D_2 at the level 5.

Further, the dependence power and driving power of a dimension are determined as explained in the previous section. Next, ranks are calculated by giving the highest rank to the dimensions that have the maximum number of 1s in the rows and columns indicating the driving and dependence power. After rearrangements, the conical matrix is obtained.

4.1.2 Development of Digraph and Building the ISM-based Model

Based on the conical form of reachability matrix, an initial digraph including transitivity links is generated by nodes and lines of the edges. Suppose there is a relationship between two dimensions, and then it is shown by an arrow from one dimension to another dimension.

This figure shows that D_1 and D_2 are the most crucial dimensions for online learning behavior and outcomes to learner as it comes at the bottom of the ISM hierarchy. D_6 and D_7 appeared at the top which indicate it will influence the entire process of online learning behavior and outcomes. The D_1 and D_2 lead to D_4. Similarly, D_4 lead to D_5 and D_3.

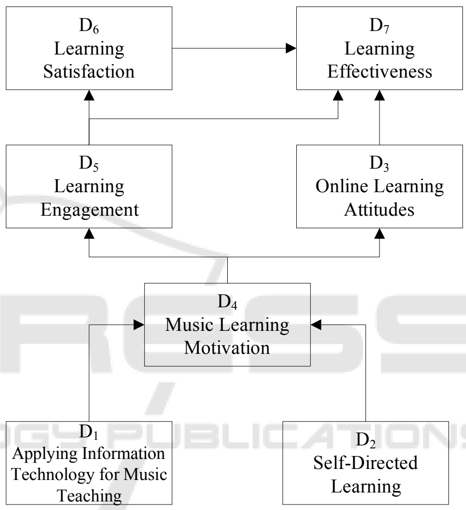

Figure 1: ISM-based Model.

4.1.3 Development of Fuzzy Direct Relationship Matrix (FDRM)

The MICMAC considers only binary types of relationships; therefore, at this stage, we have used the fuzzy set theory to increase the earlier sensitivity. With fuzzy MICMAC, an additional input of possible interactions among the barriers is established. Similar to Qureshi, Kumar and Kumar (2008), the possibility of interaction is be defined by a qualitative consideration on a 0 to 1 scale

The possibility of the numerical value of reachability is covered up on the DRM to obtain a fuzzy direct reachability matrix (FDRM). Further, the binary direct reachability matrix (BDRM) is achieved by examining the direct relationship between the dimensions in the digraph, disregarding the transitivity and making diagonal entries 0.

4.1.4 Fuzzy Indirect Relationship Analysis

FDRM is used to start the procedure of finding the fuzzy indirect relationship between the dimensions. The matrix is multiplied or repeatedly reproduced up to a power until the hierarchies of the driving and dependence power are stabilized. According to the fuzzy set theory, when two fuzzy matrices are multiplied, the product matrix will also be a fuzzy matrix. Multiplication follows the given following rule: the product of fuzzy set A and B is fuzzy set C.

$C=A*B= \max k[\min(a_{ik}, b_{kj})]$, where $A= (a_{ik})$ and $B=(b_{kj})$ are two fuzzy matrices.

4.1.5 Stabilization of Fuzzy Matrix

As discussed in the previous section, the FDRM process and matrix multiplication are used to stabilize the matrix as exhibited in Table 1. The dependence power, driving power and ranks are determined as discussed in the earlier section. The ranks of the driving power of the criterion decide the hierarchy of criterion in the system. The purpose of this classification of the dimensions is to analyze the driving and dependence power of the dimensions that influence learning behavior and outcomes to learner.

Table 1: Fuzzy MICMAC Stabilized Matrix.

Dimensions	D_1	D_2	D_3	D_4	D_5	D_6	D_7	Driving Power	Rank
D_1	0.5	0.5	0.7	0.7	0.9	0.7	0.9	4.9	1
D_2	0.5	0.5	0.7	0.5	0.7	0.7	0.7	4.3	2
D_3	0.3	0.3	0.5	0.3	0.5	0.5	0.5	2.9	6
D_4	0.5	0.5	0.5	0.5	0.3	0.9	0.9	4.1	3
D_5	0.3	0.5	0.5	0.5	0.5	0.5	0.9	3.7	4
D_6	0.3	0.3	0.5	0.5	0.5	0.5	0.5	3.1	5
D_7	0.1	0.5	0.5	0.3	0.1	0.1	0.5	2.1	7
Dependence Power	2.5	3.1	3.9	3.3	3.5	3.9	4.9		
Rank	7	6	2	5	4	2	1		

4.1.6 Key Indicators

Based on the information derived from the Fuzzy MICMAC stabilized matrix the indicators were classified into four sectors in the Driving-Dependence Graph (Figure 2). The indicators with the greatest driving power in the stabilized matrix are the key indicators. The key indicator that is nearest to the origin in the graph represents the highest driving power. Identification and classification of the key criterion is essential for management to decide the course of action to be taken for the system under study. Comparing the hierarchy of dimensions in the various classifications like direct, indirect and potential, one can decide how much importance should be given to each criterion for influencing learning behavior and outcomes to learner. This method confirms the importance of certain dimensions and also searches some hidden dimensions those cannot be identified through direct classification. These hidden dimensions also play an important role because of their indirect actions on the system under consideration. These Fuzzy MICMAC examination of direct relationships also reveals that criterion having strong impact can be suppressing hidden criterion.

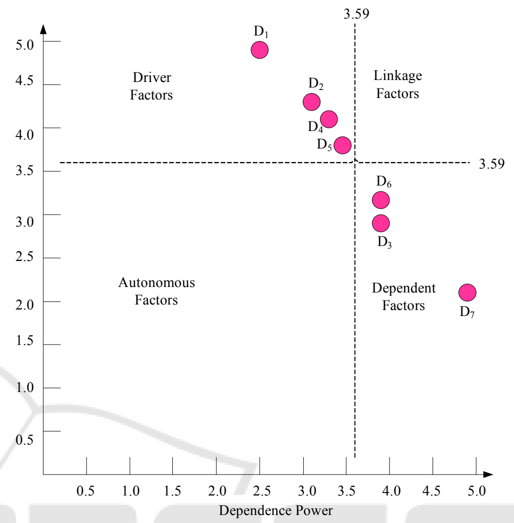

Figure 2: Driving-Dependence Power Graph for Factors.

4.2 Analysis of Criteria

The analysis of the 41 criteria is calculated according to steps 1-11 of the above dimension analysis. Fuzzy MICMAC Stabilized matrix and Driving - Dependence Graph are presented in Table 2 and Figure 3.

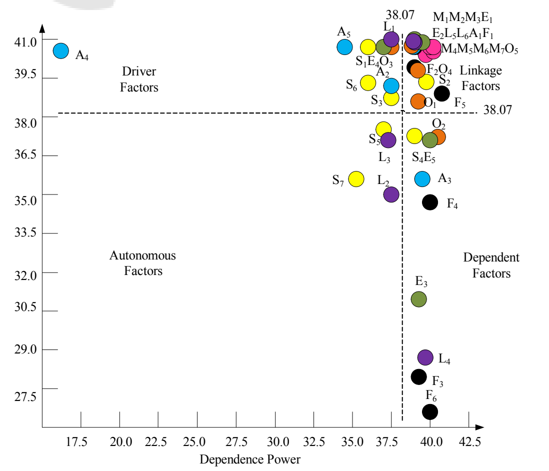

Figure 3: Driving-Dependence Power Graph for Criteria.

Table 2: Fuzzy MICMAC Stabilized Matrix.

Criteria	Drive Power	Dependence Power	Criteria	Drive Power	Dependence Power
M_1	40.3	39.3	L_3	36.9	37.8
M_2	40.3	39.8	L_4	28.7	39.3
M_3	40.0	39.7	L_5	39.8	39.1
M_4	40.3	39.9	L_6	40.5	39.0
M_5	40.2	39.9	E_1	41.0	38.7
M_6	40.2	39.9	E_2	40.6	39.0
M_7	40.3	39.9	E_3	31.0	39.0
S_1	40.3	36.1	E_4	40.2	37.2
S_2	39.3	39.6	E_5	37.5	39.1
S_3	38.8	37.6	A_1	40.3	39.1
S_4	37.2	38.1	A_2	39.1	37.7
S_5	37.5	37.1	A_3	35.2	39.2
S_6	39.2	36.6	A_4	40.3	16.2
S_7	35.9	35.7	A_5	40.3	34.6
O_1	38.1	38.6	F_1	40.3	39.1
O_2	37.1	40.0	F_2	39.9	38.1
O_3	40.2	38.0	F_3	28.1	39.1
O_4	39.7	38.2	F_4	34.5	40.1
O_5	40.2	38.8	F_5	38.8	40.4
L_1	41.0	38.0	F_6	26.7	40.1
L_2	34.9	38.0			

5 RESULTS AND DISCUSSION

This research explores the determinants and criteria that influence learners' learning behaviors and learning outcomes in information technology-assisted teaching, and provides a model of complex relationship between information technology-assisted teaching and learners' learning behaviors and learning outcomes for teaching curriculum designers, teachers and heads of educational institutions, to understand the learning behavior and learning outcome patterns that learners produce while learning online, and which factors and criteria are crucial in influencing learning behaviors and learning outcomes. First, based on the literature review and interviews with scholars and experts on online learning in Tianjin and Beijing in China, and in Taichung and Changhua in Taiwan, the Fuzzy Delphi method is used to select 7 influencing factors and 41 criteria. Secondly, an expert questionnaire interview was conducted with 20 scholars and experts to establish the relationship matrix and serve as a prerequisite for building the ISM-based model.

On the part of dimension, its ISM-based Model is shown in Figure 1. D_1 and D_2 will directly affect D4, and D_4 will directly affect D_3 and D_5. And D_5 directly affects D_6 and D_7, and finally D_3 directly affects D_7, so D_1 and D_2 indirectly affects D_5, and D_3, D_6 and D_7.

The fuzzy MICMAC method uses driving power and dependence power to classify the indicators of the Fuzzy MICMAC Stabilized matrix (as in Table 1) into four clusters (see Figure 2). Figure 2 shows that D_1, D_2, D_4, D_5 are driver factors with higher driving power, so these four dimensions are the crucial dimensions that influence learners' learning behaviors and learning outcomes, while the three dimensions of D_3, D_6, and D_7 are dependent factors with weak drivers. The three dimensions are influenced by other factors of learning behaviors and learning outcomes, namely, D_1, D_2 will influence D_3, D_4, D_5, D_6, D_7 these predispositions of learning behaviors and learning outcomes.

To further understand the complex relationship of learners' learning behaviors, an analysis between the criteria is carried out, and the results are shown in Figure 3. S_1, S_3, S_6, O_3, L_1, E_4, A_2, A_4, and A_5 are driver criteria with higher driving power. Therefore, these 9 criteria are crucial criteria that influence learners' learning behaviors and learning outcomes. While S_4, O_2, L_4, E_3, E_5, A_3, F_3, F_4, and F_6 are dependent criteria with weak drivers. These 9 criteria are influenced by the above 9 learning behaviors and learning outcomes criteria such as self-learning. The results of this research point out that the music teaching courses and teaching materials through the application of information technology should take into account the learning background, ability and demand of learners' on music and computer, and carefully choose which music courses are suitable for applying information technology in teaching. Learners' learning behaviors and learning outcomes have a variety of characteristics and complex relationships. Diversified learning activities can be adopted to cultivate the crucial factors/criteria influencing learners' learning behaviors and learning outcomes, so as to improve learners' learning behaviors and learning outcomes.

In addition, the model developed in this research represents how applying information technology into music teaching can influence learners' learning behaviors and learning outcomes, which can be applied not only to online music teaching courses, but also to online teaching courses in other fields

6 CONCLUSIONS

Applying information technology for music teaching provides learners with more personalized learning opportunities and broaden their music learning experience. Therefore, the learning background, experience and abilities of learners, including music and computer, should be taken into account before designing music curriculum and teaching materials in combination with information technology. And teaching topics should be carefully planned to suit learners' interests and needs, in line with the characteristics of the online learning environment. Diversified learning activities should be adopted, both independent learning and cooperative learning should be taken into account, and attention should be paid to increase the opportunities for learner to interact and feedback.

Because the learners' learning behaviors and learning outcomes have a variety of characteristics and tendency of complex relationship, except information technology-assisted music teaching, self-directed learning is one of the important factors influencing learners' learning behaviors and learning outcomes. Therefore, learners' self-directed learning should be enhanced. Self-directed learning is the ability of learners to trigger learning on their own and to be able to learn efficiently and systematically. And then self-directed learning can influence learning behaviors such as online learning attitudes, music learning motivation and learning engagement, as well as learning outcomes such as learning satisfaction and learning effectiveness. So to cultivate learners' self-directed learning is one of the important tasks of institutions of higher education to focus on online teaching courses.

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