Determinants Affecting Learner's Behaviour in Music Education Applying Information Technology

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Keywords: Applying Information Technology for Music Teaching, Self-Directed Learning, Music Learning Motivation, Online Learning Attitudes, Learning Engagement, Fuzzy Delphi Method, ISM with Fuzzy MICMAC.

Abstract: This article is to investigate the learner's behaviour in music teaching applying information technology using ISM with Fuzzy and MICMAC approach. Since learner's behaviour features multiple characteristics which are complicated and interact with each other, this article makes clear the relationships within characteristics of learning behaviour and provides education institutions with instruction on teaching strategies for music teaching applying information technology on activating learners' learning behaviour. This research shows that music teaching applying information technology affects behaviour relating to learners' online learning attitudes, music learning motivation, and learning engagement. Among them, the self-directed learning factor p most critical to the learning behaviour.

1 INTRODUCTION

It has been decades applying information technology for teaching over the world. However, the music teaching is a subject of learning-by-doing, one information technology for all music teaching is not enough, but a multiple and integrated system with different teaching contents and methods is needed.

A learner's behaviour is a concept of multiple dimensions. To understand the relationships beteween complicated behaviours on the music teaching applying information technology, this article aims at music teaching applying information technology for the universities in the China Tianjin and Beijing and Taichung Chunghua in Taiwan to construct a framework through questionaire of Fuzzy Delphi method to analyze the causal effects between the dimensions and criteria of learner's behavior by ISM with Fuzzy MICMAC.

2 LITERATURE REVIEW

2.1 Applying Information Technology to Music Teaching

It is an innovative concept and method integrating IT into teaching and education. Teachers are applying IT to developing multiple and innovative teaching activities and ability of IT application. (Chang and Wang, 2008; Wang, 2010).

This article is to describe the integration of IT with music teaching comprising music theory, music composition creation, music composition recording, music performance, musical instrument teaching, music appreciation, and music research (Lee, 2003; Tseng, 2009), and the corresponding online music teaching systems and courses.

2.2 Self-directed Learning

It is requested that learners' online courses have a tendency toward self-active learning and motivation. Guglielmino (1977) and Driscoll (1994) proposed that self-directed learning implies an independent and continual behaviour affecting the learning motivation, (Mount et al., 2005; Gendron, 2006; Chen and Liang, 2009).

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Knowles (1975) proposed that a self-directed learning is a process that learners can actively recognize learning requirements and evaluate learning results. Therefore, this study emphasizes self-directed learning is an ability that learners can actively learn, and make plans.

Based on self-directed learning scale, Guglielmino (1977), and self-directed learning (Oddi, 1986; Liang, 2008; Chen and Liang, 2009), self-directed was divided into five dimensions: Self-learning, continuous learning, efficiency learning, independent learning, self-understanding, planning learning, loving learning.

2.3 Online Learning Attitudes

Learning attitudes is constituted interacting with the environments, accordingly, resulting in the complexity of factors affecting learner's attitude in learning (Huang, 2003).

Online education is rapidly becoming an important method of instructional delivery for various educational contexts (Ku and Lohr, 2003). Computers and the Internet designed for educational purposes have fundamentally changed school education, especially in universities (Liaw and Huang, 2011). The attitudes of learners have been very positive and supportive toward online instruction (Chang, 2000). Online learning provides different learners with multiple teaching environments through smart phones when doing computer-aided learning, that might spawn various problems and attitudes. Rainer and Miller (1996) research points out that the main factors affecting using computer is learners' attitude. As a result, how to establish a positive attitude and computer operating skills is crucial to learners' learning effectiveness. Hignite (1990) proposed that the attitudes for computers means general senses when a person or people using computers.

In addition, this study also studies the music learning course contents for learners using computer and network facility when teaching engages in IT. For that, below are referenced as Computer Attitude Scale (Loyd and Gressard, 1984), the Online Tutoring Attitudes Scale (Graff, 2003), related research of online learning attitudes (Okwumabua et al., 2010), for constructing dimensions in online learning attitudes.

2.4 Music Learning Motivation

Learning motivation is an elementary driving force motivating a learner to learn (Wu, 2016). It is a mental experience to activate, maintain learning activities, and direct a learner toward the learning objective designated (Chen, 2007).

This study adopts scales of learning motivation, which is for undergraduate students who take music courses, that is categorized into six dimensions: Cognitive interest, self-growth, interpersonal facilitation, professional advancement, social conformity, transforming monotonous life (Boshier, 1971; Garder and Lambert, 1972; Lee and Huang, 2007; Chen and Lin, 2018).

2.5 Learning Engagement

Learning engagement of learners is an experience in a learning process, and presents main elements: behaviour, cognition and emotion (Fredricks et al., 2004). It is a critical index reflecting the learning status of undergraduate students, the degree of engagement of that will affect knowledge acquisition and cognitive development (Kuh et al., 2005; Pascarella and Terenzini, 2005). Glanville and Wildhagen (2007) indicates that learning engagement is what learners behave in schooling and psychological involvement, that can be a useful concept for obtaining education effectiveness.

Handelsman et al. (2005) emphasizes that, from the teaching viewpoints. The more the students engaged, the more willingness they persist to keep, and that further encourages teaching as well. Subsequently, paying attention to the learning status of students can provide teachers with related information improving teaching, designing, and planning activity alternatives (Lin and Huang, 2012).

Apart from motion engagement, it needs to take account the strategy, performance in classes, interaction between teachers and students for behaviour engagement in different aspects (Lin and Huang, 2012; Tsai, 2016). Consequently, this study categorized learning engagement to five dimensions: Skills engagement, emotional engagement, performance engagement, attitudes engagement, interaction engagement (Handelsman et al., 2005; Lin and Huang, 2012; Tsai, 2016).

3 ISM METHODOLOGY AND MODEL DEVELOPMENT

3.1 Research Framework

The research framework construct evaluation dimensions and criteria by two steps. First, based on

literature reviews, to synthesize with viewpoints of scholars summarizing the effects of music teaching engaged in IT to five dimensions and thirty criteria. And through Fuzzy Delphi method, we conduct the group decision making by experts and scholars who are good at IT-aided music teaching, solve and construct their consensus to the fuzzy problems affecting learners' learning behaviour in music teaching engaging IT. Important and high criteria items were selected for interviewing scholars and experts in IT-aided music teaching. Second, the 40 ISM questionnaires were issued, 20 of them from scholars in learning behaviour, and other 20 form university teachers in music teaching with IT.

3.2 Operation Steps of Fuzzy Delphi Method

This study uses Fuzzy Delphi method to screen out important items from the dimensions and criteria of learning behaviour as the steps of Fuzzy Delphi method (Liang et al., 2010):

Step1: Collect group decisive opinions: Using semantic variables in questionnaire, the measure index for the importance of various criteria can be obtained. This study uses Likert's 5 scale to evaluate learning behaviour and adopts the geometric meant to integrate expert opinions.

Step2: Construct fuzzy triangle: Calculate the fuzzy triangles of the importance of various criteria. Klir and Yuan (1995) proposed geometric mean from general models of arithmetic mean as Fuzzy Delphi method for calculating group decisive consensus.

Step3: Solve problems by defuzzification: A fuzzy number is a quantity whose value is imprecise. Therefore, we must perform defuzzification to find the best non-fuzzy performance value, BNP.

Step4: Screen the evaluation criteria: For the screen of evaluation criteria, a threshold value and statistic judgement standards of expert opinions must be established (Yeh et al., 2017). By the threshold value, the optimum criteria can be screen out from multiple ones, which generally account for 60% to 80% of the maximum value, that is 70% in this study.

3.3 Questionnaire and Survey Design

By literature reviews and data collection, this study figures out five dimensions: IT-aided music teaching, online learning attitudes, motivation to learn music, and learning engagement, and the corresponding 30 criteria, the Fuzzy Delphi method was applied to the screening. The operational definitions of 30 criteria follows: Music theory (M_1), music composition creation (M_2), music composition recording (M_3), music performance (M_4), music instrument teaching (M_5), music appreciation (M_6), music research (M_7), self-learning (S_1), persistent learning (S_2), efficiency learning (S_3), independent learning (S_4), self-understanding (S_5), learning planning (S_6), loving learning (S_7), confidence of computer/smart phones and networks (O_1), using networks (O_2), online learning (O_3), using computers/smart phones (O_4), loving to use computer/smart phones (O_5), cognition of interests (L_1), self-growth (L_2), social relationships (L_3), job progress (L_4), expectation of others (L_5), changing mono lifestyle (L_6) , skill engagement (E_1), motion engagement (E_2), performance engagement (E_3), attitude engagement (E_4), interaction engagement (E_5).

3.4 Operation Steps of ISM with Fuzzy MICMAC

3.4.1 ISM Analysis

Interpretive Structural Modelling (ISM) is an interactive learning process in which a set of varied, but directly related, elements is structured into a comprehensive, systemic model (Sage, 1977; Warfield, 1974). ISM is a well-established methodology for identifying relationships between specific items that define a problem or an issue (Jia et al., 2015).

The objective of this methodology is to construct a structural model to capture the user's best perceptions of the situation" (Bouzon et al., 2015). ISM has been applied by a number of researchers in various fields to develop a better understanding of complex systems, such as analysing vendor selection criteria (Deshmukh and Mandal, 1994), exploring the factors affecting flexibility in a flexible manufacturing system (Raj, 2012), determining the mutual relationships between the enablers of tourism value (Lin and Yeh, 2013), analysing key reverse logistics variables to improve computer hardware supply chains (Ravi et al., 2005), and identifying the barriers to the implementation of total productive maintenance (Attri et al., 2013). Using ISM, this study investigates the relationships between dimensions/criteria in music teaching applying information technology. (Farris and 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; 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.

3.4.2 Fuzzy MICMAC Analysis

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 et al., 2009; Kanungo et al., 1999). Deshmukh and Mandal (1994) claim that the primary goal of MICMAC analysis is to analyse the driving power and dependence of each variable. "Driving power" refers to the degree of influence and "dependence" is defined the extent one variable is influenced by others (Arcade et al., 1999). Based on driving power and dependence, a 2D driver-dependence diagram can be created, (Lee et al., 2010). By using MICMAC, the factors/criteria can be classified into the following clusters. Autonomous factors/criteria: with weak driving power and weak dependence. These factors are relatively disconnected from the system, with which they have only a few links. Dependent factors/criteria: with weak driving power but strong dependence. Linkage factors/criteria: with strong driving power and strong dependence. Independent factors/criteria: with strong driving power but weak dependence. Factors with relatively strong driving power are "key" variables clustered into the category of independent or linkage factors.

The establishment of an Fuzzy MICMAC involves a number of steps, which are well documented in the literature (Katiyar et al., 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 Survey Questionnaire

The research units including universities at Tianjin and Beijing areas in China and Taichung Chunghua areas in Taiwan and aiming to the research scholars and university teachers on music teaching incorporating information technology, to them 40 questionnaire respondents were validly completed in one month.

Using ISM with Fuzzy MICMAC, this research analyses the 5 dimension and 30 criteria including interacting relationships and strength between them.

4.2 Dimension Analysis

4.2.1 Structural Self-Interaction Matrix (SSIM)

With the knowledge and experience, the questionnaire respondents evaluate the relationships between dimensions and criteria and fill the SSIM, which are categorized into types of affecting variables, variables affected, variables affecting each other, and independent variables.

Through the development of the initial and final reachability matrix and the partition procedure, the conical matrix is shown as table 1.

Table 1: Conical Matrix.

	D_5	D_3	D_4	D_1	D_2	Driving Power
D_5	1	0	0	0	0	1
D_3	1	1	1	0	0	3
D_4	1	1	1	0	0	3
D_1	1	1	1	1	0	4
D_2	1	1	1	0	1	4
Dependence Power	5	4	4	1	1	

4.2.2 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.

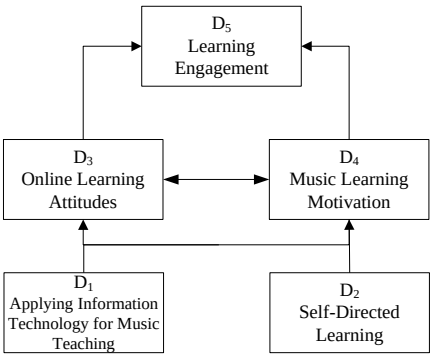

Figure 1: ISM-based Model.

The figure 1 shows that Applying Information Technology for Music Instrument Teaching (D_1) and Self-Directed Learning (D_2) are the most crucial dimensions for online learning behaviour to learner as it comes at the bottom of the ISM hierarchy. Learning Engagement (D_5) appeared at the top which indicate it will influence the entire process of online learning behaviour. The D_1 and D_2 lead to Online Learning Attitudes (D_3) and Music Learning Motivation (D_4). Similarly, D_3 and D_4 lead to D_5.

4.2.3 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 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 disregarding the transitivity and making diagonal entries 0. FDRM is presented in Table 2.

Table 2: Fuzzy Direct Reachability Matrix.

	D_1	D_2	D_3	D_4	D_5
D_1	0	0.7	0.5	0.7	0.5
D_2	0.1	0	0.7	0.7	0.7
D_3	0.3	0.1	0	0.7	0.3
D_4	0.3	0.3	0.7	0	0.9
D_5	0.5	0.5	0.5	0.1	0

4.2.4 Fuzzy Indirect Relationship Analysis

FDRM is used to find the fuzzy indirect relationship between the dimensions. The matrix is multiplied reproduced until the hierarchies of the driving and dependence power are stabilized. According to the fuzzy set theory, 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.

4.2.5 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 3. The ranks of the driving power of the criterion decide the hierarchy of criterion. The purpose of this classification of the dimensions is to analyse the driving and dependence power of the dimensions that influence learners' learning behaviour.

Table 3: Fuzzy MICMAC Stabilized Matrix.

	D_1	D_2	D_3	D_4	D_5	Driving Power	Rank
D_1	0.5	0.5	0.7	0.7	0.7	3.1	1
D_2	0.5	0.5	0.7	0.7	0.7	3.1	1
D_3	0.3	0.3	0.7	0.3	0.7	2.3	4
D_4	0.5	0.5	0.5	0.7	0.3	2.5	3
D_5	0.3	0.5	0.5	0.5	0.5	2.3	4
Dependence Power	2.1	2.3	3.1	2.9	2.9		
Rank	5	4	1	2	2		

4.2.6 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, that nearest to the origin 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 studying. This method confirms the importance of certain dimensions and also search some hidden dimensions through direct classification, which an important role on the system. Fuzzy MICMAC examination of direct relationships also reveals that criterion having strong impact can be supressing hidden criterion.

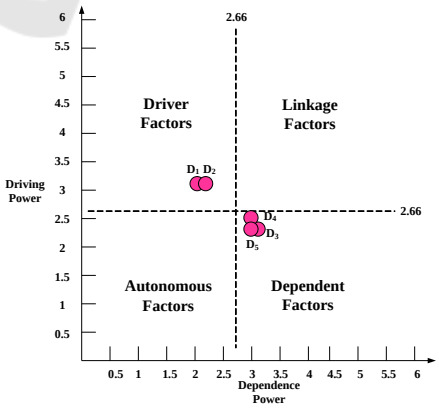

Figure 2: Driving-Dependence Power Graph for Factors.

4.3 Criteria Analysis

By conducting analysis of 30 criteria and complying step 1 to step 9 corresponding those in dimension analysis, the calculation results of Driving-Dependence Graph is as Figure 3 shown.

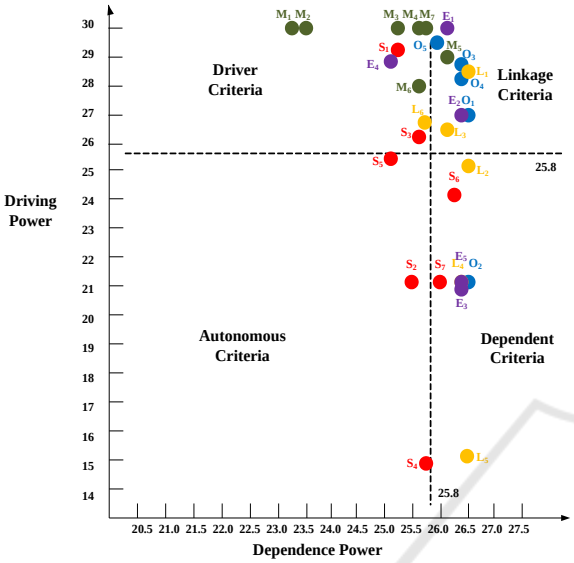

Figure 3: Driving-Dependence Power Graph for Criteria.

5 RESULTS AND DISCUSSION

This research investigates determinants and criteria of IT-aided teaching and provides teaching course designers of education institutions with a complicated relation model of IT-aided teaching to understand the model and the key factors during online learning. First, based on the literature reviews and interviewing scholars and experts in online learning by fuzzy Delphi method on the 5 affecting factors and 30 criteria, and then, interview 20 experts to construct ISM model. and interviewing scholars and experts to construct ISM model.

As for dimensions, the ISM Model is shown Figure 1. Music teaching applying information technology (D_1), and Self-directed learning (D_2) will directly affecting Online learning attitudes (D_3) and Music learning motivation (D_4), in addition, Online learning attitudes (D_3) and Music learning motivation (D_4) affects learning engagement (D_5) , and Online learning attitudes (D_3) and Music learning motivation (D_4) will affect each other, thus, Music teaching applying information technology (D_1), and Self-directed learning (D_2) will indirectly affect learning engagement (D_5).

Fuzzy MICMAC method uses Driving power and Dependence power to divide dimension values in Fuzzy MICMAC Stabilized matrix (as Table 3) into four clusters (as Fig. 2). Figure 2 shows Music teaching applying information technology (D_1), and Self-directed learning (D_2) are critical dimensions affecting learners' learning behaviour. And, Music learning motivation (D_4), learning engagement (D_5) , and Online learning attitudes (D_3) are affected by other dimensions of learning behaviour.

To further understand the complicated relationships of learners' learning behaviour, criteria analysis results were shown as Figure 3, where music theory (M_1), music composition creation (M_2). music composition recording (M_3), music performance (M_4), music appreciation (M_6), music research (M_7), self-learning) (S_1), efficiency learning (S_3), transforming monotonous life (L_6), attitudes engagement (E_4) are 10 higher driving power criteria, which are the key criteria affecting learners' learning behaviour. And planning learning (S_6), loving learning (S_7), 、network use (O_2), self-growth (L_2), professional advancement (L_4), social conformity (L_5), performance engagement (E_3), interaction engagement (E_5) 10 criteria are affected by the above 10 criteria of music theory and so forth.

6 CONCLUSIONS

Music teaching applying information technology provides learners individual learning opportunities to broaden more extensive experience of music learning. Therefore, it is suggested that take account the learners' learning background, experience, and ability combining the features of network learning environments before designing the music courses and materials applying information technology.

Since the learners' learning behaviour features complicated relationships. Apart from the IT-aided music teaching, self-directed learning is also an important factor affecting learners' learning behaviour, thus, strengthening learners' self-directed learning, independent and consistent learning and successfully the learning attitudes, music learning motivation and learning engagement will be the critical missions for the high education involving the online teaching course.

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