Determinants Affecting Online Learning Behaviour and Learning Effectiveness

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Abstract: Using Fuzzy DEMATEL, this article investigates the learner's behaviour of online learning that features multiple characteristics which are complicated and interacting with each other, and between them clears the relationships to provide or benefit schools with teaching strategies, courses design and planning activating learners' learning behaviour and achieving learning effectiveness. With respect to the dimensions, music learning motivation, self-directed learning are the determinant dimensions of learners' behaviour and learning effectiveness that affecting other four dimensions; and to the criteria, they are preference and use on computers and smart phones, online learning affecting other 31 factors

1 INTRODUCTION

The music teaching in university, integrating music theory, music art, and playing kills, is a subject of learning-by-doing. Thus, it is not sufficient to introduce a single information technology for all music teaching, but needs a multiple system with different teaching contents and methods. Most of literatures of IT-aided teaching system are case studies. As such, this study is to investigate and analyse an integrated music teaching system incorporating information technology.

A learner's behaviour is a concept of multiple dimensions for many researchers who have developed with a couple of measures to evaluate, however, haven't come to a conclusion. Thus, it is suggetsted to measure learner's behaviour with multiple quantitative and qualitative criteria. Additionally, learning effectiveness includes two measurig methods: subjective learning achievments, e.g. learning satisfaction, and objective learning effectiveness (Tu et al., 2010). To understand the relationships beteween complicated behaviours on the music teaching applying information technology, the universities located at China Tianjin and Beijing areas, and Taichung & Chunghua areas in Taiwan were selected to acquire the index and construct a framework for the learner's behaviour through questionaire of Fuzzy Delphi method for the students taking music courses, furthermore, to analyze the causal effects between the dimensions and criteria of learner's behavior and learning effectiveness by Fuzzy DEMATEL.

2 LITERATURE REVIEW

2.1 Online Teaching and Learning

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

Over the past decades, online courses have been increasingly growing. With increasing demand for online learning as well as more institutions of higher learning, which continues to grow as a viable means of providing increased access to a greater number of students. Online learning is used to refer to web-based training, e-learning, distributed learning, internet-based learning, web-based instruction, or net-based learning (Keengwe and Kidd, 2010).

This article is to describe the integration of IT into music teaching in terms of IT-aided tools, that can be applied to 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 system and courses.

2.2 Self-Directed Learning

Self-directed learning (SDL) has been identified as an approach to learning that received increasing attention in recent years, particularly in the context of higher education (Shen et al., 2014). Guglielmino (1977) and Driscoll (1994) proposed that self-directed learning implies an independent and continual behaviour and characteristics affecting the learning motivation, efforts and perseverance (Mount et al., 2005; Gendron, 2006; Chen and Liang, 2009).

Knowles (1975) proposed that a self-directed learning is a process that learners can actively recognize learning requirements, plan learning goals, seek for manpower and materials needed, and apply proper strategies to evaluating learning results. And, the learners' self-directed learning will affect their learning motivation (Liang, 2008; Mount et al., 2005; Liang, 2008), learning effectiveness (Xu and Ren, 2005; Shen et al., 2014).

Based on self-directed learning scale, Guglielmino (1977), and related research on self-directed learning (Oddi, 1986; Liang, 2008; Chen and Liang, 2009).

2.3 Music Learning Motivation

Learning motivation is an elementary driving force motivating a learner to learn (Wu, 2016). Learning motivation is a mental experience to activate, maintain learning activities, and direct them toward the learning objective designated (Chen, 2007). And, learners' learning motivation will affect their learning effectiveness including learning effectiveness (Hsieh et al., 2017) and learning satisfaction (Chen 2007; Lee and Huang, 2007). Learners' learning motivation not only affect the behaviour of the learning engagement (Wei and Huang, 2001), but the learning effectiveness (Hsieh et al., 2017) and learning satisfaction (Chen 2007; Lee and Huang, 2007).

The motivation of learning music this article indicates is a process that learners actively learn music activities, maintain, and promote those toward a mental experience. 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).

2.4 Online Learning Attitudes

The attitudes of learners affect the learning satisfaction (Chi et al., 2007) and learning effectiveness (Kuo and Lee, 2008). 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 altered 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.

This study is to aim 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 constructed five dimensions in online learning attitudes: Computer and network confidence, network use, online learning, computer/smart phone use, computer/smart phone preferences.

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). Learning engagement 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. it benefits the instruction and courses design to fully understand the degree that students have engaged. And, learners' learning engagement will affect their learning effectiveness (Tsai, 2016; Wonglorsaichon et al., 2014; Tsai, 2016).

Apart from emotion engagement, it needs to take account the strategy, effectiveness 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, effectiveness engagement, attitudes engagement, interaction engagement (Handelsman et al., 2005; Lin and Huang, 2012; Tsai, 2016).

2.6 Learning Satisfaction

Learning satisfaction is a sense or attitude to learning activities; a pleasant sense or positive attitude means satisfactory, an unpleasant sense or negative sense means unsatisfactory (Tough, 1982; Long, 1985), the production of attitude comes from learning activities and consequently have the positive attitude and sense of satisfaction (Chi et al., 2007). And, learners' learning satisfaction will affect learning effectiveness (Lee and Huang, 2007). This study aims to the learning satisfaction that learners' learning behaviour is stimulated by the wishes and needs, and finally see whether the learners will reach a pleasant sense and subjectively feel satisfactory with their learning effectiveness.

This study synthesizes some scholars' viewpoints (Long, 1985; Chadwick and Jame 1987; Chen, 2007; Wu, 2016) to come to five dimensions for learning satisfactory: Instructor's teaching ability, learning content and teaching materials, interpersonal interaction, teaching website learning environment, administrative services.

2.7 Learning Effectiveness

Learning effectiveness means achievements of students obtain on knowledge or skills after learning (Hsieh et al., 2017); Tu et al. (2010) supposes that learning effectiveness means to what degree that

learners' learned knowledge, skills or emotion in a certain discipline during a period of time.

This study aims to the learning effectiveness including the degree to that learners' knowledge, skills, and emotion can reach. Hsieh et al. (2017) pointed out that learning effectiveness comprises music skills, affection cultivating; Chen and Liu (2015) proposed that learning effectiveness consists of memory and comprehension ability, application and analysis ability, evaluation and creative ability. Thus, learning effectiveness categorizes to six dimensions: learning effectiveness, music skill, affection cultivating, memory and comprehension ability, application and analysis ability, evaluation and creative ability.

3 DEMATEL METHODOLOGY AND MODEL DEVELOPMENT

3.1 Research Framework

The research designs a framework comprising dimensions and criteria evaluation, data collection and analysis. First, based on literature reviews, previous viewpoints of scholars were synthesized for the determinants affecting learning behaviour and effectiveness, which were categorized into 6 dimensions and 34 criteria and, through Fuzzy Delphi method, the group decision making by experts and scholars who are good in online learning behaviour and effectiveness were conducted to solve the fuzzy problems affecting learners' learning behaviour and effectiveness. Second, referring to the universities located at Mainland China Tainjin and Beijing areas, and Taichung Chunghua areas in Taiwan, the questionnaire by DEMANTEL method follows, and aims to the learners in Tianjin University Mainland China for constructing relation matrix between dimensions and criteria, depicting causal effects graph and performing causal effects route analysis and further ascertaining determinants affecting learners' online learning behaviour and effectiveness completing the research framework.

3.2 Fuzzy Delphi Method

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

Step1: Collecting group decisive opinions: Using semantic variables in questionnaire, the measure index for the importance of various criteria can be obtained. For the measure criteria, this study uses Likert's 5 scale to evaluate the ability of technological innovation and adopts the geometric mean to integrate expert opinions.

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

Step3: Solving problems by defuzzification: A fuzzy number is a quantity whose value is imprecise. Therefore, we must perform defuzzification for fuzzy numbers before operating on them. The process of defuzzification is to find the best non-fuzzy performance value, BNP.

Step4: Screening out the evaluation criteria: For criteria evaluation, 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

This study figures out 6 dimensions: Self-directed learning, online learning attitude, music learning motivation, learning engagement, learning satisfactory, and learning effectiveness, and the corresponding 34 criteria, the Fuzzy Delphi method was applied to do the screening. The questionnaires were issued to scholars and experts specializing in online learning, who make decisions for taking the dimension or not by their knowledge and experience with a threshold value of 70%, that means at least 14 scholars agree with the dimensions. This study shows the six dimensions and 34 criteria, to which over 70% experts or scholars are favourable, as a result, all dimensions in this study are taken.

The operational definitions of 34 criteria follows: Self-learning (S1), Persistent learning (S2), Efficient learning (S3), Independent learning (S4), Self-understanding (S5), Learning planning (S6), Loving learning (S7), Learning Confidence on computers/smart phones and networks (O1), Using networks (O2), Loving to use computer/smart phones (O5), Cognition of interests (L1), Self-growth (L2), Social relationships (L3), Job progress (L4), Expectations of others (L5), Changing routine in lifestyle (L6), Skill engagement (E1), Emotion

engagement (E2), Performance engagement (E3), Attitude engagement (E4), Interaction engagement (E5), Teaching methods of teachers (A1), Learning contents and materials (A2), Social interaction (A3), Environments of teaching websites (A4), Public services (A5), Academic achievements (F1), Music skills (F2), Affection cultivating (F3), Memory and comprehension ability (F4), Application and analysis ability (F5), Evaluation and creative ability (F6).

3.4 Operation Steps of Fuzzy DEMATEL

As for Fuzzy DEMATEL, the linguistics scale and triangular fuzzy numbers comply with the categorization of Li (1999). The linguistics scale is divided into 5 levels: Very high effect (VH), high effect (H), low effect (L), very low effect (VL), no effect (No). To facilitate respondents to answer questionnaire, the values are among 0-4.

The operation steps of DEMATEL method are as below:

Step 1: Defining the evaluation criteria and designing the fuzzy linguistics scale.

Step 2: Establishing the direct-relation matrix and obtaining the initial one $\widetilde{Z}$ after comparison by respondents and experts.

$$\widetilde{Z} = \begin{matrix} C_1 \\ C_2 \\ \vdots \\ C_n \end{matrix} \begin{bmatrix} \widetilde{0} & \widetilde{z}_{12} & \cdots & \widetilde{z}_{1n} \\ \widetilde{z}_{21} & \widetilde{0} & \cdots & \widetilde{z}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \widetilde{z}_{n1} & \widetilde{z}_{n2} & \cdots & \widetilde{0} \end{bmatrix} \quad (1)$$

where, $\widetilde{z}_{ij} = (l_{ij}, m_{ij}, r_{ij})$ is triangular fuzzy numbers, those, $\widetilde{z}_{ii}, i = 1,2,...,n$, on left diagonal are (0, 0, 0).

Step 3: Establishing analytic structural model and converting linear scale to normal equation for comparison.

$$\widetilde{a}_{ij} = \sum_{j=1}^{n} \widetilde{z}_{ij} = \left(\sum_{j=1}^{n} l_{ij}, \sum_{j=1}^{n} m_{ij}, \sum_{j=1}^{n} r_{ij} \right) \text{ and } r = \max_{1 \le i \le n} \left(\sum_{j=1}^{n} r_{ij} \right) \quad (2)$$

Get normalized fuzzy direct-relation matrix as:

$$\widetilde{X} = r^{-1} \otimes \widetilde{Z}$$

$$\widetilde{X} = \begin{bmatrix} \widetilde{x}_{11} & \widetilde{x}_{12} & \cdots & \widetilde{x}_{1n} \\ \widetilde{x}_{21} & \widetilde{x}_{22} & \cdots & \widetilde{x}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \widetilde{x}_{m1} & \widetilde{x}_{m2} & \cdots & \widetilde{x}_{mn} \end{bmatrix}, \widetilde{x}_{ij} = \frac{\widetilde{z}_{ij}}{r} = \left[\frac{l_{ij}}{r}, \frac{m_{ij}}{r}, \frac{r_{ij}}{r} \right] \quad (3)$$

Step 4: By (3), the total relation matrix can be obtained as following equations:

$$\begin{aligned}
\widetilde{T} &= \widetilde{X} + \widetilde{X}^2 + \cdots + \widetilde{X}^k \\
&= \widetilde{X}\left(I + \widetilde{X} + \widetilde{X}^2 + \cdots + \widetilde{X}^{k-1}\right) \\
&= \widetilde{X}\left(I + \widetilde{X} + \widetilde{X}^2 + \cdots + \widetilde{X}^{k-1}\right)\left(I - \widetilde{X}\right)\left(I - \widetilde{X}\right)^{-1} \\
&= \widetilde{X}\left(I - \widetilde{X}\right)^{-1}, \text{when} \quad \lim_{k \to \infty} \widetilde{X}^k = [0]_{n \times n}
\end{aligned}$$

$$\widetilde{T} = \begin{bmatrix} \widetilde{t}_{11} & \widetilde{t}_{12} & \cdots & \widetilde{t}_{1n} \\ \widetilde{t}_{21} & \widetilde{t}_{22} & \cdots & \widetilde{t}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \widetilde{t}_{m1} & \widetilde{t}_{m2} & \cdots & \widetilde{t}_{mn} \end{bmatrix}, \ \widetilde{t}_{ij} = \left(l''_{ij}, m''_{ij}, r''_{ij}\right) \quad (4)$$

Step 5: Solving problems by defuzzification and obtaining total relation matrix $\widetilde{T}$ by (5)

$$dF_{ij} = \frac{[(r_{ij} - l_{ij}) + (m_{ij} - l_{ij})]}{3} + l_{ij} \quad (5)$$

Step 6: Obtaining column and row values by defining d and r:

$$\widetilde{T} = [\widetilde{t}_{ij}], \ i, j \in \{1, 2, ..., n\}$$

$$d = (d_i)_{n \times 1} = \left[\sum_{j=1}^{n} \widetilde{t}_{ij}\right]_{n \times 1}; \quad r = (r_j)_{1 \times n} = \left[\sum_{i=1}^{n} \widetilde{t}_{ij}\right]'_{1 \times n} \quad (6)$$

Step 7: Conducting result analysis.

The relation graph can be depicted after calculating $d+r$ and $d-r$. The value of $d+r$ stands for the effect strength between dimension and criteria called centricity indicating relation strength of a certain dimension related to others. The greater the centricity, the stronger the relationships between them. As for $d-r$, it stands for the interaction relationships between dimensions and criteria called causality indicating the strength difference between dimensions/criteria affects others and those affected. The high value of $d-r$ represents that the dimension is the cause affecting others; the low ones mean the dimension is the effect of other dimensions.

4 FUZZY DEMATEL ANALYSIS

4.1 Analysis of Survey Questionnaire

The research units include universities at Tianjin and Beijing areas in Mainland China and Taichung Chunghua areas in Taiwan and aim to the research scholars and university teachers on music teaching incorporating information technology, to them questionnaires were explained and then issued, in which 40 were validly completed in one month.

Using Fuzzy DEMATEL, this research analyses the 6 dimension and 34 criteria for the online learning behaviour and learning effectiveness including interacting relationships and strength between dimensions and criteria.

4.2 Dimension Analysis

Step 1: Defining dimensions for evaluation and design fuzzy linguistics scale: Dimensions for evaluation include: Self-directed learning (D1), online learning attitudes (D2), motivation of music learning (D3), learning engagement (D4), learning satisfaction (D5), and learning effectiveness (D6). The linguistics scale and the corresponding fuzzy numbers, attribute functions referring to the classification by Li (1999).

Step 2: Constructing direct-relation matrix.

Step 3: Constructing structural models for analysis.

Step 4: Constructing total fuzzy relation matrix.

Step 5: Solving problems by defuzzification.

Step 6: Summing values of columns and rows: The values for row (d), columns (r), sum of columns and rows ($d+r$), difference of columns and rows ($d-r$) are summarized as table 1.

Table 1: Column and row values of dimensions.

	d (row values)	r (column values)	$d+r$ (centricity)	$d-r$ (causality)	quadrant	Causal relation
D1	18.482	17.879	36.361	0.603	2nd quad	Affecting criteria
D2	17.809	18.282	36.091	-0.473	3rd quad	Independent
D3	18.845	18.184	37.030	0.661	1st quad	Core criteria
D4	18.767	18.638	37.405	0.128	1st quad	Core criteria
D5	18.233	18.679	36.912	-0.445	3rd quad	Independent
D6	18.865	19.339	38.203	-0.474	4th quad	Criteria affected
Average			37.001	0.000		

Step 7: Results analysis: After obtaining $d+r$ (centricity) and $d-r$ (causality), causal figures are drawn as figure 1.
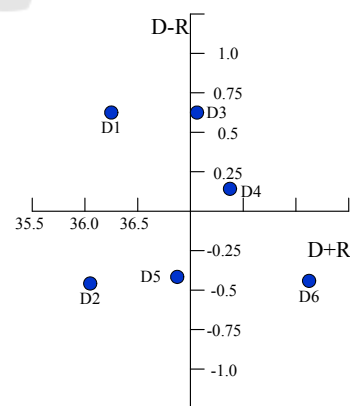

Figure 1: Causal relationships between dimensions.

4.3 Criteria Analysis

To further understand the complicated relationships between learners' learning behaviour and learning effectiveness, this research conducts the criteria analysis for each dimension.

Step 1: Defining evaluation criteria and design fuzzy linguistics scale, and evaluating 34 criteria from self-learning (S1) to Evaluation and creative ability (F6).

Step 2 to Step 7: Complying with the step 2 to step 7 as those used for the dimension analysis, the criteria analysis is conducted and the values of row values (*d*), column values (*r*), sum of column and row (*d+r*), difference of column and row (*d-r*) are synthesized as table 2 shown.

Table 2: Column and row values.

	d(row)	r(column)	d+r(centricity)	d-r(causality)	Quadrant	Causal relation
S1	5.308	4.901	10.209	0.406	1st quad	Core criteria
S2	5.178	4.868	10.046	0.310	2nd quad	Affecting criteria
S3	5.121	4.896	10.017	0.225	2nd quad	Affecting criteria
S4	4.834	4.920	9.754	-0.086	3rd quad	Independent
S5	5.084	4.912	9.996	0.172	2nd quad	Affecting criteria
S6	5.071	4.975	10.046	0.096	2nd quad	Affecting criteria
S7	4.985	5.065	10.049	-0.080	3rd quad	Independent
O1	5.380	4.928	10.308	0.453	1st quad	Core criteria
O2	4.942	4.943	9.885	-0.001	3rd quad	Independent
O3	5.484	4.883	10.367	0.601	1st quad	Core criteria
O4	5.460	4.929	10.389	0.531	1st quad	Core criteria
O5	5.591	4.906	10.497	0.685	1st quad	Core criteria
L1	5.489	5.084	10.572	0.405	1st quad	Core criteria
L2	4.594	5.105	9.699	-0.510	3rd quad	Independent
L3	4.400	4.975	9.375	-0.575	3rd quad	Independent
L4	4.494	5.161	9.655	-0.667	3rd quad	Independent
L5	5.076	5.135	10.211	-0.059	4th quad	Criteria affected
L6	4.794	5.143	9.936	-0.349	3rd quad	Independent
E1	5.621	5.152	10.773	0.469	1st quad	Core criteria
E2	5.470	5.168	10.639	0.302	1st quad	Core criteria
E3	4.819	5.211	10.031	-0.392	3rd quad	Independent
E4	5.292	5.233	10.525	0.060	1st quad	Core criteria
E5	4.678	5.213	9.891	-0.535	3rd quad	Independent
A1	5.742	5.315	11.057	0.427	1st quad	Core criteria
A2	5.423	5.308	10.731	0.115	1st quad	Core criteria
A3	4.519	5.236	9.754	-0.717	3rd quad	Independent
A4	5.277	5.134	10.411	0.143	1st quad	Core criteria
A5	4.864	4.972	9.836	-0.109	3rd quad	Independent
F1	5.590	5.292	10.882	0.298	1st quad	Core criteria
F2	5.289	5.231	10.519	0.058	1st quad	Core criteria
F3	4.965	5.200	10.165	-0.236	4th quad	Criteria affected
F4	4.877	5.280	10.157	-0.403	4th quad	Criteria affected
F5	5.300	5.393	10.693	-0.093	4th quad	Criteria affected
F6	4.478	5.420	9.898	-0.942	3rd quad	Independent
Average			10.205	0.000		

5 RESULTS AND DISCUSSION

5.1 Results of Dimension Analysis

With respect to *d+r* (centricity), Figure 1 show that the value of Learning effectiveness (D6) is the greatest compared to the other five dimensions that means the strongest in all dimensions a learner must learn music skills, application and creative ability to enhance the learning effectiveness that is the learner's ultimate achievements. As for Online learning attitudes (D2), its value 6.091 having the least strength. The influence strength in the 6 dimensions is ranking from high to low as Learning effectiveness (D6) to Online learning attitude (D2).

As for the causality (*d-r*), based on the values of *d-r* (causality), the dimensions can be classified into cause group and effect group; the dimensions with positive *d-r* (causality) values called cause group including Music learning motivation (D3), Self-directed learning (D1), Learning engagement (D4), directly affecting other dimensions which will be the critical objectives. And, the dimensions with negative values of *d-r* (causality) are categorized into effect group including Learning effectiveness (D6), Online learning attitudes (D2), Learning satisfaction (D5), which are affected by other dimensions and are the problems needed to be solved. Among the values of *d-r,* ranking from high to low as Music learning motivation (D3), Self-directed learning (D1), indicates that they most affect other dimensions; Learning effectiveness (D6), Online learning attitude, and Learning satisfaction (D5) are affected most as effects of other dimensions. The higher the Music learning motivation, the stronger the Learning effectiveness (D6), Online learning attitudes (D2), and Learning satisfaction which is the basis of learners' learning behaviour and learning effectiveness.

Overall consideration, Music learning motivation (D3) is the optimum option in all dimensions that directly affects four dimensions: the learning engagement and online learning attitudes. From Figure 1, it is found that the six dimensions are interrelated and clearly understood the Music learning motivation (D3) dimension are strongly pointing to other dimensions except Self-directed learning (D1), and only slightly affected by other dimensions. Therefore, learners should cultivate self-directed learning to activate learning behaviour and learning effectiveness apart from the motivations of cognition of interests and self-growth that comprise Music learning motivation. However, Learning effective (D6) is a dimension affected that will be enhanced when the problems with the other five dimensions are solved.

5.2 Results of Criteria Analysis

Referring to centricity (*d-r*), the 34 criteria can be classified into cause group and effect group; 18 criteria with positive *d-r* (causality) categorized into cause group directly affecting other criteria which needed to be enhanced to strengthen other criteria like Online learning (O3), Using computers/smart phones (O4), Loving to use computer/smart phones (O5) which are most influential causes positively affecting other criteria, and the bases of learners' learning behaviour and learning effectiveness. And, 16 criteria with negative *d-r* (causality) categorized into effect group which will be affected by other criteria and are problems needed to be solved.

6 CONCLUSION

Learners' behaviour features complicated, and interrelated relationships between them that it's not easy to be precisely evaluated. This research shows the dimensions and criteria for the learning behaviour and learning effectiveness. In this research, recommendations are proposed as follows.

1. It is necessary to understand learners' learning behaviour and provide information for the implementation of online learning courses.

2. Cultivating learners' self-directed online learning ability, and learning independence with strong learning desire and confidence.

3. Promoting online learning attitudes on computer and network.

4. Properly planning music courses to enhance learning motivation.

The model created in this research is subjected to the environments of online music teaching, the determinants of learners' learning behaviour and learning effectiveness.

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