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Current Situation of Chinese Primary and Secondary Innovative Teachers' Evaluation in Maker Classes

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Abstract: Maker education is a new educational pattern in China, which also caters for the political ideology called "mass entrepreneurship and innovation". Maker education pays much more attention to the students' learning processes, so it is essential for teachers to use proper evaluation to judge the students' learning situation and behaviors, so as to give students more detailed direction to get better. So investigating innovative teachers' evaluation competences is an important work to promote the development of maker education. This study tries to analyze teachers' attitude and progress when evaluating students and find some problems they have faced. A depth interview went behind the questionnaire to find whether teachers were having problems when evaluating students. At the end of the paper, some detailed suggestions are given to help the teachers evaluate students more effectively.

Keywords: Maker education, maker literacy, evaluation situation, teacher's professional development, evaluation methods

1. Introduction

In China, a new learning pattern called "maker education" has drawn public concern in the round of creative education reform. Maker education draws the advantage of information technology, and becomes a new fashion of creational education (Zhu, 2015). Innovative teachers are a new teacher type in primary and secondary schools, and their goal is to teach students how to use modern open-source hardware and software (such as 3D printer and Scratch) to make creative things. Evaluation is an essential part in the teaching process, however, teachers do not place evaluation in an important position. This study is aimed at assessing the primary and secondary innovative teachers' evaluation competencies in the process of instruction design to find whether they have some problems when evaluating students and trying to give pointed suggestions to help teachers improve their evaluation skills and build a better teaching environment.

2. Theoretical Frameworks

2.1 Maker Education in China

In China, maker education is a new teaching method. Theoretically, Zhu(2015)stated that maker education was based on the fusion of information technology, inheriting experiencing education，project-based learning and creative education and DIY idea. Maker education is an educational form to foster students' maker literacies and spirit (Zhu, 2015). In practical perspective, Xie (2016) in Wen Zhou high school has designed a series of maker education curricula to teach students how to use open source hardware to make creative products. Wu (2016) has used SCRATCH in the class to teach students how to code on the computer.

2.2 Maker Literacy in Maker Education

Maker literacy is in the setting of actively responding to “mass entrepreneurship and innovation” from Ke-Qiang Li, the Premier of State Council. Zhu (2015) stated that maker literacies consist of five dimensions: the ability of finding, analyzing and solving problems, making creative production, social competence, thinking ability and creative passion. Wang (2017) gave a clear outline about maker literacies which are also classified into 4 major dimensions. Through summing up and analysis, each of the literacy corresponds to one particular instructional objective. The following graph shows the correspondence of maker literacies and instructional objective. By knowing what students need to achieve in innovative classes, teachers can know better what to teach and how to evaluate students properly.

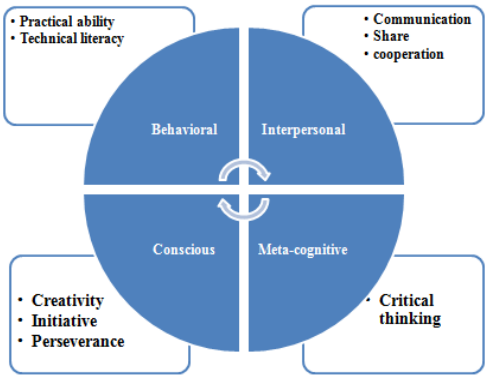

Figure 1. Map of Maker Literacies.

2.3 Evaluation Patterns: Summative and Formative

Evaluation is indispensable of instructional process. Teaching evaluation includes not only the summative evaluation, which is represented by a standardized test, but also a formative evaluation that aims at the learning and focuses on learning process (Leung & Mohan, 2004). The summative evaluation is an important means of testing the teaching results, but it cannot evaluate the teaching process, which is a critical part. However, the formative evaluation makes up for these weaknesses. The functional comparison between them is described in figure 1.

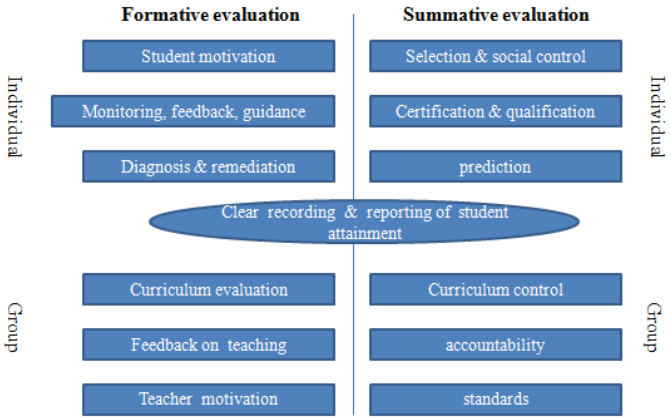

Figure 2. Map of Evaluation Functions (Murphy & Torrance, 1990).

2.3.1 Formative Evaluation

Formative evaluation is a pre-planned "process", and teachers in this teaching process continue to pay attention to and monitor the student's learning situation to collect evidence of student learning to amend the teaching (Stiggins, 2005).

The essential feature of formative evaluation is feedback and improvement (Zhao Decheng, 2013). Mo Yan (2004) thinks formative evaluation stresses the following features: the purpose is formative; the subject is extensive; the content is comprehensive; the means are flexible and diverse; the results are qualitative and quantitative.

From figure 1, it can be seen that formative assessment can offer effective diagnosis of problems in educational practice and effective feedback as well as guide educational activities to improve teaching quality. So, formative evaluation is a key and an important method of high quality teaching.

2.3.2 Summative Evaluation

Summative evaluation refers to the cumulative evaluations, usually occurring at the end of a unit or topic coverage, which intends to capture what a student has learned, or the quality of the learning, and judge performance against some standards.

The purpose of summative evaluation is various. It is to pass or fail a student; to grade or rank a student; to allow progress to further study; to assure suitability for work; to predict success in future study and work etc.

3. Research Methods and Data Analysis

3.1 Research Methods

In the case when assessing teachers' evaluation and implementation, competences seem to be either objective or subjective. No one can describe teachers' evaluative process better than themselves, so this study mainly focuses on investigating and interviewing teachers' subjective feeling about their evaluation competences situation. So questionnaire survey and interview are the main research methods. How to interview teachers' evaluation and implementation competences roundly and authoritatively is a crucial problem to solve. IBSTPI published the latest authoritative instructional designer competences scale for teachers in 2013, and evaluation and implementation is the last part of the whole scale. This part contains 3 dimensions and 14 detailed standards. It is no doubt good criteria for researchers (the author) to interview and make a questionnaire to find the unsolved questions. The step we followed, which were adapted from (Koszalka, 2013), are detailed below.

(1) **Creating the Database.** Data from this study were mission statements from innovative teachers who had some teaching experiences in primary and secondary schools in China (n=19). And the study also chose four teachers who had a wealth of teaching experience for a depth interview. Maker education is still in the initial developing period in China, so there are not abundant expert teachers for us to interview.

(2) **Defining the unit of analysis.** Researchers referred to the evaluation scale from IBSTPI and converted into an interviewing questionnaire. The questionnaire contains the following dimensions: teachers' perspective about evaluating instructional and non-instructional interventions, revise instructional and non-instructional solutions based on data, implement, disseminate, and diffuse instructional and non-instructional interventions. And then in consideration of a better understand of the meaning of each questions, researchers annotated the specialized vocabularies to be got across accurately.

(3) **Developing categories and a coding scheme**. Research team members chose Likert scale to measure the teachers' subjective assessment towards their evaluation competences in a quantitative way. And there were also some open-ended questions for the interview after the questionnaire to see whether they had run into a stone wall when evaluating the students.

(4) **Data analysis and conclusion drawing.** The results of data analysis were was presented in two aspects: quantitative description and qualitative description.

3.2 Data Collection and Analysis

The sample is mainly from the 19 front-line teachers who come from Shanghai and Beijing, including 16 female teachers, 3 male teachers. In this study, questionnaires and in-depth interviews were used to investigate. And the effective rate of questionnaire and in-depth was 100%. The questionnaire is labeled with the 5 points Likert Scale, and the options are "fully compliant, more consistent, generally consistent, less compliant, totally incompatible" with a score of 5, 4,3,2,1, and analyzes the results through SPSS 23.0.

Table 1: Evaluate Instructional and Non-Instructional Interventions.

Index	Design Evaluation Plans	Implement Formative Evaluation Plans	Implement Summative Evaluation Plans	Prepare And Disseminate Evaluation Report
Mean	2.90	2.79	2.26	2.84
Standard Deviation	.87	.78	.65	.83
Range	3.00	2.00	3.00	2.00
Total Average	2.70			

The above four indexes investigated whether the innovative teachers set up evaluation intervention in the teaching process. The survey finds that most of the innovative teachers will take the initiative to design a set of evaluation programs and publish evaluation reports (total average = 2.6974). This shows that most of the innovative teachers have the awareness and ability of evaluation. In the choice of evaluation methods, more innovative teachers incline to use the formation of evaluation.

Table 2: Revise Instructional and Non-Instructional Solutions Based on Data.

Index	Identify Product And Program Revisions Based On Review Of Evaluation Data	Revise The Delivery Process Based On Evaluation	Revise Products And Programs Based On Evaluation Data
Mean	2.21	2.05	2.16
Standard Deviation	.42	.78	.69
Range	1.00	3.00	3.00
Total Average	2.14		

These three indexes investigated the ability of teachers to reflect students' internal feedback. The study found that the overall mean of the dimension was low (total average = 2.1403). This shows that most innovative teachers do not form a good sense of reflection, and cannot do it according to the evaluation of teaching feedback to amend their own evaluation program, and do not really play the role of the implementation of evaluation programs.

Table 3: Implement, Disseminate, and Diffuse Instructional and Non-Instructional Interventions.

Index	Change Goals	Plan for Diffusion	Disseminate Interventions	Monitor Implementation	Identify Required Modifications
Mean	2.31	2.68	2.74	2.74	2.47
Standard Deviation	.95	.75	.61	.56	.84
Range	4.00	3.00	2.00	2.00	3.00
Total Average	2.45				

These indexes reflected the ability of innovative teachers to implement, promote and reflect on external feedbacks. We can see from the third and fourth indexes that the teachers now have a certain awareness of the implementation and promotion (mean > 2.50). However, there are significant differences in the ability of founding teachers to integrate knowledge goals and skills goals into the ultimate goal of teaching (standard deviation > 0.5).

And the second, third and seventh indexes show that most of the teachers did not have strong external reflection awareness and ability after the evaluation and promotion, so that they can not get timely and effective development of targeted strategies to adjust the evaluation program (mean ≈ 2.20).

3.3 Conclusions

The overall average of the three dimensions is shown above. It can be seen that the overall average of the three dimensions is between 2.0 and 3.0. Corresponding to the Likert scale, it indicates that the overall evaluation of the majority of Chinese innovative teachers is at a middle level now. From the figure 3 we can draw conclusions as follows:

(1) There are individual differences among teachers in evaluation process (standard deviation>0.5 for almost all indexes).
(2) Most teachers can plan and use evaluation in maker education.
(3) Most teachers can implement and diffuse their evaluation methods.

Teachers lack having reflection to the evaluation results and can not make good use of it

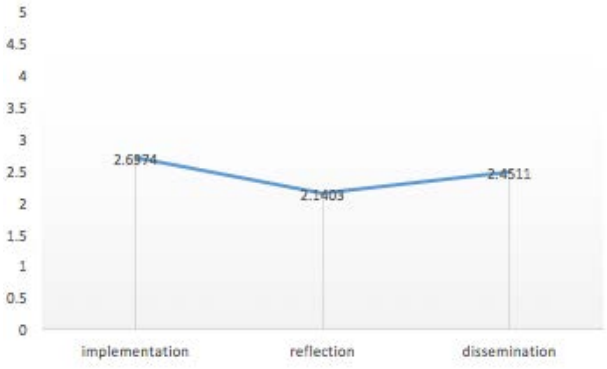

Figure 3. Map of Teacher Overall Evaluation Situation.

4. Suggestions

After combining the depth interview with the data analysis results (due to space limitation, depth interview has been already blended into the suggestions), the research team raised the following four suggestions for teachers to refer.

4.1 Establish Evaluative Scales for Students' Multiple Competences

In order to avoid evaluating students subjectively, some standard evaluative scales need to be established for teachers to find the students merits and shortcomings objectively. There are already some existing authoritative evaluative methods to measure students' competences. Take creativity as an example, creativity is complex, which has many facets and occurs in all domains of life. Lucas (2016) raised five-dimensional model of creativity which contains inquisitive, imaginative, persistent, collaborative and disciplined and its detailed evaluative indexes. Meanwhile, each school has its own philosophy of education, and schools can organize innovative teachers to formulate a characteristic evaluation scales to demonstrate philosophy of schools.

4.2 Make the Evaluation Work Diversified

Evaluation diversification can be divided into two dimensions: valuator and evaluative activities. Firstly, teachers can not evaluate students' competences thoroughly. So, try to combine teacher evaluation with self-evaluation and peer-evaluation. Self-evaluation can let the teacher know what the students really think about themselves and peer-evaluation can give students various improvement suggestions from other students. It is also a good chance for students to share their ideas and broaden their horizons. Secondly, using evaluative scales for students merely seems to be too boring and make students lose interest in the innovative classes. There are many activities to make evaluation more effectively such as class presentation and holding science and technology festivals in schools. Class presentation can give the students opportunities to show their ideas and products. It can also give students a platform to talk about the personal evaluation about their ideas, and detailed advice from both teachers and other students can also be given to the exhibitors.

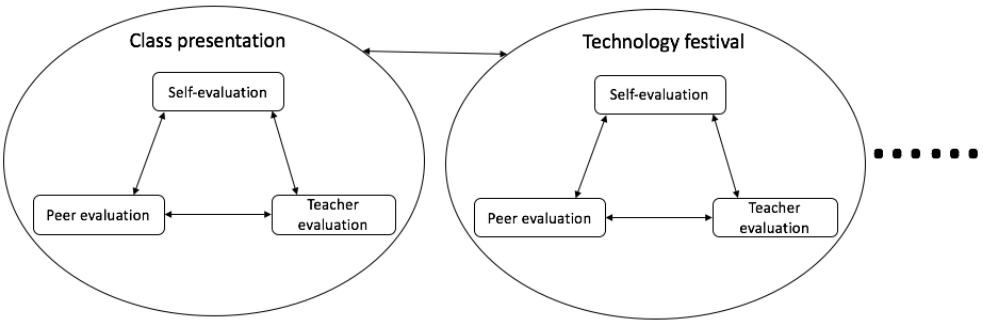

Figure 4. Different evaluation pattern.

4.3 Use Portfolio Assessment to Measure Students' Competence Enhancement

Portfolios assessment collects more than a diverse body of finished work. In fact, they gather what we have come to call biographies of works, a range of works and reflections. When students are asked to return to their collections of work, finding what has changed with time and what still remains to be refined. This learning process can help students realize their progress. It is a good evaluation method to record the phased achievements in students' personal learning process. It also helps teachers find students merits and shortcomings from different aspects. Innovative teachers can give each student a portfolio to allow them to put every idea and report in it. To be frankly, it is also a memorial thing for students and their parents.

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