

A Potential Approach to Support Pre-service Teachers' Professional Learning: The Video Analysis of the Authentic Classroom*

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This article focused on a deeper analysis of pre-service teachers' observations of video lessons based on the authentic classrooms across three stages in eight sessions in order to reveal their changes in the abilities to understand pedagogical content knowledge and the effects of specific observation frameworks introduced in the observation sessions. With those aims, we developed the coding schemas at the content and the method level to analyze the pre-service teachers' observation reports and reflections. It was found that the video lesson analysis based on the authentic classroom teaching has a great potential to support pre-service teachers' professional learning with the appropriate guidance.

Keywords: pre-service teacher, professional learning, video lesson

The Significance of the Research

It has been recommended that pre-service teachers should be offered more authentic experiences to prepare them to handle the complexity and challenges of the school context (Darling-Hammond, 1997; Goodlad, 1990; Huling, 1998; National Commission on Excellence in Education, 1983) with the two following assumptions: (1) exposure to examples of teaching creates learning opportunities for pre-service teachers; and (2) through authentic experiences pre-service teachers meld theory into practice (Santagata, Zannoni, & Stigler, 2007).

Nevertheless, the previous program for the pre-service teachers' professional development was mainly operated to impart the theories on the mathematics education and the experiences abstracted from the teaching practice in Shanghai Normal University. The pre-service teachers have such few opportunities to come into contact with the authentic classroom teaching that they believe that: (1) The theories on the mathematics education are so far away from the teaching practices that they are not useful to serve the future teaching practices of pre-service teachers when they will have been in-service in one or two years; and (2) The experiences abstracted from teaching practices stay only in the master teachers' minds but far beyond mine (Huang, 2012). The apparent chasm (Bencze, Hewitt, & Pedretti, 2001) between what often happens in

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university-based teacher education and teaching in schools—a theory-practice gap—has caused the instructors to shift much of their instructing efforts out of academia and into the usage of case (Koc, Peker, & Osmanoglu, 2009) to provide opportunities for pre-service teachers to apply their theoretical and practical knowledge to classroom contexts (Lundeberg, Levin, & Harrington, 1999).

Given the shift challenge, this research has built the pathway to getting the pre-service teachers involved in both observation and analysis of two video lessons for the purposes of facilitating their professional learning.

The use of video in teacher preparation programs has progressed from being a means to expose pre-service teachers to specific behaviors to be imitated to a tool for the development of teachers' professional judgment. While the video-based teacher learning projects offer promising results, many questions still remain open. On the one hand, many would agree that, unless one has a clear goal in mind, classroom observations can easily turn into messy and unstructured notes. Although most programs provide pre-service teachers with some kind of guidance, the focus varies widely. What counts as effective guidance is still one open question (Santagata et al., 2007). On the other hand, researches that document the knowledge growth and the conceptual changes of pre-service teachers in the learning process are lacking. This paper aims to address the two gaps by analyzing the pre-service teachers' learning process in the video lessons analysis activities.

Methods

Videotaped Lessons

Two seven-grade mathematics videotaped lessons were chosen to be the case video lessons in this research. The two lessons videotaped by the research team were an experienced teacher's authentic classroom teachings in Shanghai Tianlin Middle School, China. Its assumption was to provide an authentic classroom teaching situation for students to analyze the learning activities in the lessons, even without the field observation. The teaching contents of the two lessons were both about the proof strategies in geometric problems. And the two lessons were similarly structured with the aim of learning activities arrangement for pre-service teachers' professional learning in the research. The first video lesson would be taken as a learning practical platform on which students were able to obtain the basic skills and knowledge about how to observe and analyze a lesson; while the second one would be done as the field of the acquired skills and knowledge application. Thus, the similar construction of the second lesson to the first one was potential to stimulate students to apply the obtained skills and knowledge within the second lesson situation.

Session Organization

The whole sessions were grouped into three stages with eight sessions and each session was 80 minutes. Only Chinese was used in the sessions.

Stage one—Brainstorming observation and analysis. The first session: Encouraging students to observe the first video lesson which was projected on a big screen. Seventy-six participants who were pre-service teachers majoring in mathematics education of Shanghai Normal University were divided into 19 groups to facilitate the sharing of participants' ideas in the observation and the analysis of video lessons. Each member within every group was assigned the specific observation task by the group leader or initiatively took the task. For instance, some members took notes of the lesson sequence, and others focused on the case teacher's discourse, and so on. Then, every group uploaded its observations and reflections on the first lesson to the online forum at <http://qun.qq.com/air/#141854935> which was built up for the group discussion in the research.

After the first session, the instructor (the corresponding author) reviewed the reports of every group submitted at the online forum. The results demonstrated that: (1) Participants mainly analyzed the lesson according to their perceptions rather than reliable data collected from the lesson; and (2) Participants were not able to logically express their opinions in their report of lesson observation and analysis.

Stage two—The application of the selected analysis framework. The second session: Offering the pre-service teachers the guidance to the observation of the video lesson. Taking the review results into account, the instructor recommended Hiebert, Carpenter, Fennema, Fuson, Wearne, and Murray's (1997) critical dimensions of mathematics classroom as the classroom observation framework and instructed how to logically express the analysis results. Meanwhile, the instructor presented the excellent groups' reports and her own analysis report of the lesson observation. The third session: Encouraging the pre-service teachers to re-observe the first video lesson. The procedure of the observation activity was the same as that of the first session. Its aim was to improve pre-service teachers' abilities to observe a lesson and express their viewpoints by application of the classroom observation framework. The fourth session: Reviewing every group's report downloaded from the online forum and presenting the review results. The fifth session: Encouraging pre-service teachers to observe the second video lesson. The procedure of observation was the same as that of the first and the third sessions. This kind of design was conducive to pre-service teachers' transformation of their obtained knowledge from the previous sessions to this round observation task. Moreover, the members in each group did not change. Under this situation, it is possible to observe the each member's knowledge increase and conceptual changes during the professional learning process through the video lesson observation and analysis. The sixth session: Online discussion. Each group uploaded its report at the online forum. As a facilitator, the instructor encouraged the pre-service teachers to look into the other groups' reports and give the feedback on them. The seventh session: Reviewing the group reports on the second video lesson.

Stage three—The refinement of analysis method. The eighth session: Encouraging the pre-service teachers to reflect the whole learning process. A questionnaire was used to exam the pre-service teachers' capacities of refining the analysis method on the classroom teaching and their gains and experiences. The questionnaire included the following questions: (1) Explaining how to analyze a mathematical classroom teaching based on your previous learning activities; and (2) Summarizing the knowledge and experiences which you acquired from the previous learning activities.

Data Sources

The data consisted of the videotaped group discussion, the groups' reports, the instructor's feedback, and the questionnaires. Videotaping the group discussion was mainly intended to snatch the whole scene of the group discussion. The group reports were downloaded from the online forum and amounted to 44. The instructor's feedback contained her own observation report, the reviews of the groups' reports, and the instructions in the sessions. The questionnaire was implemented as an exam, and therefore, every participant's answer sheet was marked. In addition, participants did not post any substantial comments on the groups' reports at the online forum, so we only catch a glance at the data from online forum discussion.

Data Analysis

The content analysis techniques were utilized (Neuendorf, 2002) to explore the participants' knowledge growth and conceptual changes and the effects of analysis frameworks provided for them. In order to capture the pre-service teachers' viewpoints and thoughts in the video lesson analysis, the coding schemes based on the

five-dimensional framework of classroom (Hiebert, Carpenter, Fennema, Fuson, Wearne, & Murray, 1997) were developed at the content and the method level: (1) mathematical task, teachers' roles, classroom culture, tools, and accessibility in Table 1; and (2) statement, portion, formalization, and elaboration (including innovation) in Table 2 with the low and the high quality of coders in each dimension.

Table 1

The Codes at the Content Level

Codes	Core features
Mathematical task	Mathematics problems; Connect with where students are; Leave behind something of mathematical value
Teachers' roles	Select tasks with goals in mind; Share essential information; Establish classroom culture
Classroom culture	Ideas and methods are valued; Students are encouraged to share their ideas or methods; Mistakes are learning sites for everyone; Correctness resides in mathematical argument
Tools	Meaning for tools must be constructed by each user; Used with purpose to solve problems; Used for recording, communicating, and thinking
Accessibility	Tasks are accessible to all students; Every student is heard and contributes

Table 2

The Codes at the Method Level

Codes	Descriptions	Score interval
Statement	The context is expressed without framework and the five-dimensional framework is not applied	Low quality: 60–64
		High quality: 65–69
Portion	Parts of the five dimensions in the framework are mentioned or discussed	Low quality: 70–74
		High quality: 75–79
Formalization	The five-dimensional framework is applied by rote, but all the five dimensions are mentioned or discussed	Low quality: 80–84
		High quality: 85–89
Elaboration	The five-dimensional framework or other reasonable framework is taken as the analysis tool	Low quality: 90–94
		High quality: 95–100

Particularly, the participants' answer sheets on the Question 1 at stage three were assigned a score by the following procedures: (1) confirming a score interval by looking at the quality in each dimension at the method level (see Table 2). Comments that did not include the certain instances of the video lessons to support the general ideas summarized from the lessons were coded as low quality. Comments that included the certain instances of the video lessons to support the general ideas summarized from the lessons were coded as high quality; and (2) specifying a score within the score interval by looking at the emerging viewpoint amount. The more viewpoints were mentioned or discussed, the higher score were marked within a score interval.

Coding Reliability

We followed three procedures to ensure coding reliability: Firstly, two coders (the corresponding author's postgraduate students) individually coded the data. Then, we examined the code-matching rate. Initially, we found the matching rate was 67%; Secondly, in order to increase the matching rate, the corresponding author coordinated the disagreements negotiation in a three-way conference by going over every coded message until the coding match rate reached 85%; and Finally, the two coders coded the entire data set maintaining the 85% match rate.

Results

In this section, we provided the results of two types of analysis at the content and the method level. The results were organized into the following three dimensions.

Dimension One: The Shift From Superficial Features to Pedagogical Content Knowledge

At stage one, the pre-service teachers were encouraged to observe and analyze the first video lesson in their own way in the first session. When they first observed the first video lesson, the pre-service teachers tended to pay a lot of attention to the superficial features in the lesson. Firstly, during the observation process, they kept a watchful eye on the laughable scenarios. For instance, they could not help laughing when they saw a chubby student sitting beside the student who was answering questions, and they also talked about that the case of teacher's necktie was slanting; Secondly, in the first group reports, some groups attached importance to the description of the superficial circumstances. For example, of 19 group reports, three focuses on the description of what was going on in the lesson without substantial comments; Another three highlight on the discussion of the characteristics of the case teacher, such as the appropriate dress style, nonstandard mandarin, and the friendly face emotion; Thirdly, in the first group reports, many groups mainly stayed at the superficial perceptions on the five dimensions of the framework. For example, of 19 group reports, two mention the mathematical task in one very short sentence, such as "The examples are typical", five mentioned the case teacher's roles in one phrase, such as "Making the connection between new and previous knowledge and explaining the proof process step by step", two mentioned the classroom culture in one phrase, such as "The active interaction between the teacher and students", three mentioned the tools in one phrase, such as "The usage of the mini blackboard", and one mentioned the accessibility in two clauses, such as "The instruction is vivid and accessible, which is easy for most students to access". Consequently, even those groups mentioned the two, or three, or even four dimensions of the five-dimensional framework, they adopted the very general way to discuss those without the reasoning process from the instances of the lesson.

At stage two, firstly, the pre-service teachers were encouraged to re-analyze the first video lesson, and then to analyze the second video lesson with the instructor's guidance based on the review of the groups' reports and the introduced analysis framework. Under the guidance of the instructor, and finally, the pre-service teachers were able to focus on the analysis of the lesson tasks, the way of the case teacher helping students construct reasoning in the proof, and the students' thinking in the interaction between teacher and students, and the tools application, and so on. The specific description was as follows:

Firstly, building on their first observation and assimilating the five-dimensional framework, all the groups were able to organize their viewpoints into five dimensions in their second observation of the first lesson. However, the viewpoints were still expressed in very general way, such as "Teacher roles: instructing with the targets, stimulating students' initiative thinking by pointing out the key points, mobilizing the students' interests by question and interaction in the classroom". It was hard to link such viewpoints with the specific scenarios from the lesson. Therefore, it was also difficult to examine how the viewpoints were generalized from the evidences collected from the lesson;

Secondly, taking the above situation into account, the instructor presented her own analysis report of the first lesson and explained how to generalize and express the viewpoints based on the specific scenarios from the lesson under the five-dimensional framework. For instance, the core feature of the examples selected in the lesson in the dimension of mathematical task was the emerging variation theory. It could be illustrated by the gradual changes in the structure, the background, the covered knowledge points, the questioning type (open-closed), and the question numbers of the examples. Then, with the features, it is reasonable to understand its significance through the students' performance in the examples of learning process. Therefore, the

viewpoint-variation in the example and its expression-substantial comparison data were written in very coherent way. With the coherent expression way, it was potential to facilitate the pre-service teachers to not only improve their viewpoints expression, but also acquire the deep understanding of the knowledge of mathematical task. The instructor's analysis report was available at the online forum;

Later on, the pre-service teachers were encouraged to observe and analyze the second video lesson taking the instructor's analysis report as a reference. Among 19 groups submitting reports, it was found that 16 groups were able to express their viewpoints in very coherent way in each dimension of the five-dimensional framework. For example, CG (Clover-Four Group) generalized the following six viewpoints in the dimension of teachers' roles: (1) helping students go over the previous knowledge; (2) instructing how to prove the two lines perpendicular; (3) guiding students' thinking to grasp the concept of the analytical method; (4) helping students to find out the logical starting point of a proof; (5) paying close attention to the students' feeling; and (6) summarizing the proof method. Not only were the viewpoints generated well and truly, but also they were illustrated by the specific scenarios from the lesson. For instance, the third viewpoint was illustrated by the learning process of example one which was demonstrated by the photograph of blackboard-writing in the lesson and described by text referring to the black-writing photograph (see Figure 1). In addition, two groups did not complete their reports in very serious way. They simply mentioned some facts from the lesson in their reports without analysis of thinking inclusion. And one group did not submit the report.

(3) 引导学生思路，更加深刻的掌握分析法

既跟着学生的想法走，同时引导学生。提问同学证明方法，问同学为什么会想到这样的方法，从而完善解题思路。如例一中通过条件角 1 等于角 2 想到证明三角形等腰，再通过等腰三角形三线合一证明垂直（如图 2）。

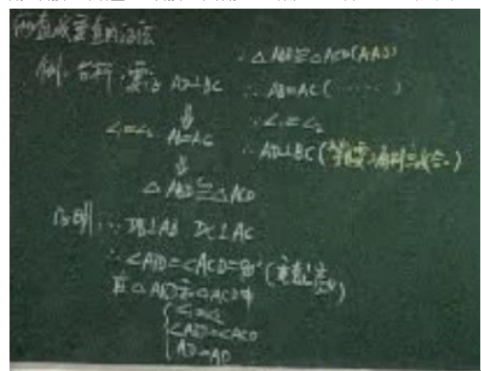


图 2

几乎是由学生给出的证明过程，教师起引导作用。既写出思路，又写出了证明过程（作为规范学生演绎证明的初始课，写出了规范的证明过程）。促进学生提高。总结方法为等腰三角形三线合一。并用不同颜色的笔标明理由，详略得当。

Figure 1. The report segment of CG.

Overall, from stage one to stage two, the pre-service teachers were able to observe and analyze the lessons from the focus on the superficial features to an understanding of pedagogical content knowledge with the five-dimensional framework.

Dimension Two: The Shift From Illogical Statement to Structured Analysis

It was found that the reports of classroom observation at stage one mainly demonstrated illogical feature in the viewpoints expression. Only one of the 19 group reports had sub-titles in the statement of observation. Three of them stated their viewpoints in only one paragraph containing multi-dimensional viewpoints at

random, such as the report of the ZG (Zhuo Group) (see Figure 2). In the report, we can see that the viewpoints were disorganized based on the emerging codes pattern-mathematical task, teachers' roles, classroom culture, teachers' roles, teachers' roles, mathematical task, accessibility, and teachers' roles, in one paragraph. Four groups paragraphed their statements based on group members' comments, and five paragraphed their statements based on the following two dimensions: merits and demerits, such as the report of the LG (Life Group) (see Figure 3). In the report, the viewpoints were organized into merits and demerits paragraph. Each paragraph generally mentioned multi-dimensional viewpoints. For example, the merits paragraph contained the following messages: detailed explanation (teachers' roles), multi-consideration of students' situation (teachers' roles), proper organization and linkage of classroom activities (teachers' roles), interaction with students (classroom culture), and going over the previous knowledge to deepen students' memory at early stage of the lesson (teachers' roles).

ZG 小组
 组长: [REDACTED] (100123089)
 秘书: [REDACTED] (100123097)
 组员: [REDACTED] (100193100)
 [REDACTED] (100123096)

这节课的主题是老师例举了几条例题让同学们学会通过演绎证明的方法来证明几何题 (**mathematical task**)。老师讲课很有技巧的引导同学让学生们主动思考, 她先通过之前做过的一条熟悉的题目讲起, 帮助同学们回忆他们之前用的证明方法, 同时顺其自然的灌输新的证明方法—演绎证明法 (**teacher roles**)。然后在例举了基本的题目让学生习惯这种证明方法的思维方式 (**teacher roles**), 并且不断的与学生互动调动学生的积极思考 (**classroom culture**), 但我组成员认为老师讲课思路的分析结束后应把其中的证明过程写一下, 让同学知道规范的证明写法 (**teacher roles**)。老师的讲课思路清晰 (**teacher roles**), 上课目的明确 (**mathematical task**), 生动易懂, 较容易让绝大多数的学生接受 (**accessibility**), 同时我们也看到了老师的耐心, 在学生不能快速并且准确的明白老师的提问时, 她表现得非常有耐心, 通过一步步简单的提示让学生能自己顺着思路里出其中的正确答案 (**teacher roles**)。

Figure 2. The report and coding of the ZG.

LLFW 小组
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 成员 100123073 [REDACTED]
 成员 100123074 [REDACTED]

优点:
 讲解仔细; 多方面考虑到各学生状况; 课程环节安排得当, 上课条理明确; 与学生互动; 课前, 回顾知识点, 加深学生记忆;

缺点:
 讲课话语冗长不够简练; 学生兴趣没有提起; 提问时, 接了太多学生的话; 画图不够准确; 例题, 不给详解, 均做分析;

Figure 3. The report of the LG.

At stage two, when the groups re-observed and re-analyzed the first lesson, it was found that 16 of 17 groups used the five-dimensional analysis framework to organize their reports (Note: Two groups did not submit their reports). However, seven groups thereof directly adopted the table and its features of the five-dimensional analysis framework to state their comments, such as the report of Lu Group (see Figure 4). It was not difficult to find out that the group tended to fill out the features of each dimension in the table by the general facts abstracted from the lesson. Therefore, to a great extent, such usage of the analysis framework as filling out the table limited pre-service teachers' thinking in the analysis of the lesson. The other nine groups were able to elaborate their viewpoints and link them to the specific instances collected from the lesson under the five-dimensions of the analysis framework.

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维度	核心特征
课堂任务的性质	使数学问题化, 把现实的问题在课堂上进行讲解分析证明; 连接学生已有知识巩固了三角形的角度关系; 有数学价值
教师角色	带着目标选择任务, 首先说明了这节课是举例证明, 主要讲解有关证明的分析法, 再根据任务确定例题; 分享重要信息, 把题目中的条件一个一个理清, 并用图形结合的方式进行讲解
课堂的社会文化	有价值的想法和方法; 学生选择和分享他们的方法; 错误是每个人的学习点; 正确来自数学争论。在课堂上每个人都积极发言, 有想法及就说出来, 不管你的想法是否正确都要大胆的说出来, 一个问题有多种解法, 不能拘泥在一种解法上, 这样课堂才能更活跃
作为支持学习的数学工具	工具的意义必须由每个学习者建构, 这样学生对这些工具才更了解比如说三角形, 圆规; 有目的地使用来解决实际问题, 在问题清楚的基础上知道自己需要哪些工具; 用于记录、交流和思考, 图形结合题目一目了然, 便于后面的分析证明
平等和易懂	任务对于所有学生都是易懂的, 让学生轻松快乐地学习; 每个学生都被倾听, 每个学生都贡献; 作为教师所要做的是提高每个学生的水平, 所以每个学生的机会应该均等, 在学生还没放弃自己之前老师不能放弃任何一个学生。

Figure 4. The report of the Lu Group.

More importantly, when the groups observed and analyzed the second video lesson under the instructor's guidance, 16 of 19 groups substantially improved the capacities of generalizing and expressing their viewpoints when they used the five-dimensional framework as the analysis tool. For example, in the report of AG (see Figure 5), each dimension led a paragraph and each paragraph discussed one topic that related to the dimension of the analysis framework. Therefore, the analysis framework facilitated the groups to clear up their viewpoints that came out during the lesson observation and analysis. Meanwhile, the analysis framework was able to stimulate the groups to deepen their concepts on the dimensions. For example, as for the dimension of tools, the groups not only discussed the obvious material objects, such as mini blackboard, ruler, and compasses, but also recognized the role of the soft tools. For example, CG considered the role of underscoring the keywords by colored chalk in helping the students understand the problems' structures. And the EG (E Group) insightfully recognized the role of the flow charts used in the explanation of problem-solving process in helping the students construct a clear train of thought.

Overall, from stage one to stage two, the pre-service teachers were able to demonstrate their viewpoints from illogical statement to structured analysis based on the five-dimensional framework.

课堂评价	
奥特家族: ■■■100123093 ■■■100123092 ■■■100123098 ■■■100123095	
课堂任务的性质:	
开始上新课之前, 老师先进行对前一节课的复习, 是同学可以对上节课知识进行回忆, 尤其是对于如何证明两个角相等的复习, 对这节新课有帮助。提出错误的结论从而引导学生给出正确的结论并且教会同学们学习的方法之一——总结证明的通法。在对上一节课总结完毕之后, 引出一节课的内容, 教会学生应用两种证明的通法证明两直线垂直。	
教师角色	
该教师在上课的时候, 并没有一味的自说自话, 不是把自己放在一个教育者的高层次, 而是作为一个引导者, 慢慢地将学生引入知识的殿堂, 并且在他们的思路想歪了的时候, 及时纠正错误。引导学生做题层层深入, 由繁变简从而得出最佳的解题思路, 例如第四道例题, 先后给出了三种方法, 从而得出引用代数的最佳方法。给予同学一定的提示, 循循善诱学生去解题。并在一个内容结束时, 做一定的总结, 让学生对知识有更深的印象。这位老师很好的扮演了作为一个老师引导学生的进行思考和探索的角色, 她把尽可能多的将思考机会给予了学生, 这样一来, 让学生在课堂上能够有很大的学习和进步的机会。老师在适当的时间教会同学如何去学习, 就是要通过总结方法, 如何解题, 就是要通过边读题目边做记号, 做到, 一边学习一边总结一边思考的学习方法。	
课堂的社会文化	
老师在教授学生一个知识的时候并没有盲目教授, 而是从定义出发, 例如该老师就先提问学生什么是“垂直”, 在搞清楚这个问题之后才能进行下面的教学工作, 否则地基打不稳, 知识的大楼	

也盖不高。当老师用小黑板给出学生题目的时候, 并没有马上开始讲课, 会站在同学的角度上: 考虑问题, 知道同学进行思考才能给出答案, 若给出题后马上进行讲解, 反而得不偿失。还有一点, 老师会在讲解题目的时候引导同学将题目的条件写在图上, 这样直观易懂, 又可以减少做题的时间。老师详细得当的分析过程以及解题过程写下来, 并且与同学们一起将每个步骤的道理写下, 同时教会学生如何思考如何书写, 这对学生以后学习帮助是很大的。课堂互动是该老师的一个很大的特点, 这样不仅可以吸引学生的注意力, 巩固知识, 还可以培养学生对数学这门学科的兴趣, 因为从互动问答的过程中, 同学们得到了成就感。

作为学习支持的教具

该教师提前准备好小黑板, 不但可以节省宝贵的上课时间, 而且可以利用小黑板带着同学们读问题, 来理解题意, 并且划出关键字, 帮助同学们找到思路, 根据题目, 在图上标注条件, 直观地引导同学深入思考。根据问题, 联系实际, 导出今天要交的内容, 先列出基本框架, 再逐个举例说明问题。用小黑板既节省了教师抄题的时间, 又有实际操作性, 方便教师在上面进行适时的标注, 对于教学教育来说真实可行, 完全不亚于其他先进的多媒体。还有用到三角尺和圆规, 该老师对于作图没有丝毫的马虎, 利用三角尺和圆规将图形很准确的画出, 这样有利于学生对题目的思考, 并且设立了一个很好的榜样。

平等和易懂

该教师的成功之处就在于与学生建立了一个平等的互相学习的关系, 就像一位和蔼导师而不是一位严厉的教师。当学生答错问题的时候, 也不急于批评, 而是慢慢地引导学生走出误区。在做例四的时候, 老师请同学上黑板来做题, 这样不仅清晰明了, 当做完题目的时候, 带动全班给该学生鼓励, 这样增加了同学的信心, 并不断地请同学给出自己的想法, 互相交流各自的方法。

Figure 5. The report of the AG (Ao Group).

Dimension Three: The Shift From the Skilled Video Analysis to the Valued Beliefs on Mathematics Teaching

At stage three, based on the two previous learning stages, the participants were asked to reflect the whole process of the video analysis activity with the intention to refine the method of analyzing a classroom teaching in the form of exam. Therefore, the collected answering sheets showed the participants' independent thinking results. Thus, to some extent, it is possible to examine the individual involvement in the previous learning activities through the statements in the answering sheet.

On one hand, it was found that 84.2% participants had set the mind upon applying the five-dimensional framework (including the other created proper frameworks) to analyze a lesson, even 15.8% participants thereof could not completely apply it (see Figure 6). This meant they were capable to refine the analysis method of the classroom teaching from the video lesson analysis process.

For example, Miss Xu offered the answer in the following way (see Figure 7): Level one—"If we want to analyze a classroom teaching, we should firstly understand the teaching content and its key points"—The dimension of mathematical task was taken as a tool to observe a classroom teaching; Level two—"For example, when I observed the first video lesson, it was found that the teaching content-analytical method and synthesized method were clearly wrote down on the blackboard"—The facts were selected from previous observation activities to support the dimension; and Level three—"It was very useful to stimulate students to realize the lesson focus—The application of the two methods in the proof problems, which definitely would mobilize their thinking"—The comments based on the facts that were able to indicate the significances of the dimension as a tool to observe a lesson. With such statement pattern, she discussed the other four dimensions of the five-dimensional framework. It was reasonable to confirm that pre-service teacher Xu was able to apply the five-dimensional framework in the methodological perspective and refine the analysis method from the previous activities as the comments—the clear analysis framework and the exact cases in point—offered from the instructor at the top of the sheet and her own summarizations in the front of her answering—from

disorganization to proper organized and multi-dimensional framework in the analysis (see Figure 7).

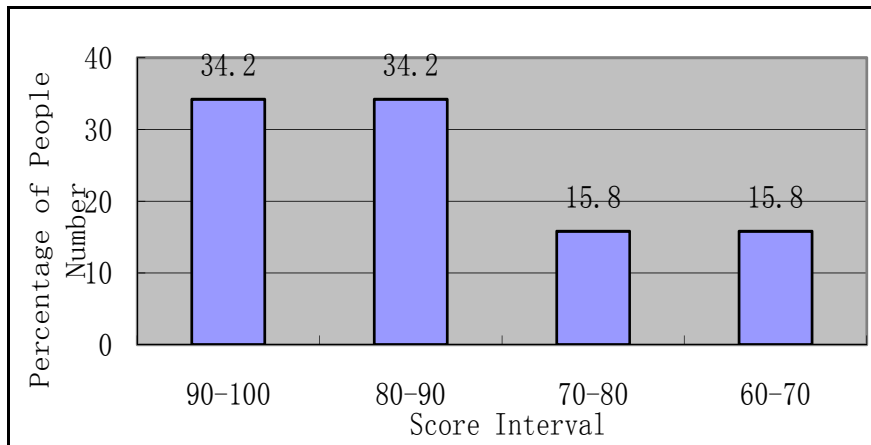


Figure 6. The reflection scores.

①分析框架清晰，论证严密。
 ②总结了所获经验。
 ③结合课例。徐红燕 学号：100123051

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(1) 首先，我们曾做过三次课堂教学的评析活动。而我对我个人而言，分析一堂课堂教学活动也是从无结构无条理转变为有条理，多方面以谁良框架的形式来分析教学活动。

要分析一堂课堂教学活动，*第一要明白这一堂课所要讲的教学内容及知识要点。比如：在观看第一次视频时，老师当时很明确的在黑板上写下了：证明方法：分析法 and 综合法。这样同学们很清楚的认识到原来我们这节课和是要运用分析法和综合法来得有关的几何问题证明出来，学生思维顿时活跃起来。

Figure 7. The report of the pre-service teacher Xu.

The reflection not only facilitated pre-service teachers to refine the method of observing and analysing a lesson, but also deepened their views on the lesson plan, the students' cognition, the interaction between teacher and students, and even the career as a mathematics teacher. For example, as for the lesson plan, Mr. Jin believed that a teacher should consider the selected examples in variation theory at the lesson plan stage and Miss Yang stated that a teacher should fully prepare himself for a lesson before it started in terms of the teaching content, the predictable students' difficulties, and the full mind state. As for the students' cognition, Mr. Sun suggested that teaching was to help students find out the solution when they confronted a new problem, not only impart to them the new concept or problem-solving skill. And Miss Li further indicated that a teacher should pay close attention to not only the students' cognitive situation but psychological health as well. For example, if a student could not answer a question, the teacher should encourage the student to further his/her thinking by offering some prompts, which was able to build the student's confidence. Likewise, Mr. Ye mentioned that an active interaction between teacher and students would exalt students' learning interests. More importantly, as for the teachers' career, 98% pre-service teachers in their reflections stated that being a

mathematics teacher was not easy and should pay close attention to a lot of things, because even a very tiny detail could greatly influence students' thinking, sentiment, and psychology. Moreover, they were going to do their best to promote their professional levels.

Conclusions

We contend that the video lesson analysis based on the authentic classroom teaching has a great potential to support pre-service teachers' professional learning with the five-dimensional framework.

Firstly, learning how to analyze a classroom teaching:

Knowing how to analyze a classroom teaching was not only indicated from the reports of the pre-service teachers, but also reflected from their concepts on the classroom teaching. For example, in the reflection, Miss Qian stated that:

I, who never paid attention to how teacher instruct and how he or she select examples, began to critically and analytically look at a mathematical classroom teaching. This was a big change for me.

Liu said:

Firstly, what I have learned was four Ws: how-how to analyze; what-what would be analyzed; where-where would start from; and why-why we can analyze like this; and Secondly, before as a good teacher, knowing how to observe a lesson was crucial to matter in terms of a higher start point we could stand.

Cheng summarized such detailed facts as:

Initiatively, I thought observing a classroom teaching was nothing but to talk about personal ideas. However, from the instructor's review of our group report, we found there were so many mistakes made even in a very short context, such as inappropriate title, the disorder context arrangement, the missing citation, and so on. More importantly, the alacritous analysis framework as a useful tool was learned to apply during the review process. The impressed scenario was the instructor classified our reports of applying the analysis framework to observe the lessons into such categories as appropriate application, ill-application, and abused application and explained every report in terms of the role of the analysis framework.

And he further summarized that:

Overall, from the review process, I knew what was appropriate and what should be improved.

Secondly, understanding the pedagogical knowledge:

Through the video lesson analysis process, the pre-service teachers were able to understand the pedagogical knowledge in the lesson context. For example, in the reflection, Mr. Yan realized that:

Qualification of being a teacher firstly helps students understand the taught content in their acceptable ways as the case teachers have done in the lessons. The case teacher could figure out the difficulties and misunderstandings of students confronting to the new knowledge and stimulate students' thinking to overcome them from the students' perspective.

In addition, Mr. Yan made it clear that:

Teaching was not a person matter, but a communication between teacher and students that tender not only students to concentrate on the learning activities, but also teacher to know well students' participation and understanding.

While Miss Gan mentioned that:

What made me deeply impressed were the examples selected in the lessons. There were only three examples in a

lesson, but it took the case teacher a lot of time, energies, and thinking to arrange them in terms of their construction, knowledge covering, the question style, and so on.

Mr. Nan draw a conclusion that:

Such analysis activities make us realize that providing a good classroom teaching needs to embody a lot of such characteristics as favorable thinking, active students' participation, powerful personalities, and strong articulation, which we should pursue in our current learning, or even long-life learning.

Thirdly, making the connection between theory and practice:

In addition to the positive reaction to the application of the five-dimensional framework, the pre-service teachers were able to examine the specific scenarios from the theories that they have learned before the sessions. For example, in the reflection, Miss Yang said:

I knew better about Freudenthal's thought of mathematics education and Polya's conception on problem-solving. Before I did not understand their significances very well. However, through these analysis activities, I could understand them in the lesson situation. For instance, I understood the function that the case teacher did not adopt the direct instruction but piloted students to solving the problems by themselves was to provide students more creation space in terms of Freudenthal's re-creation thought.

Miss Dai added that:

The active learning in Polya's conception on problem-solving was performed by such facts as students' independently thinking and discussion with classmates in the lessons. Teaching was not a matter of imparting.

Mr. Chen summarized that:

The theories in the practices were easy to understand and apply them, but we owned such few chances that we always understand them from textbooks. However, this time, our instructor provided us with such chances by encouraging and guiding us to analyze the video lessons.

Fourthly, valuing the beliefs of being a teacher:

The pre-service teachers not only realized the challenges but also orientate the process of being a successful mathematics teacher. For example, Mr. Jin noted that:

In the analysis activities, I really experienced that a classroom teaching needs to go through so many complexities. Meanwhile, I realized my insufficient knowledge and unsophisticated thinking to be a qualified teacher. So, these analysis activities directed our way to be a qualified teacher.

Miss Xu offered a detailed experience that:

Before I only knew teaching was to completely impart teacher's knowledge to students. However, now I realized it was not so simple. Teaching was a process. While teacher played a crucial role in the process. Such matters as instructing methods, students' participation, and students' performances, and so on, were the key indicators of valuing the classroom teaching effects. For pre-service teachers, learning from the analysis of experienced teachers' authentic lessons was essential to deeply understand the meaning of being a teacher.

Nevertheless, the online forum did not substantially stimulate students' group discussion. After submitted the group reports, the whole group did not give any substantial feedback to other groups' reports. Therefore, we still find it necessary to explore how to more effectively implement the video case analysis in pre-service teachers' professional learning than before in the future researches.

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