

Development of a Visualization-based System for Analyzing Teachers' Emotional Experience in Classroom Observation Activities

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Abstract: Classroom observation is a powerful tool to understand teaching, diagnose teaching problems and identify development needs of teachers. The existing studies often focus on teachers' behavior, knowledge and skills during classroom observation. However, the emotional state of teachers is neglected, though it has a significant influence on the teaching effects. The purpose of this study is to analyze teachers' emotional experience in classroom observation through developing a visualization-based system, thereby promoting active participation, and reflection of in-service teachers. This study included 55 in-service Chinese teachers who had totally observed eight classroom activities in three weeks. Eight visual reports about the emotion, the degree of satisfaction and technology acceptability were collected for analysis. The results reveals three findings. Firstly, this system can effectively display teachers' changes of emotion, teaching concerns and problems. Secondly, it has a higher degree of satisfaction and is useful and easy to use for teachers. Finally, there are significant differences among teachers with different years of teaching experience on the degree of satisfaction and technology acceptability about this system.

Keywords: visualization-based system, emotional experience, classroom observation

1. Introduction

Classroom observation activities with experts and peers can promote teachers' collaborative and self-reflection, which is a popular approach for teachers to develop their knowledge and ability. In the 2007 Teaching and Learning International Survey (TALIS), over 70% of teachers in participant countries reported that classroom observation was a component in performance evaluation and feedback (OECD, 2009), and a powerful tool for developing an in-depth understanding of teaching (David & Juan, 2011). However, a top-down approach of classroom observation may lead to only focus on teachers' behavior, knowledge and skills, and neglected the emotional state of the participants which has a significant impact on the effects (Ruiz et al., 2016). It worth noting that teachers' emotions are inseparable from their moral purposes and their ability to achieve those purposes, and are rooted in and affect their selves, identities, and relationships with others (Liljestrom, Roulston & deMarrais, 2007). Thus, a bottom-up approach, which focuses on group-based observation, discussion and reflection in a group, should be adopted. In particular, the study will center on the following questions:

- (1) How can teachers' emotional experiences in classroom observations be captured and analyzed using a visualization-based system?
- (2) What are the teacher's degree of satisfaction and technology acceptability to the visualization-based system?
- (3) Are there any differences on the degree of satisfaction and technology acceptability among teachers with different years of teaching experience?

2. Literature Review

2.1 Classroom Observation

Classroom observation can help us to understand get to know that teachers are teaching activities in real situations better (Putnam & Borko, 2000) and can provide teachers with formative feedback (Julie & Dan, 2016). Classroom observation have been regarded by researchers and practitioners as the most effective method for teacher professional promotion (Montgomery, 2002). However, teachers may be fear and even reject to being observed by other people. The reason resulting in this phenomenon may be that the feedback is always fuzzy and scattered (Haep, Behnke & Steins, 2016).

As a method of data collection, classroom observation is a powerful tool for the perspective of classroom practice (Millman & Darling-Hammond, 1990) and has been widely used to evaluate teachers' teaching effects. However, the dominating method in the vast majority of observation experiences is the top-down approach, which is mainly utilized to evaluate teachers' performance and determine their tenure. Even though a single classroom observation can provide a basis for informal teaching guidance, it cannot provide sufficient supports for the formal assessment of a teacher's tenure (Kane & Staiger, 2012). The results show that the long-term use of data-based feedback can significantly improve the teaching quality of teachers (Hurk et al., 2016). Generally, forming a reliable and constructive feedback report for teachers need much effort, which may require at least three teachers to observe one lesson, or one teacher to observe at least ten lessons to make a summative assessment (Lans et al., 2016). The use of data-driven teaching is a powerful lever to leverage the transformation of teachers' professional learning (Marsh, 2012).

2.2 Emotions Visualization

Human emotions divide into two types: positive emotions (joy, hope, pride, confidence, excitement and interest) and negative emotions (anxiety, anger, shame, disappointment and frustration). Positive emotional state can improve learners' learning effect (Ruiz, 2016). Previous studies used different tools to collect emotional data and visualize the state of emotion. For example, Samara Ruiz et al used PresenceClick to collect emotional data, so that the learners use the visual dashboard to track their emotional change and see the evaluation results (Ruiz, 2016); Gaelle Molinari et al designed the Emotion Awareness Tool which is a computer-based self-report emotional tool. The results of the above studies indicated that emotions visualization could stimulate students' participation in emotional interaction and improve the interaction quality between learners (Leony, 2013). However, the focus of classroom observation simply pay attention to teachers' knowledge and behavior, rather than emphasizing the changing characteristics and trends of the emotional state.

3. Development of a Visualization-based System for Analyzing Teachers' Emotional Experience

This study adopts text sentiment analysis and self-reported emotional marking tool to analyze emotional inclination based on teachers' classroom observation records, teaching reflection and comments. Then it identify accurately the emotion of teachers participating in the activities of classroom observation, visualize the characteristic and regularity of teachers' emotional state, and mine the hidden information.

Firstly, the information source was selected from the Learning Cell platform (Yu et al., 2015) and other tools for classroom observation activity. In this study, we select observation records, peer feedback contents and teaching reflections, as the text set of emotion identification. Secondly, this study would identify the emotion inclination of all teachers who participated in the classroom observation activities. The data for emotion identification mainly consisted of two parts: one was self-reported emotion. The second was to recognize the emotional tendency of text. Third, this study uses the software of wordcloud2 to generate word cloud of keywords about teachers' knowledge. Teachers produce a large number of observation records after teaching one or more lessons. It is difficult for teachers to efficiently find the teaching advantages and disadvantages. Therefore, this

study adopts the software of wordcloud2 to generate the word cloud of teachers' teaching advantages and disadvantages, and use the Dotted Chart Technology (Song & Aalst, 2007) to visualize the key information in classroom teaching. The visualization-based system is shown in Fig. 1.

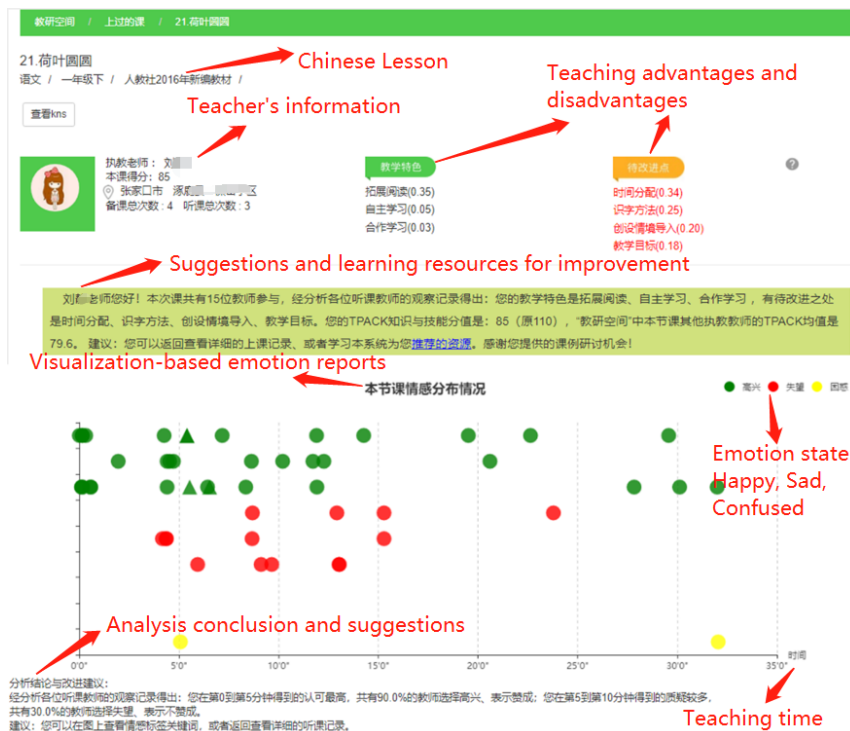


Fig 1 Visualization-based system for analyzing teachers' emotional experience

4. Methodology

4.1 Participants

All these 55 teachers who are from twelve different primary schools in China are teaching Chinese. The distribution of teaching experience is: 11 in 0-5 years of teaching experience, 16 in 5-10 years, 11 in 10-15 years, and 17 beyond 15 years. All of them were voluntary to participate in this study and researchers got ethical approval from them.

4.2 Procedure of the study

Firstly, teachers used classroom observation tools to observe eight lessons, and each teacher submitted eight observation records to the visualization-based system. Secondly, the visualization-based system provided the visual emotional experience report for in-service teachers. Thirdly, teachers carried out post-lesson discussion with emotional reports. Finally, teachers needed to complete the scales of satisfaction and technology acceptability after lessons. This study adopted semi-structured interview with focus group to collect qualitative data for further investigation.

4.3 Instruments

The degree of satisfaction with the visualization-based system was measured by the scale of satisfaction, and the Cronbach alpha coefficient is 0.91 (Chu et al., 2010). The scale of technology acceptability measured the cognitive usefulness and ease of use about the visualization-based system. It consists of two sub-parts: cognitive usefulness and cognitive ease of use. The Cronbach alpha coefficients were 0.95 and 0.94 respectively (Hwang, Yang & Wang, 2013). All responses were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

5. Results and Discussions

5.1 Teachers' emotional experiences could be analyzed using a visualization-based system

As shown in Fig 2, it is easy for teachers to find out their teaching advantages and disadvantages with the help of the visualization-based system. Firstly, teachers can adopt the visualization-based system to find out the key information in classroom teaching, to see whether there is unequal distribution of activity based on which they may determine whether there was needs for further investigation or intervention within the group (Leeuwen et al., 2014). Leony et al. (2013) analyzed that visualizing the emotional state of learners indeed can facilitate their active participation and deep interaction. Secondly, educational managers or other stakeholders can use visualization-based system to discover teacher's teaching concerns and in-the-moment changes of emotion. This is consistent with previous studies, for example, Chang (2009) considered that it is necessary to investigate teacher emotions through technology devices, which can make teachers to reflect on the teaching activities after the class on the digital tools (Ruiz et al., 2016).

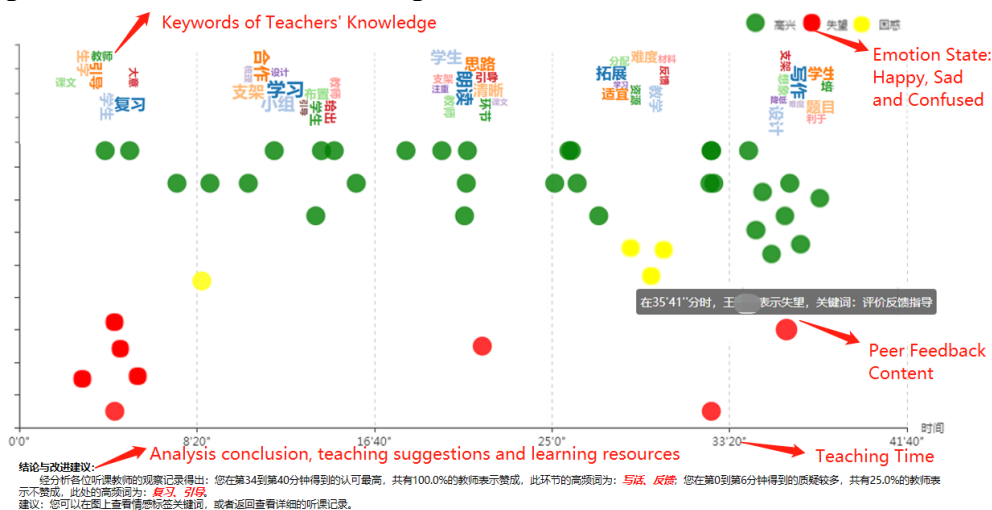


Fig 2 Visualizing the emotion experience of teachers in classroom observation

5.2 Teachers' degree of satisfaction and technology acceptability

In this study, 55 questionnaires were distributed in which 3 invalid were removed and 52 valid were obtained. The data were analyzed by SPSS20.0. The results shows that the visualization-based system can help teachers find new problems, and observation activities are more interesting than before (Mean = 4.028, SD = 0.607). Technology acceptability focused on two aspects: the cognitive usefulness (Mean = 3.949, SD = 0.682) and cognitive ease of use (Mean = 3.731, SD = 0.627).

5.3 Teachers' degree of satisfaction and technology acceptability of different years of teaching experience

This study adopted single factor analysis of variance to the difference of teacher satisfaction between four teaching ages. The results shows that there is a significant difference between teacher satisfaction in four teaching ages ($F = 7.759, p = 0.000 < 0.01$). In order to analyze accurately the differences between different teaching ages, this study used the post-event multiple comparison test to determine the significant differences. The results shows that teachers aged between 5-10 years of teaching experience and over 15 years are more satisfied with the visualization-based system than teachers who had been teaching for 0-5 years and 10 to 15 years.

The results shows that there is a significant difference of cognitive usefulness ($F = 5.350, p = 0.003 < 0.01$) and cognitive ease of use ($F = 3.747, p = 0.017 < 0.05$) between four teaching ages. This study used the post-event multiple comparison test to determine the significant differences between four teaching ages. The results showed that teachers aged between 5-10 years and over 15 years were higher in cognitive usefulness than teachers who had been teaching for 0-5 years and 10 to 15 years.

Teachers aged between 5-10 years was higher in cognitive ease of use than teachers who had been teaching for 0-5 years and 10 to 15 years, as shown in Table 1.

Table 1 *Difference of Technology Acceptability between Four Teaching Ages*

Technology Acceptability	Group	N	SD	F	Pairwise comparisons
Cognitive Usefulness	Level1	10	.681	5.350**	Level2>Level1
	Level2	16			Level2>Level3
	Level3	9			Level4>Level1
	Level4	17			Level4>Level3
Cognitive Ease of Use	Level1	10	.627	3.747*	Level2>Level1
	Level2	16			Level2>Level3
	Level3	9			
	Level4	17			

*p<0.05, **p<0.01, Level1, Level2, Level3 and Level4 respectively represents 0-5 years, 5-10 years, 10-15 years and over 15 years.

There are significant differences of satisfaction and technology acceptability between four teaching ages. The reason may be that teachers who had been teaching for 0-5 years belongs to novice teacher, whose teaching focuses on class organization and student management (Harju & Niemi, 2016), and had not mastered enough pedagogical content knowledge. The present study suggested that the benefits of visual tools are different for specific types of teachers. This is consistent with Leeuwen et al. (2014), who consider that there may be some differences on the benefits of supporting tools between beginning teacher and more experienced teacher.

Teachers who had been teaching of over 15 years generally belongs to the mature stage of teacher professional development (Fessler & Christensen, 1992). They may have abundant teaching experience, pedagogical content knowledge and higher personal accomplishment, by means of visualization-based system to carry out classroom observation activities are more likely to improve efficiency. This is consistent with the research results in the field of teacher burnout. The results from the field of job burnout indicate that the expert teachers are more likely to have a higher sense of personal achievement and lower emotional exhaustion, and are more willing to learn new things and maintain their own professional development (Droogenbroeck, Spruyt & Vanroelen, 2014). Teachers who had been teaching for 10-15 years generally belongs to midcareer teachers. Fessler and Christensen (1992) found that career frustration and burnout are typical for midcareer teachers. This maybe why teachers who had been teaching for 10-15 years was lower in degree of satisfaction and technology acceptability than 5-10 years and over 15 years.

6. Conclusions

In this study, a visualization-based system has been developed in order to analyze teachers' emotional experience and promote active participation and reflection in classroom observation activities. The results show that teachers who participated in this study are more satisfied with the system. Teachers can adopt the system to find out the key information in classroom teaching, promote the interaction between teachers, and obtain the peer feedback contents. The degree of satisfaction results show that the system could help teachers find new problems. The results of technology acceptability suggest that the system is useful and easy to use for teachers.

The results reveal that there are significant differences on degree of satisfaction and technology acceptability between different years of teaching experience about the system. This study suggests that benefits of the system are different for specific types of teachers. Teachers with 5-10 years of teaching experience and over 15 years are more satisfied with the system than those who had been teaching for 0-5 years and 10 to 15 years. Teachers who had over 15 years of teaching experience are more likely to improve efficiency of the classroom observation using the system. This is consistent with the results from the field of job burnout, which indicates that the expert teachers are more likely to have a higher sense of personal achievement and lower emotional exhaustion, and are more willing to learn new things (Droogenbroeck, Spruyt & Vanroelen, 2014).

In brief, the visualization-based system in this study can identify accurately and visualize the emotion of teachers, and mine the hidden information by analyzing peers' classroom observation records. The limitation of this study is its time and sampling. We will select more teachers with appropriate ratio of males and females to carry out more large-scale application research.

References

- Chang, M. L. (2009). An appraisal perspective of teacher burnout: examining the emotional work of teachers. *Educational Psychology Review*, 21(3), 193-218.
- Chu, H. C., Hwang, G. J., Tsai, C. C., & Tseng, Judy C. R. (2010). A two-tier test approach to developing location-aware mobile learning systems for natural science courses. *Computers & Education*, 55(4), 1618-1627.
- Droogenbroeck, F. V., Spruyt, B., & Vanroelen, C. (2014). Burnout among senior teachers: investigating the role of workload and interpersonal relationships at work. *Teaching & Teacher Education*, 43(3), 99-109.
- Fessler, R., & Christensen, J. (1992). The teacher career cycle: understanding and guiding the professional development of teachers. *Allyn & Bacon*.
- Haep, A., Behnke, K., & Steins, G. (2016). Classroom observation as an instrument for school development: school principals' perspectives on its relevance and problems. *Studies in Educational Evaluation*, 49, 1-6.
- Harju, V., & Niemi, H. (2016). Newly qualified teachers' needs of support for professional competences in four European countries: Finland, the United Kingdom, Portugal, and Belgium. *Ceps Journal Center for Educational Policy Studies Journal*, 6.
- Julie, C., & Dan, G. (2016). Building a More Complete Understanding of Teacher Evaluation Using Classroom Observations. *Educational Researcher*, 45(6), 378-387.
- Hurk, H. T. G. V. D., Houtveen, A. A. M., & W.J.C.M. Van de Grift. (2016). Fostering effective teaching behavior through the use of data-feedback. *Teaching & Teacher Education*, 60, 444-451.
- Hwang, G. J., Yang, L. H., & Wang, S. Y. (2013). A concept map-embedded educational computer game for improving students' learning performance in natural science courses. *Computers & Education*, 69(69), 121-130.
- Kane, T. J., & Staiger, D. O. (2012). Gathering feedback for teaching: combining high-quality observations with student surveys and achievement gains. *policy and practice brief. met project*. Bill & Melinda Gates Foundation, 36.
- Lans, R. M. V. D., Wim J.C.M. van de Grift, Veen, K. V., & Fokkens-Bruinsma, M. (2016). Once is not enough: establishing reliability criteria for feedback and evaluation decisions based on classroom observations. *Studies in Educational Evaluation*, 50.
- Leeuwen, A. V., Janssen, J., Erkens, G., & Brekelmans, M. (2014). Supporting teachers in guiding collaborating students. *Computers & Education*, 79(C), 28-39.
- Leony, D., Muñoz-Merino, P. J., Pardo, A., & Kloos, C. D. (2013). Provision of awareness of learners' emotions through visualizations in a computer interaction-based environment. *Expert Systems with Applications*, 40(13), 5093-5100.
- Liljestrom, A., Roulston, K., & deMarrais, K. (2007). "There is no place for feeling like this in the workplace": Women teachers' anger in school settings. In P. A. Schutz & R. Pekrun (Eds.), *Emotions in education*. San Diego: Elsevier.
- Marsh, J. (2012). Interventions promoting educators' use of data: Research insights & gaps. *Teachers College Record*, 114(11), 1-48.
- Millman, J., & Darling-Hammond, L. (1990). The new handbook of teacher evaluation: assessing elementary and secondary school teachers. *Thousand Oaks, CA: Corwinpress, Inc.*
- Montgomery, D. (2002). *Helping teachers develop through classroom observation*. 2nd ed. London: David Fulton.
- OECD (2009). *Creating effective teaching and learning environments: first results from TALIS*. Paris, France: OECD Publishing.
- Putnam, R., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*, 29(1), 4-15.
- Ruiz, S., Charleer, S., Urretavizcaya, M., Klerkx, J., Ndez-Castro, I., & Duval, E. (2016). Supporting learning by considering emotions: tracking and visualization a case study. *International Conference on Learning Analytics & Knowledge (pp.254-263)*. ACM.
- Song, M., Aalst, W. M. P. (2007). Supporting process mining by showing events at a glance. In: *Proceedings of 17th Annual Workshop on Information Technologies and Systems*, 139-145.
- Yu, S., Yang, X., Cheng, G., & Wang, M. (2015). From learning object to learning cell: A Resource organization model for ubiquitous learning. *Educational Technology & Society*, 18(2), 206-224.