Exploring the Development of Reflection Among Pre-service Teachers in Online Collaborative Writing: An Epistemic Network Analysis

Yuhe Yi[(✉)], Xiaoxu Lu, and Jing Leng

Department of Educational Information Technology,
East China Normal University, Shanghai, China
`313699389@qq.com`

Abstract. Facilitating reflection of pre-service teacher is becoming a more and more important topic in teacher education. There are a number of social media tools which can support teacher professional development. It also enables us to examine the development of individuals' reflective process and group dynamics. In this study, 50 pre-service teachers were involved to write scripts collaboratively using wikis and they were encouraged to reflect upon their written texts and script-writing strategies during the online collaborative writing process. In particular, epistemic network analysis is adopted in order to characterize learners' reflection dynamics during the two phases of collaborative script writing. The research results show that the characteristics of reflection type in different phases are different. Also, teachers tend to reflect on the content and methods of the group in the first phase; while in the second phase, they tend to reflect on the group methods and personal gains. Using content analysis and epistemic network analysis, this paper characterize the development of reflection during collaborative writing activities and provides reference for the cultivation of reflection among pre-service teachers.

Keywords: Teacher reflection · Teacher professional development · Collaborative writing · Epistemic network analysis

1 Introduction

As the practitioners of education and teaching, teachers should become active learners to improve their professional ability so as to meet teaching and learning needs in the age of information technology. Reflection is the link between individual's recent experience and past experience, and the process of individual's critical reflection on his own behavior and thoughts (Colton and Sparks-Langer 1993). It is based on past experience, a more profound internal psychological state. Therefore, it is important to understand how to cultivate pre-service teachers' reflection (Good and Whang 2002). The establishment of online communities provides a way to cultivate teachers' reflection and promote their professional development. However, one's reflection, as a mental process inside the individual's mind, is regarded as implicit and invisible. While engaging pre-

service teachers in online collaborative activities, it is important to foster their reflection upon script writing and collaborative work. In order to characterize the dynamics of reflective process, this study analyzes students' reflection journals in the process of collaborative learning.

At present, researches on reflection mainly focus on the analysis of different reflection level, the exploration of relevant cultivation modes and concepts as well as the exploration of affecting factors (Blomberg et al. 2014). However, the content of reflection journals involves multiple aspects, and each aspect may involve different types of reflection. It is necessary to find out how to dynamically construct the development of reflection and whether collaborative writing promote a more complex and interrelated mental schema among pre-service teachers during an extended period of online collaboration. In this study, epistemic network analysis (ENA) is used to explore the characteristics of individual or group cognitive framework by quantifying qualitative data. Due to its dynamic and coupling characteristics, ENA plays an important role in deep data mining, dynamic assessment of learners' ability development and improvement. It has also been favored by researchers in related fields (Shaffer 2017). The aim of this study is to use ENA method to analyze and compare the development of reflection among pre-service teachers in different phases of online collaborative writing activities.

2   Literature Review

2.1   The Cultivation of Pre-service Teachers' Reflection

The cultivation of teachers' reflection is generally considered to be an important part of their professional development. In a way, Teachers' reflection can predict the degree to which a teacher can teach students well, which is considered as evidence of teachers' effective teaching skills (Blomberg et al. 2014). Without reflection, practical experience is only a quantitative change rather than a qualitative change of experience, and teacher professional growth will not occur. And through teaching reflection, teachers can correct teaching problems and improve teaching skills (van Es and Sherin 2008). The significance of reflection for pre-service teachers is to enable them to reflect on different experiences, integrate theories with their own practical experience, form their own understanding of education and teaching beliefs, as well as put them into practice. However, pre-service teachers' beliefs and awareness of effective teaching can directly affect their attention to classroom teaching (Huang and Li 2012). At the same time, the effective reflection of pre-service teachers in their own teaching practice is an important part for them to grow and mature from novice teachers to expert teachers as soon as possible. Effective reflection can enable pre-service teachers to review and study their own teaching practice in the future teaching process. Therefore, it is necessary to pay attention to the cultivation of pre-service teachers' reflection and explore the development of their reflection.

The development of information technology has opened up new ideas for the development of teacher education. The use of technology in teaching not only promotes teachers' teaching reflection as a teaching method, but also changes and enriches

the content of teachers' teaching reflection (Mckinney 1998). For example, Krutka et al. (2014) used the social networking website Edmodo to enable teachers to conduct collaborative learning and collaborative reflection. Potter (2001) explored the development of teachers' critical reflection in the process of online collaborative research activities. Research shows that teachers' reflection is promoted during the process of collaborative learning, and at the same time, the background experience and opinions of peers have important contributions to the improvement of teachers' teaching skills and teachers' professional development.

2.2 The Epistemic Network Analysis

Ethnography is considered as an effective method to develop teachers' reflection, so ethnography can be used as a means to explore teachers' reflection (Beyer 1984). Traditional ethnography is time-consuming and difficult to be analyzed on a large scale. To solve this bottleneck, Shaffer proposed a method of "qualitative ethnography", the most important of which is epistemic network analysis. Epistemic network analysis (ENA) is not only an evidence-centered tool for quantitative analysis of textual discourse, but also a technique for modeling network topics of professional competence (Shaffer 2017). ENA has three core concepts: code, units, and sections. The code represents a set of conceptual elements, the purpose of ENA is to understand the relationships between these elements, not the individual ideas in the discourse (Shaffer and Graesser 2010). Besides, Analysis units represent ENA objects, such as activity phases or group divisions. Meanwhile, section represents the scope in which the code appears together. ENA's core idea is to establish a network reflecting the connection between different ability codes in the whole dialogue process, on the basis of the co-occurrence times of each ability codes in the context of the dialogue.

ENA has been successfully applied to the analysis of teachers' collaborative learning and scientific reasoning, and has demonstrated its outstanding characteristics (Csanadi et al. 2018). Based on this, this study will adopt the epistemic network analysis to analyze the reflection journals written by pre-service teachers during the process of collaborative learning, and explore the development process and mode of teachers' reflection in this process by comparing teachers' reflection in different phases of activities.

2.3 Research Questions

1. What are the characteristics in teachers' reflection journals while engaging them in online collaborative script writing?
2. Is there any difference in the epistemic networks of teachers' reflection between different phases of the online activity phases? If yes, what are the different epistemic characteristics of teachers in the two phases?

3 Methodology

3.1 Research Context

In this study, 50 sophomore students (23 male students and 27 female students) who took interactive courseware development course in a university were selected as experimental subjects. All of them have strong information technology literacy, and can skillfully operate various software platforms, besides, they will become an information technology teacher after graduation. Therefore, they were defined as pre-service teachers in our study. The students are randomly assigned in different groups with each containing 4 or 5 pre-service teachers. As a result, the whole class was divided into 12 groups. Before collaborative learning, the course teacher assigned the task of script writing, and required them to complete the writing task within their groups, and the activity lasted for three months.

3.2 Design

The whole collaborative scripting activity can be divided into two phases. In the first phase, the teacher group carries out online and offline discussions respectively to determine the theme and framework of script and the division of labor. After each group member completed the division of tasks, the team carried out collaborative modification to form the prototype script. The course teachers gave feedback on each group's prototype script scheme and evaluated the individual teachers' performance in the collaboration process. Then, each teacher made reflection and summary, and wrote the corresponding reflection journals towards their own understanding of the script, personal writing, group collaboration, the quality of the script, personal gains and shortcomings, etc.

The second phase is mainly to improve the prototype script. Based on the discussion results within the class and within the group, the teacher group further improved the writing of script on the Wiki platform. Each teacher participated in the collaborative modification process and finally formed the final script of the group. After course teachers' feedback, Each pre-service teacher wrote the corresponding reflection journals according to their performance in the second phase of collaborative learning activities. And the content of reflective journals mainly includes "individual performance ", "team coordination", "suggestions for script improvement" as well as "personal gains".

3.3 Coding Scheme

The data obtained in this study are mainly 100 reflection journals written by the pre-service teachers, and 50 for each phase. Taking the characteristics of collaborative script writing and reflection journals into account, we chose the reflection coding framework which is proposed by Hatton and Smith (1995) as a coding scheme to characterize different types of reflection in the reflection journal. The specific description of this framework is shown in Table 1.

Table 1. The different types in student reflections

Different kinds of reflection	Description	Coding
Descriptive writing	Not reflective at all, but merely reports events or literature	R0
Descriptive reflection	Does attempt to provide reasons based often on personal judgment or behavior	R1
Dialogic reflection	A form of discourse with one's self, an exploration of possible reasons	R2
Critical reflection	Involving reasons giving for decisions or events which takes account of the broader historical, social, and/or political contexts	R3

According to the content in student reflections, five main aspects could be identified: reflection on individual script, reflection on personal methods, reflection on group script, reflection on group method, and summative reflection. The explanation and description of each aspect are shown in Table 2.

Table 2. The different aspects in student reflections

Reflection aspects	Description	Coding
Individual content	Describing the content of individual script writing	CC1
Individual method	Explaining the methods used by himself or herself in script writing	CC2
Group content	Describing the content of the group script	CC3
Group method	Explaining the writing method of group script	CC4
Summary reflection	Analysis of its experience and harvest in the process of activities, or reflection on its shortcomings	CC5

3.4 Data Collection and Analysis

The coding of the reflection journals is done by two assistants of the course. Due to the length of teachers' reflection journals, a series of symbols representing the end of a sentence such as period, question mark, exclamation mark and so on were used as the interval points of the meaning unit during the coding in this study, and the content between each adjacent two symbols was used as a basic unit of analysis. Prior to the formal coding, the two assistants negotiated and confirmed the content of the coding framework to ensure that their understanding of it was consistent. At the same time, they randomly selected 40% of the original corpus for pre-coding, and used SPSS software to analyze the coding results, and found that the Kappa coefficient was greater than 0.7 (Kappa = 0.87), which indicating that the results of their coding were basically consistent and scientific. The two then went on to code the rest of the reflection journals.

4   Results

4.1   What Are the Characteristics in Teachers' Reflective Journals While Engaging Them in Online Collaborative Script Writing?

For the first phase, the most common reflection type was descriptive writing (R0, 56.63%). The frequency of critical reflection was the lowest (R3, 3.75%). In terms of aspects of reflection content, reflection in the first phase focused on the group content (CC3, 38.61%). In the second phase, pre-service teachers have the highest frequency in the descriptive reflective type (R1, 48.78%). The type with lowest frequency was critical reflection (R3, 10.42%). The proportion of dialogue reflection (R2, 10.42%) and critical reflection (R3, 7.32%) in the second phase was significantly higher than that in the first phase. For reflection content, the highest proportion of reflection aspect was group method (CC4, 32.88%) (Table 3).

Table 3.   Categories and frequency distributions of teachers' refection domains

	Reflection types				Reflection aspects				
	R0	R1	R2	R3	CC1	CC2	CC3	CC4	CC5
Phase one	56.63%	34.35%	5.27%	3.75%	12.24%	5.78%	38.61%	22.45%	20.92%
Phase two	33.03%	48.78%	10.42%	7.32%	8.88%	12.44%	19.96%	32.88%	26.22%
Total	46.63%	40.65%	7.51%	5.30%	10.79%	8.67%	30.34%	20.97%	20.22%

4.2   What Are the Differences Between the Epistemic Network Characteristics of Teachers in Different Activity Phases?

The epistemic network maps of each group in the first and second phase were drawn and the results showed in Fig. 1. It is shown that there are significant differences in the reflection ability of each group in the first and second phases (the first phase M = 2.27, the second phase M = −2.27, t = −7.44, P = 0.00 < 0.05, Cohen's d = 4.29).

In order to further analyze the differences between the two phases of epistemic network structure, the overall average epistemic network of the two phases is shown in Fig. 2. At the same time, the epistemic network connection coefficients of the first and second phases are shown in Table 4. The values in the table indicate the weight of the number of times each connection appears in the reflection journals. As a result, for the first phase of epistemic network, there are more connections between R0-CC3 and R0-CC4. For the second phase of epistemic network, there are more connections between R1-CC4 and R1-CC5, which indicates that they appear more frequently in pairs of pre-service teachers' reflection journals. By subtracting Fig. 2a, b and c can clearly show the difference of average epistemic network between pre-service teachers' reflection journals in the first and second phases. As can be seen from Fig. 2c, teachers' reflection in the second phase focuses more on the connection between elements in the left area, while in the first phase focuses more on the right area, which also confirms the conclusion that there are significant differences between the two phases.
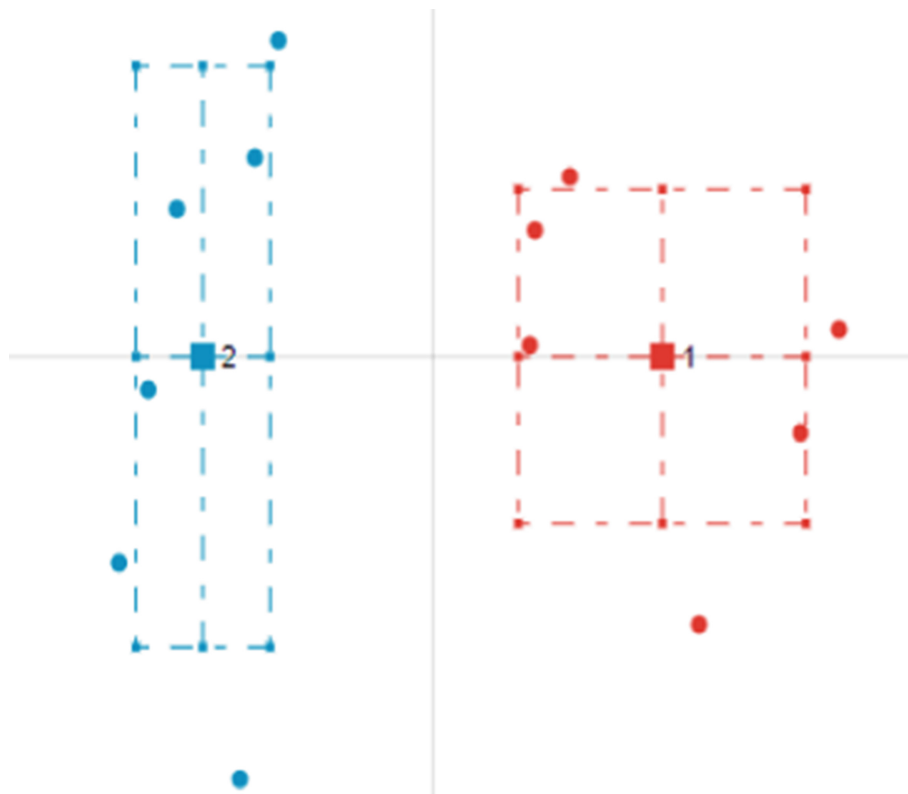
Fig. 1. Epistemic networks of the first phase (red color) and the second phase (blue color). (Color figure online)

Table 4. Connection coefficients of the two phases (Phase I & Phase II)

Connection	Phase I	Phase II	Connection	Phase I	Phase II	Connection	Phase I	Phase II
R0-CC1	1.96	1.34	R1-CC3	2.54	2.25	R2-CC5	0.64	0.45
R0-CC2	0.56	0.81	R1-CC4	1.34	3.31	R3-CC1	0	0
R0-CC3	4.75	1.58	R1-CC5	2.13	3.25	R3-CC2	0	0
R0-CC4	3.01	3.05	R2-CC1	0.03	0.15	R3-CC3	0	0
R0-CC5	0.56	0.66	R2-CC2	0.10	0.36	R3-CC4	0	0.20
R1-CC1	0.34	0.56	R2-CC3	0.16	0.56	R3-CC5	0.76	1.46
R1-CC2	0.49	1.60	R2-CC4	0.10	0.86			

Note. The connection between R0 and CC1 represents the co-occurrence of the R0 and CC1 in a stanza.
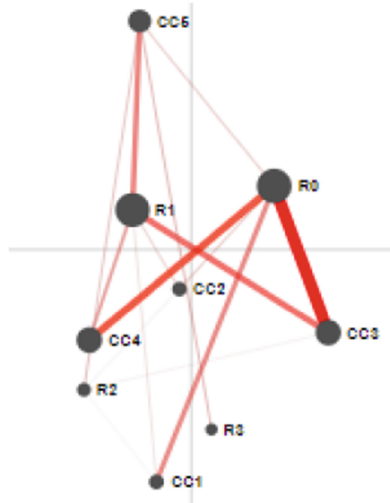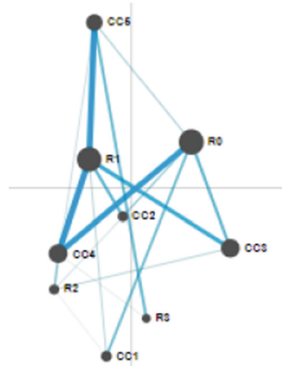
Figure 2a. Phase I

Figure 2b. Phase II
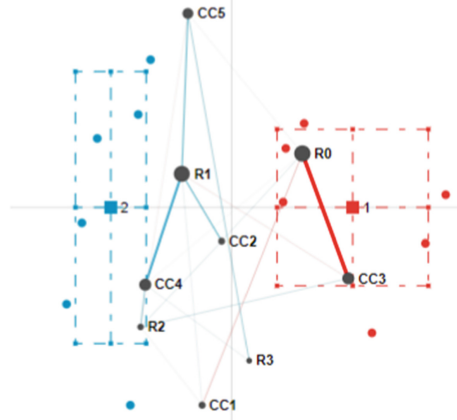

Figure 2c. The difference network between the two phases

Fig. 2. The epistemic networks of the two phases (Phase I & Phase II)

5   Discussion

Based on the online collaborative environment, this study carried out the pre-service teacher script collaborative writing activities. And research results show that the characteristics of reflection type in different phases are different. Teachers can think dialectically in a wider range of fields. Meanwhile, in the first phase, teachers tend to reflect on the content and methods of the group directly, while in the second phase, they tend to reflect on the group methods and personal gains.

In the order of the first phase and the second phase, pre-service teachers carried out collaborative activities on the online platform. In the second phase, the reflection level of teachers is higher than that of the first phase, which indicates to some extent that with the progress of the activity, a series of activity designs can effectively promote the development of teachers' reflection and enhance their reflection consciousness. Through providing specific learning feedback, pre-service teachers can deepen their understanding of the script and promote their in-depth reflection on the content.

During the activity, the reflection of teachers gradually developed. And the teachers' group discussion has strengthened the dialogue between each other to a certain extent. In the process of communicating with others, teachers have accumulated experience, which provides a reference for later individual reflection. At the beginning, the teacher simply elaborated the group content and method, and later began to deeply explore the behavioral reasons behind the method, and on this basis, reflected on its gains and shortcomings. In the process of reviewing and reflecting, the teacher continuously deepens the understanding of the script content, expands and extends the script, and improves the ability of self-reflection. Teachers' reflection is no longer a single content theory, but came to a broader field. By summarizing its experience and methods, it provides reference value for the future study.

Follow-up study will further expand the breadth and explore the epistemic network analysis in teachers' reflection development the possibility of related research. We will use the methods of multi-modal data modeling and weighted network, to construct the relation map between teachers' reflective content and their reflection, which can provide a reference for later pre-service teachers' reflection ability training.

References

Beyer, L.E.: Field experience, ideology, and the development of critical reflectivity. J. Teach. Educ. **35**(3), 36–41 (1984)

Blomberg, G., Sherin, M.G., Alexander, R., et al.: Understanding video as a tool for teacher education: investigating instructional strategies to promote reflection. Instr. Sci. **42**(3), 443–463 (2014)

Colton, A.B., Sparks-Langer, G.M.: A conceptual framework to guide the development of teacher reflection and decision making. J. Teach. Educ. **44**(1), 45–54 (1993)

Csanadi, A., Eagan, B., Kollar, I., Shaffer, D.W., Fischer, F.: When coding-and-counting is not enough: using epistemic network analysis (ENA) to analyze verbal data in CSCL research. Int. J. Comput.-Support. Collaborative Learn. **13**, 419–438 (2018)

van Es, E.A., Sherin, M.G.: Mathematics teachers' "learning to notice" in the context of a video club. Teach. Teach. Educ. **24**(2), 244–276 (2008)

Good, J.M., Whang, P.A.: Encouraging reflection in preservice teachers through response journals. Teach. Educ. **37**(4), 254–267 (2002)

Hatton, N., Smith, D.: Reflection in teacher-education - towards definition and implementation. Teach. Teach. Educ. **11**(1), 33–49 (1995)

Krutka, D.G., Bergman, D.J., Flores, R., et al.: Microblogging about teaching: Nurturingparticipatory cultures through collaborative online reflection with pre-service teachers. Teach. Teach. Educ. **40**, 83–93 (2014)

Mckinney, M.: Preservice teachers' electronic portfolios: integrating technology, self-assessment, and reflection. Teach. Educ. Q. **25**(1), 85–103 (1998)

Potter, G.: Facilitating critical reflection on practice through collaborative research. Aust. Educ. Res. **28**(3), 117–139 (2001)

Huang, R., Li, Y.: What matters most: a comparison of expert and novice teachers' noticing of mathematics classroom events. Sch. Sci. Math. **112**(7), 420–432 (2012)

Shaffer, D.W.: Quantitative Ethnography. Cathcart Press, Madison (2017)

Shaffer, D.W., Graesser, A.: Using quantitative model of participation in a community of practice to direct automated mentoring in an ill-formed domain. In: Intelligent Tutoring Systems (ITS), Pittsburgh, PA (2010)