Reflective Practices In STEM Subjects: A Review, Framework And Examination Of Two Studies

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Abstract: Reflective practice is important in professional work. This paper reports on an inquiry in which we reviewed literature on approaches to and examined our instructional strategies on reflective thinking in university course. The aim of the inquiry was to identify gaps in current reflective practices that could be filled by specific digital technologies. We specifically suggest one socio-technical reflection environment to be examined in a future study - a virtual space for teacher candidates to compose and share and comment on their reflections.

Keywords: Reflective practice, teacher education, pre-service teachers, socio-technical

1. Introduction

Reflective practice is an important part of professional work. Schön described professional workers as reflective practitioners (Schön, 1996). Emphasizing the importance of teaching reflective practice in an education context, he investigated how to mentor students in higher education to become more reflective (Schön, 1996). In this research project, we investigate the current approaches to reflective thinking in teacher education and examine our own instructional strategies on reflective thinking in university courses. The inquiry aimed to identify gaps in current reflective practices that could be filled by harnessing digital technologies. We suggest one socio-technical reflection environment- a virtual space for pre-service teachers to write and share their reflections with peers, the associate teachers, and with their course instructors.

2. Literature Review

Our process of reviewing literature on reflective thinking in teacher education aimed at creating summaries, and bridging these summaries deductively to make conclusions and suggestions for further studies (Doyle, 2003). We identified 438 articles that are relevant to the topic of using reflective technique in teacher education. Upon scanning the abstracts of the first 150 articles, ordered by relevance, we narrowed the scope down to 48 relevant articles.

It appears there were three predominant methods among reflective practices of teacher candidates. Specifically, they are: a) writing, b) discussion, and c) videotape review. Writing was done either individually or as a collective activity. Discussions involved verbal interactions with others and consisted of several formats. Examples of discussion are intimate conversations held during group meetings (Danielowich, 2007), teacher study groups (Genor, 2005), and discussions about "student actions, reactions,…, and responses to classroom learning events" (Moore, 1999, p. 261). Videotape review almost always consisted of pre-service teachers observing their own teaching after the fact (Gal, Lin, & Ying, 2009), which allows them to examine their action (Freese, 1999). All videotape reviews involved candidates reflecting on their practice in individual rather than collective environments.

Given today's technological advancements, it was important to determine if reflections activities were given digital voices. Interestingly, the overwhelming majority of studies did not make use of digital technologies in the reflective process (e.g., only 4 of 27 writing methods used technology). It is important to note that we took discussion boards, threaded discussions and online chats simply as technological extensions of discussion. We did not consider them to be

digital technology methods of reflection. Similarly, blogs, email, and narratives were taken as mere technological extensions of writing.

Through this literature review, we noticed a gap in associate teacher interactions in teacher candidate's reflection activities. Even where the reflection activities were based on a lesson taught during the practicum rarely were associate teachers involved either as part of the collective reflections or as part of the audience for the reflection.

3. Practices of Two Reflection Techniques

3.1. Practice 1: On Going Reflections in a Course

Practice 1 presents a case where a reflection questionnaire, referred to as a learned and felt journal, is used in a course for teacher candidates learning to teach mathematics. The course aims to assist teacher candidates to learn to teach mathematics and also to be comfortable with teaching mathematics. The journal consists of three prompts about what is learn, felt and what is noticed. Journals are collected after each class, briefly reviewed, ideas summarized under themes that emerge, and at times summaries distributed or read at the following class.. The preliminary data analysis involved a set of qualitative data (i.e., the reflective journals, from 17 participants). Reflection forms of the participants were qualitatively analysed using content analysis (Cohen, Manion & Morrison, 2007) to identify categories on the topic of learning to become a mathematics teacher. The analysis resulted two new factors and into a broadening of one of the pre-existing factors on the role of the course at improving teacher candidates' knowledge, beliefs and feelings toward mathematics (Namukasa, Gadanidis & Cordy, 2009). We checked the final factors to see if they were relatively stable (Akerlind, 2004).

3.2. Practice 2: Reflection in Group Activities through Documenting and Sharing Rationales

Practice 2 presents a case in which documenting and sharing one's rationales was used as a reflection strategy in collaborative learning activities. A rationale is an explanation of the reasons underlying decisions, conclusions, and interpretations. It is defined as the reasoning behind a student's decision concerning a shared task. The study was carried out in an undergraduate project management class at a major USA university. In the designed learning activities, students were required to brainstorm and evaluate ideas as well as document and share their rationales that justify the ideas and evaluation. Although it was a traditional class with students being co-located, the student groups were required to complete these activities in virtual collaborative environment.

Thirty three students chose to participate in the study that included five groups. Various kinds of research methods (e.g., questionnaires, semi-structured interviews, and field observations) were used to collect data in order to understand the effects of rationale awareness – that is to stay, one's awareness of the other members' rationales – in the collaborative learning activities.

4. Discussion and Conclusion

Practices 1 and 2 have shared features: Both studies used writing as the main reflection technique and the written reflection was constructed at the individual level. However, Practice 1 and Practice 2 are quite different in several aspects with respect to the use of digital technologies. Participants in Practice 2 reflected on their decisions as they were articulating the decision rationales, which involved meta-cognitive processes as well. Also whereas reflections were constructed by pen and papers and kept private in Practice 1, individuals' decision rationales in Practice 2 were constructed in virtual group space thus shared among the group members. Moreover, although reflections in both studies provided feedback to the instructors about students' learning progress, researchers analysed them for different purposes. The focus of inquiry in Practice 1 was to study the nature and changes in preservice teachers knowledge and beliefs during a mathematics course, whereas Practice 2 focused on the impact of sharing reflections on group members.

Findings from both studies offered valuable suggestions on developing new reflection techniques in pre-service teacher education. The findings from Practice 1 indicate the likelihood of offering pre-service teachers a journal form structured by the reflection categories that are relevant to mathematics education context. Offering such a structured form might be a way of promoting conversations among teacher candidates, course instructors as well as associate teachers on key factors involved in learning to become a teacher of mathematics. As identified in our literature review, there is need for more avenues that encourage the involvement of associate teachers in the reflective activities of teacher candidates. A structured format would likely make it easier for teacher candidates to share and comment on each other's say beliefs as well as to offer and receive feedback on specific factors.

As shown in the literature review, reflections are sometimes shared and/or constructed collectively. However, the effects of such collective or sharing practices were not studied in the related literature. The empirical evidence from Practice 2 explored the impact of sharing reflections among peer students through rationale awareness (Xiao, 2011a, 2011b). It also suggests that in virtual environments that support collectiveness and/or sharing of the reflections among peers, a control mechanism should be implemented so as to make one's reflection available to the members at a later time instead of as soon as a reflection entry is completed. There can be various ways of implementing a control mechanism adopting either push or pull strategy. For a push strategy, the user chooses when to review others rationales; and for a pull strategy, the system makes a decision as to when to share the rationales in the group. During the Practice 1 study, several members acknowledged that being able to review others' rationales helped them expand their own ideas. This seems to suggest that push strategy would be preferred, as this leaves to the users more freedom as to when to review others rationales.

We combine the two suggestions for Practice 1 and Practice 2, and present one socio-technical reflection environment to be examined in a future study - we design a virtual space for pre-service teachers to write and share their reflections with peers, the associate teachers, and with their course instructors. The virtual space offers access from different locations—from schools during practicum and for associate teachers, and at universities. As well the virtual space offers flexibility to allow different access rights for different users with respect to different stages of the reflection processes and different parts of the reflection content.

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