Investigating the Relationship between Self-assessment and Self-Efficacy of Pre-service Science Teachers

Nurcan KAHRAMAN[1]
Canakkale Onsekiz Mart University
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Abstract
Although higher education plays a crucial role in society, self-assessment does not have much to do in higher education (Nilsson, 2012). Hence, this study aims to examine pre-service science teachers' use of self-assessment and its relation to their self-efficacy. Forty seven fourth-year students from a science teacher education program participated in the study. They were asked to deliver 15-minute presentations, which were videotaped. The participants filled in Student Teacher Presentation Evaluation Checklist two times: just after the presentation and after watching the video record. Moreover, Science Teaching Efficacy Belief scale, developed by Enochs and Rings, 1990, was used to assess pre-service teachers' self-efficacy. The Pearson correlation analysis suggested that there was no significant relationship between self-assessment and self-efficacy. To gain more insight into the students' opinions about the use of self-assessment, 8 participants were interviewed.
Keywords: Self-assessment, Self-efficacy, Pre-service science teachers, Teacher education

1. Introduction

Much attention is currently paid to teacher education programs, since they are critically questioned on their inadequate impact on teachers' practices and covering "dry" theoretical material through teacher educational programs. The starting point of this discussion is the gap between students' theoretical and practical knowledge in teacher education programs which are under discussion worldwide concerning their capability to foster achievement, scientific literacy, economic development, environmental issues in society. Hence, it is agreed that traditional teacher

[1] Çanakkale Onsekiz Mart University,

Faculty of Education, Elementary Education Department

17100 Çanakkale - Turkey

Email: nurcankahraman@comu.edu.tr

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education programs need a change in a way that helps pre-service teachers become familiar with real and "good" classroom practices (Roblin & Margalef, 2012). Samuels and Bets (2007) argued that self-assessment is a way to orient teachers to understand "good" practice. It can be shortly defined as the involvement of learners in evaluation of their own performance or task (Boud & Falchikov, 1989). Moreover, it is an effective procedure which allows the learners to become aware of their strengths and weaknesses of their learning process (Hodgson& Pyle, 2010). Researchers suggest that self-assessment not only motivates students to engage in more learning activities (Dodd, 1995), but also provides dialogues of higher quality between learners and instructors because learners have detail information about educational goals (Ormand, Merry& Reiling, 2000).

One of the advantages of using self-assessment in classrooms is its direct relation with lifelong learning skills. Lifelong learning prepares individuals for real-life situations that they should face throughout their lives. It can be defined as a purposeful learning activity, undertaken on an ongoing basis with the aim of improving knowledge, skills and competence (The European Commission, 2000). Boud et al. (1993) suggest that training students as lifelong learners is a useful start to integrate self-assessment in education. In conformity with this suggestion, Chen (2008) argues that self-assessment is directly linked to lifelong learning goals.

Researchers argued that self-assessment should also be relevant to learners' judgments of themselves about their capacity to do a task (Coronado-Aliegro, 2006). Person's answers to the question of "Can I do this task?", in other words judgments of oneself to do a task refer to person's self-efficacy beliefs (Bandura, 1982, 1986; Zimmerman, 2000; Pintrich& Schunk, 2002). In this perspective, teaching efficacy refers to judgments of teachers about their capacity to organize such behaviour as motivating students to engage and learn, or designing activities needed to teach a subject (Tschannen-Moran & Woolfolk Hoy, 2001). Teachers' belief about teaching a subject is situation-specific; namely, it can change according to the specific content (Bandura, 1986). The relevant literature underlines the importance of teaching efficacy since it is suggested that students generally learn more from highly self-efficacious teachers (Çakıroğlu, Çakıroğlu & Boone, 2005). According to some researchers; self-assessment procedure is one of the factors that affect students' self-efficacy (Olina & Sullivan, 2002; Coronado-Aliegro, 2006; Andrade et al., 2009; Adediwura, 2012). On the other hand, some suggest no relationship between self-efficacy and self-assessment (Cassidy, 2007). However, there is not much research that investigates self-assessment and self-efficacy (Cassidy, 2007).

Although higher education plays a crucial role in society, self-assessment does not have much to do in higher education (Nilsson, 2012). Specifically in teacher education, it is more important to use self-assessment than in higher education since teacher candidates are responsible for not only improving their own skills, but also learning how to use alternative assessment strategies, and effectively using them in their classrooms. However, little is known about how active teachers, let alone pre-service teachers, , use self-assessment or about whether they know how to use it (Diggelen, Brook & Beijaard, 2012). Consistently with the abovementioned research, Gözleksiz and Ülkü-Kan (2010) underline pre-service science teachers' lack of knowledge about alternative measurement and evaluation techniques. They suggest that these techniques should be used in teacher education programs. Besides, according to the authors, there is not much study that investigates pre-service teachers' usage of alternative assessment techniques and their relation to other variables. The motivation of the present study is to contribute to the relevant literature by providing data to fill in this gap. Therefore, this study was conducted to enhance understanding of the relationship between self-assessment and science teaching efficacy in pre-service science teachers.

This study is valuable since it is supposed to promote the understanding of how effectively pre-service teachers use self- assessment, and whether using self- assessment is related to their teaching efficacy. It is important to know that, as mentioned above, because using self- assessment is related to many positive factors like being a lifelong learner. Besides, pre-service teachers who use this procedure tend to use it in their classrooms in the future. Considering that teacher education programs desire to train self-efficacious teachers, understanding the relationship between these two important factors gives feedback to educators about students' self- efficacy and self- assessment in the existing situation, and to improve the quality education.

Theoretical Framework

Ross and Bruce (2007) suggest a model of teacher change, presented in Figure 1. In this model, teacher's self-assessment is located at the core of the model. Teachers observe their own instructional practices, evaluate their effectiveness, and make judgments about their performance. This self-assessment procedure is susceptible to other people's opinions. In the same manner, according to the model, teachers' self-assessment can affect their self-efficacy beliefs which have direct correlations to teachers' goal setting and effort.

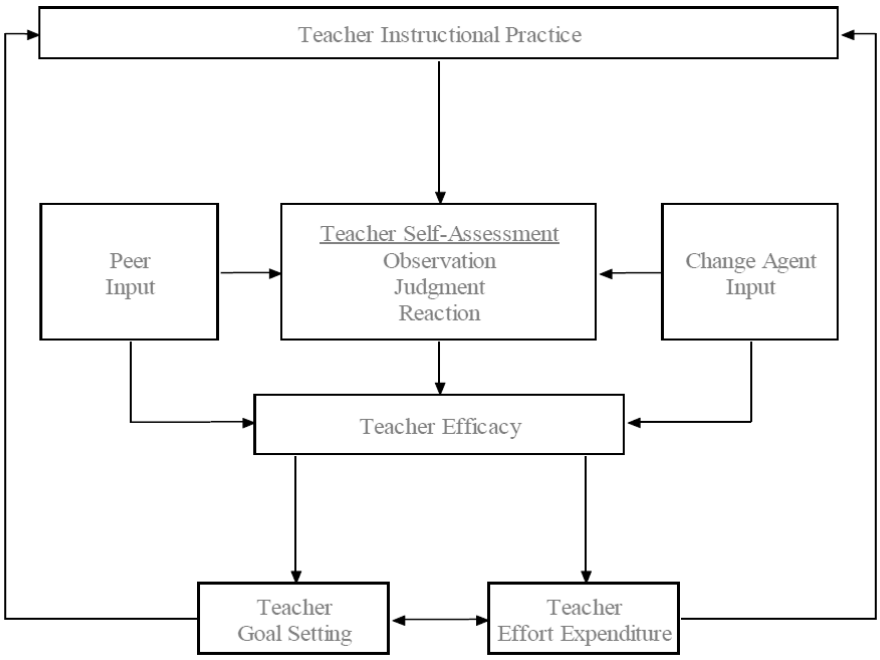

Figure 1: Model of Teacher Self-assessment as a Mechanism for Teacher Change (Ross & Bruce, 2007)

Diggelen et al.(2012) emphasize that there is not much information about how teachers use self assessment. They also suggest that teachers need to learn how to use self- and peer-assessment to practice these assessments in their classrooms. Nilsson (2012) suggests that alternative assessment practices like self-assessment should be integrated into teacher education programs to teach them how to use them effectively. Using self-assessment helps pre-service teachers to identify their strengths and weaknesses both for their own learning (Smith & Tillema, 2009) and teaching science (Nilsson, 2012).

1. 1. Self-assessment

Assessment is an important part of learning and generally used to evaluate students' knowledge and skills concerning the content in question (Karnilowicz, 2012). However, researchers underline that assessment of students at higher education institutions should transition from traditional testing techniques to assessment methods. The difference between these two paradigms is that while testing evaluates only knowledge and low-level cognitive skills, assessment culture evaluates thinking skills and adequateness (Dochy et al., 1999). In other words, assessment should be used not only for testing students' knowledge, but also for facilitating students' learning, and fostering them to take an active role in their own learning process (Harvey & Knight, 1996). Similarly, Elwood and Klenowski (2002) suggest that "assessment of learning and assessment for learning" are not the same concepts. Besides, teachers, educators and researchers have become aware of this distinction while in search of the effective assessment.

Self-assessment is one of the assessment procedure which engage students in the assessment. In this way, it assigns an active role to students in their learning and assessment process (Dochy et al., 1999). Self-assessment refers to students' evaluating their own performance according to the learning outcomes. Thus, students are expected to understand the learning outcomes more clearly. In other words, they learn about the standards for a successful task. , Self-assessment also helps instructors and students communicate with each other. Additionally, practicing self-assessment in classrooms forces students to think about their own learning process (Orsmond et. al. 2000). Self-assessment can be seen as a learning tool rather than only an assessment system because during the evaluation process, students are likely to make judgments, give feedbacks, and learn some necessary skills. Hence, they will get to take their learning responsibilities (Dochy et al., 1999, Lindblom-Ylanne, Pihlamajamaki & Kotkas, 2006).

Self-assessment does not encourage students to memorize the content or skills On the contrary, it promotes deep learning and critical thinking in students. Obviously, well-designed self-assessment procedures not only help students thoroughly understand the content (Munns & Woodward, 2006), but also help increase students' motivation (Bingham et al., 2010). Besides, students are informed about what they have learnt by assessing themselves. In this respect, self-assessment will help student become aware of how and what they learn. In other words, self-assessment enhances students' knowledge about their effective learning strategies. In brief, self-assessment is not just a learning tool, also can become a metacognitive tool (Mok et al, 2006).

Self-assessment also has significant contributions to teacher education and teachers' professional (Ross & Bruce, 2007). In teacher education, students will recognize themselves, and know their strengths and weaknesses for preparation of their professional development (Woolhouse, 1999). In terms of in-service teachers, self-assessment will help teachers update their knowledge in the relevant area and their teaching strategies, and evaluate the difference between their desired actual performances (Boud 1995; Ross & Bruce, 2007). However, alternative assessments like self-assessment are not dominant in higher education programs (Knight, 2002).

Therefore, the present study aims to integrate the self-assessment procedure in two regular courses of science teacher education program and to investigate its relation to pre-service science teachers' teaching science efficacy.

1. 2. Self-Efficacy

Self-efficacy is the core concept of Bandura's (1986) Social Cognitive Theory. It can be defined as people's judgment about their capacity for a task (Bandura, 1977; 1981). It also includes

feelings, thoughts, and emotions for the coming task situation. Broadly, the answer of "Can I do this task?" refers to people's self-efficacy beliefs (Bandura, 1977; Pintrich & Schunk, 2002; Zimmerman, 2000). Self- efficacy is an important motivational belief, since people make effort according to their self-efficacy when engaging in a task (Pintrich& Schunk, 2002; Schunk& Pajares, 2009).

From the teachers' viewpoint, teaching can also be seen as a task in which teachers should organize required activities in the learning environment. Hence, teaching efficacy refers to people's judgments about teaching a specific content to students (Ross & Bruce, 2007). Teaching efficacy is an important factor that affects other teachers' beliefs and behavioural patterns. For example, it directly affects teachers' goals and efforts. Highly self-efficacious teachers tend to set challenging goals for themselves, and tend to persist longer than others (Bandura, 1977). Hence, the relevant literature also suggests that teachers' beliefs about their ability to teach well influence their students' achievement. These teachers' students become more successful than those of others (e.g. Goddard, Hoy, & Hoy, 2004).

There are four sources of efficacy: mastery experiences, physiological and emotional states, vicarious experiences, and social persuasion. Mastery experiences refer to people's own experiences, and vicarious experiences to gaining experience by observing others, while social persuasion is concerned with feedbacks from others. It can be defined as a kind of "pep talk". From all four sources of teaching efficacy, mastery experience is the most powerful one (Bandura, 1977; 1986). If teachers were successful to teach the content to students in past, then they become more confident about their future performance (Ross & Bruce, 2007).

Back to Figure 1, it is expected that self-assessment will directly influence teachers' teaching efficacy. Contrary to what one might expect, research investigating this relationship in the relevant literature is scarce. Moreover, the findings from these studies are inconsistent. While some researchers suggest no relation, others suggest a positive relation between self-assessment and self-efficacy. For instance, Olina and Sullivan (2002) investigated the effect of self-assessment on students' self-efficacy with an experimental study. There were three groups of students: teacher evaluation, self-plus-teacher evaluation, and no-evaluation. The results suggest that students in the self-plus-teacher evaluation group tended to have a higher level of self-efficacy beliefs and greater self-confidence about independently conducting experiments than other two groups did. In a similar study, Adediwura (2012) researches the effect of self-assessment on students' self-efficacy beliefs. Obviously, involvement in a self-assessment procedure increased students' motivation to pass judgments about whether they can do the task. On the other hand, Cassidy (2007) investigates the relationship between self-efficacy and self-assessment, and finds no significant relation. Additionally, he suggests that there is a need for further research to draw a clear conclusion about the relation between self-assessment and self-efficacy.

In the light of the abovementioned literature, the present study aims to investigate the relationship between self-assessment and teaching science efficacy in pre-service science teachers. In relation to this, the following research questions are addressed:

1. Is there a relationship between self-assessment and teaching science self-efficacy in pre-service science teachers?
2. What do pre-service science teachers think about the effect of self-assessment procedure on their teaching efficacy beliefs?

2. Method

2. 1. Participants

Forty seven pre-service science teachers from Science Education Department of a University participated in the study. The sampling consists of 40 (85%) female and 7 (15%) male participants. They come from families mostly with two children (38 %). 79% of the mothers are unemployed, while 66% of the fathers have a regular work. Moreover, the majority of the mothers (53%) and fathers (47%) are primary school graduates. Besides, most of the students have exiguous reading materials, fewer than 100, at home (75%). Eight students were selected to make an interview with. Of these 8 cases, 7 were female and one was male.

2. 2. Instrument

2. 2. 1. Student Teacher Presentation Evaluation Checklist

The student Teacher Presentation Checklist was developed by Author et al (2013). While developing this checklist, they considered that there was a need in the relevant literature about evaluation of teachers' presentations. Therefore, based on the lectures' notes on effective presentation (Lowry 2010) and the checklist for presentation, European Federation of Catalysis Societies (2012) formed a new version of the checklist for teachers' classroom presentations. It is a kind of checklist which includes 2 main sections. Section 1 assesses content of the presentation. It contains three sub-dimensions, such as introduction, main part, and final part of the presentation. Additionally, Section 2 assesses presentation, and contains five sub-dimensions, such as introduction, voice, body language, visual materials, and question-answer part. First section assesses over 36 points, and the second section assesses over 34. Hence, the maximum score of the checklist can amount to 70 points. The average of the participants' scores is 63.77 and the standard deviation is .65.

The reliability of the scale was tested by assessing interrater reliability. Cohen's Kappa is one of the reliability coefficients that used to assess interrater reliability with qualitative/categorical variables. Kappa value range from 0 to 1.00, and higher values refer to higher reliability. Σa is the total number of agreements, and Σef is the sum of the expected frequencies, the formulation of kappa is;

$$K = \frac{\Sigma a - \Sigma ef}{N - \Sigma ef}$$

The Cohen's Kappa of the checklist was calculated as .73 for this study and it indicates substantial agreement (Şencan, 2005).

2. 2. 2. Science Teaching Efficacy Belief Scale

It is a self-reported questionnaire developed by Enochs and Rings (1990). The scale is a 5-point Likert scale, and comprises 2 sub-scales; Personal Science Teaching Efficacy Belief (13 items) and Science Teaching Outcome Expectancy (10 items). It was translated into and adapted to Turkish by Özkan, Tekkekaya and Çakıroğlu (2002). For the purpose of the study, only Personal Science Teaching Efficacy Belief sub-scale was administrated. It consists of 13 items like "I am

able to answer students' science questions". Additionally, the researchers calculated reliability coefficient, Cronbach's alpha value as .76 for the Turkish version. The reliability coefficient of the scale for the present study is .84.

2. 3. Design of the Study

Step 1

The participants of the study were fourth-year (senior) students of Science Education . Forty seven of them enrolled in Special Topics in Biology and Special Teaching Techniques courses. Each student who enrolled in these courses was required to deliver a 15-minute presentation. Right after the presentations, student teachers were asked to fill in the Student Teacher Presentation Evaluation Checklist. Moreover, the presentations were videotaped with students' approval.

Step 2

The presentation records were given to the related student. Eight students re-evaluated their own presentation after the video and were interviewed about their evaluation. Interviews took 15 minutes. The questions were concerning participants' opinions about self- assessment and their self-efficacy beliefs, and how this study affected their teaching self-efficacy.

Besides, the manuscript does not require the inclusion of a statement of ethics as it is not reporting on research involving human participants.

2. 4. Analyses

This is a mix study that contains both quantitative and qualitative data. In qualitative part, a multiple case study carried out to take an in-depth look at pre-service science teachers' self-assessment and teaching science self-efficacy. Of 47 participants, eight students were selected to make an interview with. The interviews were intended to find out participants' positive or negative thoughts about the study.

In the quantitative part of the study, SPSS 18 program was used to analyze the data. Means and standard deviations were used to analyze the pre-service science teachers' self-assessment and self-efficacy profiles. Moreover, correlational analysis was conducted to investigate the relation between abovementioned variables.

In qualitative part of the study, 8 of 47 participants were interviewed about self-assessment procedure. The interviews were recorded, and then transcribed. Mainly, following 3 questions were asked to them:

1. Have you ever used self-assessment procedure in your lessons?
2. What do you think about using self-assessment in class?
3. What do you think about the effect of self-assessment on your self-efficacy beliefs?

3. Results

The present study is intended to investigate the relationship between self-assessment and teaching science efficacy in pre-service science teachers. Descriptive statistics, means and standard deviations were used to investigate self-assessment and self-efficacy profiles of pre-service science teachers (Table I).

Table I. Descriptive statistics of 47 pre-service teachers' self-efficacy and self-assessment

	Minimum	Maximum	Mean	Std. Deviation
Self-efficacy	3.15	5.00	4.07	.49
Self-assessment	38.00	70.00	62.91	5.53

Results for the first research question

The first question of the current study is whether there is a relationship between self-assessment and teaching science self-efficacy in pre-service science teachers. To answer this question, Pearson Correlation analysis was conducted. Correlation coefficients were computed between pre-service science teachers' self-efficacy beliefs and self-assessment scores. The results of the correlational analyses presented in Table 2 showed that there was no significant relationship between self-efficacy beliefs and self-assessment scores. The p-value is higher than .005.

Table II. Inferential statistics results

		Self-assessment
Self-efficacy	Pearson Correlation	-.22
	Sig. (2-tailed)	.13

Results for the second research question

The second question of the current study was what pre-service science teachers think about the effect of self-assessment procedure on their teaching efficacy beliefs. To answer this question, interviews were conducted with eight participants and then analyzed. Firstly, participants were asked whether they had attended a similar study that involved self-assessment or not. All the participants told that they had never practiced a self-assessment before.

When the participants were asked how they felt about the study. All of them agreed that gaining this self-assessment experience was useful for them. Besides, they told that they wished all the courses would have contained self-assessment procedure. Actually one of the participants, a male pre-service science teacher, added his opinions as follows "*It was very useful for us. Using self-assessment allowed us to evaluate ourselves and to become aware of our mistakes and also contributed to our assessment skill. Actually, I think that using self-assessment in lessons should be started at earlier classes, maybe at middle school*"

Since the participants were asked to comment on this relationship from their own perspectives. They defended that assessing themselves actually made considerable contributions to their opinions about their teaching efficacy. For instance, a female participant stated about the effect of using self-assessment on their self-efficacy beliefs as follows: "*after evaluating myself, I became aware of what I did right and wrong during the presentation. So I believe that I won't do the same mistakes and I can do better at the second time. It improved my self-confidence to teach science*". The other 7 participants had similar opinions with their friend. In other words, all the participants were of the opinion that using self-assessment positively contributed to their efficacy beliefs. Contrary to the expectation, the quantitative analysis suggested that there was no relationship between self-efficacy and self-assessment.

4. Discussion

The present study aimed to investigate the connection between pre-service science teachers' self-assessment and teaching science efficacy. To achieve this aim, the study focused on the following questions; (1) is there a relationship between self-assessment and teaching science self-efficacy in pre-service science teachers? (2) What do pre-service science teachers think about the effect of self-assessment procedure on their teaching efficacy beliefs?

This was a running project. The first round of quantitative analysis suggested no significant relationship between self-assessment and self-efficacy, which was not really expected, since the teacher change model, developed by Ross and Bruce (2007), suggests that teachers' self-assessment should be directly related to their self-efficacy. Although the relevant literature underlines the importance of self-assessment and self-efficacy separately, there is not much research that investigates their relation, the results of which are quite inconsistent. While some researchers suggest positive relationship (Olina & Sullivan, 2002; Alaba & Adeyemi, 2012), others suggest none (Cassidy, 2007). One of the reasons of this surprising result can be self-efficacy beliefs which are not global self-efficacy but task-related efficacy beliefs. As Coronado-Aliegro (2007) suggest that studies which investigate the correlation between self-assessment and self-efficacy handle efficacy beliefs as global efficacy, not task-related beliefs. Moreover, he adds that investigating the relation between assessment and efficacy with specific task scores can change the results. Although the present study confirmed this particular change, further research is needed.

To figure out pre-service science teachers' opinions related to self-assessment procedures, some of the participants were interviewed with. The interviews were video-based; in other words, the participants had the opportunity to assess themselves just after the presentation and watching their video record. According to the interview, firstly they shared the same views about the advantages of participating in the study. They agreed that this self-assessment experience was useful, and they wished to have self-assessment tasks more often. In terms of the self-assessments' relation to self-efficacy, the participants thought that self-evaluation helped them become aware of their strengths and weaknesses while being aware of himself/ herself improved their self-efficacy to teach science. Moreover, they defended that assessing themselves highly contributed to their opinions about their teaching efficacy, and found self-evaluation at two times very useful to, especially after watching their video record. The other interesting result was that in contrast to statistical test results suggesting no significant relation between efficacy and assessment, the participants made mention of positive effects on their beliefs. Therefore, the other cause of the insignificant relation can be that this is not an experimental design study. The participants were not asked about the efficacy beliefs when the procedure was completed. They are not related at one point, but if the process is

investigated as mentioned by the students, using self-assessment in classrooms can increase students' efficacy beliefs. Confirming this suggestion, experimental design studies suggest that involving students in a self-assessment procedure tends to make them have greater confidence in themselves (Olina & Sullivan, 2002; Alaba & Adeyemi, 2012).

There are some limitations in the present study. Firstly, it is a cross-sectional study, therefore, the observed relationships do not imply causality. The longitudinal designs can be adopted for the future studies to establish cause and effect relations. Secondly, this study examined the proposed correlations in relation to pre-service science teachers. Therefore, whether the relationships are the same for other domains or not is not addressed in the present study. Additionally, the participants were from only one university in Turkey. Therefore, because the study cannot be generalized to all Turkish students, different groups and domains can be included in future studies.

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