An investigation of pre-service teacher's self-efficacy and self-image as a science teacher in Egypt

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Abstract

This study investigated the possible impact of a science teaching methods course on pre-service teachers' self-efficacy and perceptions of self as science

teachers. The study also investigated the probable relationship between these two variables, which both measure issues related to the expected behaviour teachers adopt when teaching science. Participants were enrolled in a 4-year educational programme at one of the Schools of Education in Egypt. Self-efficacy was measured using the Science Teaching Efficacy Belief Instrument, Form B (STEBI-B) developed by Riggs and Enochs (1990). The Draw-A-Science-Teacher Teaching Checklist (DASTT-C) was used to measure perceptions of self as a science teacher (Thomas, & Pedersen, 1998; Thomas, Pedersen, & Finson 2001). These instruments measure the expected behaviour teachers adopt when teaching science in light of what they think they are capable of. Pre-test and post-test data generated by both instruments from 36 pre-service science teachers representing three groups (Primary, Chemistry and Physics, and Biology) enrolled in a science teaching methods class were compared to determine the relationship between the two instruments. Significant gains on the Personal Science Teaching Efficacy (PSTE) subscale and Science Teaching Outcome Expectancy (STOE) subscale STOE were found for all three groups of pre-service teachers. Significant mean decreases in the modified total of the DASTT-C score were found for one group. Moderate correlations were found between scores from the two instruments, for those with 'high' PSTE and STOE scores. The specific design of the science teaching methods course may be responsible for these changes.

Keywords: Pre-service teachers; Science Self-efficacy beliefs; Self-images

Introduction

Self-efficacy and attitudes of pre-service teachers have been the focus of many studies (Morrell, & Carroll, 2003; Palmer, 2001; Woolfolk 2000). This is mainly due to the expected effect these might have on teachers' behaviour in classroom teaching. Low self-efficacy beliefs and negative attitudes could have varying classroom effects from less time teaching the subject (Harlen & Holroyd, 1997), employing didactic approaches (Appleton & Kindt, 1999), affecting student achievement (Ashton, 1984) to passing on to students negative attitudes towards science and teaching (Czerniak & Chiarelott, 1990; Westerback, 1982). Due to these consequences, some studies

focused on changing pre-service teachers' attitudes through interventions (Palmer, 2001).

The concept of self-efficacy is based on Bandura's (1977) social cognitive theory, and has been useful in examining people's capability beliefs. The concept of self-efficacy evaluates self in comparison with ones' past performances. It can therefore be considered as a criterion-referenced evaluation of self (Choi, 2005). There are four main sources that impact self-efficacy: mastery experiences, physiological and emotional states, vicarious experiences, and social persuasion (Bandura, 1997; Tschannen-Moran, Woolfolk & Hoy, 1998). Mastery experiences are identified as the most powerful source of efficacy information, as it derives from personal practical experience. The perception that a performance has been successful raises efficacy beliefs (Pajares, 2002). In teacher education programmes it is important to present ideal teaching models, from peers and teachers, as exemplary teaching. Such successful models of teaching can contribute to the expectation that pre-service teacher performance will be similar to the competent teacher. Attributions, identified in the 'attribution theory' (Weiner, 1986) play a role in developing a feeling of mastery. If the success is attributed to internal or controllable causes such as ability or effort, then self-efficacy is enhanced. But if success is attributed to luck or the intervention of others, then self-efficacy may not be strengthened (Pintrich & Schunk, 1996). Head (1996) stated that the 'locus of control' (p. 63) defines the responsible and controllable factors of the individual's success or failure.

Nevertheless, self-efficacy is a concept that ties to context. In other words, it is context specific (Bandura, 1982). In that sense, an individual may have a high self-efficacy for one task but a low self-efficacy for another. Implementing this view with teachers and the areas of specialty indicate that a teacher may have a high level of personal efficaciousness in the science domain, for example, yet feel inefficacious in teaching other subjects. Teachers' contextual efficacy also relates to the nature of the individual classroom and student population (Tschannen-Moran, et. al., 1998). Ramey-Gassert, Shroyer, and Staver (1996) used the STEBI to examine factors related to science teaching self-efficacy in elementary teachers. Three categories were outlined as factors that relate to science teaching self-efficacy: antecedent, internal and external. Antecedent factors included science-related experiences in and out of school, teacher preparation, and science teaching experiences. Internal factors included attitudes toward science and interest in science. External factors affecting

science teaching self-efficacy included the school workplace environment, student variables, and community variables.

Findings from previous literature show that many pre-service teachers hold negative attitudes (Palmer, 2001) which arose from their knowledge, dispositions, beliefs, perceptions and past experiences upon entry into formal preparation programmes (Abell & Smith, 1994; Mulholland & Wallace, 1996). The attitudes pre-service teachers possess, with respect to science, may be related to the ways they perceive themselves in the role of being a scientist. According to the view held of scientist's work, the perception of a scientist changes (Yager & Yager, 1985). Earlier research into the perceptions of scientists were revealed through drawings made of scientists. Results showed that perceptions were classified as stereotypical when they were refined by Chamber's (1983) Draw-A-Scientist Test (DAST). The test was later organized into a quantifiable checklist format (DAST-C) by Finson, Beaver, and Cramond (1995). Building on this concept of the ways self-perceptions can evidence themselves in drawings, Thomas and Pedersen (1998) reasoned that pre-service teachers' drawings might also reveal their perceptions about themselves as science teachers. In their work, Thomas and Pedersen, (1998) began with the DAST-C and revised it to include elements they judged to be characteristic of science classrooms and science teachers, calling the instrument the Draw-A-Science-Teacher Teaching Checklist (DASTT-C) (Thomas, et. al., 2001).

Results from a study by Finson, Riggs, and Jesunathadas (1999) that compared pre-service teachers' DASTT-C scores with those from the STEBI-B, indicated that pre-service teachers with high self-efficacies were more inclined to include drawings showing outdoor environments, students engaged in group-work doing hands-on activities, and captions which added description and detail to the drawing. In contrast, low self-efficacy pre-service teachers' drawings tended to exclude students, be centred indoors, had relatively few if any captions, and showed the teacher as the central figure. These results supported the underpinning STEBI theory's notion that those with higher self-efficacy believe in their own ability to teach, and are willing to add explanations focusing on the steps of their pictured lessons. Furthermore, the results supported the theory's premise that individuals with high self-efficacy are more likely to utilize a variety of teaching strategies.

Context of the Study

This study was administered in an Egyptian pre-service teacher educational programme. Most of the teaching and learning that take place in schools, and on some occasions in university courses, relay on 'chalk and talk'. In science classes there is little chance for practical work. Teachers use demonstrations and simple visual aids to compensate for the limited resources in schools. Generally speaking, the education system in Egypt, as in many developing countries, is dominated by a teacher-centred approach. Such approach entails teacher dominance as the central figure in class and the only source of knowledge. The major role of teachers is transferring knowledge to students' blank minds emphasising memorization and recall of facts. Students in turn have passive roles receiving the transmitted rote knowledge. Competitive individualistic learning settings take place as students listen to presented content without talking to peers, take notes and respond to occasional questions from the teacher.

However, there are many efforts individually, nationally and internationally to facilitate a shift towards a more student-centred approach and expand teachers' repertoire of teaching strategies (Arab Republic of Egypt Ministry of Education, 1996; Quality Assurance and Accreditation Board, 2005). This view emerged from the role education, especially primary education, could play in achieving economic improvement in Egypt (Hargreaves, 2001). Shifting to student-centred approaches require change in roles of both teachers and students. Teachers act as facilitators and guides who develop challenging learning environments and occasionally act as co-learners. Students are expected to have positive active roles in their learning as they search for knowledge from various sources, engage in cooperative meaningful and authentic activities experiencing both 'hands-on' and 'minds-on'.

Purpose

The purpose of this study is to identify pre-service teachers' self-efficacy beliefs and the images they hold as science teachers at the beginning of a science teaching methods course. The study investigated the possible impact the methods course might have on these two variables and the relationship between them.

The study, therefore, set out to answer the following research questions:

1) What images do pre-service teachers have of themselves as science teachers at the beginning of the science teaching methods course?
2) What science teaching beliefs do pre-service teachers have of themselves at the beginning of the science teaching methods course?
3) Does the science teaching methods course have an impact on pre-service teachers' images of self?
4) Does the science teaching methods course have an impact on pre-service teachers' self- efficacy beliefs?
5) Are pre-service teachers with high self-efficacy beliefs more inclined to include features of student-centredness in their drawing?'

Methods

Participants in this study were pre-service science teachers in a 4-year undergraduate teacher educational programme in Egypt. The programme was delivered at the School of Education in a small government university in an urban setting. Participants were 36 pre-service teachers (31 females and 5 males). The participants represented three speciality areas: Chemistry and Physics (5 students), Biology (22 students) and Primary science (9 students). Although all three groups participate in teaching-practicum in their third and fourth years of study, Primary science students start practicum in their second year.

Instruments

To answer the research questions, stated above, two instruments were used; the STEBI-B and the DASTT-C. The instruments were translated into Arabic then checked for validation and reliability. The process of validation was by referring the translated instruments to a professor of English Language for any language modifications. Reliability was determined by administrating the instruments to a group of ten pre-service teachers, other than those included in the study. Responses were analysed before the instruments were used again to calculate reliability coefficient 'Item-total statistics', using SPSS (version 10.0 for Windows), (alpha = 0.79).

The instruments were administered to all three groups at the beginning of the science teaching methods course, taught by the author of this study, and then re-administered as post-tests at the end of the term. The science teaching methods course is a 4 hour 'class' throughout a 14 week term, underpinned by a constructivist approach to teaching and learning. Students were placed in cooperative groups to accomplish tasks in and out official class times to apply and extend their knowledge of science teaching. Furthermore, pre-service teachers in this study created teaching-portfolios which promoted reflective thinking skills and increased their attitudes towards teaching in an attempt to experience a student-centred teaching and learning approach (El-Deghaidy, 2006). Topics covered by the course exposed pre-service teachers to a range of conventional and contemporary teaching strategies. In addition, the nature of science (NOS), science process skills and assessment techniques were also covered. As part of the programme, pre-service teachers had access to actual classroom teaching experiences through weekly teaching-practicum. Video recordings of their teaching were used during the classes to stimulate reflection and discussion of best practises, in both large and small groups. Microteaching presentations were held during classes to provide for first hand teaching experiences with peers assessing each other and providing supportive commentary.

DASTT-C

The 'Draw-A-Science-Teacher-Test- Checklist' (DASTT-C) was used as a tool to measure aspects related to science teachers' behaviour in class: how they view science teaching (student-centred or teacher-centred), and what mental representations they hold for their future work. Pre-service teachers were provided with an A4 sheet of white paper and given instructions according to the test Thomas, et. al., (2001) developed and validated. The instructions were 'Draw a picture of yourself as a science teacher at work' and write a short description of the drawing. This descriptive narrative assists in scoring the drawing. The pre-service teachers were given approximately 15 minutes to draw the images. It was made clear that the drawings were for a research study and were not part of their grading. Illustrations were analysed according to a checklist (Appendix 1). The original checklist developed by Thomas, et. al., (2001) included three broad categories: the 'Teacher', 'Students', and the 'Classroom environment'. Each section was divided into subscales. The 'Teacher' section, for example, was divided into two subscales which focus on the teacher's

activity (demonstrating, lecturing, using visual aids, etc.) and the teacher's position (location with respect to students, such as at the head of the classroom, and posture). The 'Students' section of the instrument is likewise divided into two subscales which focus on the activities of students (passively receiving information, responding to the teacher, etc.) and students' positions (as seated within the classroom). The third section, 'Environment', consists of elements typically found inside classrooms such desks arranged in rows, teacher desk/table located at the front of the room, symbols of teaching (i.e., chalkboards), and symbols of science (i.e., science equipment). In general, each section is scored in a dichotomous fashion with an indication of 'present' or 'not present' in the picture. Each element in each section is considered to depict teacher-centred elements of teaching and classroom images. However, since this study was investigating pre-service teachers' images and self-efficacy beliefs, modifications were made to the original categories. The categories 'Teacher' and 'Student' and the first two elements in the 'Classroom environment' category (desks arranged in rows and teacher desk located at the front of the room) were grouped under a different title. The three other elements in the 'Classroom environment' category, however, were not included as they do not represent elements of either teacher or student-centred methodologies. The suggested title was 'Teacher centredness', as it included all elements in the original checklist that would reflect, on the one hand, a teacher-centred approach if found in the drawing or, on the other hand, a student-centred approach if not portrayed. The modified checklist consisted therefore of one broad category with ten elements and scores ranging from 0 to 10. In general, the higher the score, the more teacher-centred the image being examined portraying the teacher standing centrally, students listening or watching to a lecture or demonstration and desks arranged in rows. A low score would reflect a more student-centred, alternative classroom with the teacher working at a table of students while others work in groups engaged in similar or different activities, with lesser presence of desks in rows and students moving around the class. Throughout this study the term 'teacher-centredness' reflects a high score on the modified DASTT-C total and the term 'student-centredness' reflects a low score. Appendix 2 represents examples of 'teacher-centredness' and 'student-centredness' classes.

STEBI-B

The STEBI is an instrument based on Bandura's definition of self-efficacy as a

situation-specific construct. The instrument was developed by Riggs and Enochs (1990) to measure efficacy of teaching science. There are two forms, the Science Teaching Efficacy Belief Instrument form A (STEBI-A) for in-service teachers (Riggs & Enochs, 1990) and the Science Teaching Efficacy Belief Instrument form B (STEBI-B) for pre-service teachers (Enochs & Riggs, 1990). The STEBI-B consists of 23 statements which are divided to provide two sub-scores, which are randomly embedded in the instrument. Thirteen of the statements yield scores for the Personal Science Teaching Efficacy (PSTE) subscale, which reflect science teachers' confidence in their ability to teach science. The other ten statements yield scores for the Science Teaching Outcome Expectancy (STOE) subscale, which reflect science teachers' beliefs that student learning can be influenced by effective teaching. Participants used a five-point Likert-type scale to respond to each of the 23 statements by selecting one of the following responses: strongly agree (5), agree (4), are uncertain (3), disagree (2), or strongly disagree (1). Any positively worded statement is scored by awarding five points for 'strongly agree' responses, four points for 'agree' responses, and so forth. Negatively worded statements are scored by reversing the numeric values. The possible range of PSTE scores is 13 to 65 while that of STOE scores is from 10 to 50. It is worth noting that scores of the PSTE and STOE do not add up to a total score, as they measure different aspects of science teaching self-efficacy. Reliability coefficients for the two scales were .82 and .75 for the PSTE and STOE, respectively.

Results

The results below present answers to the research questions:

Research question one: 'What images do pre-service teachers have of themselves as science teachers at the beginning of the science teaching methods course?

The 'Draw-A-Science-Teacher-Test- Checklist' (DASTT-C) was used as a tool to measure aspects related to science teachers' behaviour in class. Pre-service teachers were asked to draw images of self in the classroom in approximately 15 minutes. High scores indicate that the image being examined represents a more 'teacher-centred' class, while low scores imply a more 'student-centred' class. Thomas and Pedersen (2001), in their study, stated that scores above 6.5 reflect a more 'teacher-centred', while those below 6.5 reflect a 'student-centred'. Due to the modifications made to

the original categories, 'teacher-centredness' was assumed with scores higher than 5, and 'student-centredness' with scores lower than 5. A group of 8 pre-service teachers' drawings were randomly selected and used to determine inter-rater reliability for the DASTT-C in this study. Two raters separately scored the drawings with an acceptable reliability score (= 0.766). Table I represents frequency of 'teacher-centredness' found in participants' images.

Table I. Frequency of 'teacher-centredness' in pre DASTT-C images

Primary students n=9		**Chemistry student n=5**		**Biology students n= 22**	
Frequency	**Percent%**	**Frequency**	**Percent%**	**Frequency**	**Percent%**
7	77.7	5	100	22	100

Table I shows that the majority of pre-service teachers entered the science teaching methods course with 'teacher-centredness' images.

Research question two: 'What science teaching beliefs do pre-service teachers have of themselves at the beginning of the science teaching methods course?

The STEBI-B instrument, with its embedded two subscales PSTE and STOE, was administered to all participants in this study at the beginning of the teaching methods course to identify efficacy beliefs to selves as science teachers. High scores on the PSTE indicate a strong belief in one's ability to teach science. Scores can range from 13 to 65. High scores on the STOE indicate high expectations in regard to the outcomes of science teaching on student's achievement. Scores on this subscale can range from 10 to 50. Table II represents participants' descriptive statistics.

Table II. Descriptive statistics of scores on STEBI-B instrument

	Primary students n=9				**Chemistry student n=5**				**Biology students n= 22**			
	Min score	Max score	Mean	SD	Min score	Max score	Mean	SD	Min score	Max score	Mean	SD
PSTE	34	41	37.00	2.64	35	42	39.60	2.70	31	42	36.77	3.30
STOE	28	35	31.33	2.50	21	28	24.2	2.80	24	40	30.04	4.30

Research question three: 'Does the science teaching methods course have an impact on pre-service teachers' images of self?'

Participants were asked to draw images of self as science teachers after 14 weeks from beginning the science teaching methods course. Teaching and learning approaches throughout the course was based on constructivism. Statistical analysis was carried out using independent t-tests with SPSS (version 10.0 for Windows) on the modified DASTT-C total checklist score, 'teacher-centredness'. Table III shows that, in general, mean scores decreased from pre-testing to post-testing for all three groups. Significant decreases occurred only in the Chemistry group.

Table III. Means, standard deviations and t-tests on DASTT-C

Primary students n=9					**Chemistry student n=5**					**Biology students n= 22**				
Pre test		**Post test**			**Pre test**		**Post test**			**Pre test**		**Post test**		
Mean	SD	Mean	SD	t	Mean	SD	Mean	SD	t	Mean	SD	Mean	SD	t
7.33	1.58	6.00	1.50	1.83	7.20*	.44	5.20 *	1.30	3.24	7.68	.83	7.27	.55	1.91

* Significant at $p < 0.05$

Research question four: 'Does the science teaching methods course have an impact on pre-service teachers' self- efficacy beliefs?'

The STEBI-B instrument was re-administered to participants of the study at the end of the science teaching methods course. Independent t-test analyses with SPSS (version 10.0 for Windows) were used. As stated above, the STEBI-B instrument consists of two subscales, each measures a different aspect of the science teacher efficacy beliefs about self. The PSTE subscale reflects teachers' confidence in their ability to teach science, while the STOE subscale reflects teachers' beliefs that student learning can be influenced by their effective teaching, therefore, scores on the two subscales were treated separately. Table IV shows a significant increase ($p < 0.05$) in the mean score for all three groups of pre-service teachers on the PSTE and the STOE subscales by post-testing at the end of the science teaching methods course.

Table IV. Means, standard deviations and t-tests on STEBI-B instrument

	Primary students n=9			**Chemistry student n=5**			**Biology students n= 22**		
	Post test			Post test			Post test		
	Mean	SD	t	Mean	SD	t	Mean	SD	t
PSTE	51.22	4.35	-8.377	54.00	3.54	-7.236	51.73	4.41	-12.723
STOE	41.33	3.67	-6.751	37.6	2.07	-8.475	38.22	3.25	-7.116

Research question five: 'Are pre-service teachers with high self-efficacy beliefs more inclined to include features of student-centredness in their drawing?'

Since the educational context of this study implies a shift towards more 'student-centred' strategies in Egyptian schools and universities, the study searched for patterns in participants' responses to the instruments used. According to previous studies (Finson, 2001; Finson, et. al., 1999) portrays that represent 'student-centredness' are expected to be found in drawings of those with high self-efficacy scores, while those with low self-efficacy scores tend to portray images that represent 'teacher-centredness'. Participants' scores on the self-efficacy instrument (STEBI-B) were two separate totals from two subscales, PSTE and STOE, which can not be summed together due to the different aspects of science teaching self-efficacy beliefs each represent. From this perspective, to answer this research question subsidiary questions were apparent: do pre-service teachers with 'high' PSTE scores portray images of 'student-centredness'? do pre-service teachers with 'high' STOE scores portray images of 'student-centredness'?

Previous studies, examining correlations between self-efficacy beliefs with other variables, categorised scores from the STEBI subscales to either high or low (Kitsantas, & Baylor, 2001; Finson, 2001; Finson, et. al., 1999). Participants' scores on the PSTE and STOE subscales, in this study, were placed on the two extremes of the STEBI-B instrument, high efficacious teachers and low efficacious teachers. 'High' scores equalled to or exceeded one standard deviation above the mean, while 'low' scores equalled to or were less than one standard deviation below the mean. These procedures were followed since previous studies (Finson, 2001) indicate that participants having 'low' PSTE scores tend to teach, or view their teaching, to be more conventional and teacher-centred, while those having 'high' PSTE scores tend to

use more contemporary, student-centred strategies. In order to examine the impact of the science teaching methods course on the expected relationship between the study's variables, Pearson correlation coefficient matrix was used with pre and post scores. Table V illustrates correlations between pre and post PSTE and STOE scores with pre and post 'teacher-centredness' scores on the DASTT-C from participants of the three groups.

Table V. Pearson Correlation Coefficient Matrix for Variables in Study

PRE DASTT-C scores		**POST DASTT-C scores**	
Teacher-centredness score		Teacher-centredness score	
high PSTE n=5	-.080	high PSTE n=5	-.559
high STOE n=6	-.315	high STOE n=9	.503

* Significant at $p < 0.05$

Results in Table V show that there were negative and positive correlations between the study's variables. It should be noted that negative correlations illustrate that pre-service teachers grow to believe in their ability to teach efficiently, impact students learning and achievement moving from 'teacher-centredness' to 'student-centredness' methodologies.

Correlations between pre PSTE and 'teacher-centredness' scores on the DASTT-C showed that participants with 'high' PSTE scores had negative and little, if any, correlations (r = -.080). Negative and low correlations (r = -.315) were found between those with pre 'high' STOE scores and 'teacher-centredness' scores. Correlations between post PSTE and 'teacher-centredness' scores illustrated that participants with 'high' PSTE scores had negative and moderate correlations (r = -.559). Positive and moderate correlations (r = .503) were found between those with post 'high' STOE scores and 'teacher-centredness' scores.

Discussion

The discussion focuses on findings from the DASTT-C and STEBI-B and correlations between the two.

Pre-service teachers' images of self: DASTT-C

The drawings made by pre-service teachers illustrated that they entered the science methods course with pre-existing images of themselves as science teachers. This finding was consistent with previous research (Thomas & Pedersen 2001; Thomas et. al., 2001). Post-test images were more 'student-centred' compared with pre-testing images for the Chemistry group, as mean scores decreased significantly ($p < .05$). This finding parallels similar studies that focused on pre-service teachers' conceptions of science teachers (Louca, Rigas & Valanides, 2003). Nevertheless, the mean change for the Primary group was 1.35 and 0.41 for the Biology group (see Table III). The interpretation of these findings suggest that the science teaching methods course had limited impact changing participants' images of self. It could be that the Chemistry group linked their view to the new roles of teacher and students introduced in the methods course to their area of speciality that requires 'hands-on' and manipulation of tools and apparatus, probably in labs. Another interpretation is that quantitative analysis, resulting in significant changes, when used with small samples may overlook details. Further analysis of participants' drawings using qualitative analysis could reveal additional findings.

Pre-service teachers' self-efficacy: STEBI-B

Data from Table IV show that all three groups of pre-service teachers had significant gains in their efficacy beliefs after enrolling in the science teaching methods course and teaching during practicum. Participants felt more confident that they would be able to teach science effectively and that it would make a difference to student achievement. This finding parallels those from previous studies outside Egypt (Bleicher & Lindgren, 2005; Morrell & Carroll, 2003; Ramey- Gassert et. al., 1996; and Woolfolk Hoy, 2000) that found significant changes in both PSTE and STOE subscales. Other studies found significant changes in only one subscale. For example, Cantrell, Young, and Moore (2003), and Tosun, (2000) found significant changes to PSTE, but not to STOE. These inconsistent findings may be because of the different underpinning structure of the teaching methods course in each study, resulting in changes to either the PSTE or the STOE and sometimes to both. Gorrell & Capron, (1990) found correlations between the type of methodology advocated for in the course and teacher self-efficacy. The science teaching methods course, in this study, underpinned a constructivist teaching and learning approach including components

identified, by Bandura (1997) that may contribute to perceptions of self-efficacy. Microteaching presentations held during methods classes provided first hand experiences of teaching. Supportive comments were offered by peers that were likely to reduce initial fears about teaching in the actual classroom. Additional classroom teaching practise was experienced by pre-service teachers watching peers and school teachers teach in their classrooms or by viewing video recordings in the teaching methods classes.

Nevertheless, this study made no attempt to separate the two variables (science teaching methods course and teaching-practicum) that could be responsible for the change in participants' self-efficacy, due to university regulations. Wingfield and Ramsey, (1999) and Cannon, (2001), however, concluded that increased time teaching, during practicum, in classrooms positively impacted self-efficacy.

Relationship between drawing scores and self-efficacy scores

Participants were categorized according to their scores on the PSTE and STOE subscales to those with either 'high' or 'low' efficacy beliefs to facilitate inferences. Data drawn from this study suggest that there is a moderate correlation between pre-service teachers' perceptions of themselves as science teachers and their self-efficacy beliefs. Statistical analysis revealed both positive and negative correlations. The positive correlation was found between participants with 'high' STOE scores and 'teacher-centredness' in post-test drawings (Table V). This suggests that participants with strong beliefs, regarding the outcome their teaching may have on student learning and achievement, had images in their post-test drawings implying features of 'teacher-centredness'. It might be that these pre-service teachers cannot relinquish their control of the classroom in order to belief in their ability to affect student learning. The interpretation of effective teaching might be that of picturing the teacher at the head of the class with students sitting passively in rows. However, there are reported concerns over interpreting STOE scores (Morrell & Carroll, 2003; Bleicher & Lindgren, 2005). The concern focuses on the distinction made between the two views of how expected outcomes are perceived and conceptualised. Firstly, the view of STOE as a perception of what may occur based on how a teacher performs and secondly, of what may occur based on external influences.

The logical inference of the negative correlations, in Table V, implies that post 'high' personal self-efficacy believes (PSTE) scores correlate with 'low'

'teacher-centredness' revealed in participants post-test drawings. The interpretation of such relationship is that these pre-service teachers tend to have a more 'student-centred' perspective. Such a perspective may be due to the science teaching methods course that impacted pre-service teachers' self-efficacy.

Conclusion

In this study pre-service teachers experienced a science teaching methods course designed with constructivist teaching and learning approaches. The findings imply the impact the methods course has on self-efficacy beliefs and suggest that increased personal efficacy is associated with increased 'student-centredness' features portrayed in participants' drawing.

These findings enhance the understanding of the impact teacher preparation courses have in forming the foundation for teachers' future practise. Without confidence, based on a high personal science teaching self-efficacy belief and images of self that reflect teaching behaviour in classroom, teachers may be less likely to teach science effectively.

However, limitations of this study are that the size of the groups was small and results from quantitative analysis may be misleading. This implies the need for further research with a larger sample size and a combination of quantitative and qualitative analyses. Difficulties were found with interpreting abstract images in the absence of the pre-service teacher who drew it, suggesting that drawings should be accompanied by interviews with students about what the drawing represented. Another difficulty was with correlating DASTT-C scores with STEBI-B scores. Instead of building an instrument using 'teacher-centredness' elements that have negative interpretations, it would have been better to have an instrument that uses positive interpretations from high scores. Nevertheless, this study perceives its importance in its contribution to the current literature in the area of self-efficacy beliefs and images of self. Implications for future science teaching methods courses suggest that courses be developed with a perspective of strengthening self-efficacy. There are questions to be answered in future research that help understand the effect teacher practicum, various programmes and designs of teaching methods courses may have on pre-service teachers' images of self and efficacy beliefs. More research in this area is needed to clarify the limited impact of the teaching methods course on self-images. In addition to the unpredicted

relationships found between science teaching outcome expectancy with self-images, probably with large scale samples in order to gain a wider perspective of pre-service teachers' self-efficacy and self-images in the Egyptian context.

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Appendix

*Appendix (1) DASTT-C Score Sheet**

I. TEACHER

Activity

Demonstrating, Experiment/Activity _____
Lecturing/Giving Directions (teacher talking) _____
Using Visual Aids (chalkboard, overhead, and charts) _____

Position

Centrally located (head of class) _____
Erect Posture (not sitting or bending down) _____

II. STUDENTS

Activity

Watching and Listening (or so suggested by teacher behavior) _____
Responding to Teacher/Text Questions _____

Position

Seated (or so suggested by classroom furniture) _____

III. ENVIRONMENT

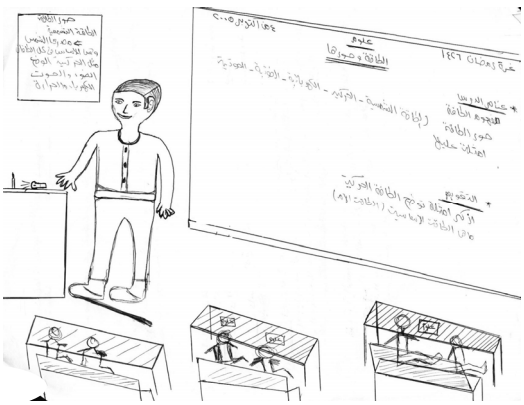
Inside

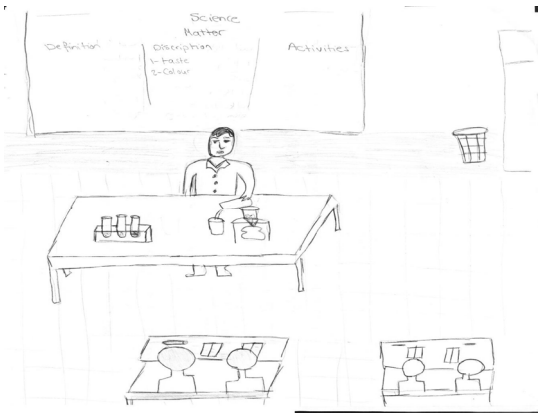
Desks are arranged in rows (more than one row) _____
Teacher desk/table is located at the front of the room _____
Laboratory organization (equipment on teacher desk or table) _____
Symbols of Teaching (ABC's, chalkboard, bulletin boards, etc.) _____
Symbols of Science Knowledge (science equipment, lab instruments, wall charts, etc.) _____

TOTAL SCORE (PARTS I + II + III) = ☐

*(Thomas, *et. al.*, 2001)

Appendix (2) Drawings' of Pre-service teachers





1) DASTT-C illustrations rated as 'teacher- centred'

2) DASTT-C illustrations rated as 'student- centred'