

Implementation of Cooperative Learning and Guided Discussion Methods in Science Teaching to Improve Professional Skills of Student Teachers

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ABSTRACT

This study aims to investigate the effects of a combined approach including cooperative learning and guided discussion methods in science teaching on student teachers' achievements and their professional skills development. Theoretical framework of this combined approach was settled and implemented by the researcher's own experiences. Hence, action research method was chosen as a research methodology. Research sample consists of 133 (45+44+44) 3rd year elementary student teachers who take courses of Science Teaching I-II in the Department of Primary Education in the Faculty of Education at the Sakarya University in Turkey in the 2005-2006 (45) and 2006-2007 (44+44) education term. It was concluded that this approach provided practitioners with an increase in their academic achievement obtaining the chance for eliciting ideas and improving their professional skills in relation to the scientific process skills about effective science learning and teaching through their own teaching practice in faculty before actual teaching practice in school.

Key Words: Cooperative Learning; Science Teaching; Student Teacher; Professional Skills Development.

INTRODUCTION

In this new millennium, academicians try to cope with all problems they met in teaching process in higher education. They also try to improve student's expectations in relation to the teaching and learning process, new demands in course planning and implementing and improving professional skills (Donnelly, 2007). It is indicated that there is limited attention to develop teaching in mixed ability classes (Angelides, 2002). For this reason, academicians need to question themselves by the way considering and practicing about what constitutes "good teaching" for academicians and "good learning" for students in higher education. In this context, many teacher educators aim to improve student teachers' multiple perspectives on issues to do with the practice of teaching during the pre-service teacher education process. However, as knowledge is not completely transferable by the means of recording documents, teaching and learning process must be managed in an effective classroom atmosphere in

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science teaching (Ovens, 1999). Furthermore, there are no formulations to arrange rules and standards to prompt teachers for professional development and no pre-defined parameters' results which can be suitable for all kinds of situations. Therefore, pre-service teacher education programs need to give crucial importance to prepare student teachers for actual world in profession. However, it is emphasized that the majority of elementary teacher education programs do not provide sufficient competency for their students during their science teaching (Moore & Watson, 1999). In addition, these programs are not able to improve self confidence of elementary student teachers sufficiently enough in science.

Considerable changes in student teachers' pedagogical skills and orientations are often extremely difficult to improve, and success in these subjects is critical for science teaching. Researchers point out that science teaching methods have remarkable impact on improving self-confidence and positive self-efficacy in terms of providing professional skills development of student teachers (Palmer, 2002). In this regard, current science education reforms need to elaborate preparation to construct purposeful practice in science teaching for practitioners (Levitt, 2002). On the other hand, student teachers emphasize that they do not implement the application activities profoundly during teaching practice because of the limitations of the process, especially regarding time (Saka, 2001). In addition to this, it is drawn out both student teachers have insufficient basic knowledge of convenient strategies to make effective decisions about teaching and they have not necessary information of what they need to know about activities in relation to science teaching (Eisenhart & Behm, 1991; Lunenberg & Korthagen, 2003). Therefore, students focus on the allowed amount of knowledge which has not any relationship with the daily life and future profession. Student teachers also indicated that teachers are not able to constitute right balance between designing learning process of their students and giving them responsibilities for learning themselves. Thus, student teachers often have completely uncontrolled feeling and constraints about learning process. It is emphasized that student teachers need to be prepared to solve classroom problems, make decisions, and construct knowledge (Putnam & Borko, 2000; Zeichner & Conklin, 2005). Hence, doing much more practice in science teaching during pre-service teacher education have crucial role to improve professional skills of practitioners.

There is an agreement with the effectiveness of cooperative learning/teaching for professional development in teacher education (Stallings, 1989). Teachers indicate that science teaching and learning process needs to be designed with the student-centered activities such as engaging hands-on activities, participating actively in learning science, gaining meaningful knowledge, improving positive attitudes about science learning (Spiringer, Stanne & Danovan, 1999; Levitt, 2002). Interaction with their peers could make a significant contribution to the quality of the science teaching/learning and professional skills improvement of student teachers (Hayes, 1997). Besides, student teachers could develop their cognitive and affective domain and individual critical thinking competences by means of cooperative learning (Slavin, 1987). It is indicated that when practitioners attempt to elicit their knowledge, experience and skills by means of cooperative learning/teaching and discussion, this process has very meaningful contribution to construct mutually acceptable benefit and enrich misunderstandings of teaching (Trent et.al., 2003). This study aims to investigate the influences of a combined approach including cooperative learning and guided discussion methods in science teaching on student teachers' achievements and professional skills development of them.

In agreement with findings from Haney and McArthur (2002), I believe that a teacher's beliefs concerning constructivism are strongly influenced by their life and professional experiences as both teachers and learners. My experience as a teacher educator for more than 10 years has supported my claim that our students' success in constructing their own science conceptual understanding influences their self-efficacy (Bleicher, 2002; Lindgren & Bleicher,

2003). Inservice and preservice primary teachers need to be supported to teach science effectively. To enrich learning outcomes in science, I believe there is a difference in the depth and meaning quality to a learning experience if it is learned using well-structured practices within a social constructivist perspective. It is important that students need time and opportunity to experience success while constructing their own conceptual understanding.

Implemented approach in the context of research includes cooperative learning and guided discussion in science education. The framework influences a combined approach which includes cooperative learning and guided discussion methods in science teaching on student teachers' achievements and professional skills development of student teachers. Researchers have analysed teaching process in the classrooms to explain how learning is constructed socially and individually by the practitioners with constructivist perspectives. Researchers pointed out that mentor teachers have crucial role for constructing of their students' knowledge and understanding (Cobb, Perlwitz, & Underwood-Greg, 1998; Driver, 1989; Driver et. al., 1994; Roth, 2002).

Vygotsky's perspective indicates that the development of a learner could be understood when the mental and socio-cultural process in which he or she participate are taken into account. In his framework, the social interaction is the most important and comes before from the individual's thinking. In this context, social constructivist principles support implemented approach including cooperative group works in which guided discussion and argumentation are taking place. It is indicated that cooperative group works and discussions develop integration of meanings and achievement in science, creative thinking, social and communication skills (Johnson & Johnson, 1994; Hackling, Peers & Prain, 2007, September). In this study, a theoretical framework is settled by the researcher. The variables covered in this theoretical framework are: the implemented approach for independent variables, achievement level and developed skills for depended variables.

Cooperative learning provides superior learning effect in science learning for young children (Hillkirk 1991; Souvignier & Kronenberger, 2007). Being in the circumstances of lively, empathic, affirming, interactional and critical friendship with peers can extremely improve sense of mutual encouragement (Roschelle & Teasley, 1995; Roschelle, 1996; Ovens, 1999; Angelides, 2002; Trent, et.al., 2003). Therefore, cooperative learning process is a kind of effective tool for science teachers to improve many skills of students in relation to the communication, trust, leadership, decision-making and conflict management, critical thinking, decision-making, problem solving, visualization and reasoning ability; and personal qualities-responsibility, self-esteem, sociability, self-management, integrity and honesty (Jongste, 1996). Cooperative learning process contributes to the practitioners in terms of helping to raise the achievement level providing a favorable ground for building positive relationship between teachers and practitioners, giving practitioners necessary experience, offering excellent opportunity for both practitioners and teacher, encouraging face-to face interaction (Ngaka, 2006). Cooperative learning process improves student teachers' confidence, self-efficacy and practice, learning science and vision of science (Hackling, Peers & Prain, 2007, September). It is considered as an important factor to improve learning and cognitive development by means of providing a more effective learning process which improves practitioners' social and everyday life skills and achievement scores (Gibbs, 1994; Lord, 2000; Lou, et al., 2001).

Guided discussion as a basis of learning theories involves inquiry strategies, teaching for conceptual change, and other classroom-supportive theories by benefiting from Bandura's (1986) four sources of effective expectations (mastery experiences, physiological and emotional states, indirect experiences and social persuasion) (Bowers & Simonis, 2004). Guided inquiry provides practitioners with an improvement in understanding of subject matter, powerful scientific skills and a strong understanding of the nature of science (Carey &

Smith, 1993; Schwarz & White, 2005; Barrier, 2005, September). Science educators indicated that such skills and understanding are crucial for all students. Practitioners reflect on their thinking skills by making generalizations and verbalizing how, when, and why each specific skill would be taken into consideration. With this way, thinking skills of practitioners are integrated into science contents and oriented to the educational goals. This process provides practitioners to engage in a metacognitive activity in terms of these scientific process skills (Zohar & Dori, 2003).

Guided discussion improves success of practitioners, teaching orientations and learning how to plan inquiry-based lessons of student teachers in science (Christina, Yovita, 2006). Teachers could use some critical reflections of students for stimulating discussion in implementing guided discussion. Allowing practitioners to reflect their knowledge reinforce curiosity and profound thinking among reflections of practitioners (Bottge & Hasselbring, 1993; McClanahan & Wicks, 1993). It was concluded that there is correspondence between level of questioning and level of knowledge-construction activity. In this situation, it is suggested that the type of questioning used for practitioners provoke the possible level of knowledge construction (Chin & Osborne, 2008, March). This process reinforced performance on science tasks in relation to the learning, investigation, knowledge mapping, knowledge construction explanations during verbal discussions for guiding students' thinking skills. It is indicated that engaging practitioners in investigative processes provides them to answer important questions (King & Rosenshine, 1993).

Low level guided discussion caused low level achievement. For this reason, it is concluded that implementing teaching strategies in instructional environment need to be constructed with the more guided discussions for practitioners to participate actively to the learning process and helping them to pitch their thinking about application, evaluation and synthesis of ideas (Tisher, 1977). Guided discussion included comprehension, prediction, anomaly detection, application, planning questions guide practitioners to take part in more actively about their ideas in science learning process (Chin & Osborne, 2008, March). This process provides practitioners deep learning by improving skills of practitioners to generate explanations, formulate hypotheses, predict outcomes, thought-experiment, interrogate anomalous data, think about application of opinions and plan next steps. In addition to these, throughout our review, it is seen in some researches implemented with cooperative learning and guided discussion by; Hogan, Nastasi, & Pressley, (2000); Zohar & Dori, (2003); Liang, & Gabel, (2005, August); Schaal & Bogner, (2005, Winter); Dymond & Bentz, (2006); Hourigan, (2006, Spring/Summer); Cammarata & Tedick, (2007); Fitzgerald, Koury & Mitchem, (2008).

METHODOLOGY

a) Research Model

Action research is regarded as a means of enabling teachers to improve and explore their practice within their own context (Carter, 1998). Teachers' research is regarded as formative assessment and reflection on practice into their everyday teaching process (Roberts, Bove & Van, 2007). Teachers try out various strategies to see what works with their practice. They collect evidence of student learning in practice and could improve instructional ideas based on the reflections. It is indicated that researchers could see themselves in action research as formulating teaching strategies to improve in one direction or the other for implementing an effective teaching process (Schostak, 1999). Action research provides practitioners improving both teacher and student learning and contributes to the development research base about science teaching (Roth, 2007).

Theoretical framework of the combined approach was settled, developed and implemented by the researcher' experiences. For this reason, action research method was

chosen as a research methodology. During the research, a mixed research approach was used with the qualitative approach including interviews with student teachers and researcher's observation of student teachers. With the qualitative approach, a survey questionnaire was used.

b) Sample

The research sample consist of 133 (45+44+44) 3rd year elementary student teachers who take courses of Science Teaching I-II in the Department of Primary Education in the Faculty of Education at the Sakarya University in Turkey in the 2005-2006 (with the 45 (35 female-10 male) elementary student teachers) and 2006-2007 (with the 44 (from classroom A-35 female-10 male) + 44 (from classroom B-32 female-12 male)) elementary student teachers) education term. The ages of participants are between 19 and 21.

c) Development of Tools to Gather Data

Before the implementation of the methodology designed in this study, student teachers who took the course of Science Teaching-I were asked to write down students' gains regarding the aim of the course. Having formed a sentence pool from their responses, the items of the questionnaire were formed regarding the frequency of the ideas encountered among the participants' common opinions. It is revealed that the questionnaire items could be grouped in dimensions; general professional skills, using methods and techniques in science teaching, material development, cognitive development, psychomotor skills, social skills, cultural skills and evaluation. In this vein, the questionnaire including 91 items was applied to 40 student teachers, and reliability coefficient (Cronbach alpha) was found as .95, employing SPSS 13.0 program. The validity of the research is provided by taking experts' view into consideration.

The gains in relation to the course of Science Teaching-I were presented in five-likert-type scale format (certainly not agree=1, not exactly agree=2, partial agree=3, agree=4, completely agree=5). Student teachers were asked to state their level of learning gains through questionnaire which has sub-dimensions such as: *General professional skills-Implementing teaching methods-Developing teaching material-Cognitive development-Psychomotor skills-Social skills-Cultural skills-Assessment skills*. Implemented approach evaluated regarding its effectiveness comparing explanations of elementary student teachers' gains, the questionnaire was applied to 3rd grade elementary student teachers who were taking the course, Science Teaching II again in the end of the implemented approach, using sum scores. And, the achievement level of student teachers obtained from the final exams' grades of practitioners at the end of the each semester.

d) Analysis of Data

The obtained data using the developed likert-type scale in the context of research were analyzed with SPSS using standard deviation, mean, compute and t-test. Data from semi-structured interviews were carried out with 35 [12+12(from classroom A+11 (from classroom B)] student teachers and analysed by using quantification of common views. Data from observations were analysed according to the frequencies of events and acts observed. At the end of the course processes of Science Teaching I-II, during the pre-application and after application of the implemented approach, obtained data were analysed using SPSS 13.0 whether there is a meaningful difference among gains in relation to the implemented approach regarding gender differences and sub-dimensions of questionnaire, using the sum-scores and employing t-test. And also, final exams' scores were analysed using SPSS 13.0 and employing t-test. Data from semi-structured interviews were carried out with 35 student teachers were analysed by using quantification of common views. To provide validity: all row data were given to the participants for member checking or respondent validity, to provide

triangulation: multiple data collection tools was used and prolong involvement implemented by participating in the process of Science Teaching-I and Science Teaching-II. On the other hand, to provide reliability; thick description was provided for the reader to improve reliability and for triangulation; that was multiple data collection techniques were employed to improve reliability.

e) Implementing Process

This study is presenting a new approach that widely prevailing model of science teaching. The development of the approach involves the following steps explained briefly:

1) *Explaining the Conceptual Framework of the Process.*

(This approach could be used in the context of the Science Teaching I-II course which second term of the continuation two terms). It is presented detailed information about stages of this process at Figure 1.

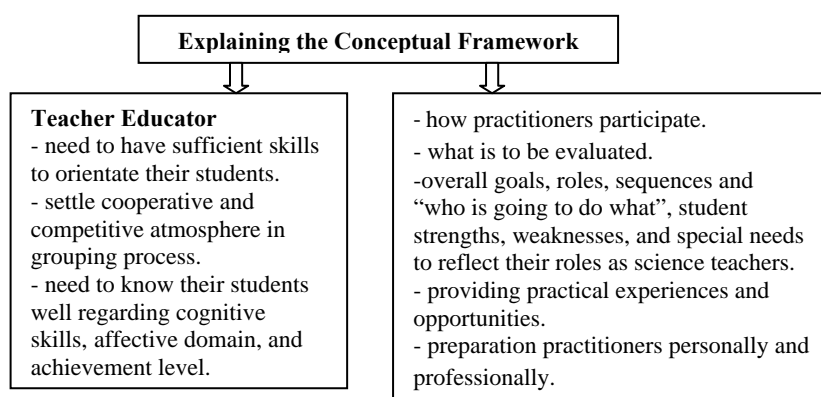


Figure 1. Detailed information about Explaining the Conceptual Framework of the Process

2) *Grouping Process*

- Teacher educator can select project group members among science education students which have sufficient cognitive skills and affective domain according to their ability in learning science in terms of participating learning process actively and gaining expected achievement in the first part of the Science Teaching-I course.
- Project group could consist of 14 or 15 students to develop science activities and will engage in improving new skills in science learning/teaching and heterogeneity is required within the all group.
- While theoretical section of each related unit is being discussed in class, project group will be engaged in developing science activities out of class in laboratory related to next unit of ongoing learning process.
- Before developing science activities, project group members are responsible for studying by recording important points on their notebook related to the unit in which they will develop activities.
- A research assistant is assigned for project group to guide them when they need and control their study records.
- Project group members could split into 4 or 5 groups and each group involves 3 or 4 students.
- Each small group has one strong leader and there could be at least also two stronger leaders who are selected among the leaders to be in charge of all project group.

- The group leaders give the copies to the selected leaders who will duplicate them to give one copy to the teacher educator and the other to the presenter group for implementing in class 2 or 3 days before the next implementation in science teaching course.
- Implementer group consists of 3 or 4 students but, two of which will take more active role to practice developed activities in classroom.
- Each two members take active role practicing 2 activities by sharing 6.
- Each two of the other members take passive role practicing 1 activity they developed themselves.
- When each of two presenter group members get passive role during the application section of science teaching by practicing only 1 developed activities in class, they can get active role in the section of the conceptual instruction of science teaching course in classroom.
- Then, next responsible implementer group members go on practicing next developed activities by project group members and the process could continue in this order rotationally.
- Implementer and presenter group members are responsible for studying sequentially the related theoretical unit which will be discussed in class and practiced developed activities by means of preparing special report and giving it to teacher educators week by week.
- With this task distribution of group members, developed activities are practiced during the process.

It is presented detailed information about stages of this process at Figure 2.

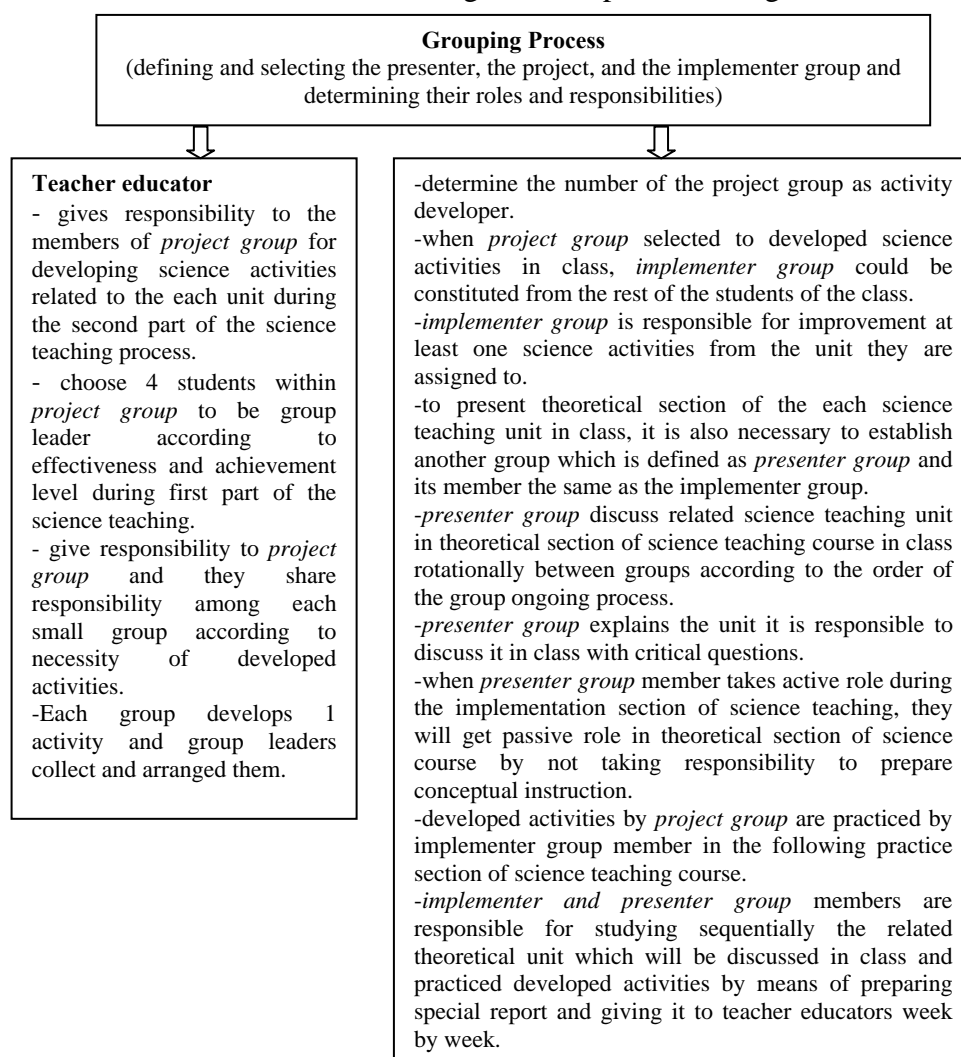


Figure 2. Detailed Information about Grouping Process

3) Observing and Recording the Performance of Practitioners (as presenter and implementer group and collecting the documents of developed science activities of project group).

- After each developed science activities which is practiced by the members of implementer group, all activities could be evaluated by whole class that also includes the project group regarding effectiveness, convenience to curriculum, relevancies with the units and applicability, and degree of difficulty.

4) Analyzing the Recorded Observations for Evaluating (using documents and teaching materials to identify and describe features of effective instructional and classroom settings).

- Practitioners could be informed about personal strengths and weaknesses (For example; how do they conceive this case, do they like these behavior patterns?, do they agree about the theories?, can they use the recommended strategies successfully in classrooms?)

- Developed activities tested in classroom by implementer group regarding applicability, convenience for curriculum and related unit could create higher retention for science education.

- And, each developed activity can be labeled by all practitioners in class with respect to measuring what the value of difficulty taking into consideration pre-determined criteria.

It is presented detailed information about stages of this process at Figure 3.

We have also presented schematic information about stages of the process regarding grouping, orientation, planning and evaluation related to teaching and learning expectations regarding behavior management, teaching methods, roles and responsibilities (e.g., see Appendix A. for grouping process, see Appendix B. for clarifying of the dimensions of the implementation process and see Appendix C. for clarifying of the process of guided discussion in the class during the theoretical section of the course).

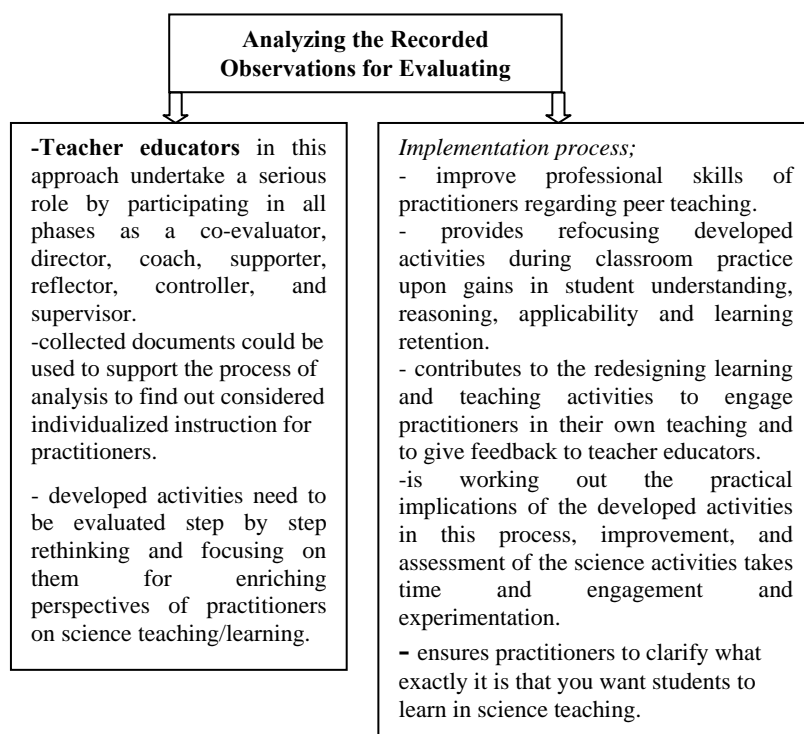


Figure 3. Detailed Information about Analyzing the Recorded Observations for Evaluating

FINDINGS

a) Survey Findings

Table 1 illustrates student teachers' views in the light of their assessment of the approach implemented in the Science Teaching-II regarding sub-dimensions of the questionnaire.

As it is seen from the Table 1; there are statistically significant differences between student teachers who took the courses of Science Teaching-I and II with respect to the academic achievement ($\bar{X}_1=54.59$ $\bar{X}_2=64.13$ $t=-5.93$ and $p=.000<.05$), general professional skills ($\bar{X}_1=3.41$ $\bar{X}_2=3.54$ $t=-2.13$ and $p=.034<.05$), implementing teaching methods ($\bar{X}_1=3.33$ $\bar{X}_2=3.54$ $t=-2.97$ and $p=.004<.05$), developing teaching material ($\bar{X}_1=3.50$ $\bar{X}_2=3.67$ $t=-2.17$ and $p=.032<.05$), cognitive development ($\bar{X}_1=3.45$ $\bar{X}_2=3.60$ $t=-2.13$ and $p=.034<.05$), psychomotor skills ($\bar{X}_1=3.33$ $\bar{X}_2=3.64$ $t=-4.13$ and $p=.000<.05$), social skills ($\bar{X}_1=3.84$ $\bar{X}_2=3.99$ $t=-2.32$ and $p=.021<.05$), cultural skills ($\bar{X}_1=2.99$ $\bar{X}_2=3.31$ $t=-3.92$ and $p=.000<.05$) and assessment skills ($\bar{X}_1=3.27$ $\bar{X}_2=3.57$ $t=-3.62$ and $p=.000<.05$). Besides, there is not statistically significant difference between male and female student teachers and between groups or classrooms take part in the sample and implemented process including different years during the application who took the course of Science Teaching I-II regarding the effects of the implemented methodology on student teachers' gains and achievement level.

Table.1 The *t* test results according to the student teachers' views based on to sub-dimensions of survey about implementation of application in the Science Teaching-II

(N=133)

<i>End of the Science Teaching-I</i>	\bar{X}_1	<i>End of the Scince Teach.-II</i>	\bar{X}_2	Ss	t	p
Achievement 1	54.59	Achiev. 2	64.13	18.52	-5.93	.000
General professional skills 1	3.41	Gen.prof. skills 2	3.54	.68	-2.13	.034
Implementing teaching methods 1	3.33	Implem. teac. meth.2	3.54	.76	-2.97	.004
Developing teaching material 1	3.50	Dev. teach. mat.2	3.67	.89	-2.17	.032
Cognitive development 1	3.45	Cogn.dev. 2	3.60	.82	-2.13	.034
Psychomotor skills 1	3.33	Psyc. skills 2	3.64	.86	-4.13	.000
Social skills 1	3.84	Soc. skills 2	3.99	.74	-2.32	.021
Cultural skills 1	2.99	Cult. skills 2	3.31	.93	-3.92	.000
Assessment skills 1	3.27	Assess. skills 2	3.57	.96	-3.62	.000
p<.05						

b) Questionnaire Findings

Findings from the interviews with the 35 student teachers about assessments of applied approach in the research process are presented as follow:

Most of student teachers especially indicated that the implemented process in the context of research provides practitioners with; more positive social learning environment and atmosphere, highly increased level of interest and active participation, implementing the course entirely in student-centered format, improving competition and working motivation within the classroom, gaining skills in relation to the effective questioning favorable the subject, gaining skills for developing interesting and instructional activities in science teaching, contributing to deepening in the subject in science by working cooperative learning groups, perceiving different aspects of the subject in science, appraising the importance of working cooperatively and learning by others, overcoming lack of learning experiences in

science teaching, gaining skills in relation to the implementation of cooperative learning deliberately.

c) Observation Findings

Researcher' observations related to the assessment of implemented approach in Science Teaching-II can be summarized as follow;

It could be stressed for practitioners that they have active participation of the process in science learning and teaching. For this reason, implemented process firstly constitutes effective learning and teaching environment, contributes to the interesting learning and teaching science and reveals differences in teaching practice skills, improved insight for their personal practice. Practitioners seem to be willing to explore their ideas and share reactions, to give and receive feedback, improve self-efficacy among practitioners. They feel themselves interactive in the learning and teaching environments and they feel competent. Peer teaching and learning is the most important attribution of the process.

DISCUSSION

In this study, the effectiveness of presented model for teaching science, the (hands-on) developed science activities, opportunities to ask questions to teacher educator, working cooperatively in groups, and social skills of group members have crucial impact on contributing to improve professional skills regarding implemented teaching methods, developing teaching material, cognitive development, psychomotor skills and assessment skills of practitioners in teaching science. All of these could be described as increasing achievement and ensuring mastery in teaching science for practitioners. But, it has not meaningful effect on student teachers' gains and achievement level in terms of gender differences and groups or classrooms across different samples and years.

In this context, the process of guided learning activities gained significantly higher scores on reasoning tasks and on science knowledge tests than students from comparison groups who studied in the traditional way (Zohar et al., 1994; Zohar, 1999; Zohar & Nemet, 2002). It is emphasized that when practitioners participate guided discussions of unfamiliar topics, they might learn how to guide such discussions in their profession by developing habits of inquiry to assist their students as practitioners and understand how pedagogy can be adapted for effective use. This process provides them with learning opportunities in the ongoing activities of their professional life and a partial contribution to help teachers to teach more than they know. It has also remarkable improvement for practitioners with respect to understanding teaching situations, evaluating the effectiveness of their actions, feeling themselves as better professionals and recommending alternative approaches to improve their teaching practice (Floden, 1997; Angelides, 2002).

Practitioners could employ hands-on activities, dramatizing, and demonstrations. In this process, they modeled how to teach science by pretending themselves as an elementary teacher to improve their own professional skills. It is therefore possible that this process could provide vicarious experiences for practitioners in terms of working cooperatively, having interaction through discussion and reflecting science teaching skills of all practitioners by means of sharing each others' experiences. It is indicated that when practitioners attempt to elicit their knowledge, experience and skills by cooperative teaching/learning and guided discussion. This process has very remarkable contribution to construct mutually acceptable benefit, and when necessary allows practitioners to decrease misunderstandings of teaching (Roschelle & Teasley, 1995; Roschelle, 1996; Trent et.al., 2003). It provides practitioners with mutual satisfaction through co-teaching in science by means of discovering, sharing, and testing each other's assessment ideas. Moreover, practitioners could have an opportunity to

try to recognize their own problems in science teaching. Practitioners could improve their social skills working cooperatively. This approach also provides them to increase self-confidence, establish face to face interaction in group and between groups, and to encourage their motivation (Veenman, et.al., 2002; Fischer & Mandl, 2005).

It is emphasized that learning does not need to constitute by direct experience. When a practitioner observes the other practitioner succeeding a role, they both have vicarious experiences which have a convincing strong impact on self-efficacy. Besides, although teachers must have a range of attention, memorial, motor and motivational processes, “anything can be learning by the way direct experience can also be learnt from observation”(p.406). From this perspective, self-efficacy of practitioners can be supported by means of observing the others arrange their role successfully observing similar peers improving their skills (Pintrich & Schunk, 2002). In this process, self-efficacy of practitioners is enriched by observing the other practitioners taking the evidence of the evaluative comments into consideration. It is pointed out that when student teachers applied more routine activities in teaching such as cooperating teaching/learning they do not need to consider deeply what they are doing in classroom setting and how to construct their teaching style (Wubbels & Korthagen, 1990). The performance or competency orientations of students could be seen as learning situations which involve normative implementations by comparing one’s performance with others. This process could have positive impact to sharpen teachers’ reasoning potentials and facilitates the improvement of the disposition to self-monitor one’s teaching practice in science during their pre-service teacher education (Slavin, 1987).

When the student teachers interact with their peers, they will learn from each other. This process enriches their motivation, and helps them to construct their own goals, designing their plan and evaluating their own professional skills development. This process also provides practitioners with opportunity for dialogue, interchange and interaction among practitioners in cooperative groups (Barron, 2000; Fischer & Mandl, 2005; Donnelly, 2007). For this reason, peer observations in teaching process become a social instrument for enriching teaching practice (Peel, 2005). This process also oriented practitioners to foster students’ development of expertise encompassing a multitude of contents and complexities of successful design requirements for improving science teaching skills. When student teachers examine peers work, they improve professional skills in terms of how to implement teaching process effectively (Smythe & Halonen, 2006). This process provides practitioners with wide engagement on the group, and facilitates the practice of co-teaching. It also provides practitioners with peer assisted learning environment supported by the use of appropriate social skills in a natural setting.

Student teachers need to become more aware of the personal practical teaching models that shape their classroom practice (Tabachnick & Zeichner, 1999). Hence, student teachers want to give more attention to their individual professional skill development than teacher educators supported them (Lunenberg & Korthagen, 2003). They could have conscious of recognizing all of the situations related to their practice are externally produced and they have sufficient knowledge that emerges to improve their teaching practice (Tabachnick & Zeichner, 1999). So, they could plan and prepare work for the forthcoming practice. This process could help practitioners to construct their own personal style of teaching and stimulate reflection on personal style and professional skills development. Morrissey (1981) indicates that to construct effective science teaching in pre-service teacher education, practicing teaching, student-centered approaches, and process approaches could have remarkable positive contribution to students’ attitudes. When the science teaching methods focus on the inquiry or other student-centered approaches such as cooperative learning and guided discussion in pre-service education program, students could improve their own professional skills especially in teaching science. This process provides practitioners with effective tools to

have an immediate and direct impact on teaching practice. Teacher guided discussion improves their higher level conceptual understanding (Hogan et al., 1999; Posnanski, 2002). However, it is pointed out that guided discussion and cooperative-learning techniques provide practitioners with high degree of knowledge and skills (Sutton, 2004).

Researchers indicate that many elementary teacher education programs have tendency to apply different kinds of teaching methods in science teaching especially such as cooperative learning, discovery, student-centered and teacher as a guide (Palmer, 2002). In this regard, it is emphasized that teacher educators could inform their student teachers to reflect elaborately and properly on different aspects of their experiences in profession (Lunenbergh & Korthagen, 2003). For this reason, the presented approach focuses on student teachers' development through learning "on the job" in pre-service education and develops their professional skills by analyzing different teaching incidents. However, it is pointing out an alternative way to contribute to the student teachers for developing their practice. In this context, it could be seen as an important source of inspiration for practitioners with respect to both providing achievement in science learning and professional growth.

CONCLUSIONS

Implemented approach in the research process improves practitioners' professional skills related to the learning and teaching science through active engagement in hands-on activities in class time. This approach indicated that working together in application process within group and also between groups enriches achievement of students in science learning and improves their professional skills by virtue of sharing their documentations, thoughts, ideas, assumptions and beliefs, ensuring mutual support by observing each others' practice and being happy when they achieve something. In this regard, implemented process of the approach provides practitioners to construct effective learning and teaching environment by supporting interest for learning and teaching science and revealing differences in teaching practice skills, improving insight for their personal practice, being willing to explore their ideas and sharing reactions and recognizing the peer teaching and learning. For this reason, it could also guide student teachers in terms of gaining motivation related to their own individual professional development. But, it is revealed that implemented approach has not meaningful effect on student teachers' gains and achievement level in terms of gender differences and groups or classrooms which take part in the sample and application process including different years. This process encourages student teachers to reflect on how they could implement effective science teaching to influence the quality of students' learning outcomes. In this regard, implemented approach which involves cooperative learning and guided discussion to practice in science teaching/learning could provide more opportunity for the student teachers by means of learning by teaching, doing and collaborating. They realized necessary qualifications in terms of increasing efficacy, raising expectations, considering future performance for science teaching performance regarding professional competences in pre-service teacher education process.

A valuable aspect of this approach is that it reflected an effective way to increase level of achievement in science learning by virtue of giving inspiration via developing activities related science teaching/learning and applying and evaluating them in interactional classroom atmosphere and offering practitioners the chance to elicit ideas about effective science learning and teaching in their own practice in faculty before actual practice in school. The emphasis of this paper lies on the construction of what could be done while applying the cooperative learning and guided discussion in science teaching in the light of the conceptual framework of developed approach. This interactional process contributes to decrease practitioners focus on memorization, increase practitioners self-regulation teaching strategies, increasing and focusing practitioners' own motivation for learning and teaching science and

recognizing the need to transfer learning from the classroom to the real world about learning and teaching science. It could be explained that this study is presenting a productive process to build upon the practitioners' needs by means of focusing on the perception and reflection of individual and cooperative learning to teach with respect to being successful in science learning/teaching and improving professional skills of practitioners. This process points out a different approach in science teaching to design a transitional stage in constructing effective professional growth of student teachers during pre-service teacher education.

We claim that a correspondence efficiency of classroom activities and improvement of science teaching/learning skills of practitioners are emerged through this process. It could ensure practitioners to gain active knowledge in science teaching/learning in terms of understanding, reasoning and utilization of developed activities. Then, they could make some kinds of brainstorming and foresee ways to overcome limitations. It could be expected from them to be thinkers, decision makers, being able to cope with constraints themselves. Thus, this process could be seen as an integral part of professional development.

SUGGESTIONS

Student teachers need to be primarily responsible for learning science. This is presenting a problem because most of student teachers' prior experience in pre-service teacher education process and previous college courses has not made them responsible sufficiently. Elementary teachers need to recognize their role as elementary science teacher as dispenser of facts to transmit a body of knowledge. In this regard, they also improve professional skills development deliberately especially with respect to constructing a base line for Science Education. In this way, they improve level of science literacy of students.

Teacher educators must obtain necessary knowledge about how to apply different approaches and design them in classroom settings to orientate student teachers in science teaching. In this process, student teachers need to obtain utmost profit for their professional growth during pre-service teacher education program, if we are to develop the quality of science teaching in elementary schools. To implement effective student-centered learning in pre-service teacher education process, method tutors must orientate student teachers to have more self-confident in their profession. They must provide student teachers with a detailed roadmap of how this interactional process is succeed and explain in detail why it will be useful to adapt such responsibility. At the beginning of the process, practitioners need to be informed of what is being attempted and why. Student teacher must be supported with the detailed syllabus that outlines everything that is expected from them for the implementation of the approach. The syllabus must also provide student teachers detailed instructions of how to go about this new interactional process of active learning in cooperative groups. In the light of this study, it is necessary to examine how to help science teaching students acquire better understanding of science teaching and learning for having remarkable contribution to professional growth of practitioners during their pre-service teacher education by means of developing such different teaching approach in science.

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Appendix A. Grouping Process

Science Teaching-I (<i>first term</i>)	50 students- participants	end of the term selected 14-15 students considering provided active participation to the course at first term	
Science Teaching-II (<i>second term</i>)			
Project Group (do not participate theoretical section)	14-15 students	Working cooperatively in lab for developing at least 4 or 5 science activities in relation to each unit sequentially according to material and give them to the implementer group for practicing in class and being evaluated them by all class.	separate 4 or 5 group select group leaders for each group select two of strongest ones to become real leaders and his/her assistant
Presenter Group taking responsibility of each group in ordering	35-36 students (rest of the class)	responsible for discussing the theoretical section of science teaching	separate 12 groups (the same member as implementer group) Group: 1, 2, 3,10, 11, 12
Implementer Group taking responsibility of each group in ordering	35-36 students (rest of the class)	responsible for practicing developed activities	separate 12 groups (the same member as presenter group) Group: 12, 11, 10,.....3, 2, 1

Appendix B. Dimensions of Implementation Process

The role of groups	Presenter (in Theoretical Section)	Project (in laboratory)	Implementer (in practicing section)
Process <i>Science Teaching-II</i>			
week 1.	group1. (1 + 2) students ↓ takes active role by discussing related subject	4 or 5 developed activities (2 students) take active role each one implement two activities	group12. (2 +1) developed extra 1 activity ↓ takes passive role (1 student) implement 1 activity
<i>When each group member take active role in presenting, they will take passive role in implementing. With this manner, When each group member take passive role in presenting, they will take active role in implementing (All this process will be done in reverse rotation).</i>			
week 2.	group2. (1+2) students ↓ takes active role by discussing related subject	4 or 5 developed activities	group11. (2+1) developed extra 1 activity ↓ (2 students) take active role and each one implement two activities
week 3.	group 3. (1+2)		takes passive role implement 1 activity
week 4.	group 4. (1+2)		group 10. (2+1) group 9. (2+1) group.2 (2+1)
.....		
week 11.	group 11. (1+2) ↓ takes active role		(2 students) take active role
	↓ take passive role		takes passive role
week 12.	group 12. (1+2)		group1. (2+1)

Appendix C. An Example of Course Plan for Implementation Process of Guided Discussion

Course: Science and Technology Education

Unit 8: Measure and Evaluation in Science and Technology Education

Period: 2 hours

Teaching Method: Guided discussion

Instructions for implementer: *Theoretical section of the course is implemented with the method of guided discussion.*

- *Student teachers are responsible to attend the course process by studying determined preparation questions in the beginning of the each unit which will be implemented next lesson and reported their answers on their notebooks.*
- *Main preparation questions(Q1,Q2,Q3,etc.) are stated bold and after that focusing questions stated are organized to focus on the target answer step by step and stated them horizontally having steps in the course plan to implement it more easily and more effectively.*
- *Expected answer of preparation questions are stated italic.*
- *Course process is implemented by reflecting the preparation questions to the student teachers by the way constructing an effective discussion atmosphere and trying to provide active participation through interaction of student teachers.*
- *In the case of could not to reflect expected answers of student teachers, different questions are asked to practitioners reducing questions to more simple level, interval and focusing to subject and orientating them to the expected answer.*
- *Finally, answer of each question is usually summarized by student teachers in the presenter group or method tutor.*

The questions for preparation:

Q1: What is measurement? Must measurements be numerical?

What are the features of the requirements that measurements are numerical?

You can clarify the question by describing measure and measurement.

Does it give any kind of message that used sub-conceptions during describing these conceptions to us in relation to the measurements need to be numerical?

Measure is quantizing events, materials or determined any kind of qualification by showing symbols or numbers. Measurement is the operation of determination in relation to the dimensions of thing which will be measure. Measurement is giving numbers to the things and events according to the rule. It is taking over that measure and measurement need to be numerical take into consideration description of measure. Symbols are also equivalent to the a number. For example; "AA" is a symbol in bell-shaped curve system. But, it is equivalent to the number of "4".

Q2: What kind of relationship there is between criteria and evaluation?

Would you describe the conceptions of criteria and evaluation?

What is taking over situation when considering to the sub-conceptions which are used making descriptions?

The results of measurement are getting meaningful in the case of comparison with the scale which criterions constituted before. This operation of comparison is evaluation and the results of this operation are value judgment. It certainly needs the conceptions of criteria and evaluation to indicate level of reach to the objectives of curriculum and determine level of achievement.

Q3: Do student achievement in science and technology education depend on the only conceptions and principles?

Student achievement mainly depends on the conceptions and principles. But, and also student achievement depends on the other factors and those also need to be examined.

What kind of situations are taking over when the process of science and technology education is examined?

- *Examining student activities*
- *Examining student performance.*
- *The reports of observation and experiment.*
- *Examining conceptions.*
- *Examining scientific process (observation, measurement, classification, interpretation of data)*
- *Examining affective objectives (motivation and interest, attitudes, values)*

Q4: How could student objectives which are measurable be obtained from the goals of science and technology course?

How can you explain goals of course of science and technology teaching?

Courses of goals are various. It is only not to contented with the gained knowledge in the context of this course.

Which subject skills are giving priority along with knowledge?

Intellectual abilities as scientific process, problem solving skills etc. aim at improvement of personal characteristic such as development positive attitudes to the science.

Do student objectives aim at in the science and technology course mainly contain objectives observable and measurable?

It is not contented with the verbal knowledge depend on the remembrance during the evaluation of science and technology course, factual objectives are measured such as; practicing knowledge, doing experiment, gathering data, evaluating data. For giving a few examples:

Measurement of actual objective, measurement of production of actual objective, measurement of designation of actual objective, measurement of the other objective which indication of actual objective.

Q5: How could evidences gathering in relation to the indication of concepts learning?

What can you say analyzing of objectives related to the knowing concepts and relationships among them?

What can be possible reflected behavior who learned any concept?

- *She/he says/writes the word that explains it when giving typical example of concept.*
- *She/he finds typical example for it when concept is given.*
- *She/he finds typical example of concept when it is given a valid feature describing concept.*

What do you expect to do when it is given a invalid feature describing concept?

- *She/he finds exception of concept.*
- *She/he describes/explains it when concept is given.*
- *She/he says/writes/selects it stating concept when a description is given.*
- *She/he finds example of subclass of it when a concept is given.*
- *She/he says involved upper class of it when a concept is given.*

What do you expect to do when it is given two or more concept?

- *She/he determines relationships between them.*

Q6. How is top level knowledge measure?

How can tools taking into consideration measurement of top level knowledge be determined?

The measurement of scientific processes can be started with the determination a student who achieve the process could do. For this reason, top level knowledge measure like this;

- *Observation: It depends on the observations of empirical knowledge and accuracy of observations.*

Childs start to observe variety situations, be sensitive to the observations and record of their observations.

- *Measurement: It is getting certainty to the knowledge.*

It is impossible improvement and increasing sensitivity without measurement.

Interpretation of data: Science mainly depends on the observation and experiment. Observation and data obtained with the experiments.

What can be done to examine also student achievement after learning activities?

It is getting student to do activity similar with the used one in the learning process. Student is observed and marked his/her behaviors when he/she is studying.

Q7: How do the skills in which aimed of science and technology course measure?

How can you answer this question taking into consideration to the each learning environment designed for students during the course?

- *Examining student activities*
- *Examining student performance.*
- *The reports of observation and experiment.*
- *Examining conceptions.*
- *Examining scientific process (observation, measurement, classification, interpretation of data)*

And also, what can be to take in the dimension of affective field which take place there field of learning?

- *Examining affective objectives (motivation and interest, attitudes, values).*

Finally, it is reached a general judgment after student' achievements measured separately in the context of explained topics.

Q8: What are the evidences indicated affective objectives are gained in the process of science and technology teaching course?

Are students gained only knowledge and skills in the context of this course?

It is not to gain only knowledge and skills in the context of this course. In addition of this affective objectives try to gain to the students.

How can you describe these affective objectives?

How can you determine students' level of interest and motivation?

Motivation and interest: Having interest to the nature, subjects of science and technology, scientist are indicated involvement of science and technology of students.

What is the essential element which takes into consideration to determine students' level of interest and motivation?

We can measure level of interest and motivation to the science and nature by observing students' behaviors.

How can we determine level of attitude to the science of student?

Attitudes: Student can be developed positive and negative attitudes to the course of science and technology teaching. Positive attitudes are acceptable and favor. Negative attitudes are negatory and opposing.

How can you determine values of students related to the nature and science?

Values: We can observe students concerning with the nature and science through verbal value judgments and actual behaviors.

Q9: What is the sort of evaluation? Would you explain it briefly?

1. Evaluation of preparation objective:

What is the preparation objective or readiness?

Before starting the unit, is it need to examine preparation objectives? When and how are they examined?

Preparation objective is the foreknowledge and skills which necessary and gained before for learning unit. Teacher can examine preparation objectives verbally during the class discussion in the process of "enter" stage of teaching method.

2. Evaluation for organizing teaching

What is the evaluation for organizing teaching? When and how is it implemented?

What are we do when we have opinion to have learned students aimed objectives in unit at least minimum level of competency?

- we can pass the other unit.

What should we need to do when we brought out that some subjects do not learn or insufficiently or wrong learn?

We can turn the related subject and once more try to teach. As you see, doing evaluation and measurement for this kind of operations is evaluation for organizing teaching.

3. Evaluation of end of term' achievement

What kind of judgments have we needed to end of the term about student?

- It is need to have value judgments such as; "pass-fail", "successful-unsuccessful" and "middle-good-very well"

What should we need to do?

- It is given a mark to the student.

Which aim is it doing evaluation in this process?

This kind of evaluation is doing to determine the level and achievement of end of term.

Q10. What are the main approaches using to measure student' achievement?

1. What is the measurement of the actual objective? When is it implemented?

What should it do when aimed objectives observed and measured?

- Directly, aimed objective is measured itself. This approach is named as measurement of aimed actual objective.

2. What is measurement of the production of actual objective? When is it implemented?

What should it do if it is not to have opportunity to observation student during doing activity?

- It is examined finished work producing end of the study. This is named as measurement of production of actual objective.

3. What is measurement of designation of objective? When is it implemented?

What should it do when actual objective could not observe and there is not brought out any production?

In this situation, it wants student to designation of work will be done. This approach is named as; measurement of designation of actual objective.

4. What is measurement of the other objective which is indication of behavioral objective? When is it implementing?

What can it do when it could not to do to the students also designation of actual objective?

In this subject, we can examine his/her knowledge and skills verbally. This approach is named as; measurement of the other objective which is indication of behavioral objective.