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An International Comparative Case Study About Using Science Notebooks in Science Teacher Education

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Abstract

Science notebook is a material, methodology, formative assessment model which develop learners' higher order thinking skills. The aim of this study is to identify perceptions of preservice science teachers from U.S. and Turkey about application of science notebooks in Science Teaching Method course. This is a case study and qualitative methodology was used. Study group consist of third grade preservice teachers (42 of them were from Turkey and 25 of them were from U.S.). Study lasted 16 weeks. Survey, observation, interview and science notebooks were used as data collection tools. Descriptive and content analyses were used for data analysis. It was found that science notebooks develop preservice teachers' teaching skills and suggestions related to applications were given at the end.

Keywords

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Introduction

The philosophy of elementary school programs in Turkey and in the world are based on student centered education and learning by doing approach. This philosophy states the need of gaining skills rather than gaining knowledge in educational environments. Skills are the constructs which of their developments can be observed in a longer period than knowledge. The assessment of these constructs can be come up with process-based multiple measurement and assessment approaches differently from the assessment of knowledge. Assessment is generally divided into two as product based and process based (complementary) assessment. The application of process based assessment covers controlling if learning occurs or not, occurance level of learning and investigation of learning for not only product dimension but also holistically all dimensions (Haladyna, 1997; Kutlu, 2004).

New assessment approach in learning-teaching environments has the characteristics of reliability, performance-based, collaboration, reflection of learning related to daily active life, realism and applicability (Spady & Marshall, 1991). Using formative assessment which is not differed the measurement and assessment dimension from learning-teaching process and giving periodical feedback to process has an importance in this case.

Formative assessment is a process which recognizes teacher and students' learning in process and gives feedback. Formative assessment covers providing feedback for development, acceleration of learning process, teaching students how to reach knowledge sources, reinforcement of learning skills and identfying the differences between defined positions and students' positions (Tuttle, 2008).

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Formative assessment is divided into two as planned and interactive. Planned formative assessment is depending upon the fundamental of teachers' having knowledge and after interpretion of knowledge having action. The attainments which students have or have not are controlled periodically in this type of assessment. It has the parts of having knowledge, interpretation and application. Knowledge about process and product can be acquired after assessment process. Parts of interactive formative assessment are feedback, definition and realization. Feedback of teacher is important in this part and it is based on application both individually and in a group. Teacher does not make a plan for giving feedback for the students in this process which depends on student-teacher interaction. Students' learnings are used as feedbacks. Application can be done in a small period of time. Personal and social learnings are also assessed besides acquired knowledge. Knowledge about product and process are acquired after assessment but these are changeable (Cowie & Bell, 1999; Ruiz-Primo, 1998; Worthen,1993). The philosophy of student-centered programs are proper for interactive formative assessment although the factors like capacity of class, structure of topics, pre-requisite of students require the use of two models together.

Indoor applications of science notebooks which is identified to be important in formative assessment step especially in the development process of writing and reading heuristic generally in the world and in the United States start to be used. Notebooks are defined by Ruiz-Primo and Lee (1998) as the meaningful combination of inputs such as recordings, instructional experiences of students in classroom process. Writing applications in notebooks is differed but can be classified under the themes of observers, shapes, taking notes, plans, reflections, explanations and results. In addition to writing, students can use as a material which make operational definition of science concepts with performance based activities. These are the reflections of students' learnings by doing in science classes in a detailed and summarized way(Ruiz-Primo, Li & Shavelson, 2002).Hereby this definition, science notebooks are adopted as effective formative assessment tools and are started to be used for meeting different educational needs such as controlling aims in input, designing instruction in process and measuring and assessing knowledge and skills in output parts.

Science notebooks become popular with integrating meaningful writing applications in science and students' internalizing science content and processes in a meaningful way (Aschbacher & Alonzo, 2006; Baxter, Bass & Glaser, 2001).Baxter, Bass and Glaser (2000) presents sample and clues about students' learning-teaching process activities in science notebooks and teachers' indoor planning processes. Science notebooks are developed in instructional process and differed upon input characteristics, variety of activities in science classes and reflection processes. Students define problems they try to solve, procedural steps they use, observations they make, results they reach and reflect in their science notebooks. Effective and proper using of science notebooks which maintains to have domination of science concepts, scientific literacy and general literacy skills provides professional development about concepts. Researchers ephasize that constructing this type of professional development, unique and inquiry based instructional environments provides teachers to develop self reflective skills (Morrison, 2008). Fulton (2012) reached a result that environments supported with individual or small groups are beneficial during the using process of science notebooks. Lots of methods are used for measuring potential advantages and disadvantages that the teachers meet during instructional applications. These methods are surveys, classroom observation protocols, tests that cover pedagogical content knowledge and content knowledge, instructional anectodes, teachers' diaries and portfolios (Martinez, Borko, Stecher, Luskin & Kloser, 2012).

Documentation of science activities in science notebooks can be in different figures like learning by doing acitivity reports, preparing reports about the results, inferention and reflection of activities. Knowledge about individual notebooks in class are grouped for having results about applied activities. If there is no knowledge about an activity in student notebook, this means that the activity is not done in class. Student's performance can be assessed in terms of input analysis in student's notebook (For instance, student notes, written reports, schemes, data sets, procedural step sor explanation of reported results). As a result, proofs based on teachers' feedbacks and students'

perceptions can be seen in students' notebooks (Ruiz-Primo et al., 2002, p.24). Science notebooks are meaningful and valuable materials for identfying teacher's and students' pervious and current perceptions about science and how conceptual understandings occur, procedural understanding, domination degree of instructional program's aims and adaptation skills of perceptions to new contents (Volkmann & Abell, 2003). Science notebooks are also the places which students indicate their questions, estimations, observations, definitions about procedural processes and importantly learn new concepts. Science notebooks are systematically supported by visual components like schemes, drawings, graphics and tables. Lots of clues about the students' experiences in classroom enviroments existed in science notebooks and students taking samples of the processes that the scientists experienced during exploration process of the world and act like this in their science notebooks (Hargrove & Nesbit, 2003, p.3).

Notebooks are used in assessment process by different ways in individual level, like students learn science concepts via providing proofs related to students' performance about course instruction, being dominant about science concepts in program, giving defined characteristics of programs to students and assessing the quality of teachers' feedback in observing student's performance. Science notebooks are divided to two as quality based science notebooks and interactive science notebooks in terms of their usage aim. Quality based science notebooks are based on assessing students' performances via graded scoring keys (rubrics) and identified criteria in identical time periods. Environments which provide teachers to develop constructivist instructional strategies and students to develop scientific literacy and inquiry-based skills (Ruiz-Primo, Li, Ayala & Shavelson, 2000; Martinez, Borko, Luskin & Kloser, 2012).Research studies show that teachers think that using graphics, lists, schemes via notebooks is the part of classroom communication and is a better way to transfer knowledge to the students. Feedbacks taken from the teachers who assess science notebooks indicate that teachers feel in a more adventageous way in terms of making detailed assessment (Luiz-Primo et al., 2002).

Constructing science notebook processeses which provide to deepen understandings of students related to science concepts with verbal and written materials is one of the important part of National Science Education Standards but science instruction with science notebooks is a complex process. Studies indicate that teachers prefer to use teacher-centered strategies and applications although they accept inquiry-based instruction and they assume that they use science notebooks. Teachers who integrate written applications with the science notebooks' philosophy can cause that their students get less benefit from science notebook applications if they adopt very descriptive and strait laced manner or very open-ended manner (Aschbacher & Alonzo, 2006).

Research studies show that if learning environment is constructed proper to aims, learning science via writing develops students' reflective, critical and creative thinking skills (Hand, Prain & Yore, 2001; Rivard, 1994). For this reason, if the students are guided to use science notebooks during communication process of learning science concepts, science notebooks can be an effective instructional strategy for teaching science to students (Audet, Hickman & Dobrynina, 1996; Fellows, 1994; Shepardson & Britsch, 1997).Writings in science notebooks develop students' literacy skills and provide to understand the world in terms of Klentschy and Molina De La Torre (2004). Students' science notebooks are useful to make relations between science, literacy skills and experiences during the construction process of meanings, internal voices of learners and scientific facts if they are used in classroom environments. Application of science notebooks is effective for students to transfer the terms used in science classes into daily life situations. Using of these notebooks provide students actively participated in the class. Notebooks can be thought as an approach which state the needs of the students who don't participate the class in this term. Science notebooks are also effective for increasing individual learning level of gifted students for providing interactions. Discussion questions are the most important factor providing this issue. Besides this, group works and process activities in science notebook applications are very important for both teachers and students (Gül, 2012). Effective usage of science notebooks which is a both instructional way and interactive instructional material to

develop students' higher order thinking skills and effective measurement and assessment tool that follow and assess students' cognitive process skills and a sample formative assessment model in elementary education level can be done with both preservice and inservice trainings. Skills that define qualified labour force in terms of todays' global world standards are underlined in internationally participated examinations like PISA (Programme for International Student Assessment), TIMSS (Third International Mathematics and Science Study) ve PIRLS (Progress in International Reading Literacy Study). Achievement levels of Turkish students in knowledge and comprehension stage are over world's mean level but their achievement level in analysis, synthesis, adaptation to daily life and assessment stages are considerably under the world's mean level in terms of analysis of these examinations. This result which is also the leading structure of curriculum development efforts show that there is a problem related to education for developing science process skills and higher order thinking skills. Research studies especially in Turkish literature indicate that there are problems in elementary teachers' application and interpretation processes of multiple assessments which are effective for developing and assessing higher order thinking skills in measurement and assessment stage of a program (Gül,2012; Okur,2008; Karahan,2007). Being not enough research studies in both teacher education and in elementary level in both Turkey and in the world about science notebooks which will bring a systematic point of view to application of process-based (complementary) measurement and assessment approaches and present a sample model is the fundamental baseline and starting point of this research study.

The aim of this study is to identify the perceptions of preservice teachers who participate science notebook applications during science teaching methodology course in Turkey and United States and also make a comparative investigation of two countries.

The research questions of this study are stated as follows;

1- What are the perceptions of the perceptions of preservice teachers who participate science notebook applications during science teaching methodology course in Turkey?

2- What are the perceptions of the perceptions of preservice teachers who participate science notebook applications during science teaching methodology course in United States

3- What are the similarities and differences between two countries in terms of using science notebooks process?

Method

This research is a case study which aims to identify the perceptions of third grade preservice science teachers in Turkey and United States about using science notebooks and make a comparative investigation between countries related to process. Case study is based on investigating daily life fact in limited event and place with process based research methodologies (Merriam, 2002; Yin, 2008). Case study is one of the qualitative research type and based on post-positivist paradigm. Qualitative research is type of a research which qualitative data collection methodologies such as observation, interview and documentation are usedand a process which facts and events are identified in a realistic and holistic way is followed (Yıldırım & Şimşek, 2000).

Study Group

The groups from Turkey and United States were identified by convenience and purposeful sampling methodologies. The study group in United States consisted of 25 third grade preservice teachers who study in University of Iowa College of Education Department of Science Education and the study group in Turkey consisted of 42 third grade preservice teachers who study Hacettepe University Faculty of Education Department of Science Education. Totally 67 preservice teachers were observed, their science notebooks were investigated and questionnaire was applied to them. Indepth focus group interviews lasted 40 minutes were conducted 12 preservice teachers (six of them are from Turkey and six of them are from United States) who were selected purposefully considering their academic achievement and voluntariness.

Data Collection Tools

a- Questionnaire: This data collection tool consists of five semi-structured questions and prepared by the researcher for identifying the perceptions about using process of science notebooks and the positive sides and the sides that can be developed and applied to 67 preservice teachers. Three researchers' views who are expert in measurement-assessment and science education fields were taken for providing the validity and the reliability of the questionnaire. The questionnaire was applied and graded by researchers and the reliability of the questionnaire was identified as 0.89.

b- Observation Form: This form consists of ten structured and semi-structured statements and prepared by the researcher for identfying the reflections from the using of science notebooks in science teaching methodology course and providing clues for preparing both process and environment. Three researchers' views who are expert in measurement-assessment and science education fields were taken for providing the validity and the reliability of the observation form.

c- Focus Group Interview Protocol: This is a protocol prepared by the researcher for identfying the perceptions of preservice teachers about using process of science notebooks, their thoughts about the future applications and possible problems and their ways of solutions. Interviews were applied to 2x3 way totally 12 preservice teachers and lasted 40 minutes. Three researchers' views who are expert in measurement-assessment and science education fields were taken for providing the validity and the reliability of the focus group interview protocol.

d- Science Notebooks: Science notebooks were prepared by the preservice teachers in both two countries during science teaching methodology course. Science notebooks are generally consisted of two stages. First stage is called as introduction and preservice teachers state their autobiographies, their pre-learnings and expectations about the science teaching methodology course in this stage. Second stage is diary which consisted of preservice teachers' experiences in science teaching methodology course, positive and negative traces, their aims and reflective processes. Third stage which the aim of the course is given is related to the content. The researcher presents student-centered activities like critical thinking questions, problem-based learning scenarios, argumentation, cartoons, experiment construction with colorful materials and wants them to adapt these activities and materials to their notebooks in this stage. Last stage is the result stage. Preservice teachers assess general flowchart of the course, process which was applied, instructor and themselves in this stage. All science notebooks in the process were analyzed with content analysis technique by the researcher and six notebooks were graded by three researchers for providing inter-rater validity and correlation between inter-raters were found as 0.92.

Data Collection Process

Data collection process conducted in 2008-2009 spring semester in Science Teaching Methodology course which is opened for third grade preservice science teachers in United States and lasted totally 16 weeks and also conducted in 2009-2010 spring semester in Special Teaching Methods I course and lasted 16 weeks. Two course which of their contents are equal covered theoretical and application samples of strategies, methods and techniques about instructional design in science education. Application was firstly done in United States and assessment tools was firstly prepared in English and then translated into Turkish. Support of one researcher who is expert in English and Turkish literature was taken during translation process. Two researcher besides the researcher of the study observed the whole process in two countries and observation forms were filled. Questionnaire was applied to all preservice teachers after the process and then semi-structured focus group interviews were conducted totally 12 preservice teachers selected from two countries. Each science notebook of preservice teachers were investigated by documentation methodology and content analysis technique and writings of the preservice teachers were associated with the themes related to the topic in the literature.

Analysis of Data

Data which was collected during the research process were analyzed by descriptive analysis and content analysis techniques. Data of the questionnaire were described by percentage and frequency techniques. Codes coming from focus group interviews, observation forms and science notebooks were analyzed by content analysis technique which corresponds the related themes in the literature.

Validity and Reliability of the Study

Although the fundamental problem of the qualitative research methodology and post positivist paradigm is not the validity and reliability, expert views were taken for providing assessment tool's validity and reliability, common criteria were identified for providing inter-rater validity and triangulation (consistency among observation, interview and documentation) technique was used for providing internal validity of the study.

Results

The first question of the questionnaire is "Is there a contribution of science notebooks to effective science education? If there is, what are they?" The data about first question are given in Table 1.

Table 1. Codes Coming From the Answers Given to the First Question of the Questionnaire and Their Descriptive Statistics

Codes	United States			Turkey			General	
	f	%	General %	f	%	General %	f	%
Being a good scientific literate	20	80	30	25	60	37	45	67
Relating science concepts with daily life situations	15	60	22	18	43	27	33	49
Learning by doing and living	12	48	18	17	40	25	29	43
Getting off memorizing	6	24	9	8	19	12	14	21
Applied learning	5	20	8	7	17	10	12	18

In terms of Table 1,from totally **67** preservice teachers, (25 of them are from USA and 42 of them are from Turkey) **45 of them-67%** (20 of them, 80% are from U.S, totally 30%; 25 of them, 60% are from Turkey, totally 37%) stated the code of***"being a good scientific literate"***,**33 of them- 49%** (15 of them-60% are from U.S, totally 22%, 18 of them-43% are from Turkey, totally 27%) stated the code of***"relating science concepts with daily life situations"***,**29 of them-43%** (12 of them-48% are from U.S, 17 of them-40% are from Turkey, totally 25%) stated the code of***"learning by doing and living"***, 1**4 of them-21%** (6 of them-24% are from U.S, totally 9%, 8 of them-19% are from Turkey, totally 12%) stated the code of***"getting off memorizing"***,**12 of them-18%** (5 of them-20% are from U.S, totally 8%, 7 of them-17% are from Turkey, totally 10%) stated the code of***"applied learning"***. This finding shows that science teaching application is proper to the concepts of student-centered education and scientific literacy which are the standards, vision and philosophy of both two countries' curricula.

The second question of the questionnaire is "What kind of skills do the science notebooks develop?"The data about second question are given in Table 2.

Table 2. Codes Coming from the Answers Given to the Second Question of the Questionnaire and Their Descriptive Statistics

Answers	United States			Turkey			General	
	f	%	General %	f	%	General %	f	%
Science Process Skills	17	68	25	8	19	45	40	60
Reading-Writing and Reflective Thinking	13	52	19	19	45	29	32	48
Critical Thinking	13	52	19	11	26	17	24	36
Creative Thinking	11	44	16	8	19	3	19	28
Reasoning and Analysis	5	20	7	7	17	5	12	18
Learning by Doing and Living	3	12	4	5	12	4	8	12

According to Table 2, from totally **67** preservice teachers, (25 of them are from USA and 42 of them are from Turkey) **40 of them-60%**(17 of them-68% are from U.S.,totally25%,8 of them-19%are from Turkey, totally 45%)stated the code of***"science process skills"***, **32 of them-%48** (13 of them-52%are from U.S.,totally 19%, 19 of them-45%are from Turkey, totally 29%)stated the code of***"reading-writing and reflective thinking skills"***, **24 of them-36%** (13 of them- 52%are from U.S., totally 19%, 11 of them-26 % are from Turkey, totally 17%)stated the code of***"critical thinking skills"***, **19 of them-28%** (11 of them-44%are from U.S.,totally 16%, eight-19% are from Turkey, totally 3%)stated the code of***"creative thinking skills"***, **12 of them- 18%**(5 of them-20%are from U.S., totally 7%, 7 of them-17%are from Turkey, totally 5%)stated the code of ***"reasoning and analysis"*,8 of them-12%** (3 of them-12% are from U.S.,totally 4%,5 of them-12% are from Turkey, totally 4%) stated the code of ***"learning by doing and living"***.This finding points that science notebook application support skill-oriented instructional approach which is indicated in two of the countries' curricula and develop preservice teachers' process-based instructional skills.

Third question of the questionnaire is "In which part of the science instruction and for what purposes can the science notebooks be used?"The data about third question are given in Table 3.

Table 3. Codes Coming from the Answers Given to the Third Question of the Questionnaire and Their Descriptive Statistics

Codes	United States			Turkey			General	
	f	%	General %	f	%	General %	f	%
In Every Part of The Course and for Different Purposes	19	76	28	27	64	41	46	69
For the Purpose of Internalizing Science Concepts in Instructional Process of the Course	10	40	15	22	52	33	32	48
For the Purpose of Assessment at the End of the Course	11	44	16	14	33	21	25	37
For the Purpose of Controlling if the Methods and Materials are Proper or not During Course Process	8	32	12	10	24	15	18	27

Regarding the Table 3, from totally **67** preservice teachers, (25 of them are from USA and 42 of them are from Turkey)**46 of them-69%** (19 of them-76% are from U.S., totally 28%, 27 of them-64%are from Turkey,totally 41%) stated the code of***"in every part of the course and for different purposes"***, **32 of them-48%** (10 of them-40% are fromU.S.,totally 15%, 22 of them-52% are from Turkey, totally 33%) stated the code of ***"for the purpose of internalizing science concepts in instructional process of the course"* 25 of them-37%** (11 of them-44%are from U.S.,totally 16%, 14 of them-33% are from Turkey, totally 21%) stated the code of ***"for the purpose of assessment at the end of the course"*18 of them-27%** (8 of them-32%are from U.S.,totally 12%, 10 of them-24% are from Turkey, totally 15%) stated the code

of***"for the purpose of controlling if the methods and materials are proper or not during course process"***.This finding is the indicator that science notebook is sample of a method, a material and at the same time a formative assessment model which can be used before, during and after the instructional process.

The data coming from the fourth question of the questionnaire which is "*Will you plan to use science notebooks in your future science classes? And for which purposes?"* are presented in Table 4.

Table 4. Codes Coming from the Answers Given to the Fourth Question of the Questionnaire and Their Descriptive Statistics

Codes	United States			Turkey			General	
	f	%	General %	f	%	General %	f	%
Teaching Science Concepts to the Students With Daily Life Examples	19	76	28	26	62	39	45	67
Earning Processes Which the Scientists Experienced to the Students	16	64	24	21	50	31	37	55
Following Students In Every Part of the Process	11	44	16	14	33	21	25	37

Regarding the Table 4, from totally **67** preservice teachers, (25 of them are from USA and 42 of them are from Turkey)all of them stated they want to use science notebooks in their classes. Besides this, **45 of them-67%** (19 of them-76% are from U.S.,totally 28%, 26 of them-62%are from Turkey, totally 39%) stated the code of***"Teaching science concepts to the students with daily life examples"*****37 of them-55%**(16 of them-64% are fromU.S.,totally 24%, 21 of them-50%are from Turkey, totally 31%) stated the code of ***"Teaching science concepts to the students with daily life examples"***, **25 of them-%37** (11 of them-44%are from U.S.,totally 16%, 14 of them-33%are from Turkey, totally 21%) stated the code of***"Following students in every part of the process"***. This finding pointed that preservice teachers perceive science notebooks as a material which is effective for integrating learnings with daily life situations, internalizing steps of science process skills and providing feedback in every part of the course.

The data coming from the fifth question of the questionnaire which is "*What are the sides which need to be developed in the using process of science notebooks?"* are presented in Table 5.

Table 5. Codes Coming from the Answers Given to the Fifth Question of the Questionnaire and Their Descriptive Statistics

Codes	United States			Turkey			General	
	f	%	General %	f	%	General %	f	%
Having Small Class Size Make the Application More Effective	2	8	3	28	67	42	30	45
Distribution of the Materials to the Groups Equally	3	12	4	19	45	29	22	33
Making Application in Elementary Level and Investigation of Sample Documents	6	24	9	9	21	13		

It can be seen that, from totally **67** preservice teachers, (25 of them are from USA and 42 of them are from Turkey)**30 of them-45%** (2 of them-8% are fromU.S.totally 3%, 28 of them -67% are from Turkey, totally %42) stated the code of***"Having small class size make the application more effective"***, **22 of them-33%** (3 of them-12% are from U.S.,totally 4%, 19 of them-45%are from Turkey, totally 29%) stated the code of***"Distribution of the materials to the groups equally"*****15 of them-22%** (6 of them-

24% are fromU.S.,totally 9%, 9 of them-21%are from Turkey, totally 13%) stated the code of***"Making application in elementary level and investigation of sample documents"***when table 5 is investigated. This finding stated the major difference between Turkey and United States in terms of the application process of science notebooks. Science notebooks are effected directly from the topics like class size, organization of class, accessibility of materials because they are student-centered applications. The preservice teachers of United States where the class sizes are small and accessibility of materials is easier stated that they experienced almost no problems during the application process of science notebooks although Turkish preservice teachers stated the problems of density of the classes and distribution of materials.

The results of the observation form and document analysis of science notebooks show that using science notebooks in Science Teaching Methodology course develop scientific literacy of preservice teachers and they follow scientific research methodology steps which scientists use during the finding a solution to problem based learning scenarios, integrate science concepts with daily life situtaions in nature, give a place to group works and collaboration, make unique designs using their imagination, take responsibility about their own learning and identify a criteria related to this by this way.Additionally, document analysis of science notebooks pointed that both two of the countries' preservice teachers' inquiry-based learning and teaching skills and science process skills like observation, constructiong an experiment,reasoning, analysis are developed with problem-based learning scenarios and critical thinking questions.

Question of "*Is there a an effect of using science notebooks on your instructional skills? If your answer is "yes" could you please explain this with samples from your science teaching methodology course*?" was asked to preservice teachers in focus group interviews and sample of preservice teachers' quotations are stated as follows;

Preservice Teacher A (United States): *" I think that using science notebooks help to develop my inquiry based and creative thinking skills. For example, I assumed myself as a cloud in class and imagine to define the processes that I experienced. I am thinking about how I organize my future science class in an inquiry based manner"* This answer shows that samples and questions related to daily life develop her inquiry-based thinking skills.

Preservice Teacher B (Turkey): *"I think that my science process skills of observation, classification, interpretation of results, relating learnings with daily life situations were developed in terms of science notebooks and I want to use science notebooks in my future science classes"*This sentence states that science notebook applications develop in all dimensions of science process skills both fundamental and experimental skills and the process are easy to be applied in every type of classroooms.

Question of "*What can be the advantages of using science notebooks in your science teaching methodology courses*?" was asked to preservice teachers in focus group interviews and sample of preservice teachers' quotations are stated as follows;

Preservice Teacher C (United States): *" Developing imagination, thinking scientifically, be one of the part of learning and teaching process…"* This sentence underlines that using science notebooks is effective for being dominant in the application process of scientific methodology and develop reflective thinking skills by taking responsibility of their own learnings.

Preservice Teacher D (Turkey): *"Participating the grading of formative assessment process, associating science concepts with daily life situations, thinking critically about scientific events"* This answer underlines that science notebooks are the applications which involve both learners and teachers to the assessment process and develop higher order cognitive thinking skills.

Question of "*What can be the disadvantages of using science notebooks in your science teaching methodology courses*?" was asked to preservice teachers in focus group interviews and sample of preservice teachers' quotations are stated as follows;

Preservice Teacher E (United States): *" I was not experienced any negative or disadvantaged position during the application process of science notebooks during science teaching methodology course, conversely I gained lots of good skills through the using process of science notebooks."* This preservice teacher stated that she was not experienced any problem because of physical or methodological conditions during the application of science notebooks.

Preservice Teacher F (Turkey): *"There was so much noise because the class was crowded and there was a problem for providing objektivity during grading but I can say that science notebook application is a very good sample of formative assessment "* This answer states that physical and economical reasons like classroom size and material distribution decrease the efficiency of science notebook application and emphasized the importance of these factors in student-centered applications.

Discussion, Conclusion andSuggestions

Science notebook application is an inquiry-based instructional design and material which covers the student-centered methodologies and techniques such as problem-based learning, project based learning, concept maps, concept cartoons. Additionally, science notebook is a systematic formative assessment model which involves the synthesis of process based measurement and assessment approaches like performance assessment, self assessment, peer assessment. Findings of this research study shows that science notebook application provides to develop and assess learners' inquiry, critical, creative and reflective thinking skills as underlined in literature. Besides this, science notebooks validate that it is an application which integrate product and process based measurement and assessment approaches which the constructivist program approach emphasized (Aschbacher & Alonzo, 2006; Ruiz-Primo et al., 2002; Hand et al., 2001).

There are differences about application process between two countries where applications were done in terms of observation and interview findings. Application was done smoothly in United States because classroom size is small and enough material exists in schools. Whereas some difficulties were experienced in Turkey in terms of crowded classrooms, scarcity of materials and grading. This is paralel with the finding that factors come from physical and economical reasons such as class size, class sitting organization, accessibility of materials affect application which learners involve learning-teaching and measurement-assessment processes as stated in literature (Rivard, 1994; Shepardson & Britsch, 1997; Gül, 2012).Fundamental similarities between two countries during the application process of science notebooks are that instructional and higher order cognitive skills of preservice teachers in both Turkey and United States are developed during and after the application process and they all want to use this application in their future professional experiences. They also stated the disadvantages as the limitations of grading and reliability issues.

Science notebooks is also an important material which cover the properties of scientific literacy which is one of the fundamental aims of science education, thinking, problem solving ways of scientists, associating science concepts with daily life situations and apply vision of student-centered education that involve learners to the learning-teaching and measurement-assessment processes. Introducing science notebooks to the educational environments and widely using in science education will be valuable for meeting vision of curricula and National Science Education Standards.

The results of this study show that instructional application based on science notebooks is an instructional model which is used for developing and scientific literacy, science process, inquiry-based instruction, critical, creative and reflective skillsof learners in science education and can be used in every stage of instructional process, systematic and effective formative assessment model for tracking learning process which is similar to portfolio for providing feedback in every stage of educational system and develop criteria based on collaboration and holistical view to dimension of application. Becoming widespread of science notebooks which is a more concrete choice for teachers who experienced problems at portfolio assessment applications in science education can be provided by reliability studies, standardization and identfying common criteria. Application of science notebooks, application and grading processes can be introduced by preservice and inservice trainings for the preservice and inservice science teachers. Studies which will be conducted with wider groups and repeated incorporation with different countries is important for spreading the process. Conducting future research studies longitudinally and aiming to control future effects of science notebooks in different educational levels (for example in elementary and secondary levels) is also effective for adapting the results to daily life.

Other suggestions which are designing mixed design studies which search the effect of science notebooks on the variables such as science process skills, attitudes toward science, motivation, self efficacy and quantitative and qualitative data are used together, intagrating science notebooks with reading and writing science heuristic applications, adaptation of science notebooks as a similar formative assessment model to different disciplines such as mathematics, geography and literacy boks are presented based on results.

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