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Full Length Research Paper

Traditional assessment as a subjectification tool in schools in Lesotho

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The concept of assessment is one of the most important practices in any education system across the globe. Tracing the concept probably to the time immemorial through the Chinese Imperial Examination System in the fifteenth century, the notion of assessment seems to have proved to be one of the indispensable markers of selection, placement and certification in modern education. In order to understand the concept, it is crucial to focus, among others, on the education system within which the notion itself is situated. As a crucial aspect of any education system, assessment is such that learners, at almost all levels of education, are subjected to a certain conventional practice with a view to categorising them according to certain pre-determined achievements. Perhaps, to examine the concept, we shall address ourselves to some of the specific questions as in who assesses whom? What form of assessment? How and why is such an assessment? On what premise is such educational assessment of learners in a particular education system? The paper intended to critically trace assessment in the context of Lesotho. Drawing on Michel Foucault's concept of subjectification, the paper intends to demonstrate the instrumentality of assessment as used in schools in the Kingdom. The paper concludes by suggesting alternative models of assessment so as to keep abreast with the twenty first century challenges facing modern education system.

Key words: Traditional assessment, subjectification tool, schools, Lesotho.

INTRODUCTION

Viewed across the globe or worldwide, traditional assessment has since the Enlightenment period/Modern Era/Age of Reason of the 18th century always been seen as an indispensable tool without which learning and the practice of teaching can happen in education. The

Enlightenment period is one of the historic events which came after the Middle Ages/Barbarism and which ushered in modernization in Western Europe, with its characteristic features of an unassailable faith in science, progress and rationality (Giroux, 1997; Ray, 2001), as well as the

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values of predictability, certainty, control, absolute truths and order. It is notable that during this period, traditional assessment was seen not only as an indispensable tool, but, it was also seen by its proponents as a modern project that had to be pursued for the advancement of society within the modernist Enlightenment perspective and the education system which came to be associated with emancipation and progress (Crossourd, 2012, Smith and Cumming, 2009; Torres and Mitchell, 1998). Rust (2009) underscores this notion by opining that assessment plays a crucial role in the education process. Broadfoot (1979) takes up the view by observing the pervasiveness of traditional assessment and associating its role with that of or far more than religion as the opiate of the people.

Therefore, it is not surprising that Lesotho is no exception to the belief that traditional assessment is an important and integral part of learning and teaching, because with the advent of Missionary Western education system the first three of whom arrived in Lesotho in 1833, traditional assessment has been used till the present. Traditional assessment in all its forms – formative/summative, formal/informal, final/continuous and process/product (McAlpine, 2002) has been so routinized and institutionalized that it is taken for granted as a normal way and a perfect tool for measuring skills learners have acquired in order to face the world of work (see Broadfoot, 2000). In addition, it seems to have been seen as a perfect tool to use for assessing teachers' performance when going about their practice. Little attention in professional discourse of educational assessment, if any has been given to the effects of assessment on those whom it is exercised. The impact of assessment on the learners has for a long time been a 'black box' (Black et al., 2004) which has not been opened and interrogated by scholars.

Therefore, using Foucault's notion of subjectification, the paper intends to open this 'black box' and deal with the consequences that arise due to assessment of learners in particular. Also implicit within the notion of subjectification is the notion of power which will be unpacked in relation to the consequences of assessment on the learners (Hargreaves et al., 2002). In order to achieve the central argument/thesis of the paper, it would be prudent to spell out from the onset how this will be achieved. First, the paper will give a snapshot of assessment and its importance in education. Second, the paper will look into who assesses whom and what. Third, the consequences of assessment on the learners will be looked into. Fourthly, alternative ways of assessing learners will be suggested, and finally, the conclusion of the paper will follow.

What assessment is and its importance

More often than not assessment means many things to

many people and it is often conflated with evaluation. Earl (2003) observes assessment as a complex undertaking that means something different to different audiences and in different situations. Assessment is one of the concepts which have many interrelated and conflicting purposes because of its role in an educational setting. Therefore, it is important to attempt at defining the concept from different perspectives. Assessment refers to the judgement of the students' work (Taras, 2005), while evaluation refers to judgements made in regard to a course or course delivery. In the same vein, Rust (2002) defines assessment as about making a judgement, identifying the strengths and weaknesses, the good and the bad, and the right and the wrong in some cases of something. It refers to all *processes* employed by teachers to *make judgements* about the achievement of students in units of study and over a course of study. These processes include making decisions about what is relevant *evidence* for a particular purpose, how to collect and interpret the evidence and how to communicate it to intended users (students, parents, administrators and so on) (Harlen, 2005, emphasis original). On the other hand, Baehr (2007) differentiates assessment from evaluation, stating that assessment is mainly concerned with how to improve the level of quality within the learners, while evaluation is concerned with the actual level of quality of the learners. Meighan (1986) sees assessment as collection of information, on which to base judgements about learning experiences, in schools.

Despite this cacophony of definitions of the term, suffice to say, this paper will use assessment to mean judgement made about students' school work by the assessors, because judgement is implicit in all the definitions. In addition, traditional assessment which is predominantly summative is perceived as an inherently subjective process (Crossouard, 2012; Taras, 2005) as it will be shown in the third section of this paper when the notion of subjectification is articulated.

As alluded to in the previous section, educational assessment is an integral part of learning and the practice of teaching and helps improve learners' achievement/attainment (Assessment Reform Group, 2009). It is, therefore, important to articulate its importance. Briefly, traditional assessment and any other forms of assessment are important in education, for example, learning and teaching in various ways:

First, in measuring the effectiveness of instruction and learning, second, in sharing information with external stakeholders (parents, boards and state), third, to help make promotion and retention decisions, fourth, help the teacher determine the pace of classroom instruction, and last, to diagnose what individual pupils know (Rudner and Schafer, 2002, Newton, 2007; Wyatt-Smith and Cumming 2009).

Research shows that it is indisputable that assessment raises standards and achievement of learners if it is

properly executed and done by those who understand it, while it is counterproductive if not properly used (Assessment Reform Group, 2009). Amongst the issues which lead to this improvement are the following factors:

1. Providing effective feedback to pupils;
2. Actively involving pupils in their own learning;
3. Adjusting teaching to take account of the results of assessment;
4. Recognizing the profound influence assessment has on the motivation and self-esteem of pupils, both of which are crucial influences on learning;
5. Making pupils able to assess themselves and understand how to improve.

Who assesses whom and what is assessed?

In traditional assessment especially in Lesotho, the common practice of assessment process which is accorded high recognition by all stakeholders is where teachers assess learners. The written reports, recorded cards and marked work by teachers where they make judgements about the learners are accorded high recognition. The skewed relations of power between the teacher and the learner are in most cases overlooked in the process. Also important is that the assessed is left out of the traditional assessment process. In the case of national and international examinations the assessed does not participate in the decision on what is to be assessed. The overall authority lies with the assessor, who may be the teacher or someone else whom both the teacher and the learners do not know. This in itself reifies the whole process of assessment as something done by an invisible hand that has power over both the teacher and the learner. At this level, assessment is also accorded high significance; grades and certificates are stressed with a lot of money being invested in this process, among others, by national and international examining bodies or syndicates.

What is assessed depends on who the assessor is, that is, if the assessment is school-based or done by the teachers themselves, it tends to be process-oriented, though at times like national and international examinations, it is product-oriented. A host of activities is assessed including, amongst others, reading, writing, answering questions, drawing and reasoning. In this nexus of assessment, consumers of traditional assessment are usually parents, employers and administrators.

Consequences of traditional assessment on the learners – subjectification

Human actions both overt and covert have intended and unintended consequences, so is the case with traditional assessment -summative. Traditional assessment with its

well-intended purposes as outlined in the second section of this paper has drastic unintended consequences for the learners on which it is administered/ exercised/ executed. The consequences may be either overt or covert, but when analysed from the Foucauldian point of view of subjectification or objectification they have far reaching repercussions.

Subjectification refers to a state whereby a person is turned into a subject and stripped off all human traits and treated as an object. For Foucault, for one to become subjectified, there is a nexus of power relations that exist in the whole setup, be it between two speakers, teachers and students, teachers and an institution and so on. Power in terms of Foucault is ubiquitous in that it does not rest within an individual and it is dynamic instead of being static. For power to be exercised, it has to be done on docile bodies/subject – subjectification/objectification. A docile subject does not resist power and control of the influencer who wants to modify one's behaviour - discipline (Bowdridge and Blenkinsop, 2011).

According to Foucault (1977), strict discipline separates, analyses, differentiates and carries its procedures of decomposition to the point necessary and sufficient single units. It makes individuals; it is the specific technique of power that regards individuals both as objects and as instruments of its exercise – objectification. There are subtle ways in which disciplinary power is exercised which, according to Foucault, are hierarchical observation, normalising judgement and examination. The three categories pervade all social institutions including schools (Foucault, 1977).

Hierarchical observation

Hierarchical observation coerces by means of observation, an apparatus in which the techniques that make it possible to see induce effects of power, and in which, conversely, the means of coercion make those on whom they are applied visible (Foucault, 1977). The main objective of hierarchical observation is that the subject must be seen all the time without its realizing that it is being observed – eyes that must see without being seen. This induces self-discipline or monitoring because an individual believes that s/he is always observed.

Normalising judgement

In normalising judgement an individual has to abide by institutional norms which when broken punishment is effected until an individual realises what is acceptable. In schools learners are subjected to micro-penalty of time (punctuality/lateness), activity (inattention/lack of zeal), behaviour (disobedience/impoliteness) and speech (insolence/vulgarity). These penalty measures are meant to differentiate, hierarchize, homogenize the subjects and

exclude those who do not conform to the institutional norms – gratification and punishment.

Examination

Examination combines both hierarchical observation and normalising judgement in that individuals subjected to examination are usually under strict surveillance by the invigilator. On the other hand, the gaze of the invigilator is a normalising one in that an individual has to abide by the norms of the examination. In addition, an individual is subjectified through documentation where they can be classified, judged, differentiated and compared with other individuals. The examination combines the techniques of an observing hierarchy and those of a normalising judgement. It is a normalising gaze, a surveillance that makes it possible to qualify, to classify and to punish (Foucault, 1977).

Taking up the claim further Ritzer (2007), observes that officials or those in authority use examinations as a way of observing subordinates and judging what they are doing. It is a way of checking up on subordinates and assessing what they have done by those in authority, thus determining what is and is not an adequate score. In this regard examinations are associated with schools and other related institutions such as psychiatrist offices and psychiatric hospitals as well as other workplaces (Ritzer, 2007). In this view, pupils increasingly consider an assessment as something which labels them; for them, it is a source of anxiety, with low-achievers in particular often being demoralized. According to this view, assessment feedback often has a negative impact, particularly on low-achieving students who are led to believe that they lack “ability”, and so are not able to learn (Black et al., 2004).

Alternative assessment to traditional assessment

Traditional assessment has been criticised widely as an inefficient tool for accurately assessing learners’ competencies and skills. Some of the criticisms are aptly pointed out by Dikli (2003). For Dikli (2003), traditional assessments are indirect and inauthentic, standardized, which reason they are one-shot, speed-based, and norm-referenced, single-occasion tests since they measure what learners can do at a particular time. However, test scores cannot tell about the progression of a child. Nor can they tell what particular difficulties the students may have had during the test. There is no feedback provided to learners in this type of assessment. The projects are mainly individualized and the assessment procedure is decontextualized. Most standardized tests assess only the lower-order thinking skills of the learner. Assessment often focuses on learner’s ability of memorization and recall, which are lower level of cognition skills.

Additionally, traditional assessment tools require learners to display their knowledge in a predetermined way. Although the public has been largely supportive of grading in schools, skepticism is increasing about its fairness and even its accuracy. Educational researchers and theorists have been critical of traditional grading practices for quite some time. In terms of measurement theory, grades are highly suspect. Why? Because teachers consider many factors other than academic achievement when they assign grades; teachers weigh assessments differently, and they misinterpret single scores on assessments to represent performances on a wide range of skills and abilities. In brief traditional assessment sorts, classifies and rewards/punishes the learners and its authenticity is in doubt especially in the 21st century.

The turn of the 21st century necessitates a rethink of how the modernist project of traditional assessment in education is looked at for various reasons: the modernist premise that science will bring progress and alleviate social problems has since proved to be an unachievable utopia (Harrison, 2004). The time of universal truths or grand narratives has been questioned from almost all the quarters of our social world. The landscape of the 21st century is a fractured one whereby, universal laws of one social aspect ‘fits all’ no longer applies. Reality is no longer reified as being out there to be found because it is socially constructed. The particular and subjective are now more important than the general and objective. Therefore, there has to be a paradigm shift from the modernist project to something new. The polemic of our time and the need for paradigm shift is summed up by Wyatt-Smith and Cumming (2009: vii) thus: ‘Post-modernism’, instead, is recognising the increasingly fractured nature of society and the limitations of science to provide solutions to the great issues of our time, such as the sustainability of the planet, poverty and social cohesion. For many, the certainties of modernism have been replaced by post-modern doubts about the possibility of progress. Recognition of the fallibilities of science has brought with it an increased recognition of the importance of diversity and subjectivity. Changes in the nature of work, globalisation, the information revolution and the increasingly social nature of contemporary challenges also suggest different priorities for education systems. These will in turn require different priorities for assessment practices.

Therefore, assessment should shift from the modernist tradition/thought and its tendencies of concentrating on product (summative). Rather it should be process-oriented so as to address unique concerns, thereby providing unique solutions of the 21st century.

The values of orderliness, reliability, predictability and rationality which are rule-bound, mechanistic and instrumental need to be reconsidered, and/or be replaced with alternative forms of educational assessment in any modern learning.

What alternative forms of assessment of learning?

Debate on alternative assessment amongst scholars shows that there is no consensus on what alternative assessment is. For some scholars, alternative assessment is a generic concept for all assessment methods which are different from traditional assessment. Other scholars claim that there are three types of alternative assessment though with some variations: assessment for learning, authentic assessment and performance-based assessment which are alternatives to traditional assessment (Dikli, 2003). However, scholars advocating for alternative assessment are agreeable on what is not alternative assessment, its forms and strategies (Baker, 2010). Irrespective of their names, all forms of alternative assessment are informed by the constructivist view of knowledge and learning. Brooks and Brooks (1993) outline five overarching principles of constructivist pedagogy:

1. Posing problems of emerging relevance to learners;
2. Structuring learning around 'big ideas' or primary concepts;
3. Seeking and valuing students' points of view;
4. Adapting curriculum to address students' suppositions; and
5. Assessing students' learning in the context of teaching.

In constructivist classrooms, students learn from active participation and have opportunities to explore their own ideas through discourse, debate, and inquiry. Instructors assume a facilitator's role and students assume responsibility for their learning. Behaviours and skills are not the goals of instruction; rather, the focus is on concept development, deep understanding, and construction of active learner reorganization (Brooks, 1993). Unfortunately, traditional assessment does not evaluate this form of instruction (Anderson, 1998).

Assessment for Learning – AFL

The first alternative form of assessment different from traditional assessment is assessment for learning. This is a type of formative assessment which is process oriented rather than product oriented. "AFL is the process of seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go and how best to get there" (Assessment Reform Group 2002; Isaacs, 2013). AFL is focused on the learner and the feedback given by the assessor is meant to help the learner develop and grow. The metacognition of the learner is the target. It can therefore be summarized succinctly thus;

Assessment for learning is any assessment for which the first priority in its design and practice is to serve the purpose of promoting students' learning. It thus differs

from assessment designed primarily to serve the purposes of accountability, or of ranking, or of certifying competence. An assessment activity can help learning if it provides information that teachers and their students can use as feedback in assessing themselves and one another and in modifying the teaching and learning activities in which they are engaged. Such assessment becomes "formative assessment" when the evidence is actually used to adapt the teaching work to meet learning needs (Black et al., 2004).

David Hargreaves described Assessment for Learning as 'a teaching strategy of very high leverage' (2004) because it assess high order cognitive skills of the learners instead of the low order cognitive skills. In addition, in assessment for learning, teachers use assessment as an investigative tool to find out as much as they can about what their students know and can do, and what confusions, preconceptions, or gaps they might have so as to scaffold the learners to a high level/ proximal level of development. The following characteristics of AFL point to this:

1. It is embedded in a view of teaching and learning of which it is an essential part. Assessment for learning is not something extra or 'bolted on' that a teacher has to do. Pupil learning is the principal aim of schools and assessment for learning aims to provide pupils with the skills and strategies for taking the next steps in their learning;

Involves sharing learning goals with pupils. If pupils understand the main purposes of their learning and what they are aiming for, they are more likely to grasp what they need to do to achieve it;

Aims to help pupils to know and recognise the standards that they are aiming for. Learners need to be clear about exactly what they have to achieve in order to progress. They should have access to the criteria that will be used to judge this, and be shown examples or models where other learners have been successful. Pupils need to understand what counts as 'good work';

Involves pupils in peer and self-assessment. Ultimately, learners must be responsible for their own learning; the teacher cannot do that for them. So pupils must be actively involved in the process and need to be encouraged to see for themselves how they have progressed in their learning and what it is they need to do to improve. Teachers need to encourage pupils to review their work critically and constructively;

Provides feedback, which leads to pupils recognising their next steps and how to take them. Feedback should be about the qualities of the work with specific advice on what needs to be done in order to improve. Pupils need to be given the time to act on advice and make decisions about their work, rather than being the passive recipients of teachers' judgements;

Involves both teacher and pupil in reviewing and

reflecting on assessment data (information). Pupils need to have opportunities to communicate their evolving understanding and to act on the feedback they are given. The interaction between teacher and pupil is an important element of developing understanding and promoting learning;

7. It is underpinned by confidence that every student can improve. Poor feedback can lead to pupils believing that they lack 'ability' and are not able to learn. Pupils will only invest effort in a task if they believe they can achieve something (Assessment Reform Group, 1999).

Assessment Reform Group (1999) further asserts that assessment for learning can be actualised in practice through the following ways:

1. Observing pupils – this includes listening to how they describe their work and their reasoning;
2. Questioning, using open questions, phrased to invite pupils to explore their ideas and reasoning;
3. Setting tasks in a way which requires pupils to use certain skills or apply ideas;
4. Asking pupils to communicate their thinking through drawings, artefacts, actions, role play, concept mapping, as well as writing;
5. Discussing words and how they are being used.

Therefore, AFL calls for a lot of planning on the part of the assessor so that the assessed could understand what is expected of them, how they are going to be assessed, how they will receive feedback, how they will take part in assessing their learning and be helped to make progress. AFL is a reflective and interactive process on the part of both the assessor and the assessed.

Authentic assessment

Authentic assessment is a form of assessment focused on the evaluation of knowledge and skills of learners in the real world. It does not encourage remote learning and passive test-taking. A variety of methods are used in order to make assessment as contextualized as possible. The decisions to assess is collaborative, that is, between the assessor and the assessed and it is a continuous process instead of a once-off as is the case with traditional assessment methods. Quigley (2012) defines authentic assessment as:

A concept that includes measurement of knowledge that is significant and meaningful; it tends to focus on complex or contextualized tasks, enabling students to demonstrate their competency in a more 'authentic' setting.

For an assessment to be authentic, the context, purpose, audience and constraints of the test should connect in some way to real world situations and problems. The

learners' have to construct responses instead of choosing or selecting a response. Direct observation of students' behaviour on the tasks has to be done. Learners input in the construction of the assessment tool must be considered. To understand better what authentic assessment entails (Quigley, 2012; Joyner and Elliot, 2002) contrasts it with traditional assessment thus:

Attributes of TA and AA

Traditional	Authentic
Selecting a Response	Performing a Task
Contrived Recall/Recognition	Real-life
Instructor-structured	Student-structured
Indirect Evidence	Direct Evidence

Winograd and Perkins (1996) say authentic assessment is an assessment that occurs continually in a context of a meaningful environment and reflects actual and worthwhile learning experiences that can be documented through observation, anecdotal records, journals, logs, work samples, conferences, portfolios, writing, discussions, experiments, presentations, exhibits, projects and other methods. While Darling-Hammond (1996) and Oakes (2003) believe that authentic assessments can more closely capture the richness of what students understand about how they can apply this knowledge than can testing for 'bits and pieces' with conventional assessment procedures.

Performance-based assessment

Performance-based assessment is an alternative assessment; it "requires students to construct a response, create a product, or demonstrate application of knowledge" in authentic context. Students are required to create a product or formulate a response that demonstrates proficiency in a skill or understanding of a process or a concept. Typically, performance assessments are "authentic" in that they are structured around real-life problems or situations. The role of the assessor is to observe the assessee and thereafter hold conference with the assessee. The assessee is given a chance to reflect on the activity and assess oneself on the criteria developed collaboratively with the assessor. The assessee's peers are also involved in the assessment process and use the criteria collaboratively designed with their assessor. Performance-based assessment is dialogic and interactive in nature (Bain, 2010) because the assessor listens to the voice of the assessed. They mediate and negotiate the outcome of the assessment process because they are not product-oriented and process-oriented.

Conclusion

In this the paper, we have attempted to trace the origins of assessment in education from the enlightenment era characterised by the rise of reason. We, thus, have articulated the importance of assessment as an integral part of learning and teaching in any education. Drawing on the premise of assessment in education as one of the centres of diffuse power, we have further explored the main role players which include those at the delivery end and the receiving end of assessment. From the Foucaultian perspective on the concept of subjectification, we argue that education through assessment (like other social services centres) plays a significant role in the process of socialisation and societal control. On the face of it, we, therefore, suggest a review of the traditional assessment because of its significant effects on learners. In the final analysis, we, therefore, propose alternative forms of assessment so as to make up for and/or complement the longstanding traditional forms of assessment.

Conflict of Interests

The authors have not declared any conflict of interests.

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Full Length Research Paper

Elementary school students' views on the homework given in science courses

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Homework is a significant part of teaching and learning process. For this reason, teachers use it constantly as tools of teaching process. The effect of homework on students' achievement and student-parent relationship has been emphasized in several studies. The present study aimed to find out the views of the middle school students (n=705) about homework. Additionally, it has been examined whether these views differ according to several variables such as gender, class level, and the education level of the parents. Survey method was used in the study. It was found out that the views of the students about homework do not significantly differ in terms of the variables such as gender or the educational levels of their parents, but they differ according to class levels. Furthermore, an important proportion of the students believe that science homework does not improve their power of thinking and creativity. In addition to this, the students stated that they were more careful about and spare more time for their homework because it will contribute to their success in the high school entrance exam.

Key words: Science, homework, middle school students.

INTRODUCTION

Science is a field that covers issues that go hand in hand with our daily life. It also includes the abstract concepts in its structure. Therefore, reviews of the topics and applications out of the school are necessary for science to be long lasting. The children between the ages 6-14 are very curious. They want to learn how most of the events happen in the world they live in. That is why they ask a lot of questions. As they learn about a topic, they ask new questions about it. Thus, the teachers should keep the students' curiosity alive and continuous. They should be given the activities that will lead them to find solutions, to think over the concepts and rules, and that will keep their attention alive. These activities can be

given both within and out of the classes (Özben, 2006).

It is expressed by most educators that homework is one of the out of class teaching activities commonly used in educational institutions (Hong and Lee, 2000). Homework has an important role on the learning process, it teaches the students about scientific thought and using the resources of information by doing research, it improves the students' study skills and the power of critical thinking (Gür, 2003) and it shows them that learning is possible out of the school, too (Sullivan and Sequeira, 1996). Knowing the styles of the homework, and giving it in accordingly improves the success of the students (Hong et al., 1995; Gür, 2003; Hizmetçi, 2007).

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A student doing the given homework regularly is a factor that affects success on its own (MacDonald, 2009).

Homework is defined as academic tasks assigned by teachers to be done by students outside of the instructional time (Cooper et al., 2012). According to this definition, homework can be considered both as preliminary investigations which ensure students to make preparations for courses and a tool which consolidates understanding. Besides being an academic task, homework has a quality which increases the interaction between teacher and student. Bembenutty and White (2013) asserted that all teachers should be encouraged to use homework logs in order to provide feedback to students about the factors that interfere with their academic performance.

Homework has differences within itself: three kinds of homework are mentioned in general. These are; (1)-Getting prepared, (2)-Practice and (3)-Comprehensive studies (project homework) (Doyle and Barber, 1990). When these are organized well and used regularly, they can contribute to learning (Foyle, 1985). 1) Homework to get prepared; the kind of homework given to contribute to the readiness levels of the students. It aims that the students do some research and have some ideas about the following classes. For instance, students may need to refresh their previous knowledge for the following topic or they may have to get ready for the activity to be done in the class. 2) Homework for practice; Improves the newly gained skills. For example, students that have just learnt to solve a science problem should be given similar problems. Ebbinghaus (cited in Baymur 1985) found that if the knowledge that is learnt is not reviewed or used, most of the material learnt is forgotten especially immediately the material was just presented. Hence, doing homework is very important in terms of permanency. 3) Comprehensive homework; the projects done to be parallel with the studies in the class and that requires a long time. This homework can be scientific projects, performance homework, or term papers and it makes the students apply what they have previously studied (Swanson, 2001). This is valid when the student goes beyond the lesson in the class and acquires suitable skills in new circumstances.

There are two contrasting views about homework. On one side of the debate are those who call for homework to be reduced or reformed, pointing to its negative family impact, capacity to entrench ability and socioeconomic differences, and limited value for academic achievement (Horsley and Walker, 2013). On the other side are those who cite positive associations between homework and academic achievement (Cooper et al., 2000; MacDonald, 2009) and who cite increasing motivation (Katz et al., 2010; Bembenutty, 2010; Akioka and Gilmore, 2013). Furthermore, there are positive factors for doing homework. These are self-efficacy and interest. Bembenutty (2010) found that students who were self-efficacious and intrinsically interested were more likely to adopt a

proactive self-regulatory approach to their homework tasks.

The views of the parents on homework affect the students' homework success, performances, and continuity. If the parents support the students about homework, the rates of the students' doing homework and thus their success increases (Cooper et al., 2000; MacDonald, 2009; Albayrak et al., 2004). Knowing the attitudes of the students on the lessons and homework and giving homework accordingly increases the students' performance on doing homework (Atlı, 2012; Yücel, 2004). Teachers sending some messages on the extent of the homework to the parents increases the students' motivation and performance of homework positively (Power et al., 2007).

Homework is an important opportunity to improve the children's feeling of responsibility and self-disciplines. Well organized homework increases the students' success, making them more responsible, and teaching them to be more self-disciplined no matter which skill it is based on (Çağlayan, 2002, p.137). Homework is a basic part of teaching science since it gives the chance to revise the topic covered in the class, and it helps students to gain the skill of scientific thinking. Homework is a good way to interact with parents and helps them to join in the learning process of the children actively, and also helps them to understand the program and monitor the child's development in the lesson (Özben, 2006).

Teachers give homework to help students review, analyze what they have learnt in class and the applications, to be prepared for the following class (Sabancı, 2010), or to make students have the necessary skills to learn by themselves and use the materials like library, and extra resource books (Milbourne et al., 1999). According to the teachers, when a student completes his/her homework successfully, it means that s/he understood the topic well. If students cannot complete their homework successfully, the teacher thinks that they need extra explanation or study (Moates and Schumacher, 1980). Besides the role of homework in increasing of achievement, Patrick et al. (2011) stated that classroom environment also has an effect on students' achievement. According to these researchers, classroom environment predicts whether students endorse mastery goals, "success is accompanied by effort and is indicated by personal improvement or achievement of a set standard" or performance goals, "learning is a means of achieving recognition of personal worth and success is indicated by outperforming others" (Patrick et al., 2011).

There are a number of studies in the literature that show that homework increases students' success. For instance, in his PhD thesis study he did with teacher candidates, Hill (2003) found out that giving homework increases students' success. Elliott (2003) concluded that the grade the teachers give to the homework affects students' school success. Hyman et al. (2005) and

MacDonald (2009) point out that homework is a key factor for the success of teaching and learning process. Some studies also reveal that the ones that spend more time doing homework are more successful academically (Konstantopoulous et al., 2001; Rowell and Hong, 2002; Paulu, 1995).

According to Costley (2013), homework is a complex issue that brings together the child, parent, and teacher in planned and unplanned ways, with positive and negative effects. Homework does have some beneficial effects and it can help students develop effective study habits and can show students that learning can occur at home as well as at school. Homework can foster independent learning and responsible character traits. Homework can even give parents an opportunity to know what is being taught at school. Parents daily can see the hopeful progress or lack of progress with their child. Furthermore; homework can also have negative effects and can lead to boredom when homework becomes overly repetitive. Homework can deny students access to leisure activities that also teach other vital and worthwhile life skills. One downfall can be parents who get too involved in homework- pressuring their child and confusing them by using different instructional techniques than the teacher (Costley, 2013).

According to Simons (1989), the two functions of homework are; didactical and pedagogic functions. It aims to improve the learning process didactically: for example, it can be used to make the topics understood better. The pedagogic function is to teach students how to study independently. It helps them gain the habit of studying in this way. It shortens the time spared for the topics covered in the class. It supports the study done at school. In addition to this, it makes the student independent, responsible, and it makes the home and school to become closer (Cited in: Özben, 2006). Akioka and Gilmore (2013), in their studies, designed a current homework intervention to incorporate not only support for autonomy through the provision of choice among homework options, but also a focus on encouraging relatedness through an increase in both peer and student-teacher interactions, and developing competence through personalized feedback. According to the result of this research, intervened current homework increased the teacher-student interaction, motivation and intrinsic interest (Akioka and Gilmore, 2013).

The place where the students put homework that has this much importance in learning has an inevitable importance. Thus, this study tried to explain the views of the students about homework and how some factors affect it.

Aim of the study

When the literature is analyzed, it is seen that the advantages of homework, the relation between homework and academic success, the views and attitudes of

teachers, students and parents on homework were studied but the studies on increasing the students' homework performances are not mentioned. However, it is only possible for student to get high efficiency if he or she is able to do homework successfully depending on how s/he perceive the homework, answer the questions about homework and present the homework subject. Therefore, this study throws light on how primary school students perceive homework given and how they are affected by which variable.

Eventually, this study aims to define middle school students' views about homework given in the science classes and whether these views differ according to various variables such as gender, class level, and the education level of the parents.

- a. What are students' views on homework given in the science classes?
- b. Is there a difference between students' views on homework given in science classes based on gender?
- c. How do students' views on homework given in science classes vary with regard to class levels?
- d. How do students' views on homework given in science classes vary with regard to the education level of their mother?
- e. How do students' views on homework given in science classes vary with regard to the education level of their father?

METHODOLOGY

Study group

The sample of the study was 705 students chosen using accidental sampling method and studying at 6th, 7th and 8th grades of state schools of Ministry of National Education in the city center of Denizli province. While 52.48% (n=370) of the sample is constituted of female students, 47.51% (n=335) of the sample is constituted of male students. 29.8% (n=210) of students are 6th grade, 32.1% (n=226) of students are 7th grade and 38.2% (n=269) of students are 8th grade.

When students' parents are grouped regarding their education level, 35.3% of students' mother (n=249) is primary school graduate, 16% of students' mother (n=113) is middle school graduate, 26.7% of students' mother (n= 188) is secondary school graduate and 22% of students' mother (n=155) is university graduate. If we take a look at educational level of students' father, 22.3% of students' father (n=157) is primary school graduate, 14.9% of students' father (n=105) is middle school graduate, 30.8% of students' father (n=217) is secondary school graduate and 32.1% of students' father (n=226) is university graduate. 30.4% of students (n=214) stated that their family's level of income is under 1000TL (about \$450), 46.7% of students (n=329) stated that their family's level of income is between 1000TL and 3000TL (between about \$450 and \$1.350), and 23% of students (n=162) stated that their family's level of income is over 3000TL (over \$1.350).

RESEARCH MODEL

In this study, survey method general screening model, which is one of the descriptive research methods, was used. General screening

model is screening regulations made on the whole universe or a selected group of universe, sample or sampling in a universe that is composed of many elements in order to reach a general conclusion about universe (Karasar, 1994).

Data collection

As data collection tools, "Personal Information Form", developed by the researcher and "Questionnaire on the Views on Homework", developed concerning the science courses by Aladağ and Doğu (2009), were used. Another scale, "Science and Technology Lesson Self-Efficacy Scale" (Tatar et al., 2009) has been also applied to the same sampling in the same time (together) and the data gathered from this scale have been used for another research report (Uçak and Bağ, 2012). In the personal information form, developed by the researcher, questions intended for gender, class level and demographic features about parents' information are included. Questionnaire on the Views on Homework is a 5 point Likert scale with 23 items. Reliability studies of the questionnaire are carried out on students studying in secondary stage of primary school. Cronbach alpha reliability coefficient of the questionnaire is $\alpha=0.81$. Students are supposed to express their views about each item in 5 point likert type scale. Answers are scored for items as "strongly agree=5", "agree=4", "neither agree nor disagree=3", "disagree=2", "strongly disagree=1" that are in compliance with 5 point likert type scale (Table 1).

Data analysis

After gathering and controlling the questionnaire forms by which research data are collected, the data is coded and entered into SPSS for Windows (11.5) program. In the analysis of the data, one way ANOVA (Analysis of Variance) and independent samples t-test besides frequency and percentage values are used.

T-tests are used to find out whether students' views about homework differ in terms of variable of gender. Frequency analysis technique is used to find out whether students' views on homework differ in terms of variables such as class level, educational level of parents and occupation of parents. Scheffe test is done to define between which groups there are significant differences, if there is any. The significance level in the study is accepted as $p=0,01$ and $p=0,05$.

RESULTS

Study findings and comments that are based on the findings are included in this section. Findings and comments acquired in the study are stated below in accordance with sub problems of the study.

As many of the students (66.8%) expressed that they have fun and agree with the statement "I have great fun while doing my homework given in the science classes"; very few of the students (15.7%) expressed that they did not have fun. Therefore most of the students stated that they had fun while doing homework given in science classes.

While 70.4% of the students expressed positive opinion for the statement "I think homework given in science classes has a major role in making me understand the science courses subjects", 12.7% of students expressed negative opinion. Most of the students have a point of

view that homework given in the science classes makes them understand the science courses subjects.

While nearly half of the students (43.2%) expressed that homework given in the science courses should be obligatory, less of the students (35.5%) expressed that homework given in science courses should not be obligatory for the statement of "Homework given in the science classes should be obligatory"

As nearly all of the students (87.1%) said that correction of homework makes a significant contribution for the statement of "Teachers' correction of homework given in science classes makes a significant contribution", 5.2% of students expressed that it is useless. According to this result, students think that it has a significant contribution if homework is corrected.

Most of the students (76.5%) said that it promotes the dialogue between teacher and student for the statement of "Correction of homework given in the science classes promotes the dialogue between teacher and student"; very few of the students (8.2%) expressed that it does not. According to students' expressions, correction of homework given in the science classes promotes the dialogue between teacher and student.

While 86.2% of students strongly agree, 3.5% of students disagree and strongly disagree with the statement, "I think it will be more beneficial if homework given in the science classes is given in accordance with course subject covered". Nearly all of the students think that it will be more beneficial if homework is given in accordance with the course subject covered.

As 82.0% of students agreed with the statement, "I try to be very careful while doing homework given in the science classes", 4.2% of students disagreed. Most of the students stated that they try to be very careful while doing homework given in science classes.

Most of the students (84.8%) "agree" while very few of them (6.1%) "disagree" with the statement, "I am more motivated to related course subject while doing homework given in the science classes". A considerable amount of students stated that they are more motivated to related course subject while doing homework given in the science classes.

33.9% of the students "strongly agree and agree", 35% of the students as "neither agree, nor disagree", 31.1% of students as "disagree and totally disagree" with the statement, "Among homework given at school, I do the homework given in the science classes" According to this result, it can be deduced that students do not do homework in a definite order. At the same time this result make us think that students do not make comparison between homework given in the science classes and homework given in any other classes.

While almost all (82.0%) of the students "agree", 6.1% of them "disagree" with the statement of "Tests that are given as homework in the science classes enable us to get ready for exams". It can be inferred that tests that are given as preliminary tests are motivating students.

Table 1. Distributions of student responses for questionnaire items.

Items	Strongly agree		Agree		Uncertain		Disagree		Strongly Disagree	
	f	%	F	%	f	%	f	%	f	%
1. I have great fun while doing my homework given in the science classes	270	38,3	201	28,5	124	17,6	61	8,7	49	7,0
2. I think homework given in science classes has a major role for me to understand the science courses subjects	281	39,9	215	30,5	120	17,0	47	6,7	42	6,0
3. Homework given in the science classes should be obligatory	152	21,6	98	13,9	150	21,3	127	18,0	178	25,2
4. Teacher correction of homework given in science classes makes a significant contribution to correct mistakes	425	60,3	189	26,8	54	7,7	15	2,1	22	3,1
5. Correction of homework given in the science classes promotes the dialogue between teacher and student	331	47,0	208	29,5	108	15,3	26	3,7	32	4,5
6. I think it will be more beneficial if homework given in the science classes is given in accordance with course subject covered	407	57,7	201	28,5	72	10,2	13	1,8	12	1,7
7. I try to be very careful and regardful while doing homework given in the science classes	315	44,7	263	37,3	98	13,9	18	2,6	11	1,6
8. I am more motivated to related course subject while doing homework given in the science classes	288	40,9	239	33,9	135	19,1	29	4,1	14	2,0
9. Among homework given at school, I do the homework given in the science classes	129	18,3	110	15,6	247	35,0	140	19,9	79	11,2
10. Tests that are given as homework in the science classes enable us to get ready for exams	375	53,2	203	28,8	84	11,9	24	3,4	19	2,7
11. It motivates me better when homework given in science classes are based on research	257	36,5	224	31,8	144	20,4	53	7,5	27	3,8
12. It is more appealing if homework given in the science classes are to be done in the lab	405	57,4	146	20,7	87	12,3	34	4,8	33	4,7
13. It motivates me to do homework if homework given in the science classes are preliminary to the exam that I will take at the end of primary school	305	43,3	223	31,6	120	17,0	25	3,5	32	4,5
14. It is enjoying to make use of multimedia services while doing homework given in the science classes	290	41,1	205	29,1	143	20,3	31	4,4	36	5,1
15. I believe that homework given in the science classes improve my imagination	177	25,1	143	20,3	135	19,1	102	14,5	148	21,0
16. I think if homework given in the science classes were a group work, I would acquire more consistent knowledge	252	35,7	166	23,5	127	18,0	75	10,6	85	12,1
17. It will be more deductive in terms of learning course subject, if homework given in the science classes is leading us to make use of different resources	308	43,7	235	33,3	107	15,2	32	4,5	23	3,3
18. Homework given in the science classes as a preparatory work makes me more willing to learn the course subject	269	38,2	209	29,6	160	22,7	37	5,2	30	4,3
19. Homework given in the science classes as an exercise, enable me to understand and comprehend course subject better	287	40,7	215	30,5	138	19,6	30	4,3	35	5,0
20. I would like to choose my term paper among the science courses subjects	249	35,3	145	20,6	193	27,4	68	9,6	50	7,1
21. I think homework and term paper given in the science classes do not improve my creativity	140	19,9	155	22,0	143	20,3	107	15,2	160	22,7
22. If homework given in science classes is related to current issues, I am more willing to do homework	259	36,7	218	30,9	157	22,3	40	5,7	31	4,4
23. I think assessment of homework given in the science classes affect final grade that teacher gives	336	47,7	203	28,8	113	16,0	26	3,7	27	3,8

As 68.3% of students “agree”, 11.3% of them “disagree” with this statement: “It motivates me

better when homework given in science classes are based on research”. Most of the students think

that they are more motivated when homework given in science classes is based on research.

Table 2. Students' views on homework in terms of gender variable.

Gender	n	M	SD	df	T	P
Female	370	3.88	.56	703	1,46	.143
Male	335	3.82	.55			

Table 3. Students' views on homework in terms of class level variable.

Class level	n	M	SD
6th grade	210	4.00	.55
7th grade	226	3.79	.53
8th grade	269	3.78	.54
Total	705	3.85	.55

78.1% of students agreed and 9.5% disagreed with the statement "It is more appealing if homework given in the science classes is done in the lab". As a result it can be deduced that students are interested in activities done in a lab environment. Besides, most of the students think that it is more attractive if homework given in the science classes is experimental.

While 74.9% of students agreed with the statement "It motivates me to do homework if homework given in the science classes is preliminary to the exam that I will take at the end of primary school", 9.5% of students disagreed. Students are in the opinion that if homework given in the science classes is preliminary to the exam that they will take at the end of primary school, they will be more motivated.

Most of the students (70.2%) agreed with the statement: "It is enjoying to make use of multimedia services while doing homework given in the science classes" and very few of the students (9,5%) disagreed. Most of the students are in the opinion that it is enjoying to make use of multimedia services while doing homework given in the science classes.

While 45.4% of students agreed with the statement, "I believe that homework given in the science classes improves my imagination", 35.5% disagreed. It can be concluded that almost half of the students think that homework given in the science classes does not improve their imagination.

More than half of the students (59.2%) "agree" with the statement "I think if homework given in the science classes were a group work, I would acquire more consistent knowledge" and 22.7% "disagree". As a result it can be said that students think if homework given in the science courses were group work, they would acquire more consistent knowledge.

As many of the students (77.0%) agreed with the statement "It will be more deductive in terms of learning

course subject, if homework given in the science classes is leading us to make use of different resources", very few (7.8%) disagree. Most of the students think that homework given in the science classes should be leading to making use of different resources.

While majority of the students (67.8%) agreed with the statement "Homework given in the science classes as a preparatory work makes me more willing to learn the course subject", few of the students (9.5%) disagree. Most of the students are in the opinion that if homework given in the science classes has a function as a preparatory work, they will be more willing to learn course subject.

As majority of the students (71.2%) agreed with the statement "Homework given in the science classes as an exercise enables me to understand and comprehend course subject better", very few of them (9.3%) disagree. Most of the students think that homework given in the science classes as an exercise enables them to understand and comprehend course subject better.

55.9% of students agreed with the statement "I would like to choose my term paper among the science courses subjects" and 16.7% disagreed. It can be seen that more than half of the students want to choose their term paper (term research project) among the science courses subjects.

While 41.9% of students agreed with the statement "I think homework and term paper given in the science classes do not improve my creativity", 37.9% disagree. It can be concluded that students think homework and term paper given in the science classes do not improve their creativity.

Majority of the students (67.6%) agreed with the statement, "If homework given in science classes is related to current issues, I am more willing to do homework" and very few of the students (10,1%) disagreed with the statement. Majority of the students have opinion that relation of homework given in the science classes to current issues motivates them to do homework.

For the statement that "I think assessment of homework given in the science classes affects final grade that teacher gives" majority of the students (76.5%) agree and strongly agree but very few of the students (7.5%) expressed negative opinions. Students think that assessment of homework given in the science classes affects final grade that teacher gives.

As it is seen in Table 2, while the average of female students' views on homework given in the science classes is 3.88 (M=3.88, SD=0.56), the average of male students' views is 3.82 (M=3.82, SD=0.55). There is no significant difference in terms of gender between students' views on the homework given in science classes ($t = 1.46$, $p = 0.143$).

When the averages at Table 3 are examined, the averages of 6th grade students' views on homework given in the science classes (M=4.00, SD=0.55) are higher than that of 7th grade (M=3.79, SD=0.53) and 8th grade (M=3.78, SD=0.54). In order to define whether

Table 4. ANOVA results of students' views depending on class levels.

Source of variance	SS	df	MS	F	p	Significant difference
Between groups	6.978	2	3.489	11.68	.000	6>7, 6>8
Intra-groups	209.613	702	.399			
Total	216.590	704				

Table 5. Students' views on homework in terms of educational level of their mothers.

Educational level of mothers	n	M	SD
Primary	249	3.84	.50
Middle	113	3.83	.53
Secondary	188	3.81	.58
University	155	3.93	.60
Total	705	3.85	.55

differences are significant or not, variance analysis is made. The results are given in Table 4.

When Table 4 is examined, according to variance analysis, it is determined that there are differences between different class levels of students' views on homework given in the science classes [$F(2, 712)=11.68$, $p=0.000$]. Scheffe test is done to define the source of this difference that exists between different class levels. According to Scheffe test, there is a significant difference between 6th ($M=4.00$, $SD=0.55$) and 7th ($M=3.79$, $SD=0.53$) grades and also 6th grade and 8th ($M=3.78$, $SD=0.54$) grade classes.

When Table 5 is examined, it is seen that the average of students' views, whose mothers are university graduate, on homework given in the science courses ($M=3.93$, $SD=0.60$) is higher than average of students' views whose mothers are primary school graduate ($M=3.84$, $SD=0.50$), middle school graduate ($M=3.83$, $SD=0.53$) and secondary school graduate ($M=3.81$, $SD=0.58$). Variance analysis is done to define whether there is a significant difference between the averages or not. The results are given in Table 6.

Analysis results explain that there is not a significant difference at the $p<.001$ level between students' views on homework given in the science courses based on educational level of mothers [$F(3, 701)=1.558$, $p=0.198$]. When Table 7 is examined, it is seen that the averages of students' views, whose fathers are university graduate, on homework given in the science classes ($M=3.89$, $SD=0.56$) is higher than averages of students' views whose fathers are primary school graduate ($M=3.82$, $SD=0.49$), middle school graduate ($M=3.85$, $SD=0.57$) and secondary school graduate ($M=3.83$, $SD=0.57$). Variance analysis is done in order to define whether there is a significant difference between the averages. The results are given in Table 8.

Analysis results indicate that there is no significant difference at the $p<.05$ level between students' views on homework given in the science classes based on educational level of students' fathers [$F(3, 712)=0.768$, $p=0.512$].

DISCUSSION AND CONCLUSION

The present study was carried out to find out the views of the secondary school students' views on the homework assignments given in the science classes and whether these views differ according to various variables such as gender, grade level, and the education level of the parents. It was found that while the views of the secondary school students on the homework given in the science classes did not show a significant difference according to various variables such as gender, education level of parents; they only showed a significant difference according to grade level. When analyzed in terms of grade level, the mean of the views of the 6th grade students on the homework given in science classes ($X=4.00$) was found to be higher than the average of the views of the 7th ($X=3.79$) and 8th ($X=3.78$) grade students. This means that as the grade level of the students increased, the mean of the views of the students on the homework given in science classes decreased. When the responses they gave to the items on the scale were examined, it stood out that as the grade level of the students increased, they wanted to study exam-oriented. As the students were subjected to success-oriented exams at the end of 8th grade to be able to study at a high school they wanted, this awareness developed as grade level increased.

Considering the gender factor between grades, it was seen that there was not a significant difference between girls and boys. In his study in 1994, Cooper concluded that gender did not have a significant effect on homework. The fact that the education level of the students' parents did not cause significant differences on the students' views on homework was among the results obtained.

When the views of the secondary school students' on the homework given in science classes were analyzed, following conclusions can be drawn: Students stated that while they were doing science-related homework, they enjoyed themselves especially in empirical and group activities. Kaplan stated in his study conducted in 2006 that unlike traditional homework assignments, giving

Table 6. ANOVA results of students' views on homework depending educational level of their mothers.

Source of variance	SS	df	MS	F	p	Significant difference
Between groups	1.434	3	.478	1.558	.198	No
Intra-groups	215.156	701	.307			
Total	216.590	704				

Table 7. Students' views on homework in terms of educational level of their fathers.

Educational level of fathers	n	M	S.D.
Primary	157	3.82	.49
Middle	105	3.85	.57
Secondary	217	3.83	.57
University	226	3.89	.56
Toplam	705	3.85	.55

different homework increased students' interests and attitudes towards homework (Kaplan, 2006). As a result of this, it can be said that when the homework assignments are planned by including group work and experiential learning, science related homework assignments become more effective and enjoyable.

Students believe that the homework given in science classes should be obligatory and homework assignments given have a significant role in comprehending the science subjects. There is not much difference between the knowledge not repeated and the knowledge not learnt. Repetitions should be done by having not too long intervals as possible. If possible, the first repetition should be done on the day the subject is treated. The subject should be repeated the following day if it is desired to make the subject more long lasting: (http://mebk12.meb.gov.tr/meb_iys_dosyalar/33/08/715812/dosyalar/2012_12/12015807_derscalimabrosur.pdf).

The purpose of the daily homework is to ensure the repetition of the subject. If the knowledge learnt is repeated regularly and the homework given is done earnestly, success is inevitable. The most appropriate way to make students repeat what has been learnt is giving homework assignment. While doing homework, students repeat the subject without noticing.

According to the data obtained from the questionnaire, students think that teachers checking the homework assignments given in science classes provides great benefits in terms of correcting the mistakes made. Homework assignments should certainly be checked and students should be given feedback. Yuladır (2009) states that the homework assignments that will not be checked and no feedback will be provided to students should not be given. Providing feedback is at least as important as checking the homework. The fact that students have

done their homework is not a criterion that is enough for the homework to reach its goal. Correcting the mistakes will eliminate any incorrect learning. Students believe that having the homework given in science classes checked will improve the dialogue between teacher and student. Özben (2006) states that homework is a technique that helps the establishment of the communication between teacher and student. Homework is perceived as a teaching technique when looked from teachers' aspect and a learning technique when looked from students' aspect.

Students believe that it will be more beneficial if the homework assignments given in science classes are assigned in a way appropriate for the subjects treated in class. According to Doğru and Aydoğdu (2004), homework assignments that will be given to students could be assigned at the preparatory stage of the unit and the purpose of the homework assignment that will be given at this stage is to arouse interest in the students towards the unit. The purpose of the homework assignments that will be given at the stage of unit planning is to make the interest towards the unit deeper and stronger. The purpose of the homework assignments that will be given at the evaluation stage should be to make up the shortage of the assignments given beforehand and correct the mistakes.

The students stated that they try to be very careful and attentive while doing the homework given in science classes and be more motivated towards the subject. Hizmetçi (2007), in his study, revealed that while doing homework, an important proportion of the students prefer to be motivated by their parents and teachers, have a snack and more light in the environment they do homework. As a result of this study, the relationship between students' homework styles and their academic achievement was found to be significant in terms of motivation, snack, and visual and structuring sub factors (Hizmetçi, 2007). In a study conducted by Donley and Williams (1997), it was concluded that the motivation of the children who are awarded while doing homework was higher (Cited in: Sabancı, 2010). In addition to this, the students are of the opinion that the tests given as homework assignment in science classes make it easier to prepare for the exams. Weems (1998) investigated the effects of math homework on the exam with two student groups consisting of 108 students in each. The exam results of the 108 students who did homework were significantly higher than the other 108 students not doing

Table 8. ANOVA results of students' views on homework depending on educational level of their fathers .

Source of variance	SS	df	MS	F	p	Significant difference
Between groups	.710	3	.237	.768	.512	No
Intra – groups	215.881	701	.308			
Total	216.590	704				

homework (Cited in: Ilgar, 2005, s.127).

The students believe that when the homework assignments given in science classes are based on research, their motivation towards the class increase as well. Demirel (1999) suggests that assigning homework before the end of the class is beneficial in order to support in-class-learning and motivate learners to do research. It is helpful that explanations regarding how the assignments will be done are clear and comprehensible and examples are provided. In their study, Trautwein et al. (2006) investigated the effort put forth on the homework assignments at 5th and 9th grades and the effects of this effort on development, motivation and classroom studies all together and stated that homework assignments increased motivation. Center for Public Education (2007) claimed that although the homework assignments given for after school did not increase the students' academic achievement consistently, they increased their motivation, study habits and self-efficacy.

The students believe that if science-related homework assignments are type of assignments that are done in the laboratory, they will draw their attention more. Cooper et al. (2006) claim that although researchers believe that assigning homework serves multiple purposes, teachers give homework for a little different reasons. According to Cooper et al. (2006), one of the common goals of assigning homework is to apply the previously learnt skills to new situations and other areas of interest. Students are of the opinion that the homework assignments' given in science classes being preliminary for the exams that will be taken at the end of the primary school increases their motivation to do homework. Cooper (2008) revised the five studies focusing on the students who completed and who did not complete their homework and stated that the students who completed their homework were more successful in the end of subject tests and general tests. Similarly, in their study they carried out on 3rd grade students, Pelletier and Normore (2007) investigated the relationship between the students' rate of doing homework and the scores they got on achievement tests and reached the conclusion that the students who completed their homework got higher scores to a large extent.

The students believe that taking the advantage of multimedia facilities while doing science homework gives great pleasure. In some of the studies carried out it is mentioned that teachers make use of laptop, internet,

overlay chart or tools like homework monitoring charts as they increase students' motivation and success rate while doing homework (Bafile, 2005; Hopkins, 2005; Shellard and Turner, 2004; Dierson, 2000; Salend et al., 2004). In addition, Salend et al. (2004) indicated that some schools have homework support websites. These websites include the lists of homework assignments given and graded assessment rubrics. The website also explains the connections between the homework assignments given. It provides opportunity to create groups and do homework. In addition, it provides access to resources they will use and provides opportunity to ask questions online, as well (Salend et al., 2004). All of these facilities bring about motivation and success as they provide opportunity for students to do homework by sharing in an environment they like.

The students believe that the science homework does not improve their power of thinking and creativity. Türkoğlu et al. (2007) grouped homework assignments and stated that development homework assignments encouraged students' personal knowledge and imagination and improved creativity and critical thinking. These assignments could be things like writing a book, finding some information on the internet or investigating local news like "Until where does a balloon flies when we leave it to the air?" or "what would happen if there were no sun?" (Türkoğlu et al., 2007). Teachers should give students some of the control they have for students to be able to find creative solutions to the problems (Sternberg and Lubart, 1991). Creativity requires the ability to see events in a flexible way and to be able to reveal creativity; firstly it should be valued (Davis and Rimm, 1990). Based on the data of the students, it can be stated that the necessary importance is not given to development homework assignments given by teachers.

The students think that if the assignments given in science classes are in the form of group work, they will help them gain more permanent information. Özben (2006) argued that the atmosphere should be socialized by giving homework assignments that will direct the students to group work. While some studies revealed that doing assignments individually would increase success and persistence (Hong and Lee, 2000; Hong and Milgram, 2000), others stated that grouping students while doing assignments and studying individually and together with the group increased their performance (Corno, 2000; Mutlu and Öztürk, 2003; Gündüz 2005; Yücel, 2008).

Hizmetçi (2007) stated that while teachers were giving homework; students who preferred working in groups should be given group homework and the ones who preferred studying individually should be given individual homework and the students who always preferred to study alone should also be given group homework to develop their social skills.

Majority of the students believe that if the homework assignments given in science classes direct learners to take advantage of different sources, they will be more effective in teaching the subject. Büyüktokatlı (2009) explained that homework assignments should be given to the students in a way that they would understand what they would do and how they would do that clearly and added that timing should also be considered and resources should be indicated. According to National Education Association (2008a) and Paulu (1998), students should be provided opportunities to find out and identify the sources such as library, internet, reference books and common sources that belong to the community.

The students are of the opinion that homework assignments given in science classes as an exercise will help them understand and comprehend the subject better and makes them more willing to learn the subject. Demirel (1989) tried to find out whether the exercises given to 5th grade students as homework assignments in foreign language teaching created any significant difference or not and it was found that the group that was given homework as an exercise was more successful than the other group that was not given homework. Mikk (2006) revealed that there was a connection between TIMSS 2003 math scores and teachers' habit of giving homework and also giving homework based on more exercise was effective in increasing success (Mikk, 2006).

The students believe that if the homework assignments given in science classes are associated with current issues, they will make them more willing to do homework. While planning a good homework assignment, it is necessary to diversify homework assignments and instead of traditional heavy assignments, original projects that could be done at home should be given. Originally prepared homework assignments and especially the ones that are associated with the real world and real studies increase students' interest (Vatter, 1992).

The students believe that assessing the homework assignments given in science classes affects teacher's final grade. Demirel (1999), in a way that he supported the views of the students, stated that the grades obtained from homework assignments and project works were effective in determining the students' success at primary and secondary schools under the Ministry of Education. Students' in-class activities and extracurricular activities take part in this evaluation as "teacher's final grade" as well (Demirel, 1999).

In conclusion, as the students who regularly do homework are academically more successful than the students who do not, it can be stated that homework assignments

have an effect on learning and increasing success at school. In addition, homework assignments help teachers determine the subjects that students lack and need help with. Another result of our study is that as the grade level increases, habit of doing homework and motivation increase as well. In addition, it can be stated that homework assignments build a bridge between school and home, help students obey the rules, start and finish work on time, take responsibility and gain the ability to do work on their own.

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Full Length Research Paper

How learning techniques initiate simulation of human mind

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The simulation of human mind often helps in the understanding of abstract concept by representing it in a realistic model and simplistic way so that a learner develops an understanding of the key concepts. Bian (1873) and James (1890) in their work suggested that thoughts and body activity result from interactions among neurons within the brain. This paper explains how the usage of synectic technique helps in experiencing and exploring a broad range of environments, objects and phenomena within the walls of the classroom through simulation which makes learning more straightforward and intuitive for many students; and supports a constructivist approach to learning. Human mind analogues to modern day computer could enable virtual reality for the students to encounter abstract concepts as well as to control their learning. A study was conducted on student teachers using the survey method on the effectiveness of synectics linked to the simulation of human mind. The result of survey revealed that synectic technique is an effective approach for improving students' learning in concept formation, skill development and content area knowledge.

Key words: Simulation, learning, virtual reality.

INTRODUCTION

The word synectics was derived from the Greek word *synectikos* which means "bringing forth together" or "bringing different things into unified connection." By definition synectics thinking is the process of discovering the links that unite seemingly disconnected elements. It is a way of mentally taking things apart and putting them together to furnish new insight for all types of problems. Recent research has proved synectic thinking technique stimulates creative thinking, mobilizes both the sides of the brain the right brain (the dreamer) and the left brain (the reasoner) which provides a free thinking state of consciousness. It is based on analogic thinking, fusion of

opposites, synergetic, converts ordinary perceptions to extraordinary ones by generating new ideas. Gordon (1961) explained synectics as an approach to creative thinking that is often used by students to develop creative responses to problem solving, to retain new information, to assist in generating writing, and to explore social and disciplinary problems. Its main tool is analogy or metaphor. Couch (1993) suggested that the teacher facilitators should extract ideas from the students to establish similarities and dissimilarities between the two words namely atomic structure and solar system in teaching chemistry or physics. The usage of synectic lesson plan

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of a particular topic in a specific curriculum should be based on the following phases:

1. Phase I: Substantive Input (The teacher presents the new topic)
2. Phase II: Direct Analogy (The teacher suggests an analogy and asks students to explain it)
3. Phase III: Personal Analogy
4. Phase IV: Comparing Analogies (Students point out the similarities between the new material and the direct analogy)
5. Phase V: Explaining Differences (Students recognize where the analogy breaks down)
6. Phase VI: Exploration (Students re-explore the original material)
7. Phase VII: Generating Analogy (Students repeat the analogy process in small groups; this time creating their own analogies).

The usage of synectics is based on constructivist philosophy suggested by Jean Piaget (1971). According to him children in the preoperational state of cognitive development understand in a better manner through their personal analogies which is a component of synectics as it engages otherwise uninterested students in classroom activities. "Students are stimulated when they are excited and encouraged when they produce original ideas related to significant subject matter. Ormrod (2006) suggested that Peer interaction also enables students to benefit from distributed cognition as they co construct knowledge by working together. The research work done by cognitive psychologists has shown learning tendencies by classifying left right brain hemisphere dominance, mind-styles, and multiple intelligences. Synectics is especially valuable in classrooms of diverse thinkers because it accommodates the vast array of learning styles in each system. Brain imaging techniques like EEG (Electroencephalogram) revealed that the brain's left hemisphere is logical, analytical, verbal and sequential, while its right hemisphere is intuitive, conceptual, nonverbal and pattern-seeking. A band of neural fibers called the corpus callosum connects the two otherwise independent hemi-spheres and transmits information between them and it was also found that individuals exhibit tasks which favor either left - or right brain dominance whereas the usage of synectics is logical to infer that an individual's learning is most complete and integrated when it involves both halves of the brain.

Relationship between synectics and simulations

The practice of synectics techniques generates thoughts considered as software and brain as the computer capable of creating simulations to enable students understand abstract concepts by providing a fertile learning environment. For example, to explain the structure of atom, if a teacher uses synectic technique

comparing the atomic structure to that of solar system produces simulation in the mind of the learner through experiencing the particular event, observing and reflecting on that, formulating abstract concepts and generalizations around that, and then testing their implications of their concepts in new situations as suggested by Koble (1994). According to Galarneau (2004), simulations generated by a computer, human made machine built for goal-based learning, internalizing processes, understanding systems, decision-making, perspective-shifting, team-building co-operation" etc mind simulations generated by one's own thought process make it appear as real situation to mind's eye. The following similarities could be drawn based on computer simulations and human mind simulations.

The model in Figure 1 explains that synectic technique when practiced in the teaching learning process could generate mind simulations similar to computer simulation.

Objectives of the study

1. To find the effectiveness of synectic technique in teaching –learning process.
2. To find the performance of students with respect to their academic achievement as the result of mind simulations

Research questions

1. Is there significant improvement in the academic achievement of students as a result of mind simulations?
2. How could synectic technique bring mind simulations?

Sample

The sample consists of 100 students (Boys and Girls in the age group); 15 to 17 years were selected for the study. 30 Boys and 25 girls were randomly selected as experimental group given training to use analogies in order to understand the concepts. The remaining was treated as control group.

METHODOLOGY

The teacher trainees were asked to use the teaching learning model involving five inter related steps (Figure 2). To begin with teacher trainee introduces the concept to students using suitable analogies. The students are encouraged to use their own analogies and to compare the analogies as mentioned by the teacher explore the analogies in order to understand the concepts. This methodology is followed for six weeks. At the end of six weeks, the students were tested in their academic achievement. The result of the experiment is given in Table 1; it shows the significant differences between pre and post academic achievement test between boys and girls of the experimental group.

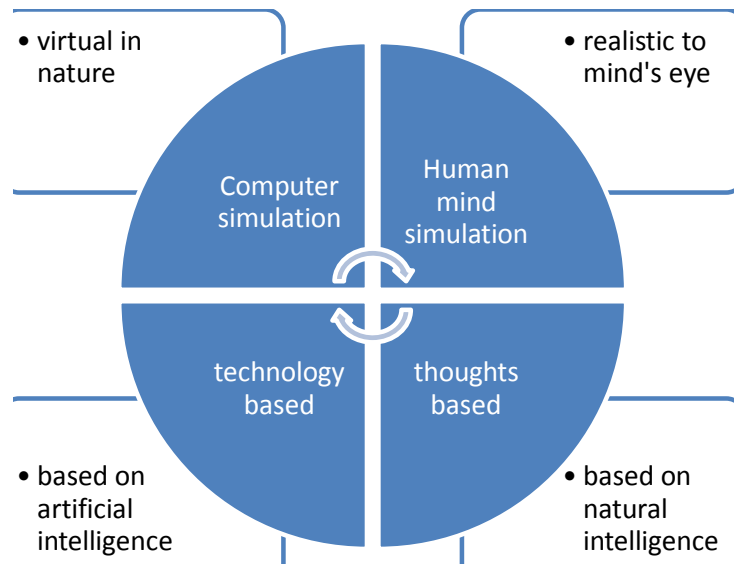


Figure 1. Study model.



Figure 2. Teaching learning model.

Table 1. The result of the experiment.

Variable	N	Gender	Type of test	Mean	S.D	't'	L.S
Academic achievement	30	Boys	Pre	80.82	15.47	3.43**	0.01
			Post	86.97	8.02		
		Girls	Pre	72.99	9.45	8.17***	0.01
			Post	84.54	6.12		

*p<0.05, **p<0.01,***p<0.001,N.S=not significant. "t" value was found to be significant for the experimental group showing that using analogies in teaching learning process helps students to understand the concepts in a better way.

Conclusion

The practice of Synectics provides mind training encouraging and enriching creative self-expression and creative thinking through simulations of human mind. Synectic technique promotes logic reasoning as a result of generating new ideas. This makes the students attain the following learning experiences:

1. Concrete experience by focusing on the solution of real-life problems.
2. Active experimentation by solving problems in a participative way with the users.
3. Abstract conceptualization by designing and facilitating problem solving processes.
4. Reflective observation by evaluating the results of a creative process.

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Full Length Research Paper

Assessment of computer technology availability, accessibility and usage by Agricultural Education student teachers in secondary schools in Botswana

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This study examines the availability, accessibility and usability of computer as a form of information and communication technologies (ICTs) by student teachers in secondary schools. 44 out of 51 student teachers of Agriculture responded to the questionnaire. Means and percentages were used to analyze the data to establish the availability, accessibility and usability of computer technology in schools. The results showed that teachers' computers were available in schools. The majority of the respondents were females: 38.6% had taught Agriculture in schools located in urban areas, while 31.8% had taught in rural-located schools. Half (50.0%) of the student teachers had taught for a period of eleven to twenty years while more than two-thirds had taught for less than ten years. The results revealed that student teachers were deficient in appropriate skills and knowledge for making use of available computer technology. Furthermore, the results indicated teachers have minimal knowledge and skills on computer and then learn how to use computers through in-service training, short courses and workshops. Based on the findings, the pre-service curriculum needs to be improved so that teachers can be more competent in using advanced technology to improve students' learning. In-service courses on ICT should be provided to all teachers as a requirement to enhance teachers' technical skills in the field.

Key words: Computers, student-teachers, Agriculture, availability, accessibility and usability.

INTRODUCTION

Since independence, Botswana's education system has undergone changes and reforms in terms of curriculum, infrastructure, schools' enrolment and teachers' education (Sebobi, 2012; Maundeni and Mookodi, 2004). The Revised National Policy on Education (1994), which is the guiding policy of education, has advanced the adoption and integration of science and technology in

education. In line with this policy, computers have been introduced in schools as information and communication technology (ICT) awareness to students. According to www.waikato.ac.nz, computer technology is the education of the hardware and software that form the foundations of modern computer systems of several education programmes. The curriculum that infuses computer education has

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been put in place for schools since the late 1990s when the policy was first implemented. Some short courses were done to up-grade and enhance teachers' knowledge and skills on computer technology. Furthermore, pre-service programs infusing computer courses have also been introduced in tertiary and higher education to prepare teachers who are capable of integrating technologies in teaching.

The use of computers in teaching and learning seems to have become popular as many educators use a variety of information and communication technologies (ICTs) like PowerPoint, Web CT, CD-ROM, www Multimedia, Moodle to enhance learning. Such development associated with computer education is a meaningful one. According to Sjøberg (2002), nowadays, societies in various countries are *"dominated and 'driven' by ideas and products from science and technology (S&T) and it is very likely that the influence of science and technology on our lives will continue to increase in the years to come"*. Shailaja (2013) stated that computers can be used in education for different purposes like programming as a developmental or authoring tool, programmed instruction, simulating experiments and as productivity tools. The Office of Technology Assessment (1995), as cited by Mishra and Cavanaugh, (2008), has found that several teachers were still reported to make minimal use of technology in the learning environments. According to Adeoye and Popoola (2011), accessibility of resources in education is important because at times the resources may be available but not accessed by the users; thus becoming meaningless. Setzer and Monke (2001) found that the majority of teachers lack confidence in computer technologies.

Setzer (2000) argued for and against the use of computers by children in schools and at home. The author pointed out that when children use computers at an early age both at home and in schools, there are several positive implications in the society and for education. The author noted that among other things, computers 'improve both teaching and students' achievement', since the literacy skill is taught as early as possible to ensure students are not left behind. Secondly, the adoption of such a machine in schools would require high support from the business community as schools alone would not be able to raise enough funds to afford enough computers for all their children. Thirdly, computers in education encourage "work force competitiveness in an increasingly high-tech world", thus making the learning of computer skills to be a priority. Fourth, 'working with computers, particularly the use of internet would connect students to their teachers and a wide network of professionals around the globe (Setzer, 2000). Arguing against the use of computers by children at an early age, Setzer (2000) pointed out that the danger and worst influence of computers on children included what the author termed "cosmetics" and the "video game" effects that affect the child's behaviors. The authors

therefore concluded that the use of computers in education particularly by young children and adolescents has influence and appeared to be a way to computerize nations.

Using Dede's (2006) model questions as framework for the views of teachers about computers' availability, affordability and usability provides an insight into the current status of computers in schools. Computers may be available in schools and not necessarily accessible for use by teachers, thus not benefiting learners. Similarly, computers may be available and accessible but not user friendly. The questions raised by Dede (2006) are a powerful interrogative form or functions to create an understanding of the environment under which teachers of agriculture work on in schools. Dede's model questions are; (i) how can schools afford to purchase enough multimedia-capable, internet-connected computers so that a classroom machine is always available for every two to three students? (ii) How can schools afford enough computers and telecommunications to sustain new models of teaching and learning? (iii) How can many educators disinterested in or phobic to computers be induced to adopt new technology-based models of teaching and learning? (iv) How do we prove to communities that new, technology-based models of teaching and learning are better than current instructional approaches? (v) How can educational technology increase equity rather than widen current gaps between "haves" and "have-nots?" If computers and ICTs are available in schools for teaching and learning of Agriculture, to what extent are they available, accessible and used by teachers of Agriculture? Such questions posed a need to examine the situation in schools of which the researchers set to establish the extent to which computers were available and used in secondary schools in Botswana. The outcome of which would inform the stakeholders on availability of computers in schools, sustainability of teaching and learning methods, the teachers' phobia in using computers, and the relevance of computers approaches. Although Dede's questions seem to draw the attention of stakeholders on issues related to resource availability, it is also important to get the perceptions of teacher practitioners on the availability, accessibility and usability of computers in instruction.

A study conducted by Zhu (2010) in China showed that in this world of digital and knowledge, the education sector is faced with challenges to move away from traditional teaching towards adopting a more innovative strategy. The author further reported that the situation "raises a great demand for the transformation of teachers' roles from traditional knowledge transmitter to a new set of roles" (Zhu, 2010:72). To address this kind of a challenge, Davis and Roblyer (2005) report that there is a need to create a model that incorporates virtual schooling in the pre-service teacher education with an appropriate assessment of the significant innovation to improve teachers' preparation at an initial stage. A study

conducted by Hadjerrouit (2008) in Norway advocated for the blended learning in higher education as new innovative information technologies based on solid learning theory and pedagogical strategies based on research findings. Similarly, a study conducted in Ghana has alluded to the fact that the tertiary education sector has advanced in the deployment and use of information technologies (Mangesi, 2007). According to Mangesi in Ghana, the universities have their own separate policy, which includes ICTs levy for students to have at least 24 h access to computer laboratories with broad band connection. This gives an opportunity for students to get used to using computers all the time.

In a study conducted by Totolo (2009), it was reported that the use of Information Technology (IT) in schools has influenced some changes in the digital scholarship, which is a modern technology applied in teaching, learning and research activities. The author, however, found that the challenge in adopting technology in education was associated with factors such as computer anxiety, digital literacy and lack of ease of use of the computers. However, these factors should not act as deterrence to the introduction of computers in schools because they could be overcome easily. This is true because anxiety problems and lack of confidence may affect teachers, but students may not face such problems; rather they would welcome them with enthusiasm as a new thing in their lives. This is supported by Bose (2009) who found that ICT at an early age is *necessary but more important would be one with relevant and appropriate resources to enhance the development of young children holistically*. According to her, an appropriate *ICT program should provide educational concepts to assist in development of problem solving skills and creativity of children*. According to Totolo (2009), countries are currently investing on computer and ICTs to enhance the education sector. Based on literature reviewed, some research work is still needed on ICTs in education particularly in developing countries, in order to examine and ascertain the computer availability, accessibility and usability of ICTs. Therefore, the purpose of this study is to examine the perceptions of student teachers of Agriculture about the availability, accessibility and usability of computers and ICTs in secondary schools where they taught before. The specific objectives of this study include:

- (i) To describe the personal characteristics of BSc Agric. Education student teachers
- (ii) To describe the availability, accessibility and frequency of using ICT services by teachers in secondary schools.
- (iii) To describe student teachers' perceptions regarding computers in schools.
- (iv) To describe approaches currently used to prepare Agriculture teachers on computers and ICTs.

METHODOLOGY

This study used a descriptive research design that employed closed

ended questionnaire to gather data from fifty one student teachers of Botswana College of Agriculture (BCA), who have Bachelor of Science degree in Agricultural Education. The group was enrolled in the AEB 223 course during the first semester of the 2013/2014 academic year. The purposively selected group comprises both pre-service and in-service students at Botswana College of Agriculture. The group was selected because; (i) had previously taught in junior secondary schools prior to enrolling into the BSc Agric education programme at BCA, (ii) were more knowledgeable about the use and adoption of computers in schools. (iii) were in the proximity to the researchers; (iv) comprised a diverse members that provided appropriate data from different districts in the country including rural and urban schools (v) had taught both practical and theory aspects of the subject in schools and, (vi) were willing to provide data about the availability, accessibility and usability of computers in schools. The group was deemed suitable to provide appropriate data about the status of computers in schools in terms of variables studied.

A questionnaire was used to collect data. The first part of the questionnaire required the student teachers to provide their personal characteristics. Part two of the questionnaire requested the student teachers to indicate on a checklist with a "Yes" or "No" answer for computers available. Furthermore, student teachers were also asked to indicate whether computers were accessible by indicating "Yes = accessible" or "No = not accessible"; and further the frequency of usage of each computer service by teachers was indicated on a 4-point- Likert- type scale: 1 = Not used; 2 = Rarely used; 3 = Occasionally used, and 4 = Always used.

The face and content validity of the questionnaire was determined by the Agricultural Education experts in the Department of Agricultural Economics, Education and Extension (AEE) at Botswana College of Agriculture (BCA). Among other factors considered by the experts in reviewing the content validity of the questionnaire, as advised by Fitzpatrick (1983), were the relevance of items to behaviors measured in this study, clarity of items, relevance to the domain of ICTs and the technical quality of items for gathering appropriate data. The suggestions gathered were used to modify the questionnaire.

To determine the internal consistency of the questionnaire in collecting reliable data, the researchers administered a pilot study at Chamabona Junior Secondary School in Mathangwane village in the Central District. Five Agriculture teachers participated in the pilot study. The test -retest form of reliability was used whereby teachers were given the instrument twice within an interval of a period of two weeks to respond to items. The instrument was found to yield approximately the same results on two different occasions. The Cronbach's Alpha coefficients for part 2 'teachers' level of agreement' and the "computers frequency of use" were 0.73 and 0.85, respectively. The re-test Cronbach's Alpha coefficients results for the instrument yielded 0.75 and 86 respectively, which proves the consistency of the instrument.

Permission was sought from the Ministry of Education and Skills Development (MEoSD) as the employer of the student teachers. A letter was attached to the questionnaire explaining the importance of the study, the value of teacher's participation in such research studies, assurance on the confidentiality of the data gathered, and the contribution of the outcomes of the study to the classroom instructions.

To collect data, fifty one questionnaires were distributed to a census of 51 student teachers. The questionnaires were hand delivered by one of the researchers to the students as they disembarked from the college hall when they finished the AEB 223 examination. Forty-four (86%) out of 51 Agricultural Education student teachers surveyed willingly completed the survey. Out of the 44 student teachers, 39 (87%) completed and returned the survey on the same day, while 5 (11%) opted to complete and return the completed survey questionnaire on the next day. At least 97% response rate was achieved, which provides the sample population for the study. The results of the study were generalized

Table 1. Demographic information about teacher respondents.

Gender		Frequency	Percent
	Male	20	45.5
	Female	23	52.3
	Missing	1	2.3
Location of school			
	Urban	17	38.6
	Rural	14	31.8
	Semi-urban	13	29.5
How long have you been teaching?			
	Less than 10 years	16	36.4
	11 to 20 years	22	50.0
	21 to 30 years	1	2.3
	41 to 50 years	5	11.4
How old are you?			
	Between 21 and 30 years old	12	27.3
	Between 31 to 40 years	24	54.5
	between 41 and 50 years	8	18.2
Last Certificate obtained			
	Diploma in secondary education	16	36.4
	Diploma in Agric Education	14	31.8
	Botswana General Certificate of Secondary Education	14	31.8
Position currently held			
	Teacher [Potential teacher]	7	15.9
	Senior teacher II	23	52.3
	Senior teacher I	6	13.6
	Pre-service teacher	8	18.2

to the 44 AEB 223 student teachers in the second semester of the 2012/2013 academic year who participated in the completion of the survey. The latest version for Statistical Package for the Social Sciences (SPSS) was used to analyze data into descriptive statistics to respond to the study objectives.

RESULTS AND DISCUSSION

Table 1 presented personal information of the Bachelor of Science degree student teachers currently at Botswana College of Agriculture, who were enrolled in the course AEB 223 (Educational Measurements and Testing) during the first semester of the academic year 2013/2014. This group had the experience of teaching after their diploma and during supervised teaching practice. The personal information gathered included gender, location of school where the teacher taught before or during their teaching practice, experience in teaching, age, position held during the teaching and the last certificate obtained before joining the Botswana College of Agriculture for a Bachelor of Science degree in

Agricultural Education (BSc. Agric Edu).

Objective 1: Personal characteristics of student teachers

The results showed that 53% of the respondents were females, showing that there were slightly more female Agricultural Education student teachers than males. Close to forty percent (38.6%) of the group had taught Agriculture in schools located in urban areas and close to two-thirds (31.8%) had the experience of teaching in rural- located schools. The results in Table 1 also showed that fifty percent of the student teachers had taught for a period of 11 to 20 years while more than two-thirds (36.4%) had taught for less than 10 years. In terms of age, 54.5% of the student teacher respondents were in the age between 31 and 40 years old, while close to twenty percent (18.2%) were in the age range between 41 and 52 years. Slightly above two third (36.4%) of the group held Diploma in secondary education, before

Table 2. Student teachers' perceptions regarding computers in education.

	N	Mean	SD
(1) Computers improve both teaching and student achievement	44	4.60	0.79
(2) Computer literacy should be taught as early as possible	44	4.79	0.41
(3) Computer technology programs require support from the business community	43	4.26	0.69
(4) Computers make tomorrow's work force competitive in an increasingly high-tech world and learning computer skills must be a priority	44	4.55	0.50
(5) Working with computers - particularly using the Internet - brings teachers valuable connections with their students and other professionals in the teaching profession	44	4.53	0.59
(6) Working with computers - particularly using the Internet - brings teachers to a wider network of professionals around the globe.	44	4.57	0.50
(7) The introduction of computers in education gives chance to improve classroom instructions	44	4.44	0.62
(8) Teachers who had learned how to program a computer and use very concrete computer models to teach their subject matter in class about learning enhance their powers as psychologists and epistemologists.	44	4.34	0.60
(9) Teachers who had learned how to program a computer could use very concrete computer models to enhance students learning	44	4.32	0.77
(10) Teachers who had learned	44	3.81	1.12
(11) I believe that the computer as a writing instrument offers children an opportunity to become more like adults	43	3.88	0.91
(12) The computers' presence in schools bring both teachers and children to a more humane relationship with mathematics	42	4.02	0.68
(13) The computer brings it into the land of the rich activities which could, in principle, be truly engaging for the novice and the expert teachers	43	4.05	0.62
(14) The computer can be seen as an engine that can be harnessed to solve the problems that face schools as they exist today	43	4.28	0.77
(15) Computation can be more than a theoretical science and a practical art	44	4.25	0.61
(16) Computers can be the material to fashion a powerful and personal vision of the world	44	3.89	0.85
(17) Computers can be the material to fashion a powerful and personal vision of the world	44	3.86	1.00
(18) Computers can be a machine to solve educational problems	43	3.93	0.91
(19) Teachers have entered a passionate and enduring love affair with computer technology	44	3.50	1.11
(20) There is a passionate love affair between teachers and computers	43	3.69	0.96
(21) The best uses of computers that I have seen in homes are so much better than what is being done with computers in schools	43	3.55	0.96
(22) Computer learning experiences give the teacher chance to become more aware of its learning culture and a chance to work with	44	3.71	0.98

enrolling in Agricultural Education program at Botswana College of Agriculture (BCA). Equal proportions of almost two third (31.8%) held the Botswana General Certificate of Secondary Education and Diploma in Agricultural Education certificates prior to enrolling in Botswana College of Agriculture for their degree program. This means that the group surveyed was made up of mainly students with different backgrounds. This would imply different backgrounds on computer accessibility and usage since they taught in different schools and an equal number of them were directly from senior secondary schools (Table 1).

Objective 2: Student teachers' perceptions regarding computers in education

Table 2 shows the statements from the arguments regarding the use of computers in school going children.

The surveyed group was asked to indicate their level of agreement or disagreement with the statements as borrowed from Setzer (2000) pertaining to how computers are used in education, their values, benefits in teaching and learning as well as how computers are perceived to contribute to the education of children. As shown by the means computed from the data gathered, majority of the means were highly above the average mean of 2.5 in a scale of 1 to 5 used for rating the benefit of computers to children. The highest statistical mean was recorded on "Computer literacy should be taught as early as possible" (Mean = 4.79; SD= 0.41) followed by "Computers improve both teaching and students' achievement" (Mean = 4.60; SD = 0.79). This means the student teacher respondents highly agreed to the statements. The least mean was computed on the statement that "Teachers have entered into a passionate and enduring love affair with computer technology" (Mean = 3.50; SD = 1.11). The results from Table 2 showed that the majority of the

Table 3. Mode of learning computers by Agriculture Science teachers.

Teachers of agriculture learn computers through	N	Mean	SD
(1) Playing games in the computer?	44	3.59	1.04
(2) In-service workshops	44	3.97	0.73
(3) Pre-service education	43	3.63	1.02
(4) Through trial and error as I type my work	44	3.75	0.92

student teachers agreed with all of the twenty-two constructs that computers are important for teachers and students to improve education. This positive response reinforces the importance of computers in education and perhaps the recognition of Botswana's Vision 2016 – 'an educated, informed nation'.

Objective 3: Methods used to prepare teachers on computers and ICT services

Table 3 presented results on methods used to prepare teachers to use computers in teaching. The student teachers were asked to indicate ways in which they learnt how to use computers in teaching Agriculture in schools. Results showed the highest statistical mean (3.97: SD = 0.73) on the statement which indicated that teachers learn computers through "in-service workshops" followed by the statement "*I learn computers through trial and error as I type school work*" (Mean= 3.75; SD = 0.92). The results mean that teachers graduate from their training with minimal knowledge and skills on computers and then learn how to use computers through in-service training and on the job training as they perform their teaching. This could also be close to the reality on ground since computers were just introduced when they were in the field. According to Bose (2009), computers were better off learnt at an early stage of children's development to minimize the challenge of phobia as raised in one of the questions posed by Dede (2000) and low self-efficacy as found by Sam et al. (2005), which may change when people use computers later in life (Table 3).

Objective 4: Technologies and ICT services available, accessible and usable in schools

Table 4 showed a list of different technologies and forms of ICT services available, accessible and usable in schools to facilitate the teaching and learning of Agriculture. The results in Table 4 showed that majority (76%) of the surveyed student teacher respondents indicated that ICT was available in schools, 63% showed it was accessible and usable ((Mean = 2.74; SD = 0.91). The results showed that spreadsheet was 84.1%; PowerPoint (88.6%) and typing Agricultural Science notes and communication were 81.8%. With regard to accessibility,

77.3% indicated that they have access to ICTs for "*Typing Agricultural Science notes*", followed by 75% on *spreadsheet*. Usability of the technology as measured by statistical means showed that the respondent indicated "*Preparing the teaching timetable*" (Mean = 3.57; SD= 0.82) followed by "*Typing quizzes, monthly tests and examinations*" [word processing] (Mean = 3.48; SD = 0.85). These results could be a true reflection of what transpires in secondary schools as the technology and ICT services studied refer to the basics of the ICTs in schools. Generally, teachers were expected to type their students' work and keep record of names of their students in computers. Therefore, the results of the study are a true reflection of what is in schools. Schools have secretaries who type examinations and other school notes; thus student teachers may be referring to that service in terms of access and usability. It will therefore be appropriate to conduct a comprehensive study to establish the extent to which teachers are able to utility computers and ICTs services in education. Based on the results, availability of the resources in schools does not necessarily imply that these resources are used by all teachers to teach or facilitate their lessons.

DISCUSSION AND CONCLUSION

The results revealed that there were more females than males in the group that was studied. The group comprises 38.6% student teachers who had taught Agriculture in schools located in urban areas and 31.8% student teachers had taught in rural-located schools. Majority of the student teachers were in their youthful age, which is why they were awarded scholarship by the government to pursue their bachelor's degree. A very high proportion of respondents indicated that "*Computer literacy should be taught as early as possible*", which is supported by the results of Bose (2009). Student teachers perceived literacy skills important in their career; hence they indicated the need to acquire skills and knowledge to enhance students' learning.

The results further showed that there were two forms through which teachers learn how to use computers: "in-service workshops" and "*through trial and error as they type school work*". However, the study did not indicate whether or not student teachers have taken some computer courses in their current studies. Based on the

Table 4. Availability, access and frequency of use of computers in schools.

S/N	Kinds of technology/ICT services	Availability		Accessibility		Frequency of Use	
		Yes	No	Yes	No	Mean	SD
1.	Typing quizzes, monthly tests and examinations [word processing]	33 (75.0)	10 (22.7)	29 (65.9)	13 (29.5)	3.48	0.85
2.	Developing PowerPoint to teach	33 (75.0)	10 (22.7)	29 (65.9)	11 (25.0)	2.16	1.03
3.	Typing agricultural science notes	36 (81.8)	8 (18.2)	34 (77.3)	8 (18.2)	2.93	0.89
4.	Keeping records [data base]	33 (75.0)	11 (25.0)	28 (63.6)	13 (29.5)	2.96	0.94
5.	Preparing the teaching timetable	35 (79.5)	9 (20.5)	30 (68.2)	10 (22.7)	3.57	0.82
6.	Accessing internet	35 (79.5)	9 (20.5)	24 (54.5)	18 (40.9)	2.98	0.99
7.	Computing students' test marks for tests and CA [spreadsheet]	37 (84.1)	7 (15.9)	33 (75.0)	9 (20.5)	3.21	0.90
8.	Presentations during agricultural subject workshops (ppt)	39 (88.6)	5 (11.4)	30 (68.2)	12 (27.3)	2.84	0.89
9.	Developing and publishing information [Publisher]	29 (65.9)	15 (34.1)	21 (47.7)	20 (45.5)	2.34	0.91
10.	Searching research articles	35 (79.5)	9 (20.5)	28 (63.6)	14 (31.8)	2.73	0.87
11.	Communication purposes	36 (81.8)	8 (18.2)	30 (68.2)	12 (27.3)	2.59	0.92
12.	Access the library catalogue	26 (59.1)	18 (40.9)	24 (54.5)	18 (40.9)	2.02	0.99
13.	Enabling Linux operations	29 (65.9)	14 (31.8)	23 (52.3)	16 (36.4)	1.91	0.86
14.	Web browsers for windows	29 (65.9)	12 (27.3)	26 (59.1)	14 (31.8)	2.59	0.87
	Total average	33 (76%)		28 (63%)	14 (30%)	2.74	0.91

results, it would be appropriate for teachers' preparation programs in tertiary and higher institutions to consider developing curriculum infusing ICT courses to prepare teachers rather than conducting in-service workshops. For those already in field, there is need to run short courses in collaboration with the higher institutions of learning which prepare teachers. The results also revealed that respondents agreed that computer technologies were available, accessible and used in schools. For example, 84.1% indicated that spreadsheet is available in schools, 88.6% indicated PowerPoint, while 81.8% agreed to typing Agricultural Science notes and communication. With regard to accessibility of ICT resources, more than 70% agreed to use computers for *typing Agricultural Science notes*, and *spreadsheet* for data analysis. Respondents also agreed that they used technology in schools.

The overall results show that student teachers agreed that computers were available, accessible and used to support their teaching career. However, what is not known is the extent to which these computers were used by teachers and whether they are adequate or not to all. Student teachers' responses were based merely on availability; perhaps there will be need to repeat the study and make further analysis of the ratio of students per computer.

Conflict of Interests

The authors have not declared any conflict of interests.

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Full Length Research Paper

The contribution of teachers' peer-and self-assessment for the implementation of active learning strategies: Perceptions of Ethiopia Primary School teachers

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The present study tries to investigate the contribution of primary school teachers' peer- and self-assessment for effective implementation of active learning in their actual classrooms. In this study, areas in which self-reflection and peer assessment include three broad categories, such as methods of teaching and learning, instructional resource utilization, and assessment techniques employed by teachers in actual classes. The study was carried out on randomly selected primary school teachers of Bahir Dar town (the Capital City of Amhara Region, Ethiopia). Using multistage sampling, five schools were randomly selected out of 25 government primary schools found in Bahir Dar town, Amhara Region, Ethiopia. And then, 50 of the teachers were randomly selected from a total of 157 teachers found in the five selected primary schools residing in Bahir Dar town. Of these sample teachers, 32 were females and 18 were males. Data collection checklists were employed to gather information from teachers about their state of using peer-and self-assessment as a means for promoting the implementation of active learning in their respective classes. The results indicated that teachers' peer-and self- assessment are insufficient in promoting active learning in primary schools of Bahir Dar town. This study, therefore, proposes means and ways of improving the roles and status of teachers in using active learning in primary schools of Bahir Dar town as suggested in the current ETP (1994) of Ethiopia.

Key words: Peer assessment, self reflection, active learning, implementation.

INTRODUCTION

Background of the study

Achieving the minimum educational quality level is the outstanding concern of Ethiopia as a nation. This is believed to be realized through the four basic strategies. The strategies, as disclosed in the country's Educational and Training Policy (ETP), include: professional develop-

ment, curriculum development, school management, and program evaluation (ETP, 1994). Of these basic variables, teachers' professional development takes the lion's share in the move towards bringing quality education in this nation (MoE, 2003).

As disclosed in the ETP (1994), education in the nation was highly authoritative, teacher-centered, which

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considered students as mere information recipients. That is, traditional methods of teaching subjects at any level employed a lecture format of instruction in which the majority of students are passively listening to the instructor and jotting down notes. In addition, the educational culture which had been flourished in the previous successive educational systems of Ethiopia was believed to obstruct teachers' practice in conformity with the philosophy of considering learners at the center of instruction.

However, current views of learning and instruction (constructivism) challenge the wisdom of this traditional pedagogic practice by stressing the need for the learner to play an active role in constructing knowledge. This is due to the fact that the main intention of any educational practice is to instill long lasting and authentic behavioral change among learners. To realize this intention utmost, it must be learners who should actively participate and lead themselves towards the required end. This being the case, the ETP has targeted teacher professional development with emphasis on the skill of facilitating students' active learning in all instructional situations.

In line with the current Ethiopian educational policy issues (1994), the Ministry of Education has set Teacher Education System Overhaul (TESO program) that articulates the nature of teacher training at different levels of education (kindergarten all through tertiary education). The main intention of such a program is to improve the quality of education in Ethiopia through boosting up teachers' knowledge, attitude and skills required to effectively and efficiently facilitate active learning in actual classes (MoE, 2003). More specifically, the program aims at helping teachers "use active learning and student centered teaching methods" (MOE, 2003, p. 6) in their actual classrooms. Put in other words, one of the major targets of the program is to develop the skill of teachers in using active learning-teaching strategy that promotes students' active participation in the teaching learning process.

Providing quality primary education for all school going age children by the year 2015 is a commitment of many countries internationally including Ethiopia. To achieve this goal, special emphasis has been given to the question of access in quite many cases. With no doubt, however, the commitment to achieve the goal is not only limited to provision of access but also to quality education provision. The Ethiopian education system with the Education and Training Policy (ETP, 1994) and consecutive Education Sector Development Programs (ESDP I, II III and IV) has made significant efforts to creating access for basic education to thousands of children. Consequently, the primary enrollment has increased dramatically. However, the quality of students' learning has been a challenge. As a result, the problem of quality in primary education has become a serious concern of the government, educators, teachers and interest groups to educational matters.

The problems in quality could be related to input factors like student-teacher ratio, student-textbook ratio, and teachers' qualification. However, of the most important factors that may be responsible to learning quality could relate to factors such as the way the teaching-learning process occurs, the extent to which teachers examine their own practice of teaching, how much school supervision is directed towards helping them improve instruction and making the learning process active and learner-centered. Accordingly, the quality of the teaching learning process can be improved by a multiple of interventions. That is, teachers can be assisted to improve their practices through school-based collegial and collaborative supervision (providing teachers to frequently assess their colleagues teaching practice). Involving teachers in action oriented research (a research and action directed towards improving, changing or better understanding their respective practice) can also be another important means of improving teaching and learning. In this respect, teachers can also be supported through peer assessment based feedback. Most important complementary move to peer-assessment is self-reflection of one's practice as a measure of improving the quality of teaching and learning. This is based on the assumption that the more teachers make their classrooms and their teaching practices open to self reflection and peer observation/assessment, the better the lesson they obtain to improve their practice and thus, improved students' learning. Student-centered learning would encourage active participation in their lessons which in turn would have positive contributions to develop abilities for creative thinking, problem solving and relating learning to real life experiences and thereby achieving the envisaged EFA goals of schooling. This can be more consolidated when a teacher is ready to engage in a continuous professional reflection on his/her own practice. Moreover, peer assessment would further enhance the professional development of teachers, which has an immense contribution to promoting active learning and quality education (Schon, 1987).

The present study, therefore, focuses on investigating how far teachers' employ peer- and personal assessment in their respective lessons with the intention of enhancing active learning during instructional sessions.

Statement of the problem

Currently, educational institutions are being urged to prepare students to meet the challenges of a changing global world. This implies that schools are required to respond to the changes of emphasizing teacher directed instructional strategies to learner centered instructional strategies by changing the way they have historically operated in designing and implementing innovations for the teaching learning process. Such kinds of changes are presumed to involve the changes from philosophical

perspectives schools adapted to the changes in the actual practice in the classroom. To realize this core intention of the twenty first century, corresponding changes in relation to professional development is highly demanding.

Research (Fullan and Hargreaves, 1996) suggests that there had never been recognition of the importance of professional development in the history of education before. Nowadays, however, several educators have identified the professional development of teachers as a major component of school reform that is necessary to provide students with the best educational practices for the years ahead. Professional development is critical to systemic educational reform and school improvement that is designed to enhance the teaching learning process (Fullan and Hargreaves, 1996). To this point, Guskey (1986) asserted that the purpose of professional development is to bring about changes in the beliefs, attitudes, and classroom practices of teachers with the ultimate goal being changes in students' outcomes.

Despite the strong criticisms (considering teachers as authority figures, and students as passive beings, its being one way information recording, etc.) on the conventional teacher-centered instructional approach, however, the teaching learning process in most schools in Ethiopia has persisted to be teacher dominated (MoE, 2003). Most classes are characterized by a situation where students are made to listen to their teachers and copy notes from the blackboard. Learning by doing, problem solving, cooperative learning and group approaches are limited in primary schools of Ethiopia and if used, they do not serve their very purpose (MoE, 2003). But, literature from the psychology of learning disclosed that true and long lasting learning occurs not through pouring of information from a classroom teacher to students but by the real engagement of learners in the process of teaching and learning.

Consequently, there is a widely shared concern that the quality of learning especially in primary schools is very low. The Ethiopian Education Sector Development Program III (2005), for instance, underlines that the education system faces serious problems pertaining to teacher qualification, shortage of textbooks, and high student-teacher ratio. The dropout rate has been high. The retention rate at grade 5 is only about 55 per cent. In addition to this, there is a wide gender gap of 18% favoring boys (ESDP III, 2005). Moreover, research findings (Pauline et al., 1997; a study by Women's Affairs Department, 2000 cited in MoE Task Force, 2007) indicate lower participation of girls in class activities. Studies also indicate that teachers do not encourage girls' participation in their classes. These situations have led to a serious concern among educators and the Ethiopia Ministry of Education about quality of education and further triggered them to find appropriate ways and means of boosting up teachers competency of managing diversities in the classroom.

The Ethiopian Ministry of Education has reacted to this

situation in different ways. The Ministry in its Education Sector Development Program III (ESDP III 2005/2006-2010/2011) document indicates the following main points as part of quality enhancement endeavors:

1. In the School Improvement Program, among the major focus areas, emphasis will be given to student-centered learning, professional development and collaboration and quality of instructional program.
2. Improving teachers' professional capability through continuous professional development.
3. Strengthening cluster based (refers to two or more school staffs sharing experiences related to their practice) local in-service training, which mainly focus on active learning methodology, action research, peer-reflection, self-reflection and the like.
4. Strengthening in-school-supervision so that experienced, skilled and innovative teachers can share their experiences and coach the inexperienced teachers. It further indicates that the content of pre-service and in-service teacher training programs will be revised to enable teachers acquire and develop appropriate pedagogical skills that are academically sound, child friendly, and gender sensitive.

Concerning active learning, the extent teachers understand the concept and the skills they have to implement it are essential conditions. Moreover, the quality and amount of feed-back teachers get on their own teaching, the extent of their readiness to accept constructive comments of their peers on their teaching are issues that are subject for investigation. Moreover, the practice of self reflection and making continuous effort to improve one's own work (teaching) is at its infant state at schools (MoE, Task Force, 2007). Hence, this study is designed to assess the extent of teachers' peer-assessment and self-reflection practiced to enhance active learning in primary schools of Bahir Dar town by proposing the following leading questions:

1. To what extent are teachers' peer- and self- assessment used to promote active learning strategies in primary schools of Bahir Dar town?
2. What kind of relationship does exist between teachers' peer- and self- assessment?
3. Is there any difference in teachers' peer- and self- assessment by experience, gender and age of participants?

Purpose of the study

The purpose of this study includes:

1. Examining the extent of teachers' peer-assessment and self-reflection implementation for promoting active learning strategies in primary schools of Bahir Dar town.
2. Indicating the relationship that exists between

teachers' peer assessment and self reflection.

3. Showing whether there is difference in teachers' peer assessment and self reflection by experience, gender and age of participants.

Significance of the study

As it is pointed out in the literature, the School Improvement Program (SIP) was developed to meet the identified needs of school teachers. It was believed to provide teachers with a practical experience to implement active learning strategies in their teaching. As it is indicated elsewhere in the literature, the successful implementation of any training for teachers largely depends on the extent to which it considers their needs and concerns for the kind of training they want to take (Solomon and Alemayehu, 2007). Hence, this study is significant in that the results will help Amhara Region Education Bureau in particular or the Ethiopia MoE in general to reconsider the ways and means of implementing SIP for primary school teachers in Bahir Dar town vis-à-vis the feedback obtained in this study. It also helps primary school teachers in Bahir Dar town to see where they are in terms of using self reflection and peer assessment as a means of professional development directed towards justifying their day to day practice in the schools.

In general, in the previous educational systems of Ethiopia, as the researcher's school experience and/or readings proved, the teaching learning process was totally considered as a secrete activity behind classroom doors, that is, it is left to a teacher and the respective classroom students. No colleague was invited to observe teacher's instructional acts.

The results of this study, therefore, are believed to further strengthen the Education and Training Policy's attempt to make teaching and learning public and thereby promote a collaborative and self-reflective instructional environment in Ethiopian schools.

Delimitation

This study would have been complete had it been made by soliciting data from different sources (students, principals, parents, teachers) and using different methods (such as Focus Group Discussion (FGD), interview, observation, questionnaire, and content analysis). But due to time inconvenience and budget constraints, the study is delimited to teachers as the only source of information, and peer-and self-assessment checklists developed by the researcher referring to the review of the related literature, the Ethiopian MOE Task Force (2007) peer- and self- assessment suggestions, and the researchers long years of educational experience at schools, Bureaus and universities as the only instruments for collecting data.

Definition of important terms

Peer-assessment: refers to colleagues' actual classroom observation feedback given to the respective classroom teacher about his/her teaching with emphasis to promoting active learning in methods of teaching and learning, instructional resource utilization, assessment techniques employed by teachers in the teaching-learning process.

Self-reflection: refers to the teacher's retrospective thinking and decision making about his/her teaching practice with emphasis on promoting active learning in actual instructional sessions based on the feedback obtained thereof.

State: current status of teachers in using peer- and self-assessment about their teaching practice in schools.

METHODOLOGY AND DESIGN OF THE STUDY

As it is stated earlier, the purpose of this descriptive study was to assess the state of teachers' peer-assessment and self-reflection in the respective instructional delivery. Hence, to meet its goal effectively, the following elements were designed accordingly.

Population and samples of the study

The population of this study includes all government primary school teachers (364 males and 422 females with a total of 786 teachers) found in Bahir Dar town. The total number of government primary schools was 25. The samples of this study were teachers in randomly selected five primary schools from the population of this study who were assigned to teach students of grades 1 through eight in 2009/2010 academic year. Teachers who were assigned to facilitate activities of the schools other than teaching like the director, vice-director and the administrative staff of the school were excluded out of the study. In other words, of the total 157 (84 females and 73 males) teachers of the selected schools, 50 (32 females and 18 males) of them were assumed as samples of the study.

Sampling technique

Out of 25 government primary schools found in Bahir Dar town, five of them were selected using random sampling technique from their list available in the Bahir Dar Special Zone Education Office. Then, 32 females and 18 male primary school teachers were selected using second round random sampling technique out of a total of 157 teachers found in the five selected schools. This sampling technique was used because the researcher found it more convenient, impartial and appropriate to take representative sample for the total population of the study.

Methods of data gathering

To gather reliable and valid data from the selected primary schoolteachers, the researcher has developed peer-assessment and self-reflection checklists through consulting the relevant literature, MoE Task Force (2007) suggestions of peer-assessment and self-reflection checklists, and his long years of educational experience at schools, bureaus, and higher learning institutes. These checklists prepared were filled in by teachers in the respective schools.

The peer assessment checklist was applied to see the state of peer observation practiced in selected primary school classes. To apply this technique, the researcher tried to modify certain criteria suggested by the Task Force based on the information from the review of the related literature and consulting the researcher's long time pedagogical background know-how. To this end, fifteen criteria were employed for assessing the status of peer-assessment implementation in primary schools of Bahir Dar town. Each item has three levels of frequency designated by 0,1,2, for *not at all*, *sometimes*, and *often employed*, respectively.

The other data gathering instrument used was self-reflection, which was conducted using self reflection checklist that has also fifteen items. Each item has three levels of frequency designated by 0,1,2, for *not at all*, *sometimes*, and *often used*, respectively. This reflection checklist was used to assess the respective teacher's state of retrospective thinking and decision making over his/her instructional practice with the intention of justifying it in latter sessions. The items of the checklist were developed by the researcher based on the information from the review of the related literature and consulting the researcher's long time pedagogical background know-how.

Data gathering procedures

Peer-observation and self-reflection checklists were given to colleagues who have long years of experience in teaching at primary schools so as to critically assess the relevance, comprehensiveness, and adequacy of those checklists in assessing the state of teachers peer-assessment and self-reflection. Before collecting data using the checklists, an attempt was also being made to see whether the checklists mean the same thing to different readers or not. To this end, the checklists were given to language editors for necessary modification. The language editors comments endorsed were in such a way that the researcher's intent of communication could better understood by the respondents of the study. Then as part of the pilot study, the checklists were filled in by seven primary school teachers who were selected arbitrarily in the mentioned population of this study. The respective checklists were collected from the seven teachers, and thereby content analysis was made by the researcher in such a way that it enables him to make relevant adjustments to the final draft of the checklists.

Finally, the checklists were distributed to sample teachers. Each sample teacher was required to fill in both the self-reflection and peer assessment checklists. The return rate of the filled-in checklists was 95 percent.

Data analysis technique

Results obtained from the peer assessment and self-reflection checklists were analyzed using Pearson correlation, t-test and Chi-square test. The t-test analysis technique was employed for the purpose of checking the difference that exists between teachers' state of using self-reflection and peer-assessment as means to enhance the implementation of active learning in actual instructional delivery, whereas the Pearson correlation analysis helps the researcher to see the relationship between teachers' state of using peer-assessment and self-reflection as means for promoting active learning. The third analysis technique used in this paper helped the researcher to see the extent of use of peer- and self- assessment as practice based strategies of promoting the effective implementation of active learning in primary schools of Bahir Dar town.

PRESENTATION AND ANALYSIS OF DATA

This part of the study tries to present and analyze the

data collected from teachers' state of practicing peer assessment and self reflection as a means to promote active learning in actual classrooms. To this end, as mentioned in the methodology section, the data collected by the checklists were analyzed using Chi-square tests, t-test and Pearson correlation coefficient.

The State of Self-reflection among Primary School Teachers of Bahir Dar Town

Table 1 shows that the frequency of using method related self reflection techniques in actual teaching-learning process is much insufficient. The residual for "never used" and "often used" method related self-reflection techniques as a technique to foster learner-centered teaching-learning strategies were by far different from the expected number of participants. That is, more respondents (114) put that they never used such a technique as part of their teaching-learning process whereas lesser respondents (63) than the expected number of participants (83) declared that they often used method related self reflection techniques as a strategy for promoting active learning in their respective classroom instructions. This variation is significant at $\alpha = 0.01$ level. The finding implies that a significant number of primary school teachers were unable to practice method related self-reflection techniques as a means for enhancing active learning in their respective classroom instructions.

Table 2 shows that the frequency of using resource utilization related self-reflection techniques in the teaching-learning process was insufficient. The residual for "never used" and "often used" resource utilization related self-reflection techniques as a means of fostering learner-centered learning strategies was by far different from the expected number of participants. That is, more respondents (138) put that they never used such a technique as part of their teaching-learning process whereas lesser respondents (43) than the expected number of participants (83) declared that they often used resource utilization related self-reflection techniques as a strategy for promoting active learning in their actual sessions. This variation is significant at $\alpha = 0.01$ level. The finding implies that a significant number of primary school teachers were unable to practice resource utilization related self-reflection techniques as a means for enhancing active learning in their respective classroom instructions.

Table 3 shows that the frequency of using assessment related self reflection techniques in the teaching-learning process was deficient. The residual for "never used" and "often used" assessment related self reflection techniques as a means of fostering learner-centered learning strategies was by far different from the expected number of participants. That is, more respondents (100) put that they never used such a technique as part of their teaching learning process whereas lesser respondents (63) than the expected number of participants (83) declared

Table 1. The state of primary school teachers' practice of method related self-reflection techniques.

Frequency	Observed N	Expected N	Residual	Chi-square(a)	df	Asymp. Sig.
never	114	83.3	30.7	17.528	2	.000
some times	73	83.3	-10.3			
often	63	83.3	-20.3			
Total	250					

Table 2. The state of primary school teachers' practice of resource utilization related self-reflection techniques.

Frequency	Observed N	Expected N	Residual	Chi-square(a)	df	Asymp. Sig.
never	138	83.3	54.7	57.848	2	.000
some times	69	83.3	-14.3			
often	43	83.3	-40.3			
Total	250					

Table 3. The state of primary school teachers' practice of assessment related self-reflection techniques.

Frequency	Observed N	Expected N	Residual	Chi-square(a)	df	Asymp. Sig.
never	100	83.3	16.7	8.456	2	.015
some times	87	83.3	3.7			
often	63	83.3	-20.3			
Total	250					

Table 4. The state of primary school teachers' self-reflection in all focal areas of their lesson.

Frequency	Observed N	Expected N	Residual	Chi-square(a)	df	Asymp. Sig.
never	352	250.0	102.0	69.624	2	.000
some times	229	250.0	-21.0			
often	169	250.0	-81.0			
Total	750					

that they often used assessment related self reflection techniques as a strategy for promoting active learning in their actual sessions. This variation is significant at $\alpha = 0.01$ level. The finding implies that a significant number of primary school teachers were unable to practice assessment related self-reflection techniques as a means for enhancing active learning in their respective classroom instructions.

Table 4 shows that the frequency of using self reflection in the teaching-learning process is much inadequate. The residual for "never used" and "often used" self-assessment techniques as a strategy to foster learner-centered instruction was by far different from the expected number of participants. That is, more respondents (352) put that they never used such a technique as part of their teaching-learning process whereas lesser respondents (169) than the expected number of partici-

pants declared that they often used self-assessment technique as a strategy for promoting active learning in their actual sessions. This variation is significant at $\alpha = 0.01$ level. The finding implies that a significant number of primary school teachers failed to use self-reflection as a strategy for enhancing active learning in their respective instructions.

The state of peer assessment among primary school teachers of Bahir Dar Town

Table 5 shows that the frequency of using method related peer assessment technique in the teaching-learning process is much insufficient. The residual for "never used" and "often used" method related peer-assessment techniques as a means of fostering learner-centered

Table 5. The state of primary school teachers' implementation of method related peer assessment technique.

Frequency	Observed N	Expected N	Residual	Chi-square(a)	df	Asymp. Sig.
never	113	83.3	29.7	19.016	2	.000
some times	80	83.3	-3.3			
often	57	83.3	-26.3			
Total	250					

Table 6. The state of primary school teachers' resource utilization related peer-assessment techniques.

Frequency	Observed N	Expected N	Residual	Chi-square(a)	df	Asymp. Sig.
never	158	83.3	74.7	103.256	2	.000
some times	57	83.3	-26.3			
often	35	83.3	-48.3			
Total	250					

Table 7. The state of primary school teachers' assessment related peer-assessment techniques.

Frequency	Observed N	Expected N	Residual	Chi-square(a)	df	Asymp. Sig.
never	105	83.3	21.7	11.096	2	.004
some times	83	83.3	-.3			
often	62	83.3	-21.3			
Total	250					

learning strategies were by far different from the expected number of participants. That is, more respondents (113) put that they never used such a technique as part of their respective process but lesser respondents (57) than the expected number of participants (83) declared that they often used method related peer assessment techniques as a strategy for promoting active learning in their actual sessions. This variation is significant at $\alpha=0.01$ level. The finding implies that a significant number of primary school teachers were deficient in implementing method related peer-assessment as a strategy for enhancing active learning in their respective classroom instructions.

Table 6 shows that the frequency of using resource utilization related peer assessment technique in the teaching-learning process is much inadequate. The residual for "never used" and "often used" resource utilization related peer assessment technique as a means of fostering learner-centered learning strategies were by far different from the expected number of participants. That is, more respondents (158) put that they never used such a technique as part of their teaching learning process whereas lesser respondents (35) than the expected number of respondents (83) declared that they often used resource utilization related peer assessment technique as a strategy for promoting active learning during instruction. This variation is significant at $\alpha=0.01$ level. The finding implies that a significant number of

primary school teachers were deficient in implementing resource utilization related peer-assessment as a strategy for enhancing active learning in their respective classroom instructions.

Table 7 shows that the frequency of using assessment related peer assessment techniques in the teaching-learning process is far behind the expected. The residual for "never used" and "often used" assessment related peer assessment technique as a means of fostering learner-centered learning strategies were by far different from the expected number of participants. That is, more respondents (105) put that they never used such a technique as part of the teaching-learning process whereas lesser respondents (62) than the expected number of participants (83) declared that they "often used" assessment related peer assessment techniques as a strategy for promoting active learning during classroom instruction. This variation is significant at $\alpha=0.01$ level. The finding implies that a significant number of primary school teachers were deficient in implementing assessment related peer-assessment as a strategy for enhancing active learning in their respective classroom instructions.

Table 8 shows that the frequency of using peer assessment in the teaching-learning process is much inadequate. The residual for "never used" and "often used" peer-assessment techniques as a means of fostering

Table 8. The state of primary school teachers' peer-assessment in all focal areas of classroom instruction.

Frequency	Observed N	Expected N	Residual	Chi-square(a)	df	Asymp. Sig.
never	376	250.0	126.0	103.968	2	.000
some times	220	250.0	-30.0			
often	154	250.0	-96.0			
Total	750					

Table 9. The correlation between teachers' peer-assessment and self-reflection.

		Frequency of self reflection	frequency of peer assessment
Frequency of self reflection participants	Pearson Correlation	1	.727(**)
	Sig. (2-tailed)	.	.000
	N	50	50
Frequency of peer assessment participants	Pearson Correlation	.727(**)	1
	Sig. (2-tailed)	.000	.
	N	50	50

** Correlation is significant at the 0.01 level (2-tailed).

Table 10. Paired samples t-test analysis of teachers' peer assessment and self-reflection.

		Paired differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. error mean	95% confidence interval of the Difference				
					Lower	Upper			
Pair 1	frequency of self reflection - frequency of peer assessment	.06202	.19478	.03795	-.01609	-.14013	1.634	49	.115

learner-centered learning strategies was by far different from the expected number of participants. That is, more respondents (376) put that they "never used" such a technique as part of their respective instructional process but lesser respondents (154) than the expected number of participants (250) declared that they often used peer-assessment technique as a strategy for promoting active learning in their respective classroom instruction. This variation is significant at $\alpha=0.01$ level. The finding implies that a significant number of primary school teachers failed to use peer-assessment as a strategy for enhancing active learning in their respective instructions.

The relationship between teachers' peer assessment and self-reflection

Table 9 discloses the fact that there is a strong correlation between primary school teachers peer-assessment

and self-reflection practices in primary schools of Bahir Dar town, which is significant at $\alpha = 0.01$ level in a 2-tailed test. That is, teachers who usually implement self-reflection as a means to justify their teaching are also open to colleague criticism of their teaching practice which is a viable means of developing teachers' competence of implementing active learning during the teaching-learning process.

Table 10 indicates the fact that t-calculated is out of the 95% confidence interval of the difference (-0.01609_0.14013). That is, the t-calculated value(1.634) is within the rejected region. This farther implies that there is no difference between the frequency of teachers practice of self-reflection and peer assessment done to better implement active learning in their respective classrooms. This is also confirmed by Table 9, which indicates the presence of strong relationship between teachers peer assessment and self-reflection.

Table 11 indicates that there is mean frequency

Table 11. Teachers' peer-assessment and self-reflection vis-à-vis age, experience and gender.

Factors		Mean frequency
Participants' Age	Above 40 years	2.10
	30____40 years	2.00
	20____30 years	1.60
Participants' Experience	Above 20 years	2.22
	10____20 years	1.80
	Below 10 years	1.36
Participants' Gender	Male	1.60
	Female	2.00

difference in teachers peer assessment and self-reflection in terms of variation in experience, age and gender of the participants. That is, as teachers' age and teaching experience increase there is a slight increase in the mean frequency of practicing peer-assessment and self-reflection attempts made for the purpose of justifying their own teaching. Moreover, the table indicates that female teachers out-perform males in terms of frequency of applying peer-assessment and self-reflection during the instructional process as a means to better manage active learning sessions. In relation to this point, Robertson cited in Anna (2000) asserted that due to the attempts made to make issues gender neutral, females are also doing best in peer-assessment and self reflection attempts made to justify their teaching and better manage active learning in the teaching-learning.

DISCUSSION OF THE FINDINGS

The extent of teachers' peer assessment and self reflection in primary schools of Bahir Dar town

The research findings in this study show that the frequency of using peer-assessment and self-reflection in the teaching-learning process is much behind the expectation of the ministry of education. That is, the residual for the frequencies for "never used" and "often used" peer-assessment and self-reflection techniques as a means of fostering learner-centered learning strategies were far from the expected number of participants. That is, more respondents asserted that they "never used" such a technique as part of their teaching-learning process whereas very less respondents as compared to the expected number of participants declared that they often used peer-assessment and self-reflection techniques as strategies for promoting active learning in their actual sessions. These variations were found very much significant at $\alpha = 0.01$ level.

As the findings of this research imply, changing teachers' instructional practice requires changing the

deep-rooted traditional philosophy they adhered to, the culture, norms and school ethos. However, it takes a long instructional time to bring the required change in these respects. In support of this point, the MoE (2003) disclosed the fact that though there exists strong criticisms on the conventional teacher based approach in education, the teaching-learning process in most schools in Ethiopia has persisted to be teacher dominated and actual classes were dictated by direct instruction which leads teaching and learning towards pouring of inert information from the classroom teacher to students. That is, most classes are characterized by a situation where students are made to listen to their teachers and copy notes from the blackboard. Learning by doing, problem solving, cooperative learning and group approaches are limited and if used, they are used haphazardly and as a result they do not serve their very purpose (MoE Task Force, 2007).

Therefore, the MoE and its attendant implementers, interest groups, users of different educational programs should work towards realizing a strong school culture which is guided by the constructivist philosophical underpinning. Here, it requires us to define what it means by strong and weak school culture. The *strength* of culture is generally defined as "a combination of the extent to which norms and values are clearly defined and the extent to which they are rigorously enforced" (Cox, 1993, p.162). Cultural strength, therefore, refers to the extent to which the behaviour of school staff is actually influenced or determined by the assumptions, values, norms and artefacts that are shared in school or recommended by the education system to practitioners in schools. Weak cultures do not informally put great pressure on school members to behave in certain ways, but simply offer a guideline for their behaviour instead. As Kilmann et al. (1985) put it, "culture only mildly suggests that they behave in certain ways" (p.4). Stated otherwise, weak cultures do not prescribe how staff *must* behave, but rather how they *might* behave.

Generally, strong school culture in line with this philosophical foundation can be realised using frequent

training and retraining of the school community, especially teachers and students. But the training should be based upon information about individual stages of concern and levels of program use of teachers (Solomon and Alemayehu, 2007). At the same time, the training usually needs to be organized in schools as supports to the current and largely used strategies of professional development, that is, teachers' peer-assessment and self-reflection.

The relationship between teachers' peer assessment and self reflection in primary schools of Bahir Dar town

Research findings of the current study discloses the fact that there is a strong correlation between primary school teachers peer assessment and self-reflection practiced in Bahir Dar town, which is significant at $\alpha = 0.01$ level in a 2-tailed test. That is, teachers who usually implement self-reflection as a means to justify their teaching are also open to colleague criticism of their teaching practice which is a viable means of developing teachers' competence in managing active learning during the teaching-learning process.

This research further confirmed that there is no difference between the frequency of teachers' practice of self-reflection and peer-assessment done to better implement active learning in their respective classrooms. The critical self-reflection of teachers would be enhanced by peer-observation and reflection. Conducting observations on peer classes and engaging in critical conversations is another important tool in promoting active learning. Discussing events teachers have experienced, and colleagues' description of what has happened benefits the teacher being observed; and at the same time they examine their own experiences and check, reframe, and broaden their own theories of practice (MoE Task Force, 2007).

Other scholars have further suggested that formative peer-assessment, a process in which work collaboratively to assess each others' teaching and to assist one another in efforts to strengthen teaching, be developed and implemented as a supplement to self-reflection in professional development endeavors. Collaborative peer-assessment probably should include opportunities to teachers to learn how to teach more effectively, to practice new teaching techniques and approaches, to get regular feedback on their classroom performance, and to receive coaching from colleagues (Menges, 1985 cited in MoE Task Force, 2007).

Difference in teachers' peer-assessment and self-reflection by experience, gender and age of participants

The results in the current study also indicated the fact

that there is mean frequency difference in teachers' peer-assessment and self-reflection vis-à-vis experience, age and gender of the participants. That is, as teachers' age and teaching experience increase, there is a slight increase in the mean frequency of practicing peer-assessment and self-reflection done for the purpose of justifying their own teaching. Moreover, it is indicated that female teachers out-perform males in terms of frequency of applying peer-assessment and self-reflection during the instructional process as a means to better manage active teaching-learning process.

The results in the current study also indicated the fact that there exists mean differences among teachers teaching experience in using self-assessment and peer-reflection as a way out for easier management of active learning in the instructional process. A stock of research findings suggested in the literature support the current finding. In this line, Marso and Pigge (1994) cited in Solomon and Alemayehu (2007), for example, surveyed approximately 300 pre-service and in-service teachers in various stages of their career. Four career periods were identified: pre-service teachers, teachers with 5-19 years of experience, teachers with 20-29 years of experience, and teachers with 30+ years of teaching. Lower levels of concerns about the task of teaching were reported by pre-service teachers compared to the in-service teachers, though in-service teachers were not significantly different from one another. Late-career teachers did, however, report lower concerns about self-survival than did mid-career teachers. Pre-service teachers also reported significantly lower levels of concern for impact on pupils than in-service teachers, and again the in-service teacher groups were not significantly different from one another. On a similar basis, Fuller (1969) revealed patterns in teacher concerns that correlated with maturity and teaching experience. Of particular importance to this study are findings that show pre-service and beginning teachers have different concerns to experienced teachers, and that pre-service teacher education courses should take cognizance of the characteristics typical of teachers at an initial stage of development.

Some other research findings suggested in the literature, however, contradict the current finding. In this line, a review made into the related literature depicted the fact that one cannot assume that an instructor's years of experience are directly related to the teacher's Developmental stage, as individual teachers move through these stages at different rates. It is also extremely important to recognize that teachers do not pass through these stages independent of the other conditions of one's life. Depending upon changing personal and professional factors, it is likely that the teachers will fluctuate among the stages. For example, if a teacher goes through a major life crisis, such as the death of a parent, it is likely that he or she will drop to a lower developmental stage while coping with this traumatic event. Also, if an experienced teacher moves to a new school district, he or she is likely to begin the first year at a survival stage of

development. Of course, this stage may pass quickly as the teacher draws on past knowledge to begin to function within the new context. However, it is important to recognize that this is likely to occur. A change from a suburban to an urban setting may also result in an experienced teacher moving to a lower stage of development, and as such, they may need assistance with strategies that will help them become successful in this new context (Fullan and Hargreaves, 1996).

Even though some of the available literature about the correlation between the use of self-assessment and peer-reflection with teaching experience uncovered inconsistent relationship, the results in this study, however, revealed the reverse. That is, the mean difference among teachers with different ranges of teaching experience is found to be related to the frequency of using self-reflection and peer-assessment as techniques for effective and efficient implementation of active learning. To see greater magnitude of relationship, however, requires support by continuous and relevant training in schools.

Participants' age may also be related to their teaching experience. It might be as a result of this that teachers' age seems related to the frequency of using peer-assessment and self-reflection. From another point of argument, one can put that our competency in using peer-assessment and self-reflection may be more justified as we get older and older due to the increase of the horizon of our life exposure. Of course, it needs extensive research in the area.

Conclusion

Notwithstanding the government's relentless effort made to bring real change in schools, however, the schools observed showed little improvement in using self-reflection and peer assessment as a tool to manage active learning in the classroom teaching-learning process. But, teachers who employ self-reflection were found better performed in terms of letting colleagues to observe their instructional practice and thereby get relevant feedback that enable them to better facilitate active teaching-learning processes. Though it is a slight difference, it is found out that experience, age, and gender of participants matter their use of those techniques in classroom instructions. The researcher found out strong support in the relevant literature about the effect of experience in using innovations, but the effect of age and gender equivocal, thus these situations require further research to affirm.

RECOMMENDATION

Based on the above concluding remarks, the following points are proposed:

1. Classroom teachers' performance is basically

influenced by different factors that undergo/ interact in the school as well as outside the school setting such as school principals, administrators, colleagues, students, parents, etc/. That is, boosting up teachers' commitment and competence to perform self-reflection and peer assessment depends upon changes made both in school culture as well as the attitudes of people outside the school setting who put significant influence upon schooling practices. Therefore, the Bahir Dar Special Zone Education Office personnel and its attendant education administrators should provide repeated orientations to the above mentioned stakeholders on the value of using peer assessment and self-reflection strategies in fostering active learning in the classroom teaching-learning processes.

2. Individuals' competency of making self-reflection is found to have a strong correlation with their openness for peer-assessment. Therefore, to flourish better peer-assessment among staff members, school principals/ department heads should motivate teachers on individual basis so that they will be highly committed for self-reflection strategy as a way out for better manages active teaching-learning processes.

3. In addition to other criteria, teachers should get promoted to the higher professional ladder mainly on the bases of their valid participation in peer-assessment and self-reflection. It is hoped that considering these performances as criteria for career development boost-up teachers' practice of peer-assessment and self-reflection as tools to increase active learning in the teaching-learning process. To this end, there is a need to have a very orderly documentation of the everyday performance of teachers. This implies that there should be trained personnel in authentic record keeping.

Conflict of Interests

The author have not declared any conflict of interests.

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Full Length Research Paper

Maple (Computer Algebra System) in teaching Pre-Calculus: Example of Absolute Value Function

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Modules in Computer Algebra Systems (CAS) make Mathematics interesting and easy to understand. The present study focused on the implementation of the algebraic, tabular (numerical), and graphical approaches used for the construction of the concept of absolute value function in teaching mathematical content knowledge along with Maple 9. The study group consisted of pre-service teachers attending Department of Primary Education Mathematics teaching at a state university. The pretest (open ended questions) achievement and the posttest (open ended questions) achievement of the group were compared based on their answers. It was concluded that CAS was influential on pre-service teachers' usage of the said learning approaches.

Key words: CAS (Computer Algebra Systems), teaching Pre-Calculus, absolute function.

INTRODUCTION

CAS is a tool aimed at introducing phenomenal, conceptual, procedural knowledge and improving metacognitive knowledge. Traditional approaches emphasize teacher-centered procedural mentality, but alternative approaches encourage more student-centered conceptual mentality and mathematical process (Hiebert; NCTM). Computer Algebra System (Maple) software contribute to in-depth usage of many Mathematics concepts (Algebraic, Numerical and Graphical) (Baki, 2008). Thus, the present study made an attempt to answer the below-mentioned question:

“How does the use of technology (CAS-maple software) in teaching contribute to the Algebraic, Tabular and Graphical representations of absolute value function by

pre-service mathematics teachers?”

When the question “What is the goal of Mathematics course in primary school, middle school and high school?” is asked, the first answer coming to mind is “to prepare for mathematical analysis” through today's constructivist approach, which refers to putting conceptual understanding in the center based on phenomenal knowledge. Mathematical analysis begins with the concepts of equation and function and the search for the ways of combining them with mathematical operations. The concept of function is a dynamic mechanism that represents change and the transformation brought by such change (input-output process). Let's assume that a elementary school teacher or a middle school

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Mathematics teacher who works on the set of numbers says, “ $2+3=5$ ”. Based on the definition, “Given the sets A, B and C that are different from empty set, but can be equal to one another, each function from a subset of $A \times B$ to C is called a binary operation.”, s/he works on a function that takes two elements in \square , and transforms them into 5, a new element, in \square by means of the operator $+$. We can continue it with multiple representations (example, sequences and series). Textbooks cover the concept of function under different titles, such as absolute value functions. The present study was considered significant in that it attempted to provide an outlook on;

1. The improvement of the analytical thinking of pre-service teachers,
2. How pre-service teachers can assess the analytical thinking skills of their students.

The Maple software is used for evaluating and providing the analytical solutions of many Mathematics problems. Some usage areas are as follows:

1. The application of complex mathematical procedures in mathematical analysis,
2. The evaluation and abbreviation of mathematical expressions, and the usage of Algebraic expressions in different ways,
3. Various operations on functional graphs (example, interventions in the movements of objects, two-dimensional and three-dimensional drawings, animations, etc.).

The review of the related literature shows that difficulties regarding the concept of function are addressed under the titles of:

1. Mathematical thoughts existing in the context of conceptual and procedural knowledge (Vinner, 1983; Hiebert and Lefevre, 1986; Harel and Dubinsky, 1992, Baki, 2008), and
2. Multiple representations used for the presentation of the concept (Eisenberg, 1991).

In this regard, the Maple is one of the computer algebra systems that are widely used for symbolic or algebraic use and visualization. In this study, an attempt was made to investigate the effect of Maple 9 on absolute value function and its properties.

The Concept of function and technology

The concept of function is the basis of both General Mathematics and Mathematical Analyses courses (Romberg et al., 1993; Harel and Dubinsky, 1992). It

constitutes the framework of other Mathematics concepts. The ways of thinking applied in search of a mathematical relation involve the expression of a concept or rule by use of verbal, graphical, tabular, or algebraic symbols (Choike, 2000; Radford, 2001). Students select among these mathematical representations when solving the problems. They apply and transform such selection (NCTM 2000). According to Breslich (1928), it is impossible to understand and appreciate Mathematics without the functional thinking that focuses on the relationships between the quantities. There are many studies dealing with functions (Bayazit and Giray, 2004; Baki, 2008, Tuluk and Kaçar, 2007). The concept of function involves many connected concepts. The representations of the function itself and the connected concepts are commutative.

In high school education, the concept of function is constructed based on the principle, “Given the sets A and B , that are different from empty set, but can be equal to one another, the relation f from A to B that matches each element of A with only one element in B is called function from A to B , and is represented as follows: $f : A \rightarrow B$ ” (the definition of Dirichlet-Bourbaki). “ \rightarrow ” shows that these two sets are compared. In addition, it is necessary to know the equation, $y = f(x)$, too. This equation is synonymous with $(x, y) \in f$ or $(x, f(x)) \in f$.

According to that, for each element in A , $f(x)$ image values can be showed with;

1. An arrowed chart.
2. A rule indicating the matching of y with x .
3. Ordered pairs.
4. A table.
5. A graph in an analytical plane (Eisenberg, 1992).

Slavit and Yeidel (1999) states that a teacher needs to establish relationships between functional properties in order to understand the concept of function. For example, 60% of the customers of a store purchased fewer than 5 bags, 30% of them purchased 5 to 10 bags, and 10% of them purchased 10 or more bags. Given that sales are between 100,000 and 200,000, how can you explain this situation algebraically? (Thuy et al., 2008).

$$\begin{aligned}
 &> a:=\text{piecewise}(x \leq 5, 2 * x, 5 < x \text{ and } x \leq 10, 10 + 1.5 * (x - 5), x > 10, 17.5 + (x - 10)); \\
 a &:= \begin{cases} 2x & x \leq 5 \\ 2.5 + 1.5x & 5 < x \text{ and } x \leq 10 \\ 7.5 + x & 10 < x \end{cases}
 \end{aligned}$$

As in the example provided above, it is necessary “to define different subintervals of the domain as separate equations, and to regard each part defined in this way as

a component of the function". In order to improve the conceptual construction of the absolute value function, the function, $f(x) = ax \pm b$ was taken as basis, and the functions $f(x) = |ax \pm b|$, $f(|x|) = |ax| \pm b$, and $|f(|x|)| = ||ax| \pm b|$ were investigated. The absolute value function is a piecewise function. Thus, the object of the task was to examine $|f(x)|$, $f(|x|)$, and $|f(|x|)|$ separately based on $f(x)$. Therefore, it can be said that the concept of absolute value function can improve one's communication, abstraction, logical thinking, and critical thinking skills. The absolute value was developed by Argand (http://en.wikipedia.org/wiki/Jean-Robert_Argand) in the 19th century in order to construct complex numbers in a complex plane (known as the Argand plane). In school Mathematics, learning goals about the absolute value are as follows:

- 1- Identifying the absolute value of a real number and showing it with symbols
- 2- Showing $-|a| \leq a \leq |a|$ for $\forall a \in \mathbb{R}$
- 3- Telling and showing the triangle inequality, $-(|a| + |b|) \leq a + b \leq |a| + |b|$
- 4- Showing $(x, y) \in \mathbb{R}^2$, $|x \cdot y| = |x| \cdot |y|$
- 5- Showing $\left| \frac{x}{y} \right| = \frac{|x|}{|y|}$ for $x, y \in \mathbb{R}$, $y \neq 0$
- 6- Showing $n \in \mathbb{Z}^+ \Rightarrow |x^n| = |x|^n$

In Mathematics, an absolute value or an absolute value function gives the unsigned numerical value of a real number. For instance, $|3|$; $|3| = 3$ and $|-3| = 3$. In computers, the mathematical function which is used for expressing this function is generally `abs(...)`

```
> abs(-3);abs(3);
3 3
```

Performing operations about absolute value involves;

- 1- Solving the first-degree equations including only a single term with absolute value in the set of real numbers, and showing solution sets on a numerical axis
- 2- Solving the first-degree equations including only one unknown and a single term with absolute value in the sets of natural numbers, integers, rational numbers, and real numbers, and showing solution sets on a numerical axis.

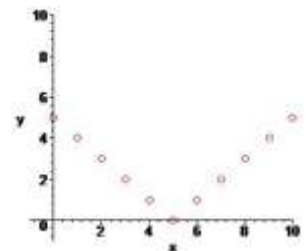
The learning goals regarding the concept of absolute

value function are as follows:

1. Identifying the domain, range, and image set of a function.
2. Identifying the graph of a function.

For mathematical analysis, it is important that pre-service teachers explore the works and discoveries on content knowledge and pedagogical content knowledge concerning the absolute value function as well as the symbols and the roles of such symbols in mathematical interaction. The concept of absolute value is the basis of many mathematical subjects such as series, sequences, convergence, divergence, limit, derivative, etc. (Şandır et al., 2002). After the pre-test was conducted, the concept of function was introduced, and first-degree equations and functions were covered. The difference between linear equations and absolute value equations was highlighted. The lesson on the absolute value started with the question, "place the natural numbers whose sum and difference are 5 in the coordinate plane". Since the pre-service had generally the experiences of hurrying, finding two points in graphic drawings, and drawing the curve in high schools and middle schools, the present study attempted to improve their experiences in thinking about ordered pairs and placing such ordered pairs in the coordinate plane.

```
> restart;with(plots):
a:=plot(0,x=-10..10,y=-10..10):
b:=pointplot({[4,1],[1,4],[2,3],
[3,2],[0,5],[5,0],[6,1],[7,2],
[8,3],[9,4],[10,5]}):display(a,b);
or
>pointplot({[4,1],[1,4],[2,3],
[3,2],[0,5],[5,0],[6,1],[7,2],
[8,3],[9,4],[10,5]},color=red);
```



In the analytic plane, the points were discussed and put on the worksheet. They formed a line segment and straight lines. Thus, it became possible to obtain the equations of such straight lines. It was observed that the pre-service teachers were unwilling to place the points given as ordered pairs in the coordinate plane (Knuth, 2000; Leinhardt et al., 1990; Van Dyke and White, 2004), and had difficulty calculating and writing (algebraic – analytical context) the equation of the straight lines based on such points. In the treatment of the equation as a function, the following algebraic process was examined:

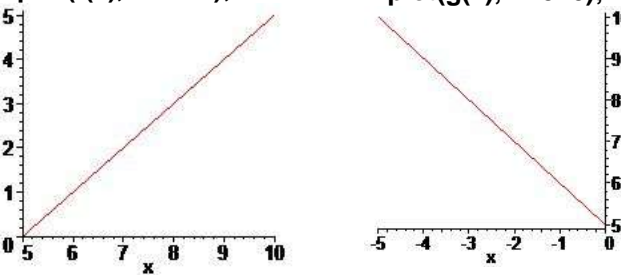
```
> with(student):
f:=makeproc([5,0],[10,5]);
f:=x -> x - 5
```

```
> with(student):
f:=makeproc([5,0],[0,5]);
f:=x -> -x + 5
```

```

> restart:with(plots):f:=x->x-5; > g:=x->-x+5;
f := x → x - 5                    g := x → -x + 5
> plot(f(x),x=5..10);              > plot(g(x),x=-5..0);

```



The determination of the domain and the range failed to attract the attention of the pre-service teachers. In addition, it was difficult to create willingness for changes (example, $x=5.0$, $x=-5.5$). It was seen that the pre-service teachers watched the computer like a television screen or a presentation screen on which only the lesson would be taught, but no operation would be performed. That may have resulted from the habits of the pre-service teachers regarding representing functions via charts or writing only a couple of ordered pairs and revealing a curve (it can be a straight line, too) in the plane. Inexperience in writing notations via Computer Algebra Systems may have caused that. However, it is thought that awareness should be raised among the pre-service teachers that computer is a writing and calculating tool on whose screen data are entered and operations are performed, and the pre-service teachers should be encouraged for making use of the writing and reading functionality of computer. Following the above-mentioned examinations, the representation of piecewise function was focused on in the algebraic expression of the function.

```

> h:=piecewise(x>5,x-5,x=5,0,x<5,-x+5);
h := {
  x - 5    5 < x
  0        x = 5
 -x + 5    x < 5

```

The pre-service teachers were requested to deal with the ordered pairs again and pay attention to the instructional need.

```

> for x from 5 to 10 do > for x from -5 to 0 do
print (x, f(x)) od;    print (x,g(x)) od;
5, 0                   -5, 10
6, 1                   -4, 9
7, 2                   -3, 8
8, 3                   -2, 7
9, 4                   -1, 6
10, 5                  0, 5

```

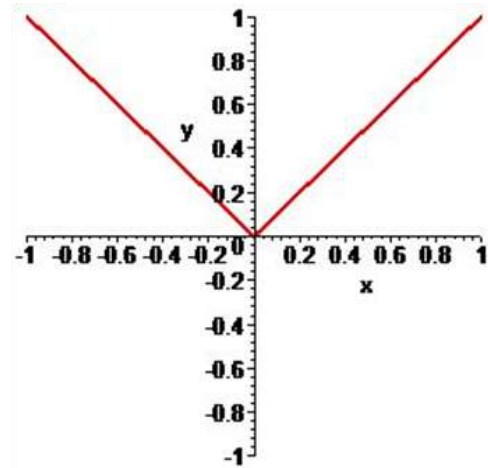


Figure 1. The definition of $|x|$

With the above-mentioned commands, it was started to develop an understanding on the how the table came up and how the said ordered pairs determined the graph. Domain and range were worked on. The acquisition of a function as a real-value and single-variable function was discussed. The piecewise function was proceeded to. Graphs were drawn for two straight lines separately. Then such two graphs were turned into a single graph. In addition, representation was focused on. It was indicated that for making out the equation, the geometric approach could be used

```

> with(Student[Precalculus]);
> Line([5,0], 1)[1];
y = x - 5

```

```

> Line([0,5], -1)[1];
y = -x + 5

```

Or (veya)

```

> with(geometry):point(A,5,0),point(B,6,1);
> line(l,[A,B]);Equation(l,[x,y]);
l 5 - x + y = 0

```

Different representations (example, the one provided above) could be employed through computer algebra systems.

```

> f:=x->abs(x);
plot(f(x),x=-1..1,y=-1..1,thickness=3);
f := x → |x|

```

In the graph (Figure 1), based on the definition of $|x|$, the absolute value function, f should be included in the

Pretest sample answers

$$1) f(x) = \begin{cases} x > 0, & x > 1 \\ 0, & x = 1 \\ x < 0, & x < 1 \end{cases}$$

$|f(x)| = \begin{cases} 2x-1 > 0 \Rightarrow 2x > 1 & x > 1 \\ 2x-1 < 0 \Rightarrow 2x < 1 & x < 1 \\ 2x-1 = 0 \Rightarrow 2x = 1 & x = 0.5 \end{cases}$

Bu fonksiyona mutlak değeri dışında fonksiyon denir.
 Mutlak değeri dışında fonksiyon denir.

Posttest sample answers

$$|a| = \begin{cases} -a, & a < 0 \\ 0, & a = 0 \\ a, & a > 0 \end{cases}$$

mutlak değer tanımına göre yandaki fonksiyonları parçalı biçimde yazabiliriz.

$$f(x) = \begin{cases} 2x-2, & x > 1 \\ 0, & x = 1 \\ -2x+2, & x < 1 \end{cases}$$

x=1 noktası fonksiyonun kırık noktasıdır. Bu noktaya göre fonksiyon parçalı şekilde yazılır.

Figure 2. Pretest and post test achievement scores

expression through the definition, $f(x) = \begin{cases} x, & x > 0 \\ 0, & x = 0 \\ -x, & x < 0 \end{cases}$.

Attention was drawn to algebraic representation, that is, how to write an equation.

In this expression which is a piecewise function, it should be emphasized that in the plane, $\square x \square$, the union $[OA \cup [OB$ of the half-lines, $\{OA = \{(x, y) : y = x, x > 0\}$ and $\{OB = \{(x, y) : y = -x, x \leq 0\}$ should be interpreted geometrically based on the following construction: "it is a curve, but looks like a wide V letter or a broken line". Since $y = f(x) = |x|$ is not addressed as a function, less attention is paid to $f : \square \rightarrow 0 \cup \square^+$ in terms of domains and ranges. Verbally, that should not require leaving out, in terms of geometric representation, the interpretation that the graph of $y = f(x) = |x|$ consists of the half of the straight line, $y = f(x) = x$ and the left half of the straight line, $y = f(x) = -x$, as showed in the Figure 2. Most of the pre-service teachers made such explanations in the pre-test. In Mathematics lessons, the outlooks of pre-service teachers on subjects should be strengthened in terms of different representations. That should be taken into consideration while covering the concept of relation in algebra courses. That is reinforced by the Maple as the following:

> **f:=x->piecewise(x>0,x,x=0,0,x<0,-x);**
 $f := x \rightarrow \text{piecewise}(0 < x, x, x = 0, 0, x < 0, -x)$

> **f:=piecewise(x>0,x,x=0,0,x<0,-x);**
 $f := \begin{cases} x & 0 < x \\ 0 & x = 0 \\ -x & x < 0 \end{cases}$

The function is symmetric in view of the axis y (straight line of symmetry). It is associated with reflection in secondary education. The symmetry is based on the axis y . Since $f(x) = f(-x)$ for $f(x) = |x|$, f is the even function. Thus, its standing as an even function should be stressed. The origin (0,0) is an intersection point of the function. It is a critical point. The derivative of an absolute value function reveals that it must be treated as a piecewise function, and must be constructed very well due to the whole angle coming into existence at 0. The primary concept needed for mathematical analysis is function. This is because we cannot initiate an analysis, or we have difficulty initiating it without understanding it. If a student studying in the field of sciences starts mathematical analysis without understanding this concept, s/he may have difficulty in understanding other subsequent concepts and even other mathematical objects (Schwarzenberger, 1980; Tall, 1992).

In the later 17th century, Leibniz became the first mathematician who used the notation of function in his

Table 1. Question 1- In-group comparison of the algebraic representations of the function, $f(x) = |2x - 2|$ (pretest-posttest).

MD-C	\bar{X}	df	t	P
Pretest	1.96	25	-2.601	0.015
Posttest	2.42			

writings in order to explain a varying y value depending on the x variable (Tall, 1997). The concept was presented with a specific formula and the general use of $y = f(x)$ in the following centuries. The review of the related literature shows that teachers turn to conceptually understanding various Mathematics concepts via alternative approaches without losing basic procedural skills (Hiebert, 2003; Hiebert and Wearne, 1996; Kamii and Joseph, 1989; Wood and Sellers, 1996). Moreover, the process standards suggested by NCTM (problem-solving, reasoning and proving, interaction) are more careful than those provided by traditional approaches (Hiebert, 1986, 2003; NCTM, 2000). The pre-service teachers were not interested in tabular representation and algebraic representation in the first graphical drawing. The absolute value function is a function that must be written algebraically, that is, as a piecewise function. 3 students solved the equation, $2x - 2 = 0$, and showed that the point, $x = 1$ was the critical point. Since they were the pre-service teachers studying in the department of Mathematics, they did not employ tabular representation. In addition, they did not think that there was a need to determine the domain and the range of the function. In the pre-test, none of 26 students emphasized that the domain and range of the function should be determined.

Thus, with the question, “place the natural numbers whose sum and difference are 5 in the coordinate plane” at the beginning of the lesson, the determination of the points, the extension of a straight line on two points, the acquisition of the equation of the straight line, and the absolute value function (on the arising graph) were worked on. In this way, the absolute function was included in the equations of straight lines on the points, and thus the expression of a piecewise function.

METHODOLOGY

The research participants were 2nd grade prospective teachers attending a state university located in the Western Black Sea Region of Turkey in the fall semester of the 2012 to 2013 academic year. None of the pre-service teachers participating in the study had experienced a learning environment where they had faced any CAS software or graphing calculator in textbooks or other printed sources beforehand. None of them had used any graphing calculator, CAS, or dynamic graph calculator (DGS). Furthermore, it

was seen that the students did not have much knowledge and ability to write math signs on computer.

Many Mathematics educators expect students to employ tabular (numerical), algebraic, and graphical approaches and move between such representations flexibly so that they can understand the subject of function (NCTM, 2000). Before the study began, three open ended questions, as part of pre-test, were addressed to the pre-service teachers. The questions were taken from Monaghan and Özmantar (2007) on abstraction. The researcher gave the function of $f(x) = 2x - 2$, and examined how the pre-service teachers dealt with the functions of $|f(x)|$, $f(|x|)$ and $|f(|x|)$. Then

the pre-service teachers studied in the computer laboratory for 4 course hours in order to learn how to use Maple 9. After that, the lessons were launched. The study was carried out by the researcher in the computer laboratory in 4 course hours for 2 weeks. The post-test was administered to the pre-service teachers at the end of 4 course hours. In the present study, absolute value function was examined in terms of:

1. MDF-C: algebraic (symbolic) interpretation (domains and ranges, the solution of equation)
2. MDF-T: tabular interpretation
3. MDF-G: the graphic drawing of function. By integrating technological knowledge into pedagogical content knowledge.

The answers of the pre-service teachers to the questions were charted. Based on the research of Weber (2008), the chart coded the answers of the pre-service teachers as follows:

- 1- Correct (pre-service teacher made explanations by indicating the necessary information – capability to make proper mathematical explanations),
- 2- Deficiency in resorting to the knowledge (pre-service teacher made some correct explanations without displaying the necessary information),
- 1- No comment (explanation)
- 0- Incorrect.

Research design

When the same subjects are measured by a dependent variable before and after quasi-experimental process, the subjects are exposed to repeated temporal measurements, and the obtained results are interrelated. It is called repeated measures design. It is an in-group and one-factor design (Büyükoztürk, 2001).

FINDINGS

According to Table 1, there was a significant difference ($t(25) = -2.601$ $p < .015$) between the pretest and posttest achievement scores of the pre-service teachers learning via CAS (Maple 9 software) in the algebraic expression of the absolute value function ($f(x) = |2x - 2|$). Thus, it was understood that the CAS was influential on the algebraic expression of the absolute value function. As shown in Figure 2.

According to Table 2, there was a significant difference ($t(25) = -12.810$, $p < .000$) between the pretest and posttest achievement scores of the pre-service teachers learning via CAS (Maple 9 software) in the tabular expression of

Table 2. Question 2- In-group comparison of the tabular representations of the function, $f(x) = |2x - 2|$ (pretest-posttest).

MD-T	\bar{X}	df	t	P
Pretest	1.19	25	-12.810	.000
Posttest	2.65			

Table 3. Question 3- In-group comparison of the graphical representations of the function, $f(x) = |2x - 2|$ (pretest-posttest).

MD-G	\bar{X}	df	t	P
Pretest	2.69	25	-1.806	0.083
Posttest	2.92			

Table 4. In-group comparison of the algebraic representations of the function, $f(x) = 2|x| - 2$ (pretest-posttest).

MD- C	\bar{X}	df	t	P
Pretest	1.46	25	-2.206	0.037
Posttest	1.92			

the absolute value function ($f(x) = |2x - 2|$). Thus, it was understood that the CAS was influential on the tabular expression of the absolute value function. As shown in Figure 3

According to Table 3, there was no significant difference ($t(25) = -1.806$, $p < .083$) between the pretest and posttest achievement scores of the pre-service teachers learning via CAS (Maple 9 software) in the graphical expression of the absolute value function ($f(x) = |2x - 2|$).

Thus, it was understood that the CAS was not influential on the graphical expression of the absolute value function. Although, most of the pre-service teachers had a concept image for graphical drawing, they had difficulties in algebraic and tabular expressions. CAS helped them in that matter.

According to Table 4, there was a significant difference ($t(25) = -2.573$, $p < .016$) between the pretest and posttest achievement scores of the pre-service teachers learning via CAS (Maple 9 software) in the algebraic expression of the absolute value function ($f(x) = 2|x| - 2$). Thus, it was understood that the CAS was influential on the algebraic expression of the absolute value function. As shown in

Table 5. In-group comparison of the tabular representations of the function, $f(x) = 2|x| - 2$ (pretest-posttest).

MD-T	\bar{X}	df	t	P
Pretest	1.81	25	-2.379	0.025
Posttest	2.27			

Table 6. In-group comparison of the graphic representations of the function, $f(x) = 2|x| - 2$ (pretest-posttest).

MD-G	\bar{X}	df	t	P
Pretest	2.15	25	-3.143	0.004
Posttest	2.85			

Figure 4.

According to Table 5, there was a significant difference ($t(25) = -2.379$, $p < .025$) between the pretest and posttest achievement scores of the pre-service teachers learning via CAS (Maple 9 software) in the tabular expression of the absolute value function ($f(x) = |2x - 2|$). Thus, it was understood that the CAS was influential on the tabular expression of the absolute value function. As shown in Figure 5. For example, lack of algebraic and tabular interpretation in the pretest caused a failure in writing that the graphical drawing consisted of two separate equations.

For example, lack of algebraic and tabular interpretation in the pretest caused a failure in writing that the graphical drawing consisted of two separate equations.

According to Table 6, there was a significant difference ($t(25) = -3.143$, $p < .004$) between the pretest and posttest achievement scores of the pre-service teachers learning via CAS (Maple 9 software) in the graphical expression of the absolute value function ($f(x) = |2x - 2|$). Thus, it was understood that the CAS was influential on the graphic expression of the absolute value function. As shown in Figure 6.

While most of the pre-service teachers were successful in solving algebraic equations, they had difficulty in drawing the graphs of such equations (as a straight line). That was more apparent in the case of absolute value function. In high school mathematics, the equation presented with the rule, $y = ax \pm b$ is drawn in the coordinate system by finding two points providing it. However, an understanding should be developed on not only drawing a straight line by finding two points but also directions from southwest to northeast and from northwest to southeast.

Pretest sample answers

1) $|f(x)|$ mutlak içinde parantez olması $|f(x)|$ in sonuçunun $2|x-2|$ olduğundan büyük olduğu anlamına gelir. $f(x)$ değeri $2|x-2|$ ile eşit olurken x 'e verilen tüm değerler (negatif veya pozitif) tüm değerler için $2|x-2|$ olduğundan büyüktür.

$2|x-2| \rightarrow 2x-2 \geq 0$

$2x-2=0$

$x=1$

$x > 1$

Posttest sample answers

1-) $|f(x)| = |2x-2|$
 $|f(x)| = |2(x-1)| = 2|x-1|$

$x-1=0$
 $x=1$

x	$-\infty$	$+$	$+\infty$
$f(x)$	$-$	$ $	$+$

$x=0$ için $y=2$
 $x=1$ için $y=0$
 $x=-1$ için $y=4$
 $x=2$ için $y=2$
 $x=-2$ için $y=6$

Figure 3. Difference between the pretest and posttest achievement scores of the pre-service teachers learning via CAS

Pretest sample answers

2- $f(|x|) = 2|x|-2$

$f(|x|) = 2|x|-2$

$2x-2=0$
 $2x=2$
 $x=1$
 $x=-1$

x değeri 1 'dir ya da -1 'dir. 0 değeri dikkate alınmaz.

2) $f(|x|) = 2|x|-2 > 0$

$2|x| > 2$
 $|x| > 1$
 $x > 1$

$2|x|-2 > 0$
 $2|x| > 2$
 $|x| > 1$ $-x < -1$
 $x < -1$

3-) $|f(x)| \rightarrow$

Posttest sample answers

2) $f(|x|) = 2|x|-2$

$f(x) = \begin{cases} 2x-2, & x > 0 \\ -2, & x=0 \\ -2x-2, & x < 0 \end{cases}$

$x=0$ noktası fonksiyonun kritik noktasıdır. Fonksiyon bu noktaya göre parçalı fonksiyon şeklinde yazılır.

2-) $f(|x|) = 2|x|-2$

$2|x|-2 = \begin{cases} 2x-2, & x > 0 \text{ ise} \\ -2, & x=0 \text{ ise} \\ -2x-2, & x < 0 \text{ ise} \end{cases}$

Burada $|x|$ 'in içinde x 'in sıfırdan büyük değerleri için fonksiyon $2x-2$ olur, x 'in 0 değeri için fonksiyonun değeri -2 olur, x 'in sıfırdan küçük değerleri için fonksiyon $-2x-2$ olur.

Figure 4. Algebraic expression of the absolute value function.

Table 7. In-group comparison of the algebraic representations of the function, $f(x) = 2|x|-2$ (pretest-posttest).

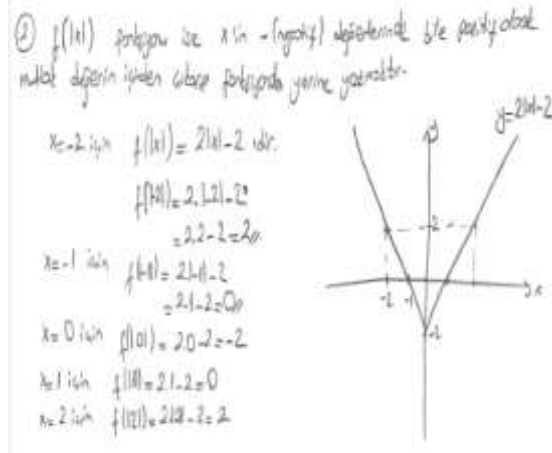
MD- C	\bar{X}	df	t	P
Pretest	1.31	25	-2,184	,039
Posttest	1.69			

According to Table 7, there was a significant difference ($t(25)=-2.184, p<.039$) between the pretest and posttest

achievement scores of the pre-service teachers learning via CAS (Maple 9 software) in the algebraic expression of the absolute value function ($f(x)=|2|x|-2|$). Thus, it was understood that the CAS was influential on the algebraic expression of the absolute value function. As shown in Figure 7.

According to Table 8, there was no significant difference ($t(25)=-1.690, p<.103$) between the pretest and posttest achievement scores of the pre-service teachers learning via CAS (Maple 9 software) in the tabular expression of the absolute value function ($f(x)=|2|x|-2|$).

Pretest sample answers



Posttest sample answers

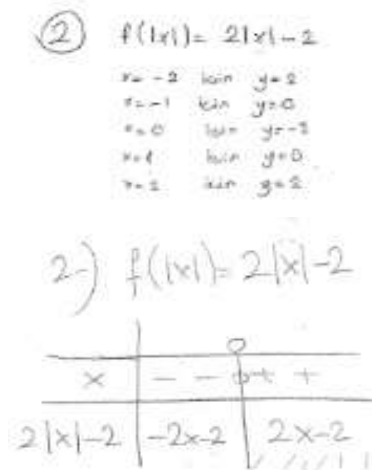
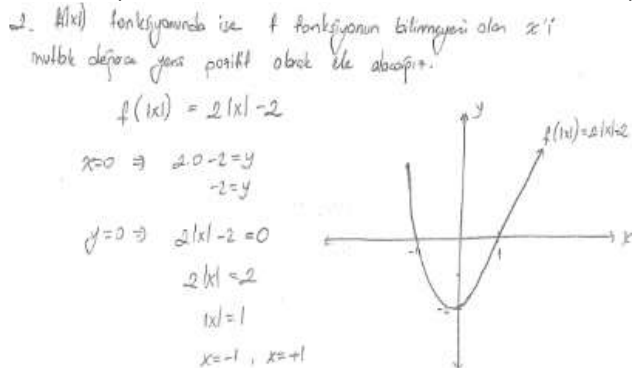


Figure 5. CAS influential on the tabular expression of the absolute value function.

Pretest sample answers



Posttest sample answers

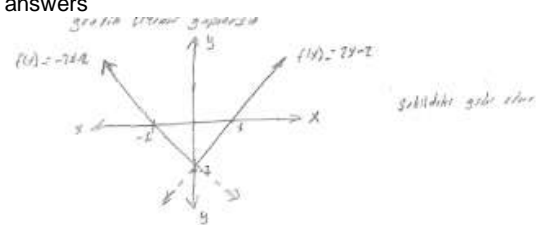


Figure 6. CAS was influential on the graphic expression of the absolute value function.

Table 8. In-group comparison of the tabular representations of the function, $f(x) = |2|x| - 2|$ (pretest-posttest).

MD-T	\bar{X}	df	t	P
Pretest	1.62			
Posttest	1.92	25	-1.690	.103

Thus, it was understood that the CAS was not influential on the algebraic expression of the absolute value function.

According to Table 9, there was a significant difference ($t(25) = -2.961, p < .007$) between the pretest and posttest achievement scores of the pre-service teachers learning via CAS (Maple 9 software) in the graphical expression of the absolute value function ($f(x) = |2|x| - 2|$). Thus, it was

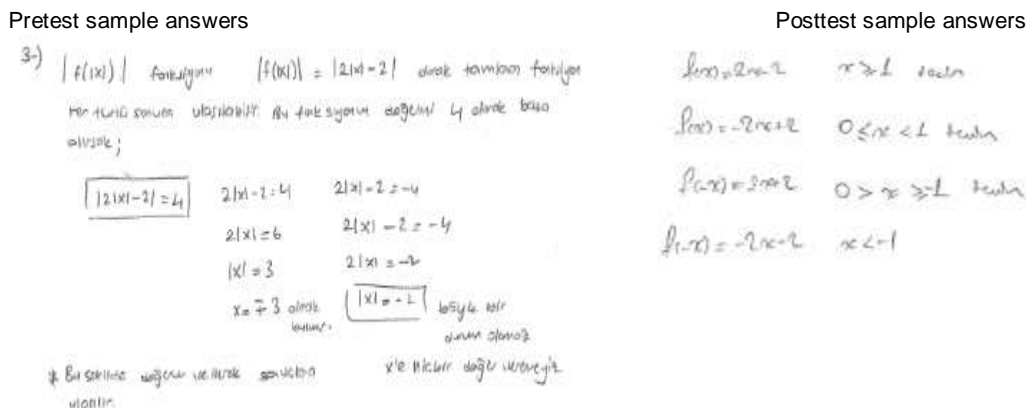


Figure 7. CAS was influential on the algebraic expression of the absolute value function.

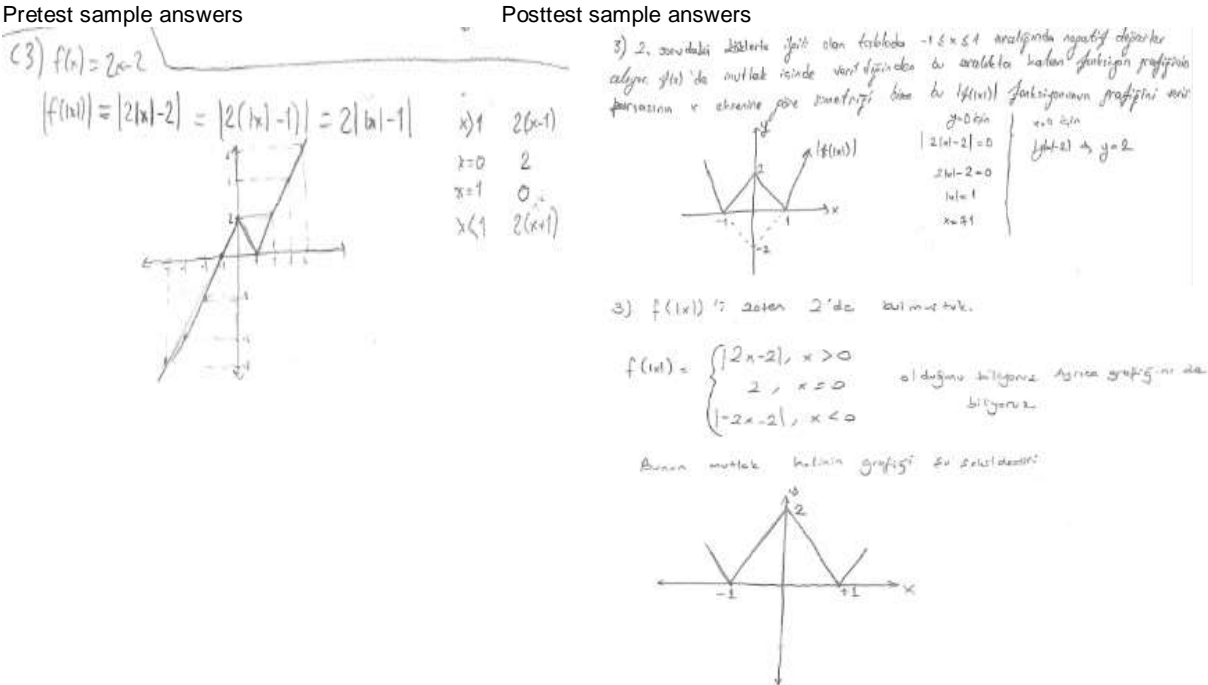


Figure 8. CAS was influential on the graphical expression of the absolute value function.

Table 9. In-group comparison of the graphic representations of the function, $f(x) = |2|x|-2|$ (pretest-posttest).

MD- C	\bar{X}	df	t	P
Pretest	1.92	25	-2.961	.007
Posttest	2.62			

Figure 8.

CONCLUSION

In the study conducted by Even (1998) with 152 university students, it was found out that 14% of the students succeeded in establishing associations between the algebraic and graphical representations of functions. This study made an attempt to bring forward a solution, via CAS, for the difficulty in expressing the absolute value function algebraically, tabularly and graphically. Functions

understood that the CAS was influential on the graphical expression of the absolute value function. As shown in

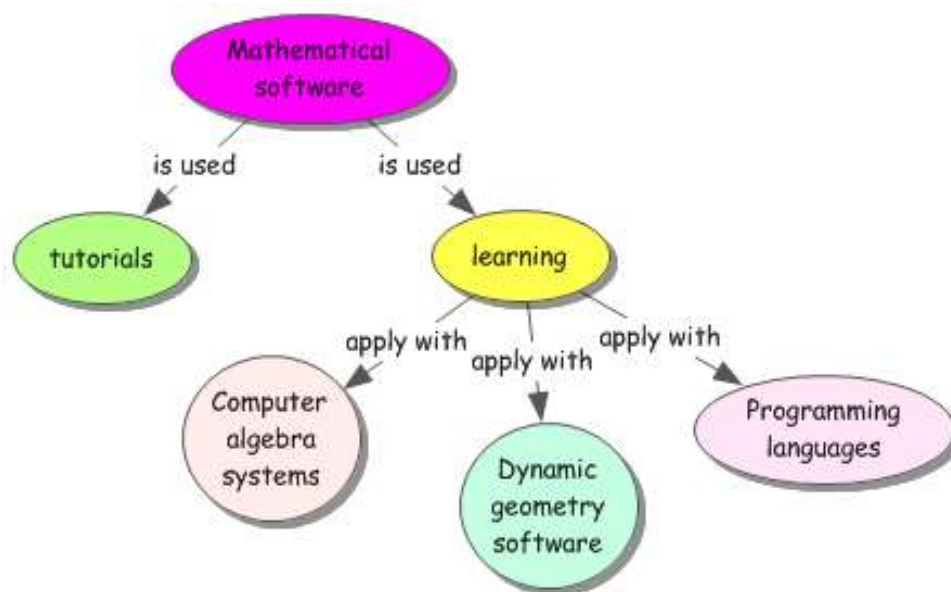


Figure 9. Analysis and General Mathematics courses supported by software fit.

can be examined in many ways including formulas, graphs, ordered pairs, arrow diagrams, tables, etc. (Eisenberg, 1992). That confronted us as a difficulty in the algebraic, tabular, and graphic representations of the function, $|f(x) \pm a|$ (Vinner, 1983, Leinhardt et al., 1990). The pre-service teachers had difficulty in the graphical representation of the piecewise functions composed of curves and straight lines. CAS software can be helpful in this matter. In general, function is regarded as a formula (Graham and Ferrini-Mundy, 1990). That makes it difficult to acquire the concept (Eisenberg, 1991). A large majority of students consider the function an arithmetic or algebraic rule (Vinner, 1983; Sfard, 1992). CAS software may be helpful in the case of the absolute value function, too. General Mathematics courses can be treated as part of preparation for courses on mathematical analysis. The structures of such courses and the use of technology in the conduct of these courses need to be researched and discussed in Turkey. Analysis and General Mathematics courses can be supported by software fit for the purpose, as indicated in the Figure 9.

The present study showed that the pre-service teachers' learning of the absolute value function was improved by interactive software (example, Maple). It is evident that educators should employ such software besides traditional approaches.

Conflict of Interests

The author have not declared any conflict of interests.

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Full Length Research Paper

Assessing model data fit of unidimensional item response theory models in simulated data

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The pupose of this paper is to give an example of how to assess the model-data fit of unidimensinal IRT models in simulated data. Also, the present research aims to explain the importance of fit and the consequences of misfit by using simulated data sets. Responses of 1000 examinees to a dichotomously scoring 20 item test were simulated with 25 replications. Also, data were simulated to fit the 2-PL model. 4-step procedure has been used for model-data fit and BILOG was used as software. Results were discussed in the frame of the literature.

Key words: Item response theory, unidimensionalty, model-data fit, invariance.

INTRODUCTION

Researchers in the field of educational assessment are continually developing new approaches to improve the efficiency of assessments. They are often concerned with methodologies that can extract the most useful and accurate information from students' responses to test items (Wu and Adams, 2006). With the help of improved mathematical models and computer technologies, new theories have been developing in the field of educational and psychological assessment.

In the measurement history, the leading theory to explain latent trait underlying exaimee's test performance is Classical Test Theory (CTT). CTT is a simple model which states that the observed score on a test is the sum of the true score and measurement error. CTT is based on weak assumptions, that is, the assumptions can be met easily by most data sets, and therefore, the models can and have been applied to a wide variety of test

development and test score analysis problems (Hambleton and Swaminathan, 1989). Group dependency of test and item characteristics, providing information about examinee performance from whole test and having no information about examinee's performance on a single test item are crucial shortcomings of CTT (Hambleton et al., 1991). In psychometrics, CTT was the dominant statistical approach to testing data until Lord and Novick (1968) placed it in context with several other statistical theories of mental test scores, notably item response theory (IRT) (Sijtsma and Junker, 2006; Seungho-Yang, 2007).

One of the most imortant improvements the last century is IRT, also known as latent trait theory, in psychological measurement. IRT is a modern test theory which explains examinee's ability level by using responses to test items with strong assumptions against CTT's weak assumptions

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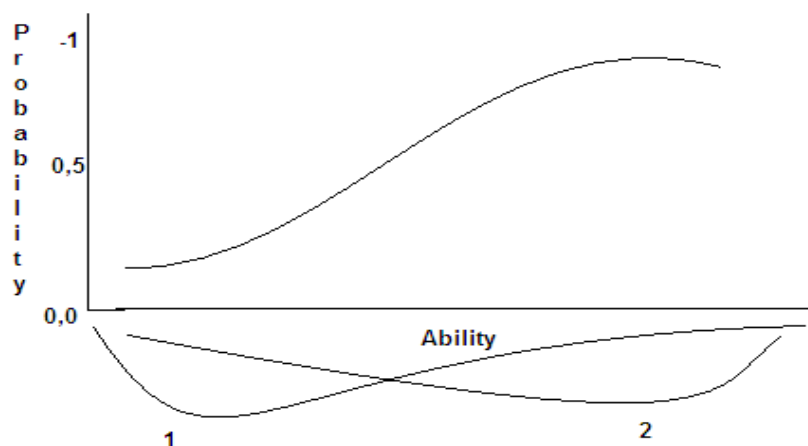


Figure 1. An item characteristic curve and Distributions of ability for two groups of examinees

with mathematical models (Bobcock, 2009). According to Embretson and Reise (2000), IRT is a “modern” test theory utilizing a set of propositions or mathematical models related to individuals’ responses to items, providing a probabilistic way of linking observable data to theoretical constructs, with the ability to statistically adjust scores for properties of test items such as difficulty, discriminating power, and liability to guessing.

The origin of IRT can be traced to the efforts of Thurstone (1925; cited in Bock et al., 1997) and others to scale the tasks that made up the Binet test of intelligence. The objective of their work was the criterion of quantitative scales, not unlike those of physical science, on which the strength of a trait could be expressed. From this beginning, developments have continued to focus on the measurement of psychological constructs assumed to underlie persisting individual differences in behaviour (Bock et al., 1997).

Item response theory (IRT) makes a sharp distinction between the observable scores of a respondent on a set of items and the scale on which the unobservable psychological construct is measured. The construct can be a personality trait, a cognitive ability, an educational achievement, an attitude, or an opinion, in short, a latent trait. Typical of IRT measurement is that interest almost always lies with the respondent’s position on the latent trait scale to be denoted theta (θ) (Sijtsma and Hemker, 2000).

IRT has a number of advantages over CTT methods. The most important advantages of IRT are placing the ability of the respondent and the difficulty of the item on the same measurement scale (Spencer, 2004). Additionally, the estimated item parameters are invariant with regard to who is sampled from the population, the estimated proficiency level remains constant regardless of which items are administered and also IRT can

estimate examinee ability with more precision of measurement and less measurement errors (Lee, 2007). CTT statistics such as item difficulty, item discrimination and reliability are contingent on the sample of respondents to whom the questions were administered. In addition, CTT yields only a single estimate of reliability and corresponding standard error of measurement, whereas IRT models measure scale precision across the underlying latent variable being measured by the instrument (Cooke and Michie, 1997).

The property of invariance of item and ability parameters is the cornerstone of IRT and its major distinction from classical test theory. This property implies that the parameters that characterize an item do not depend on the ability distribution of the examinees and the parameter that characterizes an examinee does not depend on the set of test items.

When an IRT model fits the test data of interest, several desirable features are obtained. Ability estimates obtained from different sets of items will be the same (except for measurement errors). In IRT, item and ability parameters are said to be invariant. Figure 1 shows distributions of ability for two groups of examinees. Examinees of the same ability have the same probability of giving a correct response to the item, regardless of whether they are from Group 1 or Group 2 (Hambleton et al., 1991). In other words, if you pick different samples and estimate the item characteristic curves (ICC), you should get the similar values of a , b and c , that is you get same ICC (Drasgow, 1982). The property of invariance is only present when the IRT model fits the test data, and when model parameters are estimated properly (Hambleton et al., 1991). The property of invariance or item free measurement and sample free measurement allows for generalization beyond the specific test (Kreiter, 1993). The invariant property of IRT makes it possible to solve

problems in measurement and testing that are difficult to solve in CTT, namely test equating, item banking, item bias, and the use of computer adaptive testing-CAT (Hambleton et al., 1991).

A variety of IRT models have been developed for dichotomous and polytomous data. The most commonly used models for dichotomous items are the logistic models (e.g. two parameter model and three parameter model). Samejima's graded response model is applied to polytomous data, where options are ordered along continuum (e.g. likert scales). The early IRT applications involved primarily unidimensional IRT models. However, several multidimensional IRT models have been developed. These models usually are direct extensions of unidimensional models (Liu, 2007).

Before one uses any statistical model for any purpose, it is obviously necessary to insure the model chosen is appropriate for the data (Kingston and Stocking, 1986). Statistical models, such as item response theory, are based on assumptions. There are three assumptions of the most commonly used IRT models: unidimensionality, local independence and particular shape of the item response function.

A common assumption of IRT models is that only one ability is measured by a set of items in a test. What is required for the unidimensionality assumption to be met adequately by a set of test data is the presence of a "dominant" component or factor that influences test performance. This dominant component or factor is referred to as the ability measured by the test (Hambleton et al., 1991). Any violation of this assumption would result in inadequacy of the model in describing the data and hence unreliable estimation of the examinee's ability. Therefore, the correct specification of the number of the latent dimensions is directly tied to the construct validity of the test (Sheng, 2005).

Local independence, which is the second assumption, means that the response of an individual to an item from the test is not influenced by his or her responses to the other items that the same test or by other traits that theta (Sijtsma and Hemker, 2000). This assumption is necessary in IRT to assure the independence of items and hence their multiplicative property when ascertaining likely abilities for response patterns (Pomplun, 1988). According to McDonald (1982), a theory of unidimensionality should be based on the assumption of local independence.

The third assumption of IRT is item characteristic curve (ICC). An ICC is defined completely when its general mathematical form is specified and when the parameters of the curve are chosen. In current popular IRT models the general form is a cumulative logistic ogive. The current popular models differ on the number of parameters for the curve (Pomplun, 1988).

Once an IRT model has been applied to a set of data, its appropriateness should be investigated with data-model

fit analysis. Otherwise, the researcher is under the risk of drawing incorrect conclusions regarding the scientific problem of interest. Substantial lack of fit should result in the replacement or extension of the model if possible (Sinharay, 2005). Traditional methods are most widely used to assess model fit; especially, the likelihood ratio chi-square goodness of fit statistics and these are provided in the most popular current software packages, such as BILOG, BILOG-MG and PARSCALE (Zhao, 2008). The most common criticism about the chi-square likelihood statistics is that they are sensitive to sample size (Hambleton and Swaminathan, 1989). When the sample size is large, the statistical test rejects just about every model since with large sample sizes (Zhao, 2008).

The assessment of data-model fit is important because the application of an IRT model can be justified only when data fit the model. The most general approach for assessing model-data fit of IRT models is to compare an observed score distribution with an expected score response distribution across discrete ability levels for each item (Seungho-Yang, 2007; Kreiter, 1993; Dodeen, 2004).

In IRT models, various approaches were suggested for investigating model-data fit (Glass and Falcon, 2003; Hambleton, 1994; Stone, 2000; Stone and Zhang, 2003; Sinharay, 2005; Yen, 1981). These studies summarize the discrepancy between observed values and the values expected under an IRT model.

Zhao (2008) has recommended that judgments about the fit of the model to the test data be based on four steps of evidence:

1. Choosing software and initial classical analysis,
2. Checking basic assumptions of unidimensionality and local independence,
3. Assessing model data fit,
4. Checking model parameter invariance; item parameters invariance and ability parameter invariance.

The purpose of this article is to assess the goodness of fit of unidimensional IRT models in simulated data. In many IRT applications model data fit have not been investigated adequately. As a result, less is known about the appropriateness of particular IRT models. This study aims to give an example how to evaluate model-data fit, explain the importance of model-data fit and the consequences of misfit.

METHODS

This study was conducted based on a simulated data set. There are two major steps in the simulation; data generation and data calibration. A computer program WINGEN was used to simulate the item response data. Responses of 1000 examinees to a dichotomously scoring 20 item test were simulated with 25 replications. Also, data were simulated to fit the 2-PL model.

Data were simulated to have two normally distributed levels of item discrimination (a) and item difficulty (b). The person's ability (θ)

Table 1. Estimated item parameters for simulated data.

	a	b		a	b
1	-1,925	0,115	11	1,757	-2,481
2	1,124	-0,403	12	0,690	1,399
3	0,473	0,016	13	0,359	-0,916
4	-0,135	-0,447	14	0,203	0,447
5	1,074	-0,863	15	-1,479	-0,672
6	0,295	0,091	16	-0,755	-0,334
7	0,334	-1,843	17	0,550	0,462
8	1,711	-0,375	18	0,558	0,412
9	0,659	-0,200	19	0,293	0,002
10	0,210	-3,220	20	-0,170	-1,540

was simulated to be normally distributed with a mean of 0 and a standard deviation of 1. Next, 2PL model was used to calibrate model parameters. Table 1 shows estimated item parameters of item difficulty and item discrimination.

RESULTS

In this section, it is aimed to provide an example of procedures for investigating model data fit using simulated 20 dichotomous items from responses of 1000 examinees. The first step in the research is choosing software and providing classical analysis.

Classical item analysis can assist in choosing IRT models. In the dichotomous case, the level of variation in item discrimination indices provides an indication about whether or not a discriminating parameter is needed. A wide range of classical item discrimination indices may suggest the need for the discriminating parameter in an IRT model, otherwise considerable information would be lost and model fit would be poorer. The level of difficulty of multiple-choose items provides an indication of the need of a "guessing parameter" in the IRT model. If items are easy, the guessing parameter may not be necessary (Zhao, 2008).

This research was conducted by simulated data sets and data were generated to fit the 2-PL model. Item discrimination and difficulty parameters were simulated to be normally distributed. For these reasons, classical item analysis is not necessary in this step. BILOG, BILOG-MG and PARSCALE are three main programs for IRT analysis. In this research BILOG was used.

The second step in the research is to determine the dominance of the first factor (unidimensionality), and check the other model assumptions. Unidimensionality assumption can be checked by exploratory factor analysis or confirmatory factor analysis. Cook et al. (2009) do not recommend CFA for checking unidimensionality. They argued that CFA's fit values are sensitive

and not reliable to decide the factors. For this reason, a linear factor analysis procedure is a popular approach to investigating the unidimensionality assumption. For this aim, factor analysis has been used for checking unidimensionality assumption. Figure 2 shows the dominance of the first factor.

From the scree plot, the largest eigenvalue is easily distinguishable from the smaller ones. This plot serves as a baseline for interpreting the dimensionality of the simulated data. As a result, these findings show the unidimensionality of the data. Local independence, which is the second assumption, means that the response of an individual to an item from the test is not influenced by his or her responses to the other items of the same test or by other traits of theta (Sijtsma and Hemker, 2000). This assumption is necessary in IRT to assure the independence of items and hence their multiplicative property when ascertaining likely abilities for response patterns (Pomplun, 1988). According to McDonald (1982), a theory of unidimensionality should be based on the assumption of local independence.

The third step in the research is the assessment of model data fit. Because of the binary response format of the items, either the one-parameter logistic IRT (Rasch) model, the two parameter logistic (2PL) IRT model or the three parameter logistic (3PL) IRT model may be appropriate for the data. Goodness of fit statistics can be used to test for the amount of improvement in model fit to the data. IRT models are nested models. The degree of freedom for the test of the difference between the goodness of fit statistics and the nested models is the difference the additional parameters needed to be estimated for the more complex model. In BILOG, -2Log likelihood ratio is commonly used to check the goodness of model fit.

Model differences in these values (-2Log likelihood ratio) may be evaluated as chi-square statistics to evaluate the improvements made by the successively more complex models (Embretson and Reise, 2000). Improvement made by the 2-PL model over Rasch model is evaluated as follows;

$$X^2 = -2\text{Log likelihood}_{\text{RASCH}} - (-2\text{Log likelihood}_{2\text{-PL}}) = 12142,537 - 10857,662 = 1284,875$$

At 20 degrees of freedom, the X^2 of 1284,875 is very unlikely. Thus, 2-PL model fits significantly better than the Rasch model. Similarly, the difference between the 3-PL and the 2-PL models can be evaluated by;

$$X^2 = -2\text{Log likelihood}_{2\text{-PL}} - (-2\text{Log likelihood}_{3\text{-PL}}) = 10857,662 - 10853,048 = 4.614$$

The resulting value of 4.64 is significant at 20 degrees of freedom; therefore, the 2-PL model fits significantly better than the 3-PL model.

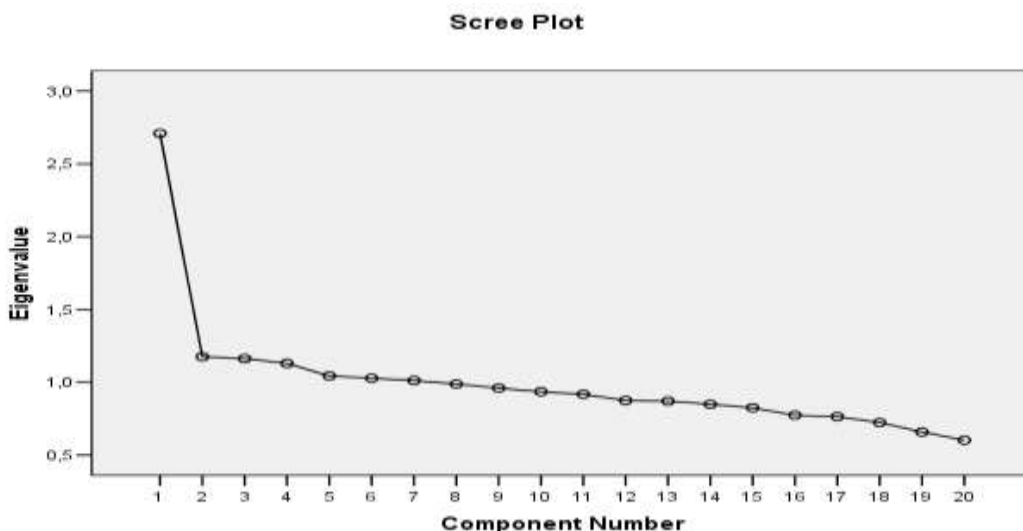


Figure 2. Scree plot.

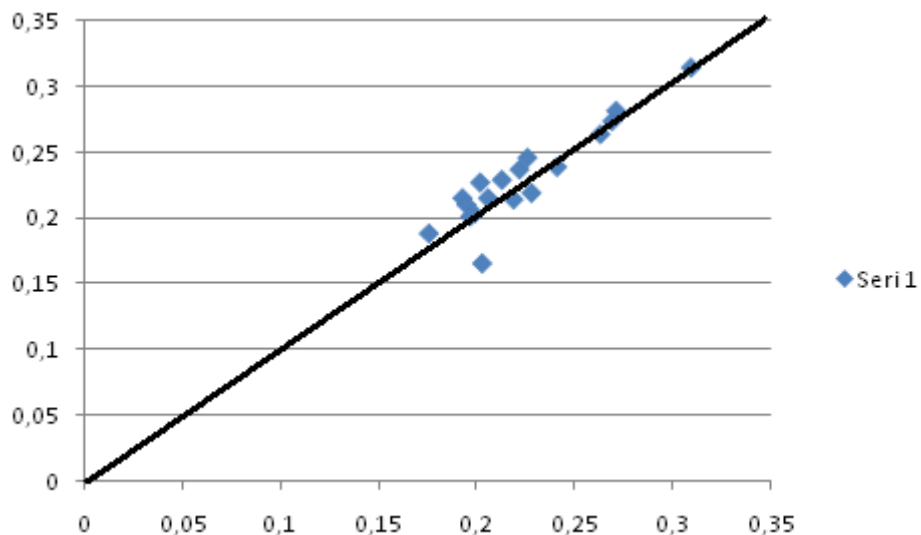


Figure 3. Item discrimination values based on two groups of examinees.

The most common criticism about the chi-square like statistics is that they are sensitive to sample size (Hambleton and Swaminathan, 1989). In this research sample size was 1000. For this reason invariance of item and ability parameters should be checked.

The next step was to investigate the invariance of the model parameters for the 2-PL model. The sample of 1000 examinees was split into two randomly equivalent groups of 500. In these groups, two ability groups were formed: the top half of the distribution and the bottom half of the distribution. After that, item difficulty and item discrimination parameters were estimated for each ability

groups. These plots show high relationships between the sets of "b" and "a" values in the two samples. Figure 3 and 4 indicate that item parameter invariance is present.

Invariance of ability parameters over randomly equivalent test forms (e.g. ability estimates based on examinee performance on the odd-numbered items and the even numbered items) indicates the variability due to the sampling of test items. A more rigorous test of invariance would be a comparison of ability estimates over tests consisting of the easiest and hardest items in the item bank (Hambleton et al., 1991).

Invariance of ability parameters across different

Table 2. Item difficulty parameters of easy and hard items.

Easy Items		Hard Items	
Item	β	Item	β
10	-3,220	16	-0,334
11	-2,481	9	-0,200
7	-1,843	19	0,002
20	-1,540	3	0,016
13	-0,916	6	0,091
5	-0,863	1	0,115
15	-0,672	18	0,412
4	-0,447	14	0,447
2	-0,403	17	0,462
8	-0,375	12	1,399

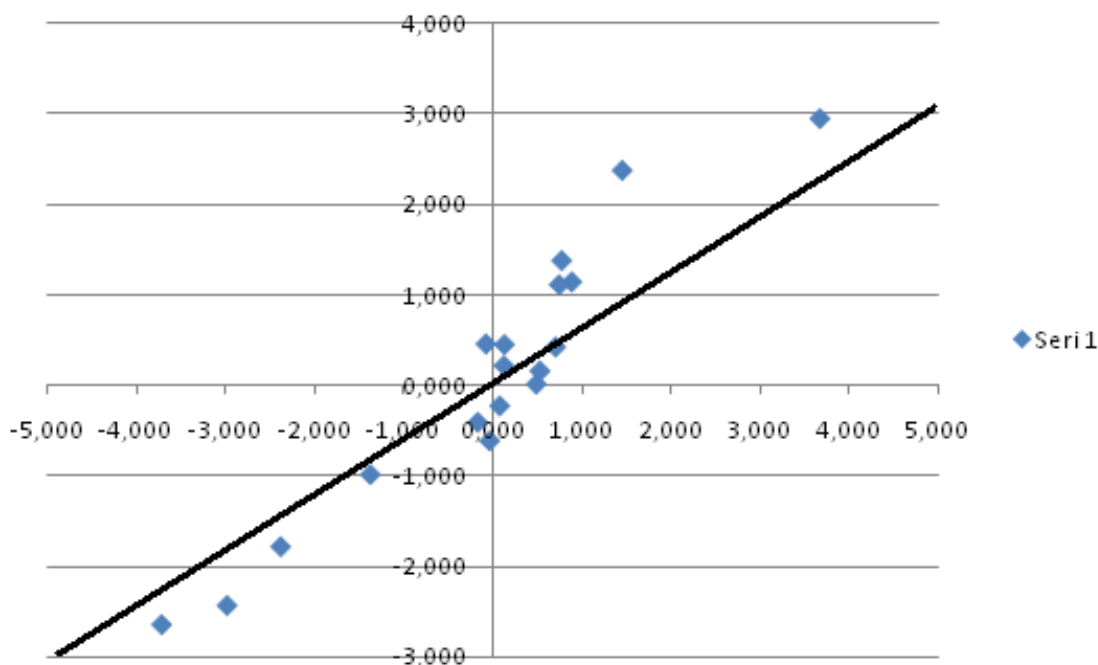


Figure 4. Item difficulty values based on two groups of examinees.

samples of items was investigated. For this aim, items were divided into two groups (10 hard and 10 easy items) (Table 2).

The ability parameter of examinees was calculated for easy and hard items. The scatter dot graph is obtained for abilities.

Figure 5 shows that abilities are estimated from two testlets on the line. This result provides evidence of the invariance of ability parameters over tests of varying difficulty. Based on the plots and other findings, it is obvious that simulated data were fit for the 2-PL model.

Conclusion

The purpose of this article is to assess the goodness of fit of unidimensional IRT models in simulated data. In this study an example of how to evaluate model-data fit was given. Assessment of model data fit is a stepwise procedure. Zhao (2008) suggested four step procedures for model data fit. With the help of simulated data, assessment of model data fit was exemplified by using these steps for unidimensional IRT models.

Assessing model data fit is an important part of the test

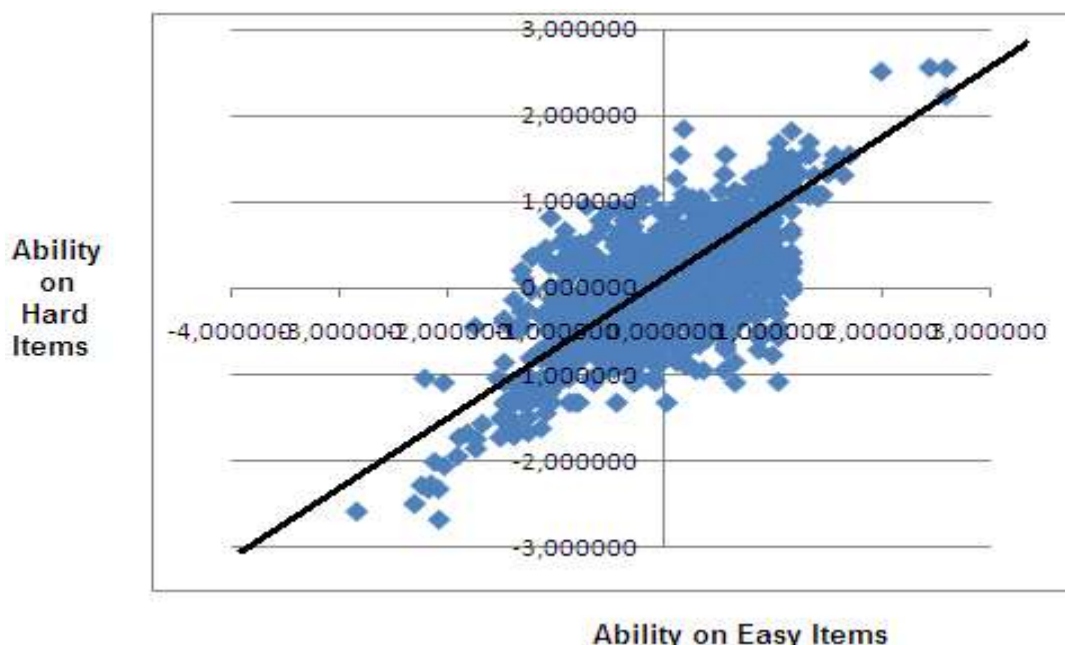


Figure 5. Invariance of ability parameters across different samples.

validation process. Assessing IRT model fit to item response data is one of the crucial steps before an IRT model can be applied with confidence to estimate proficiency or ability levels of examinees (Stone and Zhang, 2003).

The assessment of fit of IRT models usually involves collecting of a wide variety of diagnostic evidences for model fit and then making an informed judgement about model fit and usefulness of a model with a particular set of data (Hambleton, 1994). Besides these, model-data misfit may be attributed to violation of model assumptions or the specific parameterization for the IRT model (number of parameters). For example, exclusion of relevant item or ability parameters may influence the appropriateness of IRT model. However, IRT model fit studies have not received the attention they deserve among test practitioners. Possible reasons for this neglect are the complexity of assessing fit, the lack of understanding of the fit statistics and the absence of comprehensive model fit software (Zhao, 2008).

This study can be replicated for different distributions, sample sizes and test lengths in simulated and real data. Also assessing model-data fit can be investigated in polytomous IRT models and multidimensional IRT models.

Conflict of Interests

The authors have not declared any conflict of interests.

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Full Length Research Paper

Self-regulation skills of pre-service music teachers

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The purpose of this study is to identify how a four-semester music teacher education programme on self-regulation changes as they progress through the programme. The participants of the study included a total of 101 music teachers in four different semesters of their teacher preparation programme. The instrument used in this study is the Motivated Strategies for Learning Questionnaire (MSLQ). It has 81 items. It is composed of two parts: the first part deals with motivation and contains six subscales and the second part deals with learning strategies and contains nine subscales. The cronbach alpha reliability coefficients of these subscales ranged between .86 and .41, whereas the collected item-total correlation ranged between .19 and .66. One-way ANOVA was used to identify patterns within cohorts regarding pre-service teachers' beliefs about self-regulation skills. The inquiries of this study included that preservice music teachers' motivation areas of self-regulated learning skills improved at only one specific category during four years' music teacher education preparatory programme. In the motivation area, freshman and sophomore; freshman and senior pre-service teachers scored significantly higher on the scales of Extrinsic Goal Orientation. In the learning strategy area, freshman and junior pre-service teachers scored significantly higher on the scales of Critical Thinking.

Key words: Self-regulation, preservice music teacher, teacher education, teacher education programme.

INTRODUCTION

For a long time, researchers have endeavoured to explain the reason why some students are highly motivated to comprehend and learn important concepts in a short time while some of them have difficulty and are not interested in understanding the concepts. In the 19th century, when learning concept was regarded as a formal discipline, it was thought that students' failure in learning resulted from individual limitedness such as their intelligence and performance, and the students could overcome the individual limitedness in order to benefit from school programme. In the late 1970s and early 1980s, a new perspective was brought to individual differences among

students with the studies conducted on social cognition and meta-cognition (Zimmerman, 2002).

The individual, who has been defined in Bandura's social-cognitive theory, is able to observe his/her own behaviours and evaluate these by comparing with his/her own criteria and organise his/her behaviours by corroborating or punishing himself/herself (Bandura, 1997). Bandura explains this character of the individual with the concept of self-regulation. "Self-regulation learning" is a result of the endeavours so as to implement Bandura's theory. Self-regulation learning has become much more important in our century in which

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information has increased rapidly.

Self-regulation is an effective and constructivist process in which learners determine their own aims for learning and try to observe, organise and control their cognition, motivation and behaviour within their aims (Bandura, 1997; Pintrich, 2004; Pintrich, 2003; Schunk, 2005).

Zimmerman (1998, 73) defines self-regulation as 'self-generated thoughts, feelings, and actions for attaining academic goals'. After examining self-regulation research that was done over 20 years before, Zimmerman found similarities between studies as they identified conceptual structures of student's self-regulation in learning. On the other hand, Pintrich (2004) separates the regulation of learning within the learning process into four phases and areas (Table 1).

Motivation/Affect

It is another aspect of self-regulation and includes attempts to regulate different motivational beliefs that have been discussed in the achievement motivation literature such as goal orientation (purposes for doing task), self-efficacy (judgments of competence to perform a task), perceptions of task difficulty, task value beliefs (beliefs about the importance, utility, and relevance of the task), and personal interest in the task (liking of content area) (Pintrich and Schunk, 2002). The MSLQ includes measures for extrinsic and intrinsic goal orientations, task value and test anxiety, students' self-efficacy and control of learning, reflecting a general expectancy component of motivation (Pintrich, 2004).

Cognition

Cognitive control and regulation include different types of cognitive and metacognitive activities that students and instructors use to improve their learning (Pintrich, 2004). On the MSLQ, five different scales have been used as indicators of cognitive regulation, which are rehearsal (oriented toward reproducing), elaboration (integrating new information with prior knowledge); organization (selecting appropriate information and constructing connections with respect to the information to be learned), critical thinking (applying previous knowledge to new situations); and metacognitive self-regulation (planning, monitoring and regulating their learning and study strategies) (Table 1).

Context

In terms of self-regulated learning, regulation of context that involves controlling time and learning environment, which facilitate goals and task completion, is important for self-regulation. Student-centered classrooms provide

many opportunities for students to engage in contextual control and regulation. In student-centered classroom, students are very active participants in their learning. They control their academic tasks and classroom environment. They design their own project and experiments. They have a chance to work together in collaborative or cooperative groups (Pintrich, 2004).

Behavior

Regulation of behavior is an aspect of self-regulation that involves time and effort, planning or management (Table 1). Effort control involves self management and reflects a commitment to completing tasks and achieving goals despite difficulties. While time management involves scheduling a time to study for assignments, examinations, and using the studying time effectively for realistic goal setting, environment management refers to the physical place where students study (Pintrich and Schunk, 2002). On the MSLQ, three different scales have been used as indicators of cognitive regulation.

The pre-service teachers with self-regulation strategies organize and control their learning process by developing different strategies towards their targets. Especially the experience at school, home and the learning environment at school are important factors to develop these strategies. Although there are researches on self-regulation in different fields in our country from primary education to higher education (Alci and Altun, 2007; Haslamam and Askar, 2007; Isreal, 2007), there is no research on the development of self-regulation about pre-service music teachers. The rising interest in self-regulation emphasizes the importance of developmental research on this field.

In curriculum of education faculties, where future teachers are trained, the relation between pre-service teachers' perceptions, attitudes and self-regulating abilities must be considered. Self-regulation may be an important factor especially for pre-service teachers, who will educate their own students in future, to settle effective teaching strategies and to conduct effective teaching practices. In this context, teacher education programmes have become important. Effective instruction in music teacher education programme should not only increase learning, but also help pre-service music teachers develop the lifelong learning skills needed to succeed at higher levels of music education, and reconstruct their conceptual knowledge and procedural strategies when necessary (Stankiewicz, 2007).

Moving from this point of view, this study has been designed to investigate the development and change in self-regulation skills of pre-service music teachers at the Pamukkale University Music Teacher Education Programme (MTEP) over the four-semester sequence. The following main question was presented:

How have the changes in self-regulations of pre-service music teachers been evaluated according to grade?

Table 1. Phases and areas for self-regulated learning.

	Areas for regulation			
	Cognition	Motivation/Affect	Behavior	Context
Phase 1				
For thought, planning, and activation	Target goal setting prior content, knowledge activation, metacognitive knowledge activation	Goal orientation adoption, Efficacy judgments, perceptions of task difficulty	Time and effort planning, planning for self observations of behavior, task value activation	Perceptions of task, perceptions of context, Interest activation
Phase 2				
Monitoring	Metacognitive awareness and monitoring of cognition	Awareness and monitoring of motivation and affect	Awareness and monitoring of effort, time use, need for help, self-observation of behavior	Monitoring changing task and context conditions
Phase 3				
Control	Selection and adaptation of cognitive strategies for learning, thinking	Selection and adaptation of strategies for managing, motivation, and affect	Increase/decrease effort, persist, give up, help-seeking behavior	Change or renegotiate task, change or leave context
Phase 4				
Reaction and reflection	Cognitive attributions	Affective attributions	Choice behavior	Evaluation of task, evaluation of context
Relevant MSLQ Scales	Rehearsal Elaboration, organization, critical thinking Metacognition	Intrinsic goals, extrinsic goals, task value, control beliefs, self-efficacy, test anxiety	Effort regulation, help-seeking, time/study, environment	Peer learning, time/study, environment

METHOD

This research has simple descriptive survey approach. The simple descriptive survey approach is one-shot survey for the purpose of describing the characteristics of a sample at one point in time apart from the other approaches namely cross sectional and longitudinal surveys (Mertens, 1998). In this research, simple descriptive survey is conducted in order to describe how a four-semester sequence teacher education programme helps pre-service teachers' perceptions about self-regulation skills change.

Population and sampling

One hundred and one (101) pre-service teachers enrolled in Pamukkale University Music Teacher Education Programme (MTEP) during the fall semester of 2013 were invited to participate in the study. All of them volunteered to participate in the study. Thirty one (31) freshman pre-service music teachers enrolled in basic music courses (Piano I-II, Major Performance I-II, School Instruments I-II, Solo Vocal Training I-II, Ear Training and Musical Literacy I-II, Chorus I). At this level, they have taken the courses of introduction to educational music and educational psychology. Fifteen (15) sophomore pre-service music teachers have enrolled in basic music courses (Piano III-IV, Major Performance III-IV, Solo Vocal Training III-IV, Ear Training III-IV, Chorus II-III, Harmony-

Counterpoint Accompany I-II, History of Music, Traditional Turkish Folk Music Training, Electronic Organ Education) and also started to take courses about music teaching and music education programme and planning. Twenty eight (28) juniors pre-service music teacher have completed the sets of basic music courses (Piano V, Major Performance V, Orchestra Chamber Music I, Ear Training V, Chorus IV, Traditional Turkish Art Music, Repertoire of School Music, Contemporary Popular Music, History Of Turkish Music) and also started to take courses on Teaching Music Education (such as Special Methods of Music Teaching I, Instrument Maintenance and Repair). Twenty seven (27) seniors, who are at their last year of pre-service teacher programme, have completed courses on music teaching (such as Special Methods of Music Teaching II, School Experience, Teaching Practice, Turkish Educational System and School Management, Community Service Applications).

Data collection tool

Motivated Strategies for Learning Questionnaire (MSLQ) was used to generate the main data to answer the research question, because it was designed to measure self-regulated learning skills of music teachers, which is the controlling of a process or activity by them who are involved in problem solving. MSLQ was developed by Pintrich (2004) and was adapted into Turkish Language by

Table 2. MSLQ sections and scales.

Motivation Section		Learning Strategy Section	
Components	Scales	Strategies	Scales
Value Component	Intrinsic Goal Orientation	Cognitive and Meta-cognitive Strategies	Rehearsal
	Extrinsic Goal Orientation		Elaboratio
	Task Value		Organization
	Control of Learning Beliefs		Critical Thinking
	Self-Efficacy for Learning and Performance		Meta-cognitive Self-Regulation
Effective Component	Test Anxiety	Resource Management Strategies	Time and Study Environment Management
			Effort Regulation
			Peer Learning Seeking for Help

Büyüköztürk et al. (2004). The MSLQ is a self-report instrument designed to assess college students' motivational orientations and their usage of different learning strategies. It includes 81 items and response to items are scored on a seven point Likert-Scale from 'not at all true of me (Abel and Lederman, 2007) to 'very true of me (Kahle and Boone, 2000). It is composed of two parts, the first part dealing with motivation and containing six subscales and the second part dealing with learning strategies and containing nine subscales. The Cronbach Alpha Reliability Coefficients of these subscales are ranged between .86 and .41, whereas the collected item-total correlation is ranged between .19 and .66. The MSLQ consists of two sections (Table 2), which are motivation section and learning strategy section, and six motivation scales and nine learning strategy scales (Pintrich et al. 1991).

Data analysis

To answer the research questions; the results of the MSLQ were analyzed using the Statistical Package for Social Sciences (SPSS) version 21.0. The level of significance was set at .05. To identify patterns in the scores obtained from the MSLQ for each cohort, a one-way analysis of variance (ANOVA) was conducted. Descriptive statistics were computed. The ANOVA analysis was chosen because the analysis of variance deals with differences between or among sample means; it imposes no restriction on the number of means (Fraenkel and Wallen, 2008)

RESULTS

Turkish version of the MSLQ was conducted to assess self regulated learning skills of the 101 pre-service science teachers that were enrolled in Music Teacher Education Programme at Pamukkale University in 2013-2014 fall semesters. In this study, self regulated learning skills were examined under two main sections; motiva-

tional section and learning strategy section. The first part of these results is presented in Table 3.

Statistically significant differences were found between pre-service music teachers in freshman and sophomore and also between freshman and senior teacher candidates' mean scores on the Extrinsic Goal Orientation scale increasing from first year through fourth year. As seen in Table 4, there are no significant differences in other subscales of *Motivational Section*.

The analysis also indicated that for Critical Thinking scale, pre-service music teachers in the third year gained significantly higher means than pre-service music teachers did in the first and second year. The result showed that senior teacher candidates had lower mean scores than junior teachers on Critical Thinking subscale.

DISCUSSION

In the last century, many countries started to follow new reforms in their educational systems and they put the learner in the centre. In fundamental of the reforms, researchers have tried to answer some questions such as; How do students learn? How can teachers maximize their learning? How can teachers organize the classroom environment? etc. Current theoretical accounts of learning view students as active seekers and processors of information. Learners' cognitions can influence the instigation, direction, and persistence of achievement behaviors (Schunk, 2001). For this reason, especially nowadays researchers focus on improving self-regulation skills of the learner for effective learning (Jinkens, 2009; Agricola et al., 2012). In addition, Turkish Government

Table 3. Comparison of observed cohort mean differences of motivational operation as measured on MSLQ.

Dependent Variable	(I)	(J)	Mean Difference (I-J)	Std. Error	Sig.
Intrinsic Goal Orientation	1. 00	2. 00	,35753	,33242	,705
		3. 00	-,04724	,27555	,998
		4. 00	-,20729	,27822	,879
	2. 00	1. 00	-,35753	,33242	,705
		3. 00	-,40476	,33817	,630
		4. 00	-,56481	,34035	,351
	3. 00	1. 00	,04724	,27555	,998
		2. 00	,40476	,33817	,630
		4. 00	-,16005	,28507	,943
	4. 00	1. 00	,20729	,27822	,879
		2. 00	,56481	,34035	,351
		3. 00	,16005	,28507	,943
Extrinsic Goal Orientation	1. 00	2. 00	1,06505 [*]	,35107	,016
		3. 00	,31624	,29101	,698
		4. 00	,96505 [*]	,29383	,008
	2. 00	1. 00	-1,06505 [*]	,35107	,016
		3. 00	-,74881	,35715	,161
		4. 00	-,10000	,35945	,992
	3. 00	1. 00	-,31624	,29101	,698
		2. 00	,74881	,35715	,161
		4. 00	,64881	,30107	,143
	4. 00	1. 00	-,96505 [*]	,29383	,008
		2. 00	,10000	,35945	,992
		3. 00	-,64881	,30107	,143
Task Value	1. 00	2. 00	,44122	,33841	,563
		3. 00	,40630	,28052	,473
		4. 00	,00418	,28323	1,000
	2. 00	1. 00	-,44122	,33841	,563
		3. 00	-,03492	,34427	1,000
		4. 00	-,43704	,34649	,590
	3. 00	1. 00	-,40630	,28052	,473
		2. 00	,03492	,34427	1,000
		4. 00	-,40212	,29021	,511
	4. 00	1. 00	-,00418	,28323	1,000
		2. 00	,43704	,34649	,590
		3. 00	,40212	,29021	,511
Control of Learning Belief	1. 00	2. 00	-,07796	,28821	,993
		3. 00	-,08093	,23891	,987
		4. 00	,19982	,24122	,841
	2. 00	1. 00	,07796	,28821	,993
		3. 00	-,00298	,29320	1,000
		4. 00	,27778	,29509	,783
	3. 00	1. 00	,08093	,23891	,987
		2. 00	,00298	,29320	1,000
		4. 00	,28075	,24716	,668
	4. 00	1. 00	-,19982	,24122	,841
		2. 00	-,27778	,29509	,783
		3. 00	-,28075	,24716	,668

Table 3. Cont'd

Self Efficacy for Learning and Perfor.	1. 00	2. 00	,39382	,32500	,621
		3. 00	-,01541	,26940	1,000
		4. 00	-,03674	,27201	,999
		2. 00	1. 00	-,39382	,32500
	2. 00	3. 00	-,40923	,33063	,605
		4. 00	-,43056	,33276	,569
		1. 00	,01541	,26940	1,000
		2. 00	,40923	,33063	,605
	3. 00	4. 00	-,02133	,27871	1,000
		1. 00	,03674	,27201	,999
		2. 00	,43056	,33276	,569
		3. 00	,02133	,27871	1,000
Test Anxiety	1. 00	2. 00	-,07699	,37646	,997
		3. 00	-,63318	,31206	,185
		4. 00	-,50514	,31508	,382
		2. 00	1. 00	,07699	,37646
	2. 00	3. 00	-,55619	,38298	,470
		4. 00	-,42815	,38545	,684
		1. 00	,63318	,31206	,185
		2. 00	,55619	,38298	,470
	3. 00	4. 00	,12804	,32284	,979
		1. 00	,50514	,31508	,382
		2. 00	,42815	,38545	,684
		3. 00	-,12804	,32284	,979

*. The mean difference is significant at the 0.05 level.

approach. This programme was applied to all the faculties of education in the country in 2006-2007.

The Music Teacher Training Programme described here is a four-year undergraduate programme that includes eight semesters of intensive coursework in general and subject-specific pedagogy. Pre-service teachers observe a music teacher and his/her teaching in elementary school at least three times in a week during the 7th semester. In addition, pre-service teachers participate in student teaching field experience in the 8th semester at elementary schools under the guidance of a classroom teacher and a university supervisor. This study aims to determine the effects of the Music Teacher Training Programme sequence on the pre-service music teachers' self regulation learning skills regarding motivational operation and learning strategy.

The current study involved an investigation that pre-service music teachers' motivation areas of self regulated learning skills improved at only one specific category during four-year teacher education preparatory programme. In the motivation area, sophomore and senior pre-service music teachers scored significantly higher on the scales of Extrinsic Goal Orientation. These findings are consistent with many studies (Sungur and Tekkaya, 2006; Agricola et al., 2012). Extrinsic goal orientation refers to

the degree in which students perceive themselves to be participating in a task for reasons such as grades, rewards, performance, evaluation by others and competition (Garcia and Pintrich, 1995; Pintrich et al., 1991). In the light of this definition, the significant difference on this scale is seen between junior and sophomore, and junior and senior. According to Pintrich (2002), students can learn to be self-regulated and that self-regulation is a way of approaching academic tasks which they learn through experience and self- reflection. Very little research exists in Music Education regarding pre service teachers' self regulation (Jones and Parkes, 2009). In Music Teacher Training Program, in the first and second years, pre-service music teachers have to take a wide range of courses, such as Piano, School Instrument, Musical Literacy, etc. In the first year, pre-service music teachers have low GPA scores. The first year of university is tough for many university students, because many of them continue their academic career far from their family and most probably, it takes too much time for them to adapt to a new city, new school, new courses and instructors. But after the first year with low score of GPA, they may focus on their GPA and may want to increase their grades. Most probably the reason for which the senior pre-service music teachers scored significantly higher than freshmen

Table 4. Comparison of observed cohort mean differences of learning strategies as measured on MSLQ.

Dependent Variable	(I)	(J)	Mean Difference (I-J)	Std. Error	Sig.
Rehearsal	1. 00	2. 00	,15645	,35310	,971
		3. 00	-,28283	,29270	,769
		4. 00	-,47133	,29553	,386
	2. 00	1. 00	-,15645	,35310	,971
		3. 00	-,43929	,35922	,614
		4. 00	-,62778	,36153	,311
	3. 00	1. 00	,28283	,29270	,769
		2. 00	,43929	,35922	,614
		4. 00	-,18849	,30281	,925
	4. 00	1. 00	,47133	,29553	,386
		2. 00	,62778	,36153	,311
		3. 00	,18849	,30281	,925
Organization	1. 00	2. 00	,06075	,33621	,998
		3. 00	-,05472	,27869	,997
		4. 00	-,10962	,28139	,980
	2. 00	1. 00	-,06075	,33621	,998
		3. 00	-,11548	,34203	,987
		4. 00	-,17037	,34423	,960
	3. 00	1. 00	,05472	,27869	,997
		2. 00	,11548	,34203	,987
		4. 00	-,05489	,28832	,998
	4. 00	1. 00	,10962	,28139	,980
		2. 00	,17037	,34423	,960
		3. 00	,05489	,28832	,998
Elaboration	1. 00	2. 00	,10323	,32799	,989
		3. 00	-,21582	,27188	,857
		4. 00	-,41776	,27451	,429
	2. 00	1. 00	-,10323	,32799	,989
		3. 00	-,31905	,33367	,775
		4. 00	-,52099	,33582	,411
	3. 00	1. 00	,21582	,27188	,857
		2. 00	,31905	,33367	,775
		4. 00	-,20194	,28128	,890
	4. 00	1. 00	,41776	,27451	,429
		2. 00	,52099	,33582	,411
		3. 00	,20194	,28128	,890
Critical Thinking	1. 00	2. 00	-,18538	,27565	,907
		3. 00	-,67442*	,22849	,020
		4. 00	-,33501	,23071	,470
	2. 00	1. 00	,18538	,27565	,907
		3. 00	-,48905	,28042	,307
		4. 00	-,14963	,28223	,952
	3. 00	1. 00	,67442*	,22849	,020
		2. 00	,48905	,28042	,307
		4. 00	,33942	,23639	,480
	4. 00	1. 00	,33501	,23071	,470
		2. 00	,14963	,28223	,952
		3. 00	-,33942	,23639	,480

Table 4. Cont'd.

Help Seeking	1. 00	2. 00	-,12419	,31732	,980
		3. 00	-,32776	,26303	,599
		4. 00	-,30197	,26558	,668
	2. 00	1. 00	,12419	,31732	,980
		3. 00	-,20357	,32281	,922
		4. 00	-,17778	,32489	,947
	3. 00	1. 00	,32776	,26303	,599
		2. 00	,20357	,32281	,922
		4. 00	,02579	,27212	1,000
	4. 00	1. 00	,30197	,26558	,668
		2. 00	,17778	,32489	,947
		3. 00	-,02579	,27212	1,000
Peer Learning	1. 00	2. 00	-,51828	,35639	,469
		3. 00	-,52304	,29542	,294
		4. 00	-,71087	,29828	,087
	2. 00	1. 00	,51828	,35639	,469
		3. 00	-,00476	,36256	1,000
		4. 00	-,19259	,36490	,952
	3. 00	1. 00	,52304	,29542	,294
		2. 00	,00476	,36256	1,000
		4. 00	-,18783	,30563	,927
	4. 00	1. 00	,71087	,29828	,087
		2. 00	,19259	,36490	,952
		3. 00	,18783	,30563	,927
Metacognitive Self-Regulation	1. 00	2. 00	,26373	,27114	,765
		3. 00	-,14254	,22475	,921
		4. 00	-,19822	,22693	,819
	2. 00	1. 00	-,26373	,27114	,765
		3. 00	-,40628	,27583	,458
		4. 00	-,46195	,27761	,348
	3. 00	1. 00	,14254	,22475	,921
		2. 00	,40628	,27583	,458
		4. 00	-,05568	,23252	,995
	4. 00	1. 00	,19822	,22693	,819
		2. 00	,46195	,27761	,348
		3. 00	,05568	,23252	,995
Effort Regulation	1. 00	2. 00	,10710	,29975	,984
		3. 00	-,30576	,24847	,609
		4. 00	-,37587	,25087	,443
	2. 00	1. 00	-,10710	,29975	,984
		3. 00	-,41286	,30494	,531
		4. 00	-,48296	,30690	,398
	3. 00	1. 00	,30576	,24847	,609
		2. 00	,41286	,30494	,531
		4. 00	-,07011	,25705	,993
	4. 00	1. 00	,37587	,25087	,443
		2. 00	,48296	,30690	,398
		3. 00	,07011	,25705	,993

Table 4. Cont'd.

Time and Study Management	1. 00	2. 00	,22312	,26769	,838
		3. 00	-,10873	,22190	,961
		4. 00	-,05929	,22405	,993
	2. 00	1. 00	-,22312	,26769	,838
		3. 00	-,33185	,27233	,617
		4. 00	-,28241	,27408	,732
	3. 00	1. 00	,10873	,22190	,961
		2. 00	,33185	,27233	,617
		4. 00	,04944	,22956	,996
	4. 00	1. 00	,05929	,22405	,993
		2. 00	,28241	,27408	,732
		3. 00	-,04944	,22956	,996

* The mean difference is significant at the 0.05 level.

on the scales of extrinsic goal orientation is that senior may focus on completing their degree and they may be hired as a music teacher as soon as possible (Miksza, 2011). In short, becoming a self-regulated pre service music teacher not only requires high road transfer from a given to a new situation (Perkins and Salomon, 1988); it likewise requires developing new strategies to learn in novel situations.

In the area of cognition, junior and senior pre-service music teachers scored significantly higher on the Critical Thinking. Junior and senior pre-service music teachers are better at applying previous knowledge to new situations in order to solve problems, reach decisions, or make critical evaluations. This is because at Music Teacher Training Program, junior and senior have to take many pedagogy courses such as Special Methods of Music Teaching II, School Experience, Teaching Practice, etc. In addition, they are doing too many solos and performing in many concerts. Thus, they have a chance to adapt their previous knowledge to new situations. These applications help them improve their critical thinking skills (Köse, 2007). Considering the demands of teaching, it is difficult to imagine an effective teacher who has not developed self-regulated learning strategies. Teaching itself may have afforded teachers opportunities to develop critical thinking learning strategies.

This study includes some important results regarding curriculum development. We need more study effects of teacher education programme on self regulation skills, because there is not enough research available about music pre-service teachers' self regulation skills. For a future study, we recommend that educators may work on the same students' longitudinal study; in this way, it is possible to mention the development of pre service music teachers' self regulation learning skills during the program. In addition, this is just a descriptive study, which is the limitation of this study. One of the recommendations

to the future researches is that researchers should do longitudinal study and support quantitative data with qualitative data.

Conflict of Interests

The author have not declared any conflict of interests.

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