

**Teaching Mathematics to Deaf and Hard of Hearing
Students: An Experimental System
Dynamics Approach**

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Abstract

Studies over thirty years show that many deaf and hard of hearing students are under performers in the field of mathematics as compared to their hearing counterparts. This study explored the contribution of system dynamics methods to improving understanding and performance of deaf and hard of hearing students in 'økonomi'-commercial mathematics.

The contribution of system dynamics method was assessed through an interactive learning environment (ILE) component 'Math Interactive Learning Environment for Students (MILES). The MILES, a computer-based simulator for solving mathematical problem was developed and used to carry out the system dynamics instruction. The experiment involved first term tenth-grade DHH students as the main participants. They were given the task of solving mathematical problems using the developed MILES after the teaching experiment. The result indicated an improved performance of the deaf and hard of hearing in solving mathematics problems. Participants pointed out that the use of icons, graphs and the simulation process in the MILES facilitated their understanding of the topic.

In conclusion, although the results may not be generalised due to the sample size, the result is conclusive in the context of this study.

Key words: Deaf and hard of hearing, mathematics, system dynamics method, interactive learning environment, teaching.

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Introduction

The Problem

Mathematics is a challenge to many in school. Research studies however, shows that the performance of Deaf and Hard of Hearing (DHH¹) pupils in mathematics is below that of their hearing colleagues in school (Frostad, 1996; Frostad, 1999 and Kelly & Gaustad, 2007). Therefore, a gap is created between the mathematics performance of the DHH and that of the hearing (Nunes, 2004). Wood, Wood and Howarth (1983) studied mathematical abilities of deaf school leavers; they found that DHH lag behind in approximately three years despite their normal nonverbal intelligent quotient.

Traxler (2000) who studied the Stanford Achievement Test 9th edition and national norming as well as performance standards for the deaf and hard of hearing student's scores, also showed in his study that, half of the high school students he studied are comparable to sixth-grade hearing students. Hall (2005) reviewed Nunes (2004) study on 'Teaching mathematics to deaf children' and identified that some DHH students do well in math while many perform lower than their hearing peers in arithmetic and problem solving. The low performance of the DHH students however, cannot be traced to the level(s) of hearing loss, school placement, or the students' gender (Swanwick, et al., 2005). Nunes (2004) agrees that even though most DHH students' performance in math is low; it cannot be traced to their IQ.

¹ In this study, 'Deaf' refers to any person who cannot hear, particularly those who use sign language as their natural language (World Federation of the Deaf, 2003). 'Hard of hearing' refer to all people who have hearing loss and whose usual means of communication is by speech and it includes those who have become totally deaf after acquisition of speech (<http://www.ifhoh.org/wfd.htm>). This research would use the combined term Deaf and Hard of Hearing (DHH), for the people who form the core participants for this study.

In the study teaching mathematics to DHH students, Nunes (2004) recognised challenges of the DHH students to include problem solving in addition, subtraction, multiplication, division and use and application of money (Hall, 2005). The problem of low performance in mathematics in the case of deaf and hard of hearing is identified to start before formal education. When young DHH children were examined on their informal and formal mathematical knowledge prior to formal schooling at age four to six, the children demonstrated evidence of academic delays (Kritzer, 2009; Hall, 2005).

Various researches conducted from 1979 to 2000 indicate mathematics performance for the DHH continued to fall below expectation (Powers et al., 1998 and Frostad and Ahlberg, 1999, Swanwick, et al., 2005). System dynamics methodology has attained success in teaching various subjects in regular schools for the hearing but there is no literature evident of using system dynamics method in teaching the deaf and hard of hearing. Studies has been done using system dynamics as a method to facilitate learning in regular basic and second cycled schools in subjects such as English language (Draper, 1992; Platt, Quaden, and Lyneis, 2000), social studies (Reid 1996), economics (Wheat, 2007), science (Quaden, 2003) and mathematics (Quaden and Lyneis, 2000; Fisher, 1992; Msefer, 1993).

This research sets out to investigate the contribution of system dynamics methods in the teaching of mathematics to DHH students in Norway. It seeks to explore the use of system dynamics method in the teaching of commercial math 'økonomi' to DHH students through an experiment. This topic stems from the fact that 'use and application of money' is one of the challenges many DHH students have been identified with (Nunes, 2004). The study is to help identify the contribution system dynamics could make in improving the performance of DHH and serve as encouragement for others in the field of systems to explore research in both mathematics and other subjects in schools for DHH. The initial choice of place for the study

was Ghana-my home country. However given that the schools do not have needed facilities such as computers, the choice of place shifted to Norway. Also Norway is one of the countries advanced in provision of equal and universal basic education nation-wide including education for the DHH pupils.

This study is outlined to continue with the literature review which explores earlier studies on mathematics challenges of the DHH and attempts made to solve the problem by others. This is followed by the experiment design which highlights the research questions, teaching treatment and strategy as well as data analysis procedures used in the study. The results of the experiment which shows the output of the students work during pre-test, teaching instruction, post-test activities and interviews is then presented. After this the discussion of the results and conclusion is presented.

Purpose of Study

The mathematics challenges identified with DHH students include language use in math problems, understanding of element linkages in math problems, limited use of basic mathematics operations outside school and lack of pre-application of money. The purpose of this study is to teach mathematics to DHH students using system dynamics methods. The specific objective is to explore through teaching experiment, the contribution of system dynamics tools in the solving of mathematics problems ('økonomi', translated in English as commercial math) to the DHH students.

Research Question

How does system dynamics method contribute to learning and teaching mathematics to DHH students?

Literature Review

Ninety percent of children with hearing loss are born to hearing families (Edwards and Crocker, 2007). Parents tend to depend on professionals for guidance, aid, and direction on how to communicate with the child, school placement and other related issues. Children acquire language through natural interaction with users of the language within their immediate environment. In the case of deaf children, they do not have the natural ability to acquire spoken language as hearing children do. Due to the fact that they are mostly born into hearing families, deaf children acquire sign language outside the family environment at a later stage of their preschool years or afterwards. Language acquisition of DHH is dependent on when the child enters school and interacts with colleague users of the language (Svartholm, 2010).

The ability of a child with hearing loss to develop pre-school activities such as basic numeracy and reading readiness is not well developed before the child enters school (Zarfaty, Nunes and Bryant, 2004). On the other hand, the hearing child has access to interaction involving numbers. He is guided to use number rhymes as well as incidental use of numbers in the home. They could also link to countless information shown on television and radio. This lack of practical encounters with numbers and basic vocabulary affects the DHH child throughout his education. There is delay in developing language in the home with parents and siblings and neighbours. The child's ability to learn through questions as in hearing children is reduced. The child therefore begins school without the relevant previous knowledge (Gregory, 1998).

In a study conducted by Traxlar (2000) to describe mathematics achievement of deaf and hard of hearing, the 9th edition of Stanford Achievement Test was used. The test provided

a context of actual performance of hearing and DHH students. The results showed that median mathematics grades for fiftieth percent of DHH students who were 8-18 year-olds fell within basic class levels (between 5th and 6th grades). Reviewed literature of a report from the Department for Education and Employment points out also that DHH students fall behind hearing learners in mathematics (Powers et. al, 1998).

Other studies which focused on calculation skills for grades 1 through 9, did not differ in their results (Frostad, 1996; and Wood, Wood and Howarth, 1983). However, Hall (2005) found in Nunes (2004) that some student perform well in math when compared to their hearing age mates in school while many perform well below their hearing age mates. In the use of visual-spatial schemes to study participants from middle school, high school and college student for hearing and deaf students, the hearing performed significantly better in solving math problems compared to their deaf peers. In each of the levels examined the deaf remained low in their performance (Blatto-Vallee, et al., 2007).

Other studies continue to describe the math performance of DHH as a 'lag behind' situation. In 1957 the National Council of Teachers of the Deaf in England carried out a study with large sample of DHH students. The report of the study indicated that DHH students lag 2.5 years behind in math achievement tests NCTM (1957). Nearly three decades after Wood, Wood and Howarth, (1983) did not find any improvement on the earlier report about the performance of the DHH in mathematics. In their study, DHH students were identified as 3.4 years behind their hearing counterparts.

Swanwick, et al., (2005) analysed sample test papers with the aim of identifying differences existing and possible explanations in relation to access to mathematics teaching, assessment and column provision. Their evidence from 1980-2000 found out that the deaf lag behind between 2 to 3.5 years. In the test of mathematics ability of four to six years of age of

DHH children also, over half of the participants scored well below average while close to half of the participants score showed one-year or more behind normal age equivalent scores (Kritzer, 2009).

Nunes & Morenu (2002) also examined a couple of studied literatures which agree to the low performance of the deaf. Although they confirmed the situation, they suggested that deafness is not a direct cause to DHH student's difficulty in mathematics. They did an intervention study for promoting DHH pupils achievement in math. They found out that deafness is a risk factor; secondly they found out that 15% of profoundly deaf students could perform above average, and showed evidence that not all DHH students are weak in solving math problems. They also they showed that there is a small correlation between deafness and mathematics attainment. For this reason Nunes, & Morenu (2002) concluded by saying that hearing loss places DHH at risk for the difficulties identified in mathematics achievement. Other studies have also shown similar results (Nunes, & Morenu, 1998; Wood, Wood and Howarth, 1983).

Reasons for the under-performance

Reasons allocated for the fall behind are the child's limitations before beginning school. Some specific challenges are the inability to follow teachers' presentation in class and limited required pre-school knowledge (Zarfaty, Nunes and Bryant, 2004). Many deaf people live in an information disadvantaged environment. As stated elsewhere, the means of communication around them are not quiet accessible to them. They are limited in accessing information from neighbours, radio and television (Nunes, & Morenu 2002). Nortey (2009) studied social participation of the deaf. She recounted how DHH individuals experienced isolation and neglect of social interaction within their homes, neighbourhoods and communities where they live.

The opportunity for hearing children to learn about basic number counting with direct guide and reinforcement from their parents, as well as the ability to question the concepts involving number relations are not available for the DHH. There are no opportunities for the DHH child to hear, question or express himself adequately for understanding of parents and siblings. Unlike DHH children, preschool hearing children may well be familiar with counting orally through the help of parents. In exploring the effect of limited incidental learning among children with hearing loss, Gregory (1998) found that limited parental guide for DHH children affects their ability to develop preschool concepts such as in mathematical concepts prior to formal education (Gregory, 1998).

Deaf children have significant difficulty working with events that unfold over time and keeping up with gaps of unknown elements. For example when events occur successively over time and a DHH child is asked to find the missing item within a specific time gap it is a challenge to relate to the occurrences of events to be able to give the required answer (Nunes, & Morenu, 2002). At pre-school DHH pupil begin to fall behind due to difficulties in sequential recall and lack of experience in the use of counting. Many DHH pupils do not have enough pre-experience in everyday use of mathematical concepts such is in addition (Hall, 2005).

Moreover, they have problem in recognising the connections linking elements such as relational words and concepts words in math problems. Relational words such as 'faster than', 'three times as many', 'or half the number', 'less than' and 'more than', 'less than' use of 'either... or', 'neither ...nor', 'if x ...then y', is difficult for them to identify with (Serrano Pau, 1995). They often fail to recognise these relationships in linking elements in math problems. DHH adults and students lack understanding of these properties and relationships that are common in math problems (Blatto-Vallee et al., 2007). Language use was one of their main

problems. Word phrases such as ‘more than’, ‘less than’ and pronouns such as ‘he’, ‘she’, ‘it’, ‘that’ and identification of key mathematical concepts poses challenges to DHH students (Swanwick, et al., (2005). DHH student primary ability to solve mathematics story problems have been studied by Ansell and Pagliaro (2006). They found out that the pupils they studied did not relate the story accompanying the math problem with mathematical functions they used to solve the problem. They concentrated on numbers in the problem instead of linking the numbers to issues in the given problem.

In another study report involving hearing and DHH college students, the performance of the DHH students dropped as the complexity of the mathematics word problems increases compared to the hearing. In that same study, mathematics problems involving graphics and numbers, the hearing and the DHH students did equally well (Kelly and Mousley, 2001). Gregory (1998) suggests that the use of sign language in teaching mathematics could be explored in explaining mathematical concepts. Using sign language to teach across the curriculum helps in teaching math to children with hearing loss because it is intuitive, visual, and spatially organised language which has much to offer in teaching the subject. Sign language offers clear information about size, location and spatial relationship than spoken language.

Mathematics teachers of DHH students dwell more on the use of visual-based strategies compared to analytical strategies. They therefore prepare them for ‘practice problem’-a form of straight forward problem more than they do for true problems which require analytical skills (Kelly et al., 2003). Other teachers say DHH pupils have challenges working in all the four mathematical operations and application of money (Gregory, 1998; Nunes, & Morenu, 2002; Hall, 2005; Edwards & Crocker, 2008). For Latu (2005), the language problem is not only associated with DHH pupil but with learners who study

mathematics and other subjects in a second language. The difficulty, according to him, arises because of limitation of learners unfamiliarity with the second language used as medium of instruction.

Mathematics challenges for the deaf

A research was conducted to find out why DHH have difficulty in mathematics. In this research, counting number sequence for the DHH and hearing pupils between the ages three and six years was investigated. In most oral spoken languages, counting number sequence makes use of number base-10 rule, whereas most sign languages of the world ascribe to number base-5 rule. The investigation covered abstract counting, object counting and creation of sets of a given cardinality. Deaf children were noted to have made age related lags in number sequence and in counting. This reflected the number base rule in sign language. The hearing children who had longer base rule indicated counting sequence on the number string better than it was predicted by their knowledge of the linguistic sequence of numbers. The article asserted that sign language provides deaf children opportunities to develop counting abilities just as their hearing colleagues (Leybaert and Cutsem, 2002).

In another study done to search for scientific evidence about strategies DHH pupils use to solve mathematical problems, Frostad (1999) used task that involved four canonical additions and subtractions involving numbers 1- 25. The pupils were 5 six year olds, 6 seven year olds, 6 eight year olds, 7 nine year olds and 5 ten year olds. The participants were interviewed and two video recordings of the interviews were analysed to identify the strategies used in the participants' activities. The study showed that the 6 year olds solved problems in the number range 0 to 5 while only one of them is able to solve the problems involving number range 6 to 10. The 7 year olds solved problems from 0 to 10 but only 4 of the 6 pupils worked on number range 11 to 20 and 1 solved a task beyond 20. Number range 0

to 20 problems were solved by the ages 8, 9 and 10 except for one participant, while the task beyond 20 was solved by half of the 8 and 9 year olds though 4 out of 5 of the ten year olds also did solve the problems correctly.

In a related study, pupils used 'centimo-rods and plates' learning aids which contain 10 and 100 cubes to explain the problem. Some moved the cubes to show how they shared the apples while others showed how the apples were eaten using sign language. The researcher observed that students using both hands to explain depending on the situation used one hand to represent people and the other to represent apples. They related among the hands using 'localisation' of subjects and objects in order to explain themselves. Those who used both hands cautiously did well unlike those who used their hands arbitrary. Besides, rhythmic movements were observed to show how they did their repeated additions. Those who did not maintain the rhythm failed to get the right answer except mediation.

Although most of these pupils were experienced Swedish Sign Language (SSL) users they could not solve the problem given them. The study revealed that the pupils skill in SSL could facilitate formation of concepts in mathematic although it did not correlate in solving mathematical problems. However, over reliance on sign language could make problem solution complex and confusing due to the long processes required before getting an answer. The researcher identified that DHH pupils need more time to learn mathematics and special attention need to be paid to understanding of complex concept as compared to the hearing (Foisack, 2007).

Teachers experiences in teaching DHH

There are limited math specialists teachers for the DHH. Most teachers of the deaf are not quite comfortable teaching the subject at higher levels for this reason (Swanwick, et al., 2005). Teacher's training and experience in teaching mathematics to the DHH influences

performance among the students. Studies show that adequate mathematics pre-service training has positive effect on student's performance in the subject than those without adequate pre-service training. However studies shows that most mathematics teachers of deaf students were inadequately prepared and some have not taken mathematic courses (Kluwin, and Moores, 1985).

With regards to teachers experiences in teaching the subject, they find that the DHH's knowledge base in mathematics is insufficient for continues education or in professional fields without adequate language base. However, in his studies about mathematical achievement of DHH, Frostad found that the students did much better than had been recorded by preceding research works (Frostad, 1996). Teachers in special schools are of the view that they have improved records of mathematics performance compared to those in inclusive settings. Kelly, Lang and Pagliaro (2003) see the situation as a function of students' placement. They gave their reason based on their study to survey problem solving practices of children in grades 6 to 12. They found that teachers in integrated system are not likely to see oral or written language as the main barrier to problem solving for DHH students. They realised that teachers give more attention on concrete-visual strategies more than they give to analytical strategies. In addition teachers give exercises on 'practice problems' where the problems does not require much thought and the operation is obvious than 'true problems', where neither procedure nor answer is not obvious to the student.

Dealing with the challenge

In examining factors which promote recall of math, Lang and Pagliaro (2007) found that among familiarity, correctness and imagery and signability, imagery followed by familiarity were best predictors of geometry recall. School assignments are a way by which students can achieve familiarity, problem solving skills and build up learning based on

previous knowledge. Assignments done with the involvement of parents often helps also. In a study to find the benefits of family involvement in student's homework, results indicated that well-designed interactive homework assignments positively engage parents and promote student achievement (Van Voorhis, 2001).

Besides these, there are conditions and aspects of communication which influence teaching and learning mathematics. Communication in teaching and learning the subject could involve human and non-human agents. Tall (2008), cautions that non-human materials such as computer programs and other teaching and learning materials need to be designed appropriately to fit the lesson and concepts to be taught. The use of information technology is a strategic instrument for teaching various courses including math for the deaf. Wireless technology enhanced classroom (WiTECH) environment have been developed and used to explore math teaching and learning activities. The technology which was used to teach geometry helped students to understand content of teaching and reduced students' mistakes, communication difficulties and augmented class interaction and participation. Students expressed the desire to continue to use the 'WiTECH' technology (Lui et al., 2006).

Software for math education for the deaf in 3D interactive computer based technology model 'Mathsigner', has also been developed as a tool to help improve math competency of DHH students. The program incorporates interactive environment in both spoken and sign language animation in three dimensions. Prototype of this software technology is being tested at the moment to assess how it affects learning among the DHH students Adamo-Villani & Wilbur, (2007). Visual-spatial scheme is also known to have helped improve mathematics performance among DHH students. However, when this scheme was applied to student beyond middle school level, as stated elsewhere, the hearing student performed well at all

levels from middle school to college levels but DHH student performances were low (Blatto-Vallee et al., 2007).

Another study to enhance performance of DHH students' performance in math gave opportunity for the students to learn core mathematical concepts which many hearing individuals have access to informally and promoted connections of the concepts to mathematical representations used in the school. This was merged with access to information to word related problem and transformations over time. The researchers reduced the need to retain information of sequence of events in memory. Success in the intervention was attributed to teaching plan processes, visual materials and motivation of the learners (Nunes, & Morenu, 2002).

The National Council of Teachers of Mathematics' learning principles for schools suggest the need to link math concepts to student's previous knowledge. In their view this linkage facilitates problem solving situation for learners. They also recommend the need to build up learning based on previous knowledge of students (NCTM, 2000). In a review of Nunes, (2004) teaching mathematics to the deaf, Hall, (2005) also noted the need for teachers to find ways of bridging the 'incidental concept gap' between the hearing and their learners. He suggests the need for math teachers of DHH students to systematically teach concepts and ideas when teaching math in class.

System dynamics approach to teaching math to the DHH students

Given the peculiar problem with regards to their hearing counterparts, people who are DHH use an acute sense of vision in capturing information. Using sign language alone to teach the concepts of mathematics for these students is not enough to increase understanding (Blatto-Vallee et al., 2007). There is a high emphasis on the use of visuals in teaching educational contents to the deaf (Lang, H. G., <http://people.rit.edu/easi/easisem/lang1.htm>).

The literature on how the mathematics challenge is being dealt with suggests that the use of technology and computers in bridging the knowledge gap is not a new concept. System dynamics could therefore bring an addition to the various efforts to close this gap. System dynamics approach to learning and teaching is a computer modelling method with techniques for understanding and discussing complex issues and problems. ‘A system is more than the sum of its parts’ A problem with any part affects the other parts of the system. When the learner focuses on the problem and its relation to other parts of the system, the student is able to synthesis understanding of the problem with a broad view as it connects to other parts of the system (Meadows, 2008).

As mentioned earlier, DHH students have difficulties relating elements of math problems to find solutions to them (Blatto-Vallee et al., 2007). System dynamics methodology such as interactive learning models model and causal loops provide graphical images that link elements in mathematical problems and have potential to facilitate understanding for DHH students. Besides system dynamics method provides learners with opportunity to explore problem areas for their understanding with the guide of teachers unlike the traditional way of teaching where the teacher is the source of knowledge (Latu, 2005).

Fisher (1994) has identified the system dynamics approach to learning of mathematics as a tool for creating and understanding complex concepts in mathematics. The concepts include algebra and calculus courses. The approach has the capacity to show mathematical problems solved to include the issue over time. Students of her class understood the problem solved and could relate it to a real world situation. Students describe mathematics as a difficult subject because, they are unable to appreciate that it is a language which happens to be rigorous.

Mathematics according to her has some uncertainty related to its symbols. The abstract nature of the subject makes student think that it is a very difficult subject to learn. However system dynamics tools help students to identify math as concrete and interesting subject to study (Fisher, D. http://www.clexchange.org/lom/cle_books.htm). The success of system dynamics method in teaching in the past portrays great potential in facilitating learning for pupils from kindergarten upwards. Once teachers introduce the topic and guide pupils, the pupils take over and teachers serve as guides to the lesson. The shift of roles helps learners to develop skills and responsibilities to discover for themselves (Stuntz et al., 2002).

Lang and Pagliaro (2007) examined factors that aid recall of mathematics terms by Deaf students and its implications for teaching. They found that concrete terms are readily recalled compared to abstract terms. They cited that geometrical terms signed are easily recalled than those finger-spelled or represented with compound signs. This shows that the use of system dynamics modelling would provide a concrete visual environment from which DHH peoples can easily identify with the basis for which problems are solved resulting in improved understanding in mathematics.

The National Council of Teachers of Mathematics Standards 2000 Project, suggests the need for math teachers of special needs education, to adjust to the use of computer as an appropriate tool that facilitates deep mathematical teaching and learning (NCTM, 2000). Computer technology used to teach math according to Lui et al., (2006) did not only improve students participation in class and reduced mistakes of students but students showed interest to use the WiTECH environment to learn other topics in math. System dynamics use computer modelling technique to create the problem, study it through analysis of its parts through the feedback of the elements of the structure to understand the problem. This helps the students understand the links and find the solution required. This provides DHH students

the opportunity to investigate problems given with tools in system dynamics unlike the use of practice problems which does not allow for analytical thinking in math (Kelly et al.,2003).

The decision to conduct research in this area despite the small class sizes of DHH schools are due to the evidence that this method facilitates learning in various subject such as in mathematics (Quaden, and Lyneis, 2000; Fisher, 1994; Msefer, 1993). The method also uses visual language in the form of icons and graphs. DHH individuals rely heavily on visual icons and symbols in the processing of information and in communication through sign language which is a basic medium of communication for the deaf. Also the use of visual images promotes recall among DHH students (Lang, and Pagliaro, 2007).

Besides, model building is an iterative and intuitive skills that can be transferred to other areas of study when learnt. These reasons should make it possible to apply the modeling methods to facilitate learning for DHH students in mathematics. According to Forrester, (1992), as a learner centred approach to learning, it provides common foundation for many fields of study including mathematics in basic schools. Teachers in basic and secondary schools use system dynamics tools to improve e their teaching and learning. Stock and flows diagrams, behaviour over time graphs, causal loop diagrams, simulation games and computer models facilitates understanding of mathematics problems. These tools promote mathematical reasoning, problem solving and communication skills of students (Lyneis, & Fox-Melanson, 2001).

Experimental Design

Experimental Design

DHH students at two schools for the deaf were the participants of this experiment. These students have small class sizes throughout the country. The initial participants for the study were eight, but four dropped out before the study was completed². The remaining four who became the main participants for the study were tenth grade pupils. To find out the differences in mathematics performance between the DHH and the hearing, 28 hearing tenth grade pupils were also involved in a part of the study.

The schools for DHH were special educational institutions where student population of the class is small (usually between one (1) and six (6)). Some of the pupils have additional challenges in addition to their hearing loss condition and so there are separate classes organised for them. The one-group pre-test post-test-one and post-test-two design was used for the study. The small sizes of the classes used could not allow for randomization and control of groups (Spector 1993; Cook, & Campbell, 1979). The DHH participants received the pre-test³ using the regular method (RM⁴) of solving questions, teaching instruction in

² The study started with two schools for the Deaf and hard of hearing. Due to the small nature of students in a class for these special schools, there were four participants from each school. In the middle of the study, participants from one of the schools had to dropout due to the need for them to prepare for final examination. Therefore, the four remaining participants from the other school were the only participants whose data is analysed in this study.

³ The pre-test is test administered to the participants to obtain their previous knowledge and performance on the topic. The test was based on questions from their mathematics textbook. The pre-test was also done using their regular method of solving mathematics problems.

⁴ RM refers to the regular method in which pupils are taught and by which they solve questions. In this paper, it written after either pre-test (RM) or the post-test-two (RM).

system dynamics and the post-tests⁵ on math topics in their respective text books. The hearing participants received only the pre-test (RM). The students were pre-informed ahead of the study. The design was carried out successively as their subject time table permitted followed by interview of the tenth-graders. The pre-test and post-tests questions were conceptually the same but neither the words nor numerical contents were the same. Time between tests and interview of DHH participants were closely done to reduce intervening errors.

Research Method

The research method used for the study is a teaching experiment. The ‘within subject’ design is adopted for the purpose of analysis. There are three main parts of the design. They are the pre-test, the teaching instruction in system dynamics and the post-tests. In addition there was an interview. The pre-test was first administered to examine the previous knowledge of participants on the subject matter. This was followed by the teaching instruction for DHH participants. The post-test was divided into post-test-one (SD⁶) and post-test-two (RM). Post-test-one (SD) was carried out to assess participants’ knowledge gained in system dynamics and how they solve problems using it. Post-test-two was conducted to examine whether system dynamics teaching instruction made an impact in improving their understanding of the topic treated. The post-tests were followed with an interview with participants to explore their experiences in using the regular method and system dynamics method. Teachers were also interviewed.

⁵ The post-tests were tests conducted after the teaching instruction in system dynamics. Post-test-one was based on the teaching instruction in system dynamics. Participants solved mathematics problems using system dynamics method. In post-test-two, they used the regular method in solving similar mathematics problems. Post-test-two was conducted to enable the researcher identify the impact of the system dynamics teaching instruction on participants’ understanding of the topic.

⁶ SD in post-test-two refers to the use of system dynamics method in solving the test questions. It is written as post-test-one (SD)

The topic 'økonomi' was used for the deaf and hard of hearing as well as the hearing participants. The term 'økonomi' is the Norwegian word for 'commercial math'. This was taken from students' mathematics text book 'Matematikk for ungdomstrinnet, Faktor 2', (Hjardar, & Pedersen, 2007).

Data collection and analysis Procedure

Data was collected from the result of pre-test, post-test-one and post-test-two as well as from interview of participants and teachers of the deaf and hard of hearing. Some data was also collected during the teaching intervention. Teaching interventions were carried out using the Math Interactive Learning Environment for students (MILES⁷). The MILES was first drafted in English and later translated to Norsk. The drafted version in Norsk was proof read by colleague Norwegians who made corrections to the MILES.

English language was used for the instruction because of my limitation in Norwegian sign language. The administration of the school organized at least one teacher of the school to serve as a sign language interpreter in each of the days teaching was done. The test scripts were collected for marking when the tests were completed.

Analysis of the tests data

The pre-test, post-test-one and post-test-two scores were marked. Both pre-test and post-test had the same characteristics of questions. The marks were entered into Microsoft office excel spreadsheet for the analysis of raw data and the development of graphs used in

⁷ Throughout this paper, MILES would be used to refer to the interactive learning environment that was designed.

explaining the result. The pre-test was used as a benchmark of the study and post-test-one and post-test-two was compared to it. The hearing classmates completed only the pre-test of the study. Their pretest result was compared with that of the Deaf and hard of hearing to find out the differences that exists in their performance levels. This comparison is to make the study follow the pattern of other studies involving the DHH, where they always compared their results with that of the hearing.

Interview

To access participants' situational perception, behaviour and attitude towards mathematics, an interview was conducted in the school concerning their learning experiences. A guided semi-structured interview questions were designed to facilitate the interview process (Patton, 2002). The questions included thoughts about math in the past, during the experiment and reflection on the teaching-treatment processes and its usefulness in understanding the topic. The interviews were conducted for participants on four different days. It was scheduled according to the class mathematics periods. During the interview, teachers assisted in the sign language interpretation. The interviews were recorded and transcribed on the same day the interview was carried out. This was done to maintain the quality of data collected during the study. The participants were informed of the purpose of the interview and their permission was sought to take part as well as to record interaction of the interviews.

Interviews were also conducted for five teachers of the Deaf. Their interview was a general discussion involving challenges of the deaf and hard of hearing in mathematical performances and other related issue in deaf education.

Analysis of interview data

Data collected through the interviews were analysed by first familiarizing myself with the data collected by repeatedly listening to the interview records of participants and reading the transcripts. This was done to in order to represent the integrity of the participants narratives (Green & Thorogood, 2004). After gaining a good understanding of what participants were saying, the data was coded according to the questions asked during the interview. From codes created, quotations were selected to portray what participants said and to bring out their perceptions of both system dynamics as a new method in learning mathematics and the traditional way of learning the subject.

Sequence of Experiment

Sequence of the experiment			
Part	Activity	Groups and their participation in sequence	
		1st term DHH tenth-graders	1st term Hearing Tenth-graders
One	Pre-test	Commercial mathematics	Commercial mathematics
Two	a) Teaching treatment using system dynamics	Commercial math	Not applicable
	b) Post-test- one	Commercial math	Not applicable
	c) Post-test-two	Commercial math	Not applicable
Three	Interview	Issues prior to the study, pretest and post test	Not applicable

Table 1 The sequence of the experiment according to their parts

Pre-test

Students worked on the pre-test questions based on their previous knowledge on the topic ‘commercial math’ in the test book. This preceded the teaching treatment. The test instrument is attached at appendix two.

Teaching treatment

A. Teaching Objectives:- At the end of the teaching, students received instructional guide on practice situations involving finding: i) percentages on quantity/amount, sales /discount offers given in percentage and final cost of item on sale, ii) value added tax on items (goods and food items) and final cost of the items, iii) decrease on quantity/amount-discount/sales offers given in percentage and the final cost of item and iv) interest on bank account based on money at the bank and period of savings. Prior to the above four items, a discussion on basic concepts on the topic was held to serve as introduction to the lesson. Both the pre-test and post tests are in norsk and had the same concepts and purposes. However, the words and numbers used differ. The tests copies are however presented in English language at the appendix two. The teaching was carried out by me with the help of teachers who took turns to assist to interpret lessons in Norwegian sign language to participants.

B. Teaching Material Design and Strategy A computer based Mathematics Interactive Learning Environment for Students (MILES) was designed using the STELLA software. This was used to demonstrate how to solve mathematic problems. Participants then practiced its usage and used it in the solving of the class exercises and tests assigned them.

Teaching material design and strategy were in five different sections as follows:

1. Introduction: Concepts (key words) on the topic 'økonomi'
2. Calculating percentages of quantity/amount
3. Find total cost of items given without value added tax
4. Find price of items on sale offers/reduced prices
5. Find growth on bank account with interest over a period.

Introduction: Concepts (key words) on the topic: To introduce the lessons, general discussions were carried out for participants to get general view of the lesson such as value

added tax, interest, p.a, (per a year), rebate and VAT inclusive to name a few. Figure 3 are picture illustrations which discussions held on as part of the introductory activities.

Participants were shown labels of fruit juice, yogurt and peanuts and were asked to talk about their constituents. The portions of the main constituents were listed according to the inscriptions on their respective labels. The overall content volumes were also noted on the writing board. Participants were informed that the information taken would be used to find their respective actual volume in the items used as illustration.

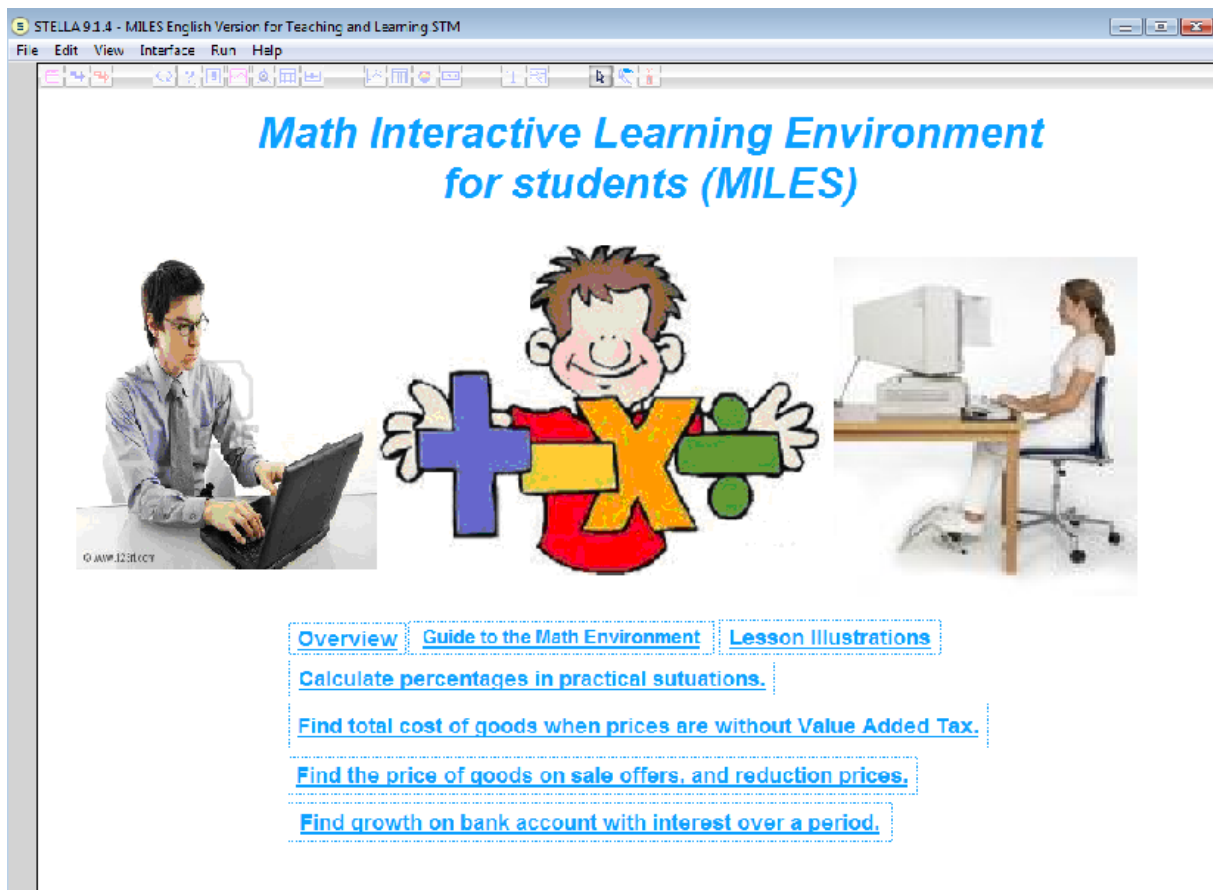


Figure 1 Introduction of interactive learning environment (MILES⁸) and math topic

⁸ Teaching interventions were carried out using system dynamics interactive learning environment which was created by the researcher for the purpose of the study. The interactive learning environment is known as Math Interactive Learning Environment for students (MILES).

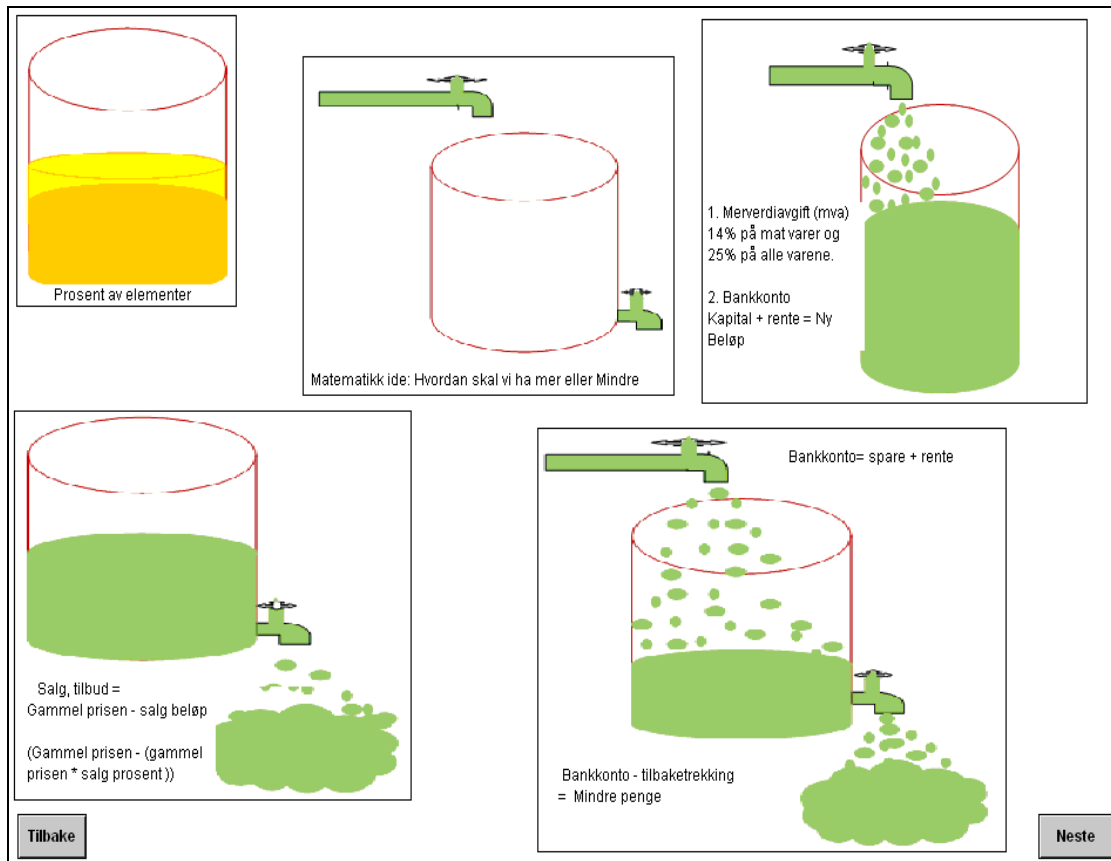


Figure 2 Illustrated barrels fitted with inflow and outflow pipes to depict accumulation

Participants were also asked to talk about the price tags on items and clothes in shops they have seen. A sample illustration in figure 4 was shown to guide the discussions. Issues of the discussions centered on sales offers, value added tax inclusive and exclusive, comparing prices of different shops, high purchase possibilities and interest on such purchases.

A question was asked to find out participants knowledge on operating savings account. Participants responses were used to draw their mind to interest people get when they save money in banks and differences in the rates given to youth and adults.

A) Calculate percentages in practical situations.



LITAGO 2x vanilje-, aprikos- og bananyoghurt

INGREDIENSER:
 Banan: 9% banan, 0% sukker
 Aprikos: 9% aprikos, 0% sukker
 Content 125 g

FAKTA:
 Energi: 200 kJ (48 kcal)
 Protein: 3,2 g
 Fett: 3,2 g
 Karbohydrat: 11,2 g
 Folsyre: 0,1 mg



ELDORADO TROPISK NEKTAR

INGREDIENSER:
 Vand, tropisk frugtjukskonserver
 (Ananas, appelsin, søde passionfrugt, mango, appelsin, guava, ingefær)

Næringsindhold pr. 100 g:
 Energi: 250 kJ (60 kcal)
 Protein: 1,1 g
 Karbohydrat: 11,3 g
 Fett: 0,2 g
 Kostfiber: 0,1 g



Mills PEANUT Butter GROV TYPE 350g e

INGREDIENSER: Peanøtter (74 mg), malket mælk, smør, salt, sødestof
 (Ester)
 Protein: 20 g
 Karbohydrat: 19 g
 Folsyre: 0,1 mg

PEANUT BUTTER

INGREDIENSER: Peanøtter (74 mg), malket mælk, smør, salt, sødestof
 (Ester)
 Protein: 20 g
 Karbohydrat: 19 g
 Folsyre: 0,1 mg

Figure 3 Labels of fruit yogurt, Fruit juice and peanut butter showing content of items and their constituents

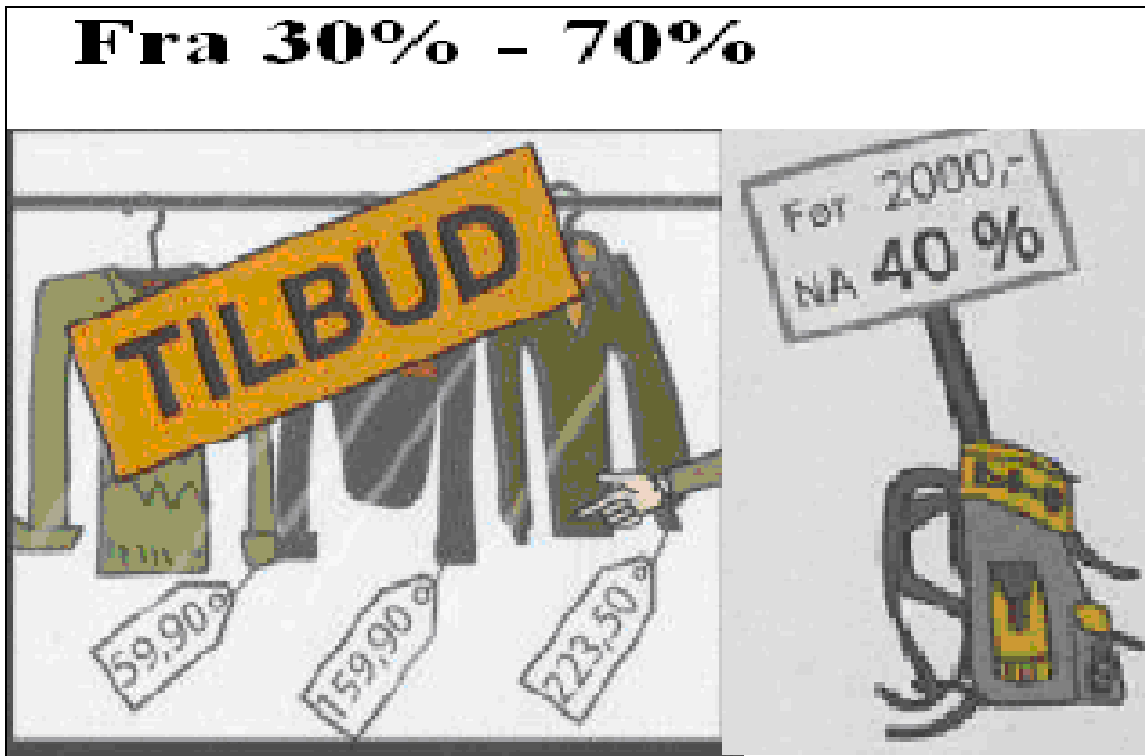


Figure 4 Display of clothes with their regular price tags with their sales offers and reduction in percentages

Calculating percentages of quantity/amount: The section was aimed at finding portions of quantity of items in volume and amounts of money. There was a brief review on the introduction on fruit and juice labels. The contents of the labels and the total volume were also listed.

Participants were asked to identify the elements and their percentages as well as the total volume/amount of money. The elements identified in the labels were also identified in a sample question which was put on the writing board.

Participants were led to solve sample question using the regular method. They were also guided through the use of the MILES. This interactive environment detail is displayed in the 'Appendix 1'. A demonstration on the use of the MILES with the element participants had identified earlier in the questions was done on the writing board. They were then guided to

identify how to read values of simulations on the smart-board. Participants were then asked to use the MILES to solve similar problems as illustrated in the figure 5 below.

There after participants were grouped into twos to use the MILES to solve sample questions from the class math text book. During this period, the student-researcher went round to observe, question and attend to questions of participants.

This model in ‘figure 6’was the one of the four models developed to calculate percentage of an item such as part of an item, quantity or an amount.

$$\text{Equation 1: 'percent_of_item = Item*percent_value'}$$

$$\text{Units: 'Kr = (Kr)*(Unitless)'}$$

Unit of the ‘item’ in the equation is generic and could accept other units being measured. But the percentage-value remains ‘Unitless’. Participants used it to determin given portions of items.

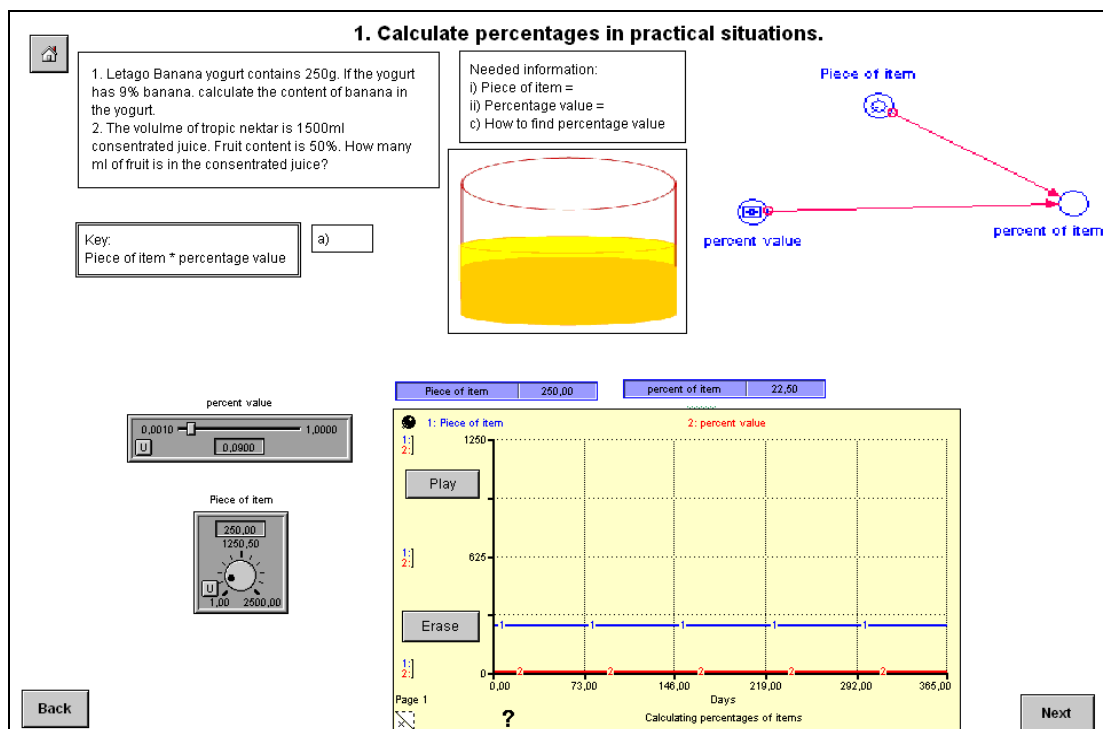


Figure 5 Sample worked on finding volume of part of a constituent using percentage and total volume

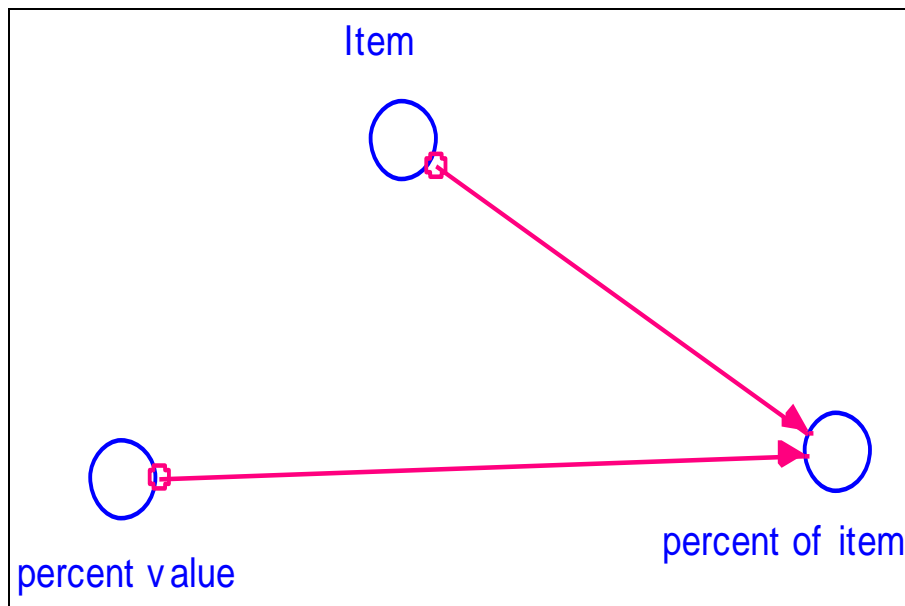


Figure 6 The model used to calculate percentage of an item, quantity or amount

Find total cost of items given without value added tax (VAT): The section was aimed at calculating value added cost of the item for sale and adding it to the sale price to determine the total cost of the item. Once again a brief overview of the tag on consumer items at the sales shop which has VAT inkl., and excl., was done to introduce the section.

With the help of MILES the difference between VAT inclusive, VAT exclusive and rate of food VAT as 14% and non-food VAT as 25% were explained to participants. Other VAT exceptions such as transport fares were also discussed. Receipts from shops were used as additional teaching and learning materials as shown in ‘figures 7 and 8’.

B) Find total cost of goods when prices are given without Value Added Tax (VAT).

Merverdiavgift

? Hva er forskjellen på inklusiv og eksklusiv?

MP3 spiller
600 kr ekskl. mva.

Digitalkamera
600 kr inkl. mva.

Vi betaler en merverdiavgift (mva.) på mange varer. Denne avgiften kaller vi i dagligtalen for moms. I 2006 var merverdiavgiften på de fleste varene 25 %. På matvarer var merverdiavgiften 14 %. Hvis prisen på en vare er oppgitt uten merverdiavgift, må vi legge til merverdiavgiften for å finne ut hvor mye vi skal betale.

Pris uten merverdiavgift forkortes slik:
Pris ekskl. mva.

Pris med merverdiavgift forkortes slik:
Pris inkl. mva.

Hva betyr ekskl. mva. og inkl. mva.?

Ekskl. betyr eksklusiv, og inkl. betyr inklusiv.

Figure 7 Illustration of VAT % and amount on food, non-food item

SAFARI FANTOET
ORG. NR. 976 959 056 MVA
FAKTOFVEIEN 16
TLF: 55 27 92 10

07.09.10 19:11 Kasse:003
Kvitt:25029 OperN:039

LITTELH. ØKOLOGISK 1..	14%	17,20
EPLEJUICE 2L. HÅRST. PÅLID	14%	14,90
MELLEMGRØVT BRØD SKÅRET	14%	26,90
BÆREPUSE	14%	0,90
SUBTOTAL		59,90
Sum 4 varer		59,90

BANK 59,90

Mva%	Grunnlag	Mva	Totalt
14,00	51,75	7,20	59,00
25,00	0,72	0,18	0,90
SUM	52,47	7,43	59,90

BANK: 11289503-714477
bankkonto: 2277-4
AIB: 0570000023010
02.09.2010 16:47
Ref.: 301088 038:20 IAL

Beløp = 59,90

0390300291291
DIN KASSEFØR
ØIKSER DEK
VELKOMMEN TILBAKE TIL
EN NYGJELDIG HANDEL
ÅPENT 9-21 (20)

Velkommen til
REMA 1000 NYGARDSGATEN
ORG. NR. 992 331 658 MVA
TLF: 55 32 04 05

31.08.10 09:11 Kasse:001
Kvitt:590480 OperN:011

HYETE RUNDSTYKKE	14%	19,00
10 x kr 1,90		
BANAN I POSE	14%	17,41
1,514kg x kr 11,50		
DURACELL ULTRA M3	25%	44,50
PEANØTTER LANDLORD	14%	10,30
BÆREPUSE	25%	0,70
ØREAVRUNDING		0,09
Sum 14 varer		92,00

KONTANT 100,00
KONTANT TILBAKE 8,00

Mva%	Grunnlag	Mva	Totalt
14,00	40,97	5,74	46,71
25,00	36,16	9,04	45,20
SUM	77,13	14,79	91,91

Takk for handelen
Velkommen igjen!
Åpningstider:
08:00-22:00 (09:00-20:00)
De smarte sparer tusener!
Sammenlign priser på www.rema.no

TELEFON 55 39 07 20
LAMYRANE 6
5132 NYBORG
ORG. NR. 988 170 759 MVA

REG 01-09-2010(Ons) 13:05
EKS. 5 KASSE 1 100

HERRE	25%	129,00
GR. LAG 25%		103,20
25% MOMS		26,80
TOTALT		129,00
BANKKORT		129,00

BAX: 320113-71031986
01/09/2010 13:04
bank øxep:
*****22776-4
A10 05780000021010
TVR 8000048000
TS1:6800
REF:282 024656002580
BELØP= 129,00

TAKK FOR BESØKET
VELKOMMEN IGJEN!

Kvittering

Kvitteringsnummer: 0
SISForsvarets: 206
11:08 08:08:2010
Partiskysss / skss (59)

Kortnr: 1105080170
Kr. 640,00
Herav mva kr. 47,41 (8,00%)

Fra: annerks plass, bybanestopp S11
Til: Linje 1

610881 80NE:
110-113-114-117-121-148-149
Gyldig for reiser
Innenfor grensene i Sørøst-Norge
Gyldig til: 01 10 2010
God reise!
Restrent på kort: 0,00

Org. Nr.: 80 992 051 885 sva
18333,19

Figure 8 Receipts from different shops showing purchase records with their respective VATs

Participants were led to go through three questions using the regular method to solve a sample question involving VAT exclusion. The MILES was opened and participants were allowed to identify meaning and elements required for each of the questions. Participants were led to put in values of the elements identified and simulated the MILES. Participants were then called to the smart-board to read the value of the simulation.

Participants worked individually to try their hands on sample questions given them. They worked on both VAT on food and non-food items. While they were doing this, the researcher went round to observe, guide where there are difficulties, question them to explain what they were doing, explain their findings and answer questions from participants. Figure 10 shows sample of the work on VAT. The class ended by reassembling to talk about what they did and their observations.

The model in 'figure 9' is the model constructed to calculate value added tax of an item for sale given without the VAT amount. It is used to teach participants how value added tax adds to actual value of an item being sold.

$$\text{Equation 2: 'VAT_in_kr} = (\text{The_item_price_without_VAT} * \text{VAT_in_}\%)'$$

$$\text{Units : 'Kr} = (\text{Kr}) * (\text{Unitless})'$$

$$\text{Equation 3: 'The_item_price_with_VAT} = \text{The_item_price_without_VAT} + \text{Step}(\text{VAT_in_Kr}, 185)'$$

$$\text{Units: 'kr} = (\text{kr}) + \text{STEP} ((\text{kr}), 185)'$$

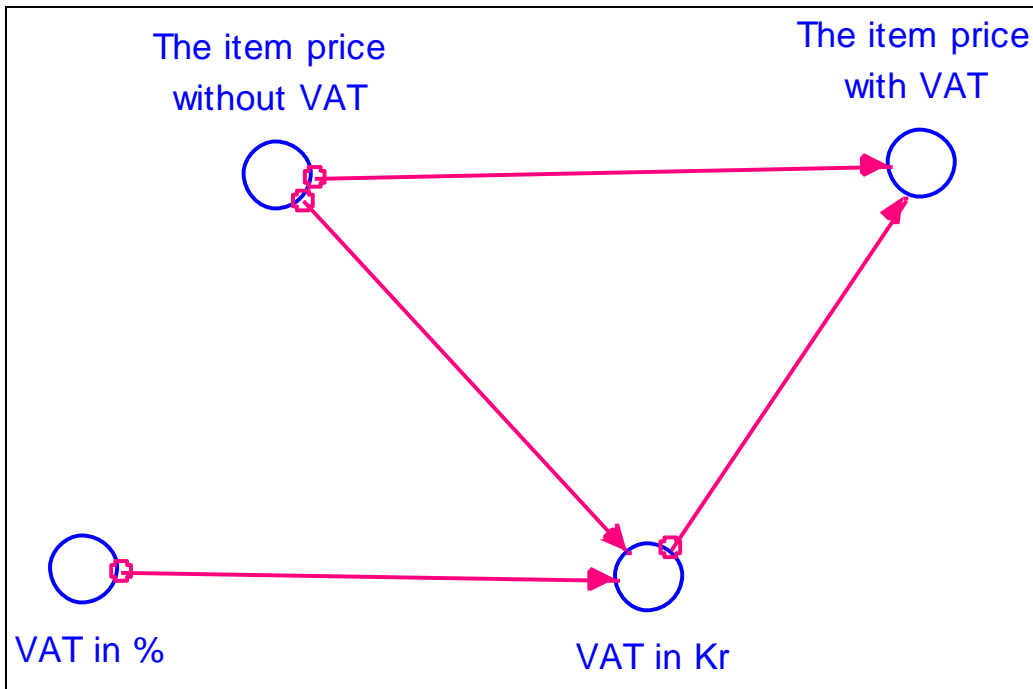


Figure 9 Model for the VAT calculation in the ILE

Find price of items on sale offers/reduced prices: This section was aimed at calculating the price of items with sales offers or reduction sales. Sales items and other offers were given in percentages while the old prices are on display. Prices and offer differences of same item shown at different places were also compared.

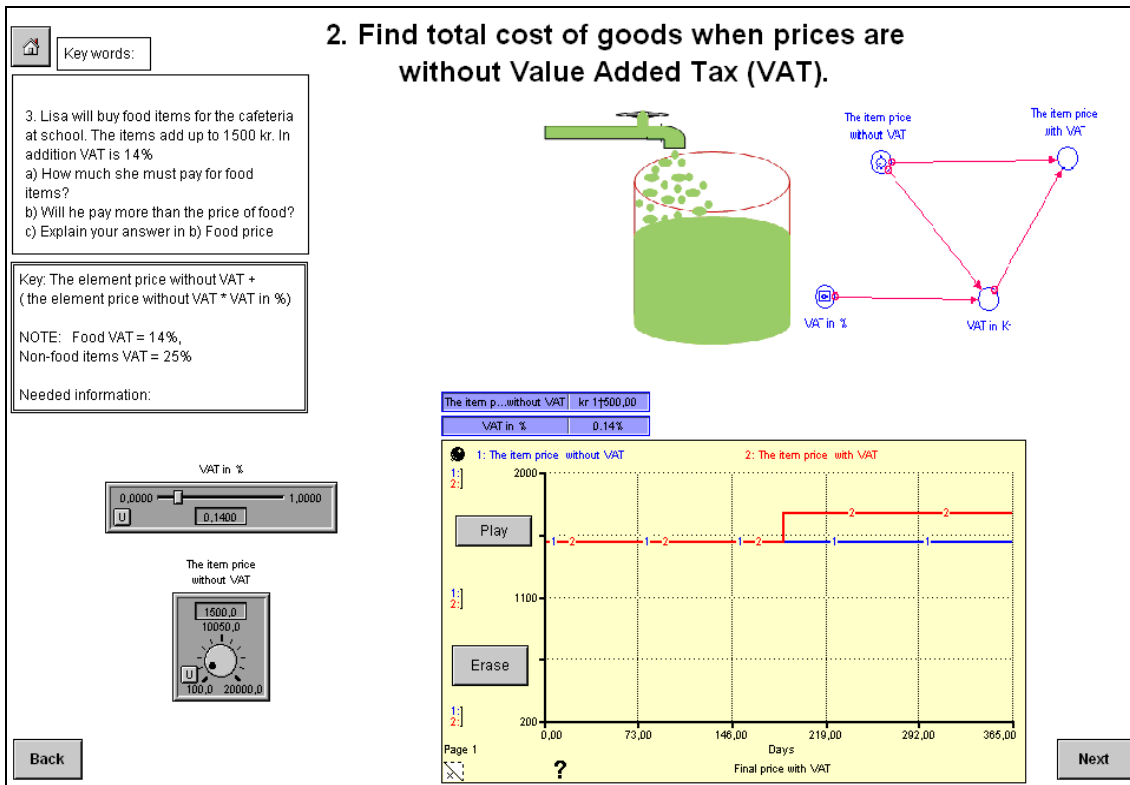



Figure 10 Participants work sample on food VAT on food items purchased showing the final value

The lesson started with a smart-board display of items on sales. Participants talked about the prices and the sales offers. One participant was called to lead in working out sample sales question put on the smart-board using the regular method. The participant was to first explain the question and its requirements, and secondly to identify elements in the question needed to solve the problem.

After this, participants were led in using elements in the question. Participants were then asked to insert elements into their appropriate places in the MILES. Participants took turns to simulate and read the values on the graph. Questions were then asked on the simulation to see how students understood the question they have worked on. Sample of the MILES used is illustrated below in ‘figures 11, 13 and 14’.

C) Find the price of goods on sale offers, and reduction prices.

Rabatt



Hva mener vi med rabatt?

Noen ganger gir forretninger rabatt, det vil si avslag i prisen. Varene blir da billigere enn den opprinnelige prisen.

Eksempel

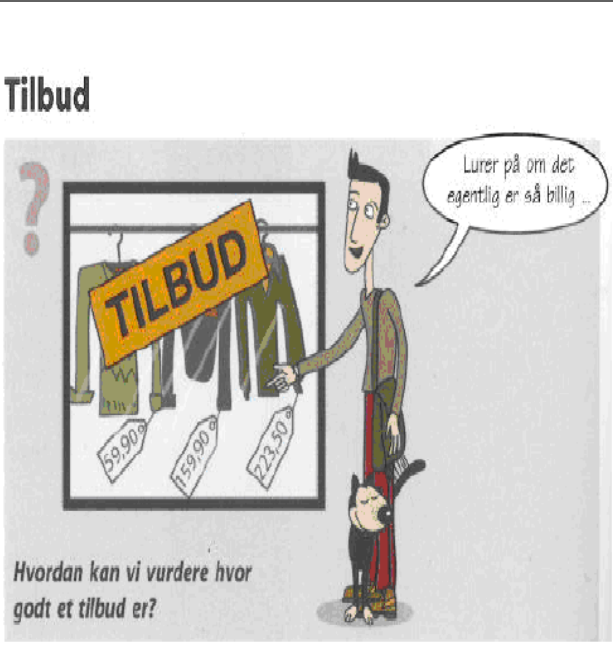
Sara kjøper en jakke. Hun får 5 % rabatt. Jakke kostet opprinnelig 420 kr. Hvor mye må Sara betale for jakka?

Løsning

Jakke kostet:	420 kr
5 % rabatt: 0,05 · 420 kr	= 21 kr
Ny pris:	= 399 kr

Sara må betale 399 kr for jakka.

Tilbud



Lurer på om det egentlig er så billig ...

Hvordan kan vi vurdere hvor godt et tilbud er?

Figure 11 Illustration to show Display of prices with sales offers and reduction prices of items in shops

The sales/ reduction in prices model shown in ‘figure 12’ is the third of the models built to enable participants investigate how sales/ reduction in prices of items cut down the amount customers pay for items on such offers.

$$\text{Equation 4: sales_or_reduction_value_in_kr} = \text{Item_present_price}$$

$$* \text{Sales_ \% _or_reduction_ \%}$$

$$\text{Units: Kr} = (\text{kr}) * (\text{Unitless})$$

$$\text{Equation 5: New_sales_or_reduction_price} = \text{Item_present_price} -$$

$$\text{step}(\text{Sales_or_reduction_value_in_kr}, 100)$$

$$\text{Units: Kr} = (\text{kr}) - \text{step}((\text{kr}), 100)$$

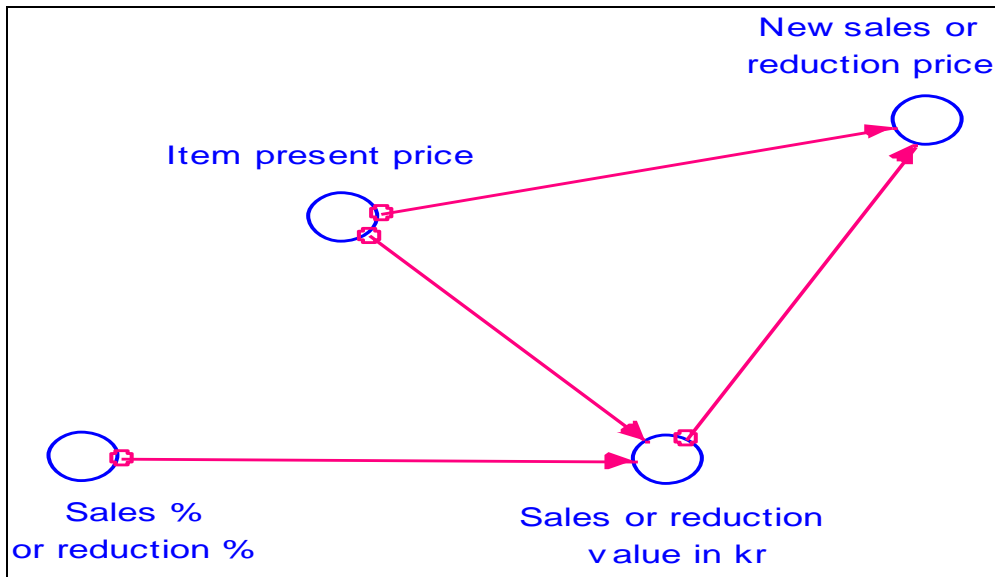


Figure 12 Model for the sales/ reduction calculation simulator

3. Find the price of goods on sale offers, and reduction prices.

a) Solveig buys a jacket at 5% rebate. The jacket regular price was 420 kr. How much must she pay for the jacket with the given rebate?

b) Martin shall buy a new bicycle with the price at 5000 kr, but he was offered 8% cash reduction. How much must she pay for the bicycle?

c) Simen buys a new stereo. The regular price is for the stereo is 8500 kr but he got it at 10% rebate. How much must Simen pay for the stereo?

Key: Item present price - (item present price * sales or reduction %)

Needed information:

a) Item present price =

b) Sales% or reduksjon % =

c) Calculate

Item present price

Sales % or reduction %

Item present price kr 420,00 Sales % or reduction % 0.05 %

1: Item present price

2: New sales or reduction price

Play

Erase

Page 1

?

The price on goods on sales offer or reduction in prices

Figure 13 Participants worked sample of sales offers on clothes

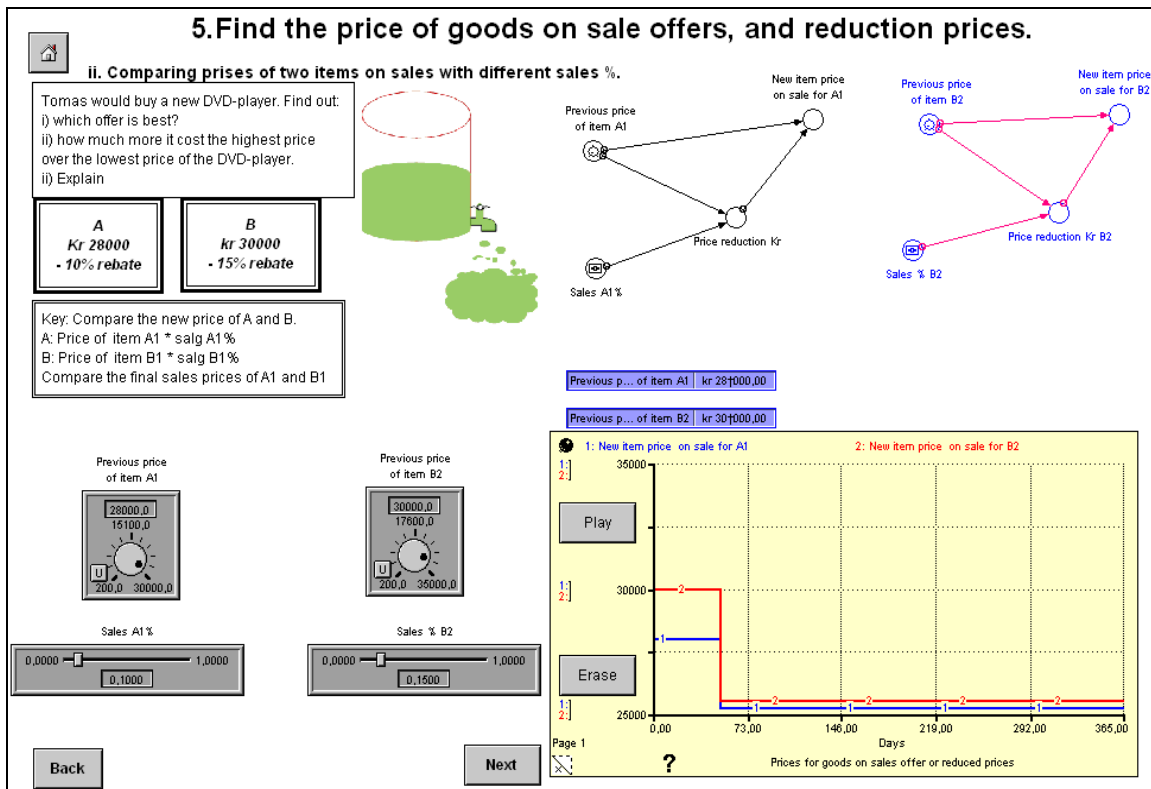


Figure 14 Participants worked sample on sales at two different shops

Participants worked in twos to work on three sample questions each. The researcher went round to ask participants what they had done, what has happened in their work and the meaning of what they have worked on. Where participants have difficulties they were assisted with explanation of the situation to guide them. The model for this interface and its model are in ‘figure 15’ and ‘figure 14’ respectively. The equations are as follows:

$$\text{Equation 6: } \text{Price_reduction_kr_A1} = \text{Previous_price_of_item_A1} * \text{Sales_A1\%}$$

$$\text{Units: Kr} = \text{'(Kr) *(Unitless)'}$$

$$\text{Equation 7: } \text{New_item_price_on_sale_for_A1} = \text{Previous_price_of_item_A1} - \text{step}(\text{Price_reduction_Kr}, 50)$$

$$\text{Units: Kr} = \text{'(Kr) - step((Kr), 50)'}$$

Equation 8: 'Price_reduction_kr_B2 = Previous_price__of_item_B2*Sales_B2%'

Units : 'Kr=(Kr) *(Unitless)'

Equation 9: 'New_item_price_on_sale_for_B2 = Previous_price__of_item_B2-step
(Price_reduction_Kr B2,50)'

Units: 'Kr = (Kr)-step((Kr),50)'

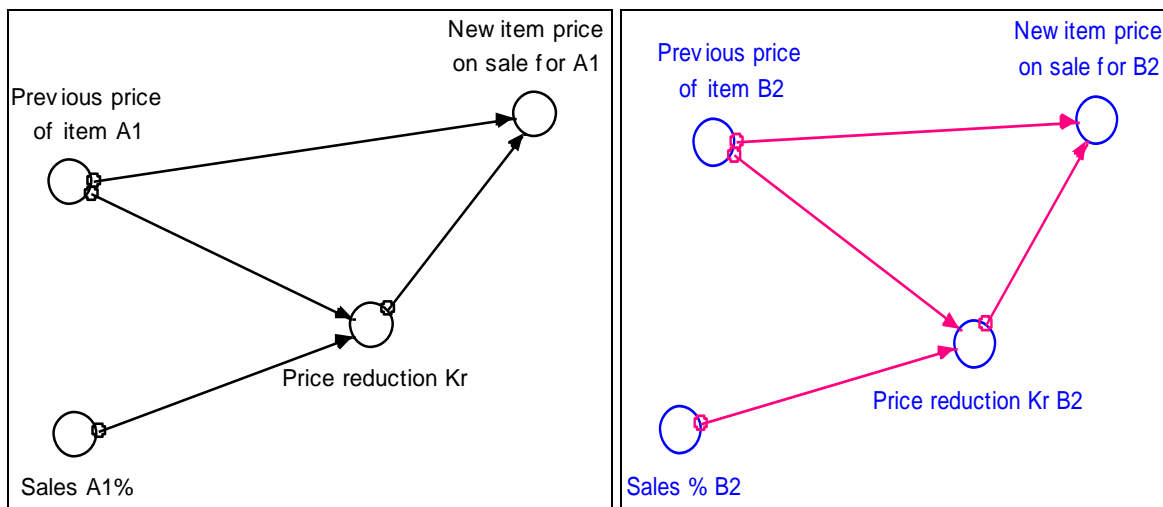


Figure 15 Comparing prices of an item of the same quality in two different shops

Find growth on bank account with interest over a period: Banks take in money from customers and lend them to others with an aim of promoting business. The banks take additional money (interest) from borrowers and pay part of this interested to those who put their money in to the banks. This section dealt with calculating interest on bank account and how it influences growth of money initially put into the bank by customers.

Business enterprises are noted for making profit over time when their intentions are fulfilled. In this direction, the more investment they make the more profit they earn over time. The interest money saved in a bank earns over time served as an illustration. The picture illustrated below in 'figures 16 and 17' were used earlier to show depositing money in the bank and how interest on the deposits adds to the original amount deposited.



Opportunity Int., <http://www.opportunity.org/our-work/bank-building/>

Figure 16 Bank customer depositing money into his savings account

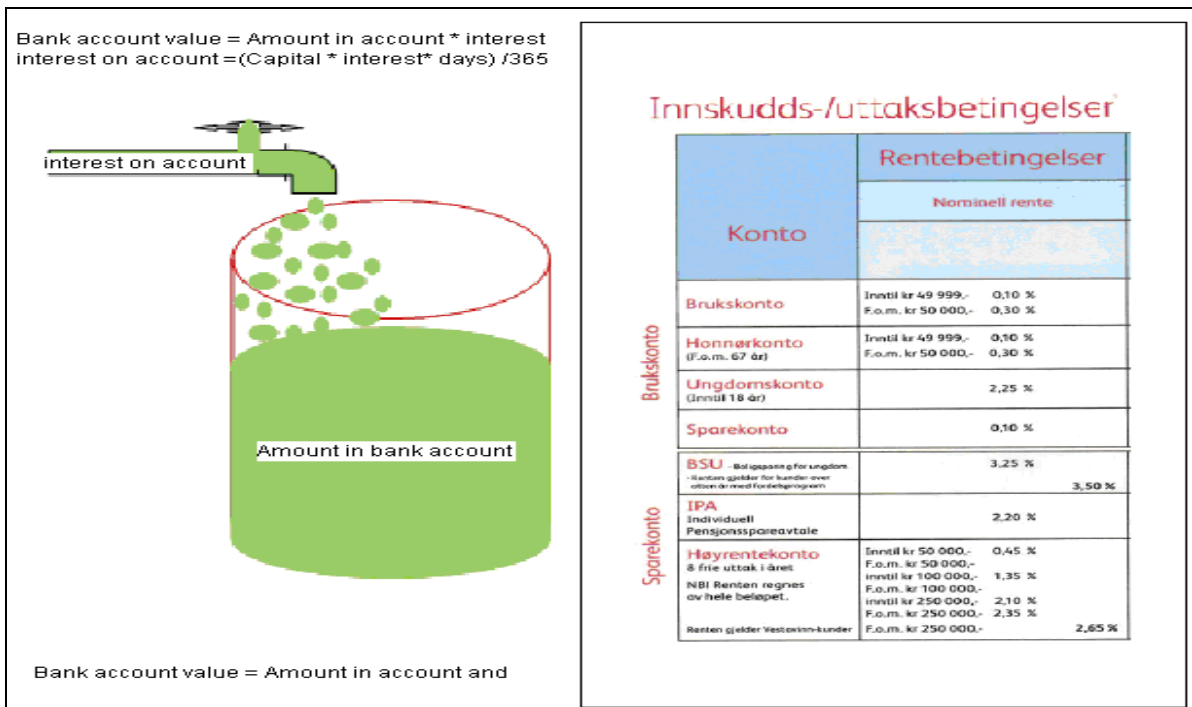


Figure 17 Bank customer depositing money into his savings account

Questions and answers on how banks work with money customers put in the bank, what the bank does with the money and how banks return interest on customer's money were used as explanation. This was discussed with background picture of someone at a bank

counter giving money to the teller. Another illustration shows the various interest banks pay to customers such as youth and adult accounts.

The interests showed in the MILES were used to calculate interest accrued on bank account over five months. Sample questions were shown from the class textbook and worked using the MILES. Participants took turns to work out on their own. Sample worked on the MILES are shown below in 'figure 19'. Appendix one' has details of the MILES designed.

The bank account sample model in 'figure 17' was built to help participants learn how interest accumulates over time.

Equation 10: 'Capital * (interest in percentage)'.
Units: 'kr/day = (kr)*((1/day))'.

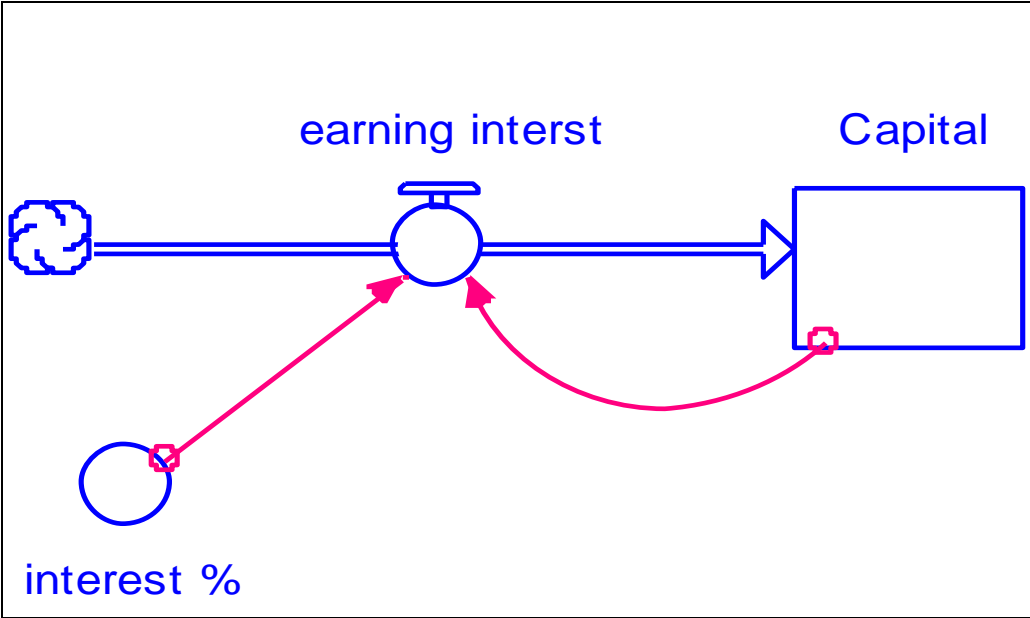


Figure 18 Model for the bank account calculation simulator

6. Find growth on bank account with interest over a period.

6. Martin has 5000 kr in the bank from January 1st. The bank gives him 2% p.a. as interest.

a) How much more would he receive after June than after March.
b) Explain

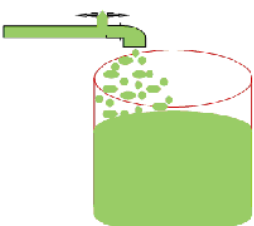
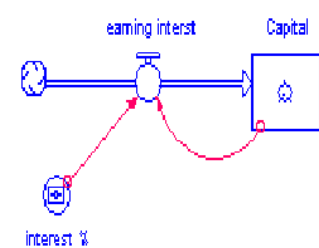
Q7. Herman and his friend put 10,000 kr in the bank. They get 5% interest p.a. on their money each year. After a year they withdraw and share the money with interest.

a) How much did they get in total that year?
b) If Herman got 7000 kr, how much did his friend get?
c) Explain your answer in b) above.

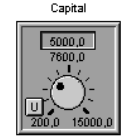
Key: $(\text{Capital} * \text{interest} * \text{number of days}) / 365$

information:
a) Capital in the bank =
b) interest given =
c) days/ 365


How to solve the problem

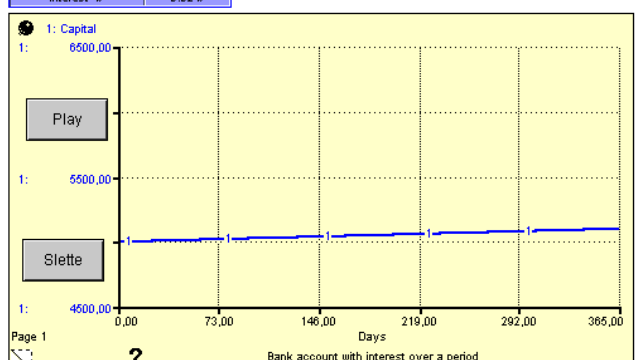
Capital



Interest %



Capital	kr 51101.01
interest %	0.02 %



? Bank account with interest over a period

Figure 19 Participants work sample on growth of savings account over a period (within one year)

Strategic approach in teaching

The strategy adopted for teaching was an inductive approach to learning math. It is a learner centred strategy that builds on the learners' previous knowledge through questions, answers and through personal investigation of a math interactive environment. The study used problem based techniques to identify key issues in questions presented in the class. The usage of MILES was demonstrated and participants practiced with it, before using it to solve math problems given them from their school mathematics text book.

By this approach, participants discovered for themselves the meaning to the problem put before them besides finding solution to the given problem. These processes helped learners to find solution to issues and problems in the topic treated and solved. According to Prince& Felder, (2006), the approach involves active participation of learners throughout the lesson period. The inductive process takes care of defining issues, identification or

development of principles and their application. The process although devoid of swift learning, provides opportunity for motivation and confidence building in the process of acquiring knowledge Merchant (2007-09).

The following are the steps of the strategic approach used in the teaching instruction. This is shown in 'figure 20'.

1. Recognition of problem: Learners need to clearly understand and define the problem.
2. Identify requisition of problem and search for data required to solve the problem: Learners collect data from the problem in relation to the required item.
3. Teacher guides learners to select and organise the key data they have identified in the data collected.
4. Lead learners on how to use the data collected by putting them in the Math Interactive Learning Environment for Students (MILES) to solve sample problems. In this process learners contribute and discover processes involved and used. The solutions and learners' challenges are discussed and verified.
5. Apply solution to related learning: Apply the process applied to other problems in class or as home work.

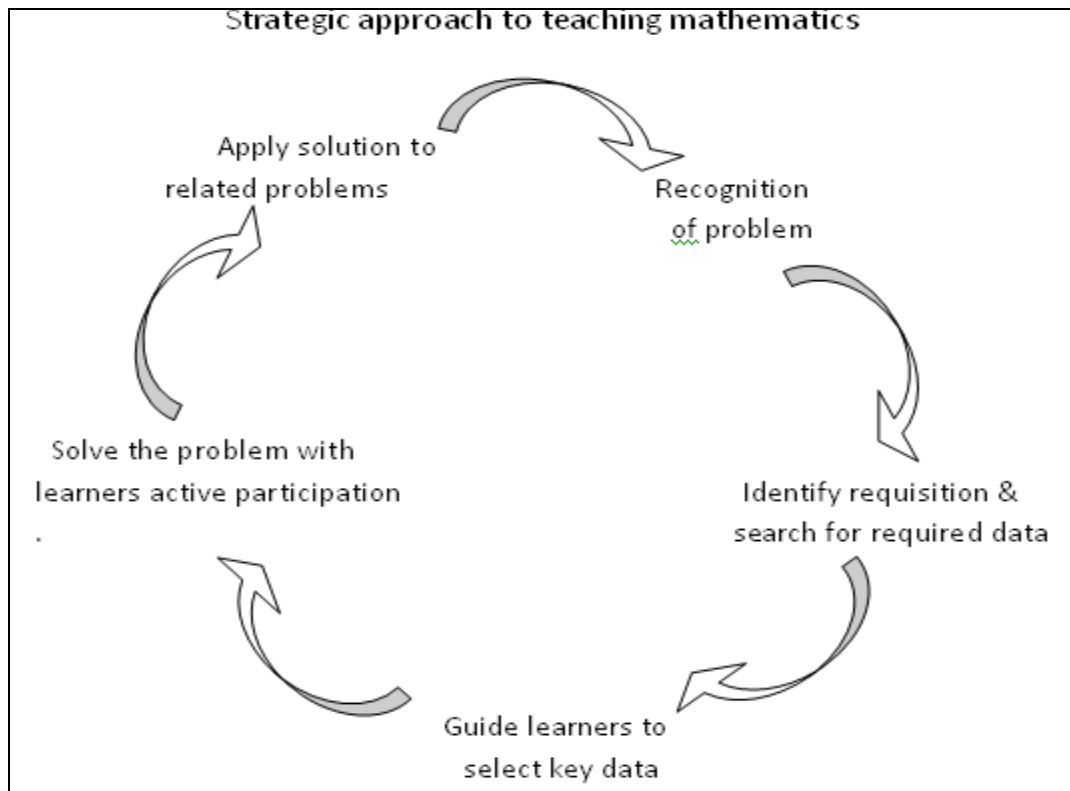


Figure 20 Strategic approach applied during the teaching treatment

Ethical concerns

Ethical issues encountered with the study involved working with DHH children. Permission was sought at the schools where participants study and parental consent was also obtained. Participants had opportunity to withdraw at any step of the study. Participants who were mainly DHH students had access to all information and communication. For the purpose of confidentiality, there was no identification of any of the participating student, teacher or sign language interpreter or settings in writing the report.

Validity and Reliability Issues

The sample size of the main independent variable DHH was small and therefore result cannot be generalised across groups of people, periods of time and different places or settings. The size also did not allow for random selection of participants into groups. Participants were informed a head of the study. They did the pre-test, post-test-one and post-test-two within a

short time (one week). We used every subject time on the institution time table until the last test was done. This therefore did not allow time and other event to interfere with the result of the study.

The test instruments were designed from the same topic in the class text book with different set of questions for each section treated. There was no selection because the group was small and a second group was not possible due to distant and financial constraints. Although the above approximate internal validity issues are ruled out, the result is suggestive due to the size of participants. A further study using the methodology used in this research is required (Cook and Campbell, 1979; Spector, 1993).

Challenges of the study

A major challenge associated with this study was in finding statistically appropriate sample size for the research. DHH pupils are not many in schools in Norway due to the mass hearing support systems provided and parents' preference for their wards to attend school in communities where they live. This means that the deaf is scattered all over the country in various academic environments. This makes the number of students in the center schools to be few. To get more participants, Time was spent in contacting prospective institutions in search for participants. To this end, I travelled to Oslo to arrange for conducting the experiments there as well. However, due to financial and time constrains, I couldn't continue with Oslo. It was also not possible for me to travel to all the schools in the country for the same reasons.

In addition to the fewness of the sample size of this experiment, agreements with the various institutions contacted for the study was not easy to arrange. Fixing dates for the data collection and finding an available interpreter for the day was a challenge because the institutions that agreed for me to carry on the study had its own tight program schedule. They had to go through their schedule to fix the study at their convenience. Therefore it took time

before they could set a date for the study to begin. In spite of this, there were occasional hold ups due to the absence of a teacher, or a student or program that comes up. In the initial school for instance, the study started one day only to be halted because of time constraints. This led to the choice of the participants of the other school alone as the main study participants.

Yet another challenge faced was the drafting of the interactive learning environment test instruments from English language to the Norwegian language. I finally found some colleagues who were willing to go through the translation to proof read it.

Critique

Prior to the pre-test for the DHH participants a request was made for an observation to be made on the teaching processes used in the school. During this class observation time, the subject teacher organized a revision class on the topic. The level of performance of the DHH participants may have been influenced by the revision work carried out just before the pre-test was carried out. Although, I recognize the possible influence of the revision, participants' experience shared in the interview showed that the system dynamics teaching instruction was useful to them and this made them increase their scores in the post-test-two (RM).

Results

The mean performances of participants were 53.50% in the pre-test, 75.25% in the post-test-one (SD) and 72.25% in post-test-two (RM). Using the pre-test as a benchmark for the purposes of comparison, participants improved on their scores in the post-test-one (SD) and post-test-two (RM) over the pre-test scores. The bar graph in 'figure 21' shows the mean details.

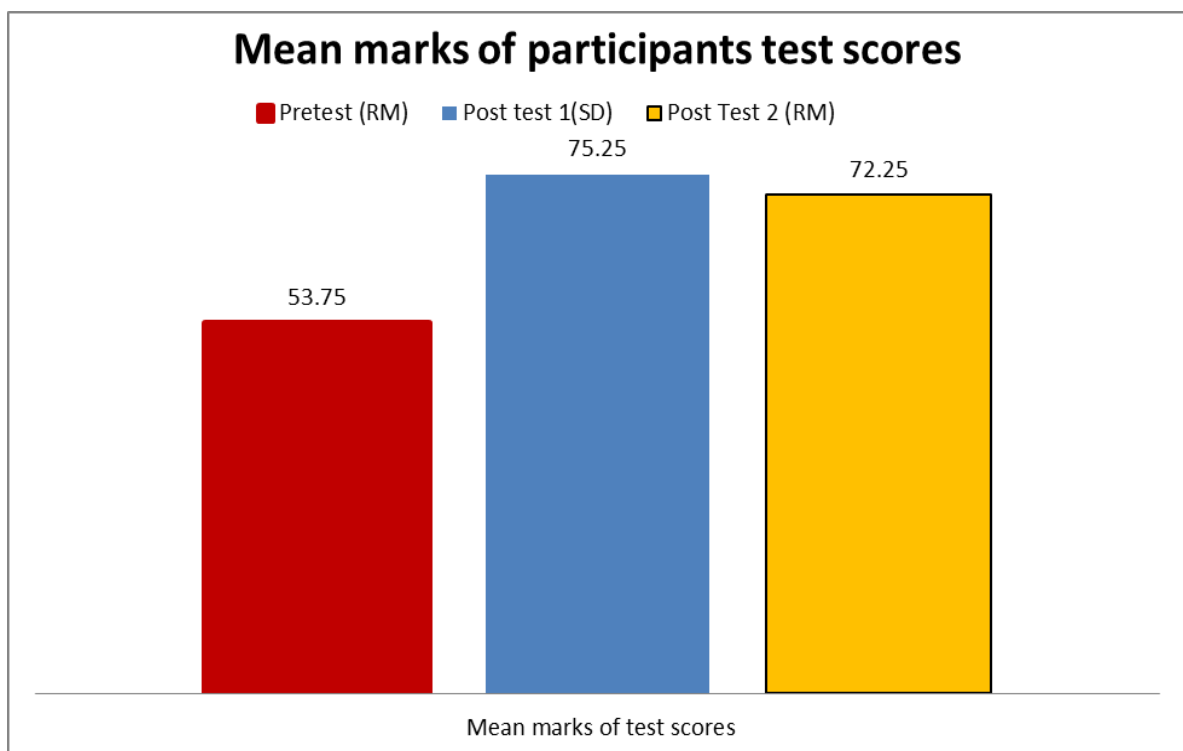


Figure 21 Participants mean scores of pre-test (RM), post-test-one (SD) and post-test-two (RM)

Participants' scored the highest where the system dynamics method MILES was used. In the post-test-two (RM) also, participants did better than the pre-test. The differences in post-test-one (SD) and post-post-test-two (RM) shows that participants improved after the system dynamics teaching treatment.

Individual participants' scores in the pre-test and post-test-one and post-test-two are shown in 'figure 22'. In the bar graph, the green shaded bars with reddish border represents

the pre-test scores, the bluish bar represents the post-test-one (SD), while the black bar represents the post-test-two test results.

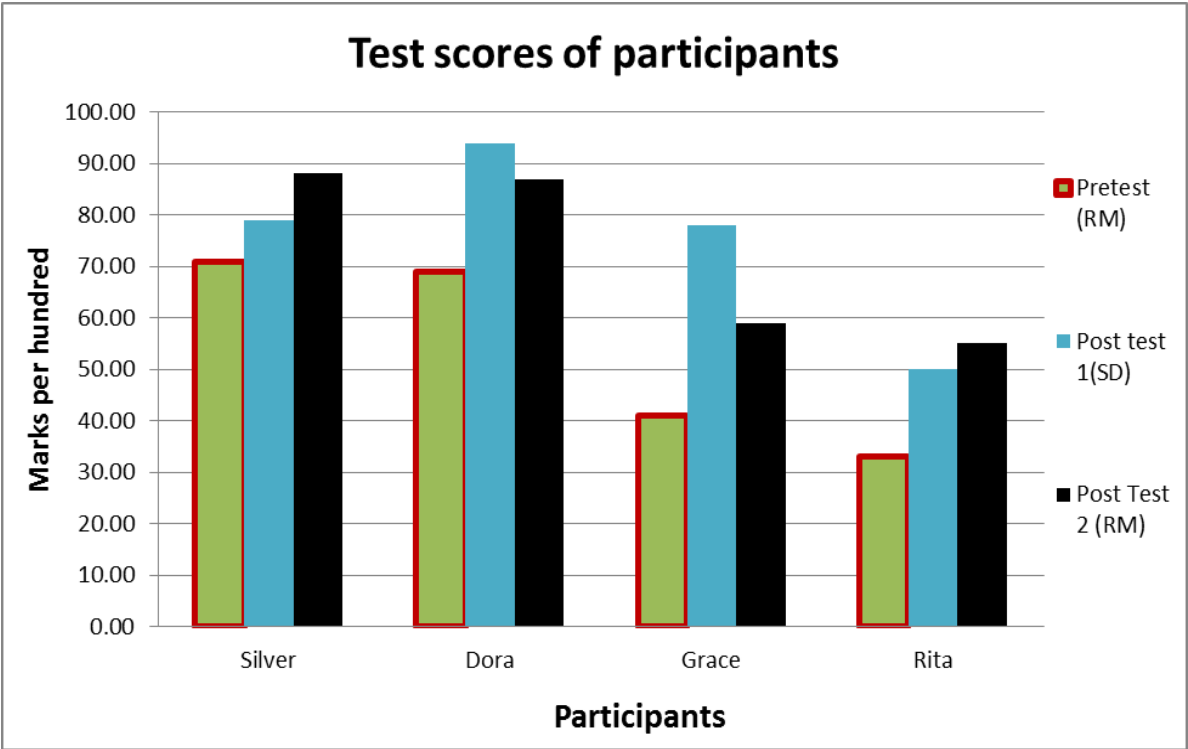


Figure 22 Participants scores of the pre-test (RM), post-test-one (SD) and post-test-two (RM)

The participants test scores displayed in ‘figure 22’ shows that although two of the participants scored above 50% and the other two scored below 50%, each of the participants obtained higher scores in the post-test-one(SD) and post-test-two (RM) compared to the pre-test. Samples of the students work are in the ‘Appendix 4’

The differences in individual participants’ scores are shown in ‘figure 23’. Among the participants, Grace had the highest score and Silver had the least difference in comparing post-test-two (SD) to the pre-test (RM). In the case of post-test-two, Rita had the highest.

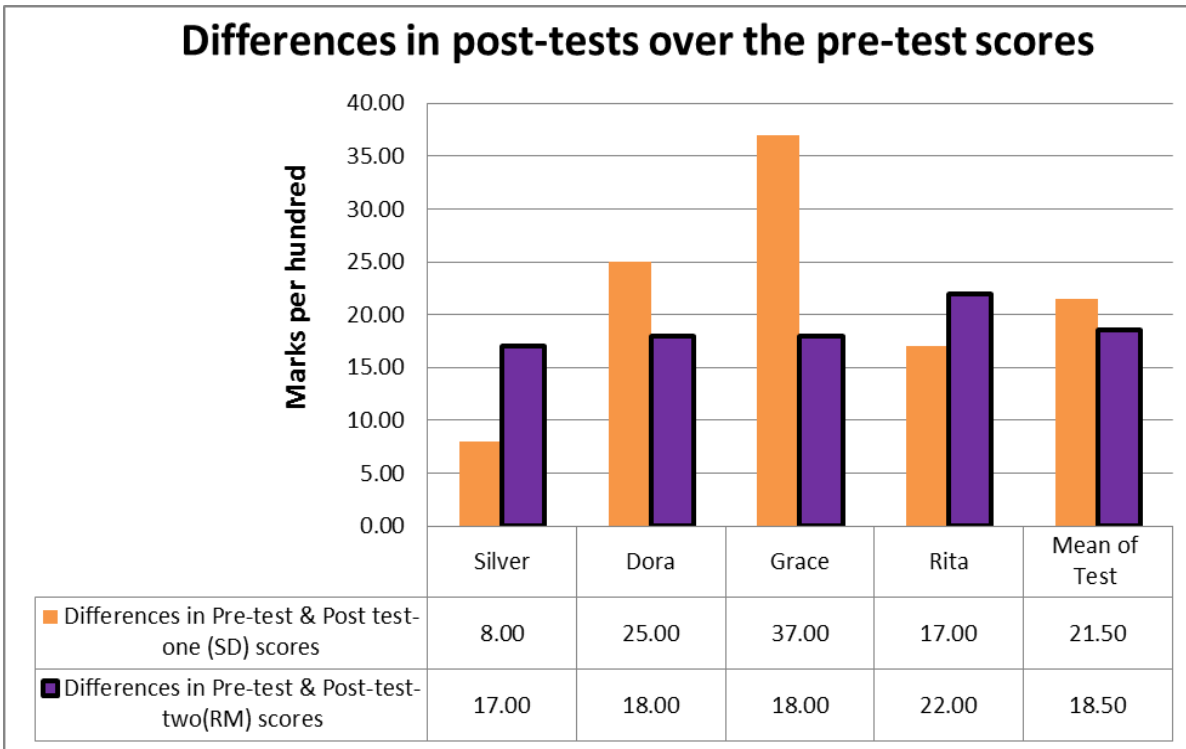


Figure 23 The differences participants made in post-test-one (SD) and post-test-two (RM) over pre-test (RM)

In ‘figure 24’, pre-test scores of hearing and DHH participants are presented in a bar graph. The need to compare the hearing and the DHH arose as result of the desired to let the study conform to other study report involving the DHH which is usually compared to the hearing.

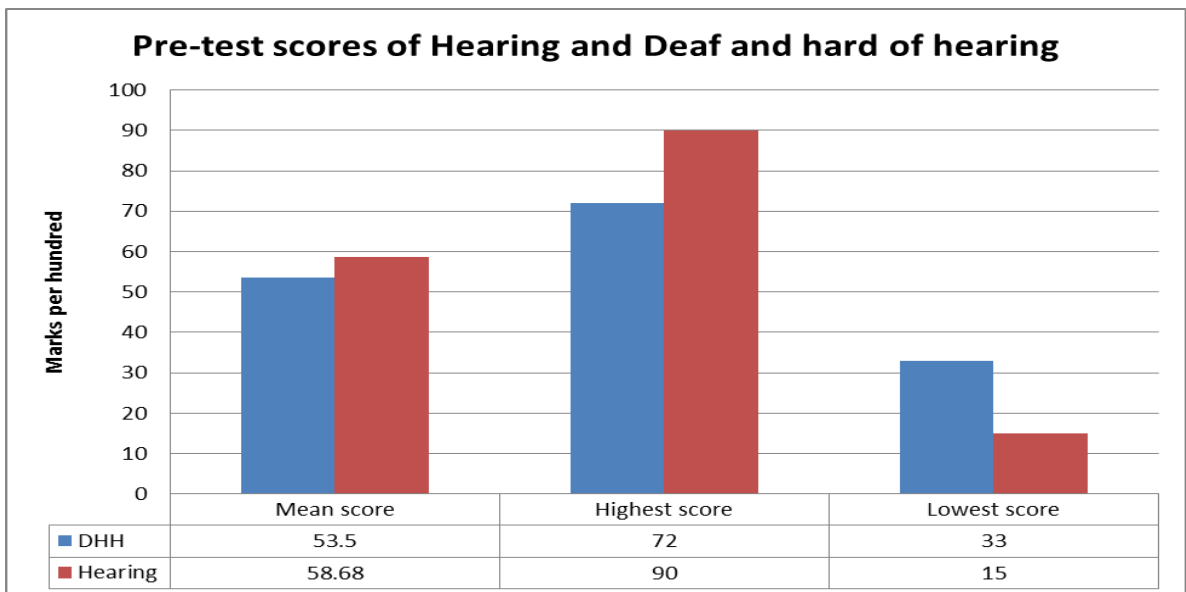


Figure 24 The pre-test scores of the hearing and DHH

The results in 'figure 24', indicates the mean, as well as the highest and lowest scores. The hearing had the highest and the lowest scores while the DHH scores fell within the scores of the hearing. The result indicates a contrast in what have been reported in the study documents reviewed in this study. Studies reviewed shows that the DHH are 2.5 years and 3.4 years behind. Another study indicated that 18 year old DHH pupils performed at the level of grade five and six grade pupils compared to their hearing counterparts (NCTM, 1957; Wood, Wood and Howarth, 1983; Traxler, 2000).

Interview with the participants

In the interview, participants were asked to expound on 'What their past experience is in learning mathematics at school?' two participants said 'It's boring' and one said 'I don't like it very much', and the other 'I don't like mathematics; it's not fun to do mathematics'.

Another one who said he doesn't like mathematics very much, remarked when probed further that 'It is advanced... at a higher level, yes it is difficult but I am able to do some of them'

This statement sums up the perception they hold about mathematics. 'Everything, working with numbers, the number rules (method) is difficult to follow. It is difficult to follow the teaching'.

Another participant said 'We just revised a couple of things we've learnt earlier. Just now we've learnt about the 'two number system' I get confused sometimes with the use of language; is it in English language or norsk. Is it sign language? I get confused sometimes about this but I try to follow.'

When asked to clarify what she was confused about, she said ‘I’m confused with the language used for the subject.’ This is an indication of how language use can become an impediment in learning for the DHH.

Participants were also asked their thoughts on other subjects learnt at school. One said excitedly, ‘English, Yes, English language is interesting.’ She however said she was o.k. with mathematics-word-problems but did not show any excitement in saying it.

When others were asked of their experience on the mathematics-word-problem, one said ‘I do not have problem in reading word problems’ another participant responded ‘reading is not difficult for me’ and the last person said ‘The words are not too difficult. I am sure about them but sometimes they are difficult’

On the question of whether they have been asking their parents, sibling and friends to help them with mathematics assignments: one said ‘Yes, I ask them and I get help from them sometimes, on some occasions it is difficult to get help other times I get help’. Two participants said they do not seek help from them.

When asked why they have not been asking their parents help to do mathematics assignment, one of the three said ‘I work alone; because it’s difficult for them to understand me. Seldom do I ask them questions about school work but I ask ...when I need money.’ The other one said ‘my family, do not understand and my friends are at distant places I cannot go out there to talk to them about my difficulties.’ When she was asked what she does when she has a difficulty she said she request help from her teachers.

Participants were then asked to share their experience in teaching ‘økonomi’ using system dynamics interactive environment. Some of the responses given are ‘It was quiet

interesting', 'It seems easier', 'It's not too difficult and not very easy also' and 'It's not so hard'.

When they were asked to explain what makes learning mathematics with system dynamics easier to understand, they responded that 'It is quiet easier to do and to find the answer', 'It is much easier' and one said 'You don't have to use your brain.' The one who responded you don't have to use your brains was asked to explain his response and this is what he said. 'You don't have to think about numbers, there is therefore no risk of mixing them up. Addition and subtraction are okay but when you start with division and multiplication it gets difficult,' he added.

All Participants were asked to further explain what makes learning mathematics with system dynamics easier and different from the regular method. Of the two participants who said that their past experience with mathematics is boring, one replied 'the graph comes up automatically and we see it. We can tell how the graph is changing. We can see when the graph is changing upwards or downward through reading the graph.'

And the other one said 'reading the graph is helpful you can see where it increases and where it reduces. The questions are easier to answer with this method. In this method you just need to understand the question, put in the values and press play. You can change the values and learn about how it changes. That makes it easier to understand. This method does not give any... boring feeling. You need to use your brains a lot trying to work out in the regular method but in this the graph helps to understand how the values change.'

The other participant who earlier said he doesn't like mathematics and that it appears advanced to him said using system dynamics to do the mathematics is quiet interesting. When asked further, he said 'It is not so hard, we just put in the numbers and click 'play'' When he

was further again asked to describe how he does the work using the system dynamics method, he said ‘I read the question, understand and use the information in the question given to put in the numbers. First change a percentage to decimal and put in decimal number at its place in the computer with other values and then click in play and watch the graph. Then we watch the graph, read the graph’

Participants were asked to indicate which area of the system dynamics teaching treatment helped them to improve their understanding, all participants pointed to the MILES simulator. Two participants responded that it is ‘the input tabs and graph,’ another participant said ‘the graph makes it possible to see the increase and decrease of the value. We also changed the input variables and see how the graph changes’

Participants were also asked after the interview to find the growth of a bank account and explain their observation in solving the problem. This was done as part of the interview to confirm whatever experiences they narrated. The question was ‘Joe has 8000 kr, Clement has 12 000 kr and Bjørg has 16 000 kr all at the same bank at interest rate of 4% p.a.

Find out the growth of bank account for:

- a) Joe, Klement, and Bjørg. You observe what happens and record the answers for them.
- b) Explain in your own words what you observe on the growth of the three accounts at the end of the year.’

According to the results they presented for this question, the values of the three accounts were close to others. This is because some put the cursor on the graph at exactly at the end of the graph while others were close to the end point on the x-axis (365 days). Their

responses were correct except that each explained with their own words. The following are some of the explanations they gave for their responses:

‘Those who had more money had more than those who had small money. The amounts show that the more money you have at the bank, the more interest you get.’

Another said ‘the bank amount increases more when the amount at the beginning is higher. Klement had more than Joe. Joe’s initial amount was small so he got smaller interest on his money. Since the interest on each of the account is the same, the bigger amount returned much more amount. The smaller amount increased a little when the two accounts are compared the same day on the graph.’

One person also said ‘a higher amount gives a higher bank account increase at the end of the year. The interest increases the bank account. Bjørg had the highest amount so she got the highest bank account.’

The interview ended after the solving of this problem.

Interview with teachers of DHH

Challenges in education for DHH pupils

Information gathered from interviews with teachers of the deaf affirmed that DHH pupils generally have problems in learning school subjects. Three of the teachers confirmed that the problem also exists in their learning of mathematics. One teacher would not take sides on whether they perform well or not and said that it is difficult to take a position on that issue. Some of the issues they talked about in association with the challenges that affect their studies in school and specifically in the learning of mathematics are as follows:

Usually, the understanding of word connections and terms which the hearing pupils have pre-information on, are not applicable to DHH pupils. DHH children are not like hearing

children who acquire language as they listen and hear other people speak. Most parents of the DHH are hearing, so communication in the home is not smooth. Moreover inferential learning instances from sibling and other family relations are not easily available to children who have hearing loss. Thus common expressions used before the child begins school are usually not available to the child who has hearing loss. Due to this situation, teachers take time to explain subjects, but it remains hard for them to get the terms in such a way that they can relate to them in mathematics problems.

They also indicated that there are icons and abstract words used in the sign language which appear differently when used in spoken language. Some are conceptually used differently depending on the situation. In the sign language there are specific signs for some of those words which do not have the other variations signed in the same way. In Norwegian sign language for example the word 'through' and 'during' are signed the same way but the concepts are distinguished according to context of the sentence(s) used.

These appear differently when used in mathematics problem. With regards to teachers' use of accurate signs as description of terms in the teaching of mathematics, it was found out that most teachers use very general words in teaching the subject. It was also mentioned that many deaf pupils do not show keen interest in mathematics except for a few. To create interest in the subject, the use of icons and special symbols known as 'Tegnskrift' sign writing has been developed by one of the teachers (Roald, 2006). She uses these icons to teach mathematics and science subjects to DHH pupils. She believes that these icons can help to support teachers to effectively teach concepts to pupils.

One teacher however, noted with regards to mathematics in particular that some DHH pupils are good while others are average and therefore it is difficult to say exactly that they perform well or not. His perception contradicted what the others had said earlier with regards

to general school mathematics performance being below average. He agreed with the others though, that there are a lot of challenges whether the DHH pupils go to center-schools or regular school.

Also noted was the fact that there are differences in the level of signing in a class. Some come to school with fluent sign language while others come without any sign language. This makes teaching difficult for the teacher because he has to teach, language and the subject topic at the same time within the scheduled time table.

Discussion

This chapter evaluates the results of the study in order to answer the research question ‘How does system dynamics method contribute to learning and teaching mathematics to DHH pupils?’ The discussion is based on information from the literature reviewed, the test results and their interview responses.

The contribution of system dynamics

The result of DHH participants from the pre-test and post-tests suggest improvement in the participants performance in their understanding of the topic treated. This was evident in their higher scores for post-test-one (SD) and post-test-two (RM) results compared to the pre-test. The reason for the improvement in the post-tests results could be attributed to these factors. Interview responses of participants clearly indicated the ease with which they used the MILES. The MILES interface had well-designed visual elements that aided in the understanding of concepts used in solving the problems.

The DHH have a highly acute sense of vision that compensates for their hearing loss. This means that they rely highly on visuals information processing. The use of visual images for instance have been said to promote recall among DHH students (Lang, and Pagliaro, 2007). Participants in this study were asked to indicate which part of the system dynamics instruction method helped in their understanding of the topic studied, all of them pointed to the use of icons, graphs and the simulation process which aided in their understanding. The process of exploring using the MILES to find solutions to math problems was also noted to be an important way by which their understanding was increased.

The interview responses on their experiences using system dynamics and that of their previous method confirms the use of tools such as diagrams, graphs, simulation interface

among others promote mathematical reasoning, problem solving and communication skills of students (Lyneis, & Fox-Melanson, 2001). While they found the regular method boring and difficult, they found the system dynamics method to be more interesting, engaging and increases their understanding more. In the interview reports, individual participants were asked of their previous experience in the subject, three out of four (3/4) said math is boring and not an interesting subject; and one said learning math is not fun.

In contrast to this past experience, they said it was easier to use the system dynamics method. Participants pointed to the graph simulations, input section of the interactive environment used, in put sections for the math problem variables and the possibilities of changing values. They said it was quiet easier to work with the system dynamics interactive environment to find answers to the mathematics problems. The participants found that with the system dynamics method it is possible to change values and see changes on the graph. The practicality of the system dynamics method used in this study was witnessed by the participants when they changed values in the MILES and saw the corresponding changes at different times. They indicated that this improved their understanding and made the most impact on their learning for the period of study. The visual and interactive nature of the MILES therefore is a suggestive key factor in their improvement.

The challenges of the DHH in mathematics performance, is confirmed in literature reviewed as well as by the interview with participants and teachers. However, in this study after the teaching instruction in system dynamics, participants improved in their post-tests result. Fisher and Potash in 1991 indicated that that system dynamics creates a learning environment where pupils who are uncertain about their math reasoning abilities could excel in the math (Fisher and Potash <http://site.educ.indiana.edu/Portals/161/Public/Fisher%20&%20Potash.pdf>).

Participants of this study enjoyed using the MILES and actively participated in problem solving activities. They showed curiosity in learning by putting in their own values in the MILES to increase their understanding of how it works. Forrester (1992) has said that system dynamics method combined with learner centred approach provides ingredients such as motivation, curiosity and cohesive meaning across subjects including math. The MILES designed is a departure from the teacher centered way of teaching. It allowed participants to take charge and initiate their own learning after receiving instruction in its usage. This way, there are no additional pressures on learners (Latu, 2005).

The impact of system dynamics on participants' performance is seen in the results of the post-tests. Besides improving in test results using the MILES in solving questions, they also improved in their performance in the post-test-two (RM). Post-test-two was conducted using the regular method and was taken after the system dynamics based test in post-test-one. The improvement in their post-test-two (RM) results indicate that the system dynamics teaching instruction assisted in increased understanding and this understanding gained, had a carried over effect in solving test questions using the regular method. It is acknowledged that any teaching method could improve performance, however, participants of this study, indicated during the interview, particular elements in the teaching instruction which they think led to improvement in their understanding and thus improvement in the post-test results.

Peculiar challenges of DHH pupils

Certain challenges peculiar to the situation of DHH pupils identified in the literature were also identified among the participants of this study. However, participants of this study also showed some differences in relation to these peculiar challenges of the DHH. Study report on tests and interview of participants could not specifically access information on DHH

participants' challenges in incidental learning outside the school environment as shown by Gregory, (2008).

However, participants informed in the interview that they are unable to discuss their school assignments with parents and sibling due to language difficulties. The lack of effective interaction with parents and siblings also affected how much they can benefit from incidental learning. This confirms an earlier study to find out how parents' involvement in a well-designed interactive homework influences students learning, Van Voorhis (2001). The issue of inability to relate to most close relations is also consistent with study reports by Nortey (2009) as well as Nunes and Morenu, (2002).

Language use was identified in the literature reviewed to be a major problem for the DHH in solving mathematic problems. It has been said that they often fail to recognise words linking elements in math problems and using word phrases such as 'more than', 'less than' (Blatto-Vallee et al., 2007; Swanwick, et al., 2005) Participants in this study however did not show any difficulty in understanding of the mathematic word problems that was presented to them even though some of the required the understanding of linking word phrases. Again the questions presented to them in this research most of the time was in the form of a story problem. However, they did not have problems with the story problem format as indicated by Ansell and Pagliaro (2006).

Language problems associated with mathematics performance has also been identified as a challenge for hearing pupil who learn the subject in a second language as well (Fiosak, 2008; Latu, 2005). According to Kelly et al., (2003), the use of visual and problem solving strategies, helps in solving this. This is particularly useful for any second language learners of which the DHH is included. This study learnt from participants that a blend of visual and problem solving strategies as used in the system dynamics method is very useful. Participants

used the visual elements (graph, icons and input parts) shown in the software such as the mathematics interactive environment to relate to the math problems. They also used the interactive environment by changing of values, reflecting on the simulation in the interactive environment and practiced on their own to up-date their knowledge on problem questions offered. They indicated in the interview that they learnt a lot from this interaction.

Another issue is DHH pupils' inability to make inferences in relation to time. This experiment worked on one section where bank account problem was learnt in the experiment. In the case of the participants studied, they did not show problem in relation to time sequence as shown by Nunes and Morenu, (2002) and Hall, (2005). Participants did in most cases explain the situations except one of them who did not answer the question at where they were to compare bank account growth within two different periods. It is not clear whether he had problem with this because it was an optional question.

DHH pupils were reported by Blatto-Vallee et al., (2007) and Ansell and Pagliaro (2006) as having challenges in understanding 'linking/relational words' in math problems. However the participants studied did not show any sign of word-problems in their assignments. They worked on the math problem given them with ease except few linking words such as 'less than', and in finding 'half of a sum'.

Subject teachers try to bridge the gap in knowledge of DHH students to help minimise some of the factors that affects their low performance. One of the teachers described the situation of spending time to explain key words of every topic, before beginning of each main lesson in math. He said since the pupils are not as many as in the mainstream schools, it is possible to assist pupils to find procedures in working out math problems where pupils find challenges.

Performance of DHH and hearing participants

The results of the pre-tests of hearing and DHH participants were compared to find out the differences that exist in their performance levels. While the hearing had the highest marks, they also got the lowest score. Nearly, 20% of the hearing classmates who did the same pre-test scored below the DHH in this study. The scores of the DHH participants fell within the scores of the hearing. The same pre-test was given to both participants, so that the results can be used to confirm what the literature says about the DHH lagging behind in mathematics education. The result in this study indicated a contrast a in what have been reported in the literature reviewed in this study. Studies reviewed showed that the DHH are 2.5 years and 3.4 years behind. Another study indicated that 18 year old DHH pupils performed at the level of grade five and six grade pupils compared to their hearing counterparts. (NCTM, 1957; Wood, Wood and Howarth, 1983; Traxler, 2000).

The comparison with the hearing in this study is done to confirm this particular problem and also to make the study follow the pattern of other studies involving the DHH, where they are always compared with the hearing. Though the results indicate that they are not below the hearing, the results of the DHH participants may have been better because of the prior revision of the topic before the experiment.

Conclusion

This study experimented with teaching mathematics to the DHH using a computer-based interactive learning environment. The purpose of the study was to investigate teaching mathematics to DHH students using system dynamics methods. Often when math is taught using the regular methods, practical application of the learning process is not very visible. With the use of system dynamics methods, the practical issues are dealt with and this gives deeper understanding of the topic studied. Due to the practical nature of the MILES, participants were prepared to find out more on their own. They also explored the MILES by changing values, reflecting on the simulation in the interactive environment and practiced on their own to up-date their knowledge on mathematics questions offered.

The learner centred approach to teaching in the system dynamics method used in this study was obviously something the participants liked. They indicated in the interview that they learnt a lot from this interaction. This is different from their attitude to the traditional approach where they yearn for quick end of a lesson because it appears abstract to them. The study result suggests improvement in the post-tests results of participants. In the interview conducted after the experiment, participants pointed out that the use of icons, graphs and the simulation process in the MILES facilitated their understanding of the topic.

The results of this study suggests that a blend of visuals and sign language in an interactive learning environment, and problem solving strategies as used in the system dynamics method is very useful and would make a difference in the learning and teaching of math to deaf and hard of hearing pupils. Participants used the visual elements (graph, icons and input parts) shown in the software such as the mathematics interactive environment to relate to the mathematics problems.

Many studies in the literature suggest that the low mathematics performance of DHH pupils is due to complexities involving language, concentrated use of visuals as against problem oriented teaching strategy, and cognitive issues. Other issues in this study which were consistent with the literature reviewed were pupils' inability to discuss their mathematics homework or related challenges with parents, siblings and friends due to their limitation in the spoken language.

It is suggested that since most parents attend to the 40-week sign language training meetings and other meetings such as parent-teacher meetings held each year, a discussion is held with parents to improve relations. This way, parents would be able to express what their difficulties are and teachers would be able to guide parents in possible ways to go about helping their wards with homework/assignments even if they are not familiar with the topics learnt in class.

It was also evident in comparing the pre-test results, that the performances of DHH and hearing pupils do not show that DHH lag behind their hearing colleagues as shown in literature. The fact that that this study report is not consistent with other studies, does not confirm or debunk any such previous research. Also, the revision exercise carried out for the DHH participants prior to the study could have influenced the results of the pre-test. Comparing the pre-tests of the DHH to their post-tests, their performance increased. This is suggestive that the continuous use of system dynamics method would potentially transform the challenges DHH pupils exhibit in mathematics.

This experimental study serves as an initial exploratory research into what contributions system dynamics would make in teaching mathematics to the DHH. Based on the results and discussion of the study, the method made progressive contribution in the learning of the participants studied. Due to the sample size used in this study, there is the need

for further study in this area to investigate and affirm the contribution of system dynamics in teaching mathematics topics to DHH. When this is firmly established, it could then be extended to studies in other subject areas to improve understanding in subjects studied by DHH students, thereby improving their educational performance.

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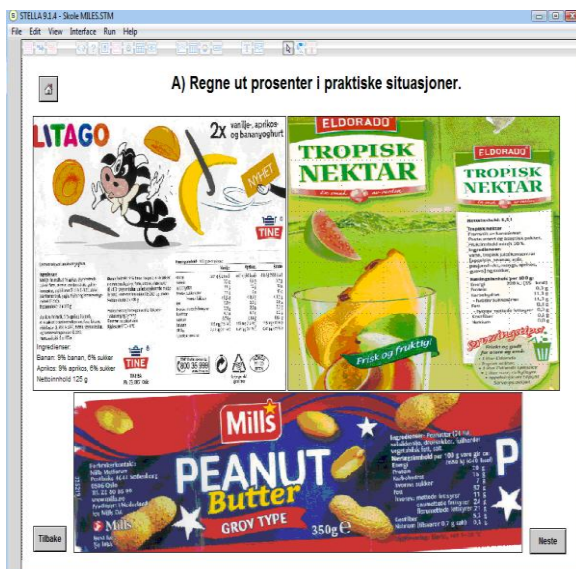
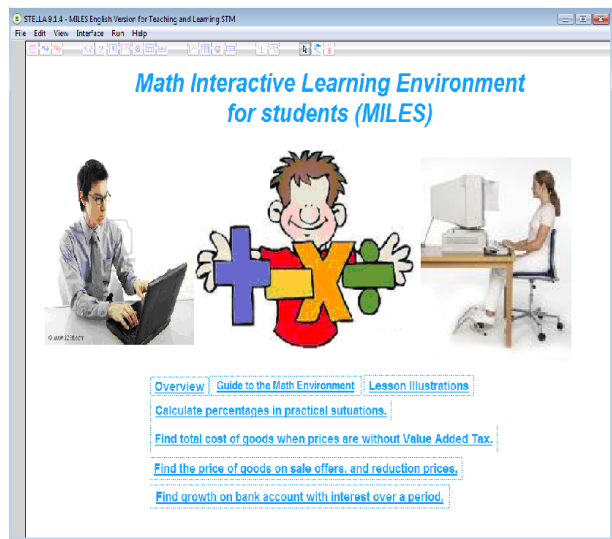
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Appendix

Appendix One: Math Interactive Learning Environment for Students (MILES)



STELLA 9.1.4 - Skole MLESSTM

1. Regne ut prosenter i praktiske situasjoner (Grupper A og B; to studenter).

Nødvendig informasjon:
 i) Stykke element = 40 kr
 ii) Prosent verdi = 45 %
 c) Hvordan kan jeg regne?

Prosent verdi: 45 %
 Stykke element: 40 kr

1: Stykke element = 40 kr
 2: Prosent verdi = 45 %

RESU UT PROSENT AV VOLUM (Student Points)

STELLA 9.1.4 - iModels English Version Test1.1STM

1. Calculate percentages in practical situations.

Test 2a and 2b
 2. a) In seawater, there are some places have 4% salt. How much salt is in 200 kg of this sea water?
 b) Calculate 2.5% of 1200 books

Needed information:
 i) Piece of item = 1200
 ii) Percentage value = 2.5
 c) How to find percentage value

1: Piece of item = 1200
 2: Percent value = 2.5

Calculating percentage of item

STELLA 9.1.4 - Skole MLESSTM

B) Beregn totale kostnaden for varen når prisen er gitt uten merverdiavgift (mva).

Merverdiavgift

Hva er forskjellen på inkludert og ekskludert?

MP3 spiller 600 kr ekskl. mva.
 Digitalt kamera 600 kr inkl. mva.

Gammal pris + Mva

STELLA 9.1.4 - iModels English Version Test1.1STM

B) Find total cost of goods when prices are given without Value Added Tax (VAT).

Merverdiavgift

Hva er forskjellen på inkludert og ekskludert?

MP3 spiller 600 kr ekskl. mva.
 Digitalt kamera 600 kr inkl. mva.

The old price + VAT

STELLA 9.1.4 - Skole MLESSTM

Beregn totale kostnaden for varen når prisen er gitt uten merverdiavgift mva.

REMA 1000

Artikkel	Pris	MVA	Totalt
Hotte Rundstykke	149	18.00	167.00
Sjokolade	17.20	1.90	19.10
Bakk	23.50	2.82	26.32

skysss

Artikkel	Pris	MVA	Totalt
Herre	285	34.20	319.20
Skilakk	125.00	15.00	140.00

STELLA 9.1.4 - iModels English Version Test1.1STM

Find total cost of goods when prices are given without Value Added Tax (VAT)

REMA 1000

Artikkel	Pris	MVA	Totalt
Hotte Rundstykke	149	18.00	167.00
Sjokolade	17.20	1.90	19.10
Bakk	23.50	2.82	26.32

skysss

Artikkel	Pris	MVA	Totalt
Herre	285	34.20	319.20
Skilakk	125.00	15.00	140.00

STELLA 9.1.4 - Skole MLESSTM

2. Beregn totale kostnaden for varen når prisen er gitt uten merverdiavgift

Nøkkelord: a) merverdiavgift eller mva, b) prisen inkl. mva, c) avbetaling, d) prisen ekskl. mva, e) p.p.a, f) salg tilbud, g) rabatt, h) rente, i) rente, j) prisen ekskl. mva.

1. Noret kjøper nye motorsyklal som koster 10 000 kr. Prisen er ekskl. mva. a) Hvor mye skal han betale for den nye prisen hvis mva er 25%? b) Fortolk hvorfor han betale dette beløp. Eller 1. Du er en leder av butikk som selger datamaskiner. Kostnaden for hver datamaskin er 10 000 kr ekskl. mva. Deacon Miki er 25%. a) Hvor mye vil du selge hver av datamaskinene? b) Fortolk seg om dette selge pris.

NOTE: Mat mva = 14%, Alle varene mva = 25%

Nødvendig informasjon: a) Skykke element pris uten mva = b) mva % =

Stykke element pris uten mva = 3000,00
mva % = 2,25%

1. Skykke element pris uten mva
2. Skykke element pris med mva

Days: 0,00, 72,00, 144,00, 216,00, 288,00, 360,00

Endelige pris med mva (Student event)

Tilbake Neste

STELLA 9.1.4 - IPModels English Version Text1 STM

2. Find total cost of goods when prices are without Value Added Tax (VAT).

Key words: Test 3

3. Lisa will buy food items for the cafeteria at school. The items add up to 1500 kr. In addition VAT is 14%. a) How much she must pay for food items? b) Will she pay more than the price of food? c) Explain your answer in b) Food price

Key: The element price without VAT = (the element price without VAT * VAT in %)

NOTE: Food VAT = 14%, Non-food items VAT = 25%

Needed information: The item price without VAT = 2000,00
VAT in % = 0,25

1. The item price without VAT
2. The item price with VAT

VAT in % = 0,25
The item price without VAT = 2000,00

Play Erase

Page 1

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STELLA 9.1.4 - Skole MLESSTM

1. Merverdiavgift (mva) 14% på mat varer og 25% på alle varene.

2. Bankkonto Kapital + rente = Ny Beløp

Bankkonto = spare + rente

Bankkonto = tilbakebetaling = Mindre penge

Prosent av elementer

Hvordan skal vi ha mer eller mindre

Salg tilbud = Gammel prisen - salg beløp (Gammel prisen - (gammel prisen * salg prosent))

Bankkonto = tilbakebetaling = Mindre penge

Tilbake Neste

STELLA 9.1.4 - IPModels English Version Text1 STM

Math symbols for illustrations

1. Value added tax (VAT) 14% on food items and 25% on non-food items of all other items

2. Bank accounts Capital + interest = Ny amount

Mathematics idea: How can we have more or less here.

Bank account = savings + interest

Bank account = withdrawal = reduced bank account

Sales, reduction offers = The old price - sales amount (The old price - (the old price * sales percentage))

Tilbake Neste

STELLA 9.1.4 - Skole MLESSTM

C) Finne prisen på varer på salg, tilbud eller reduserte priser.

Rabatt: 40% rabatt

Tilbud: Lurer på om det egentlig er så billig.

Hvor mye er det mest billige?

Noen ganger gir forretningsrabatt, det vil si avslag i prisen. Varene blir da billigere enn den opprinnelige prisen.

Sara kjøper en jakke. Hun får 5 % rabatt. Jakke kostet opprinnelig 420 kr. Hvor mye må Sara betale for jakka?

Lansering: jakke varen: 420 kr, 5 % rabatt: 0,05 * 420 kr = 21 kr, Ny pris: = 399 kr

Sara må betale 399 kr for jakka.

Hvordan kan vi vurdere hvor godt et tilbud er?

Tilbake Neste

STELLA 9.1.4 - IPModels English Version Text1 STM

C) Find the price of goods on sale offers, and reduction prices.

Rabatt: 40% rabatt

Tilbud: Lurer på om det egentlig er så billig.

How much is the most billige?

Some times give business discount, that is a discount in price. The goods become cheaper than the original price.

Sara bought a jacket. She got 5% discount. The jacket cost originally 420 kr. How much must Sara pay for the jacket?

Lansering: jakke varen: 420 kr, 5% discount: 0,05 * 420 kr = 21 kr, New price: = 399 kr

Sara must pay 399 kr for the jacket.

How can we evaluate how good a offer is?

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3. Finne prisen på varer på salg tilbud eller reduserte priser.

Q2 En datamaskin er solgt for 6500 kr.
 2a) Hva er kostbasen hvis i laget av et salgstilbud på 5%?
 2b) Hva sier til den nye prisen?

Svaret
 2a)
 2b)

Nødvendig informasjon:
 a) Elementprisen nå =
 b) Prosent salg % reduksjon =
 c) Beregne

Elementprisen nå =
 (Elementprisen nå) * salg prosent eller prosent reduksjon

Et element pris nå: 6500.00
 Salg % eller prosent reduksjon: 0.05

Et element pris nå: 6500.00
 Salg % eller prosent reduksjon: 0.05

1. Et element pris nå: 6500.00
 2. Ny salg eller reduksjon pris

Prisen på varer på salg, tilbud eller reduserte priser

3. Find the price of goods on sale offers, and reduction prices.

a) Solveig buys a jacket at 5% rebate. The jacket regular price was 420 kr. How much must she pay for the jacket with the given rebate?
 b) Martin shall buy a new bicycle with the price at 5000 kr, but he was offered 8% cash reduction. How much must she pay for the bicycle?
 c) Simen buys a new stereo. The regular price for the stereo is 9500 kr but he got it at 10% rebate. How much must Simen pay for the stereo?

Key: Item present price - (Item present price * sales or reduction %)

Needed information:
 a) Item present price =
 b) Sales% or reduksjon % =
 c) Calculate

Item present price: kr 420.00
 Sales % or reduksjon %: 0.05

Item present price: kr 5000.00
 Sales % or reduksjon %: 0.08

Item present price: kr 9500.00
 Sales % or reduksjon %: 0.10

1. Item present price
 2. New sales or reduction price

The price on goods on sale offer or reduction price

4. Finne prisen på varer på salg tilbud eller reduserte priser.

Sammenligne prisene på

Q3 Herman vil kjøpe en ny genser. Den koster 543 kr i innbutikken og 515 kr på storvarenet. For å komme til storvarenet må han ta buss som koster 18 kr hver vei.

Nøkkelt: Sammenlign den totale prisen for A og B
 A: Pris på element A =
 B: Pris på element B =
 C: Hva er salg % gift for A eller B
 D: Hva er den nye prisen for A og B
 E: Sammenlign A og B
 F: * Pris vare * salg % ELLER
 G: * Kostnaden for kjøp element A & B

Pris av element A: 543.00
 Pris av element B: 515.00

Pris av element A: 543.00
 Pris av element B: 515.00

1. Pris av element A
 2. Kostnaden for kjøp element B

Prisen på varer på salg, tilbud eller reduserte priser

4. Find the price of goods on sale offers, and reduction prices.

Comparing prices of the same item in two different shops 1

Q4 Herman will buy a new sweater. It cost 543 kr in a nearby shop and 515 kr in shop B at a distant area. It would cost 18 kr each way for bus fare to the shop in the distant area.
 a) Which price is better for Herman?
 b) Explain your answer.

Key: Comparing total price for A and B
 Price of item A =
 Price of item B =
 What is the bus fare for A and B
 What is the new price for A and B
 Compare A and B
 * The price of item - bus fare
 * The cost of item in shop A and B

Price of item in shop A: kr 543.00
 Price of item in shop B: kr 515.00

Price of item in shop A: kr 543.00
 Price of item in shop B: kr 515.00

1. Price of item in shop A
 2. Total cost for buying in shop B

Prices of items compared in different shops

5. Finne prisen på varer på salg tilbud eller reduserte priser.

Sammenligne prisene på produkter 2

Sara vil kjøpe ny DVD-spiller. (Hvilken tilbud er best?)
 Hvordan mye mer koster den dyreste spilleren enn billigste spilleren?

A Kr 2800 - 10% rabatt
 B Kr 3000 - 15% rabatt

Nøkkelt: Sammenlign den totale prisen for A og B.
 A: Pris Børn * salg rate ELLER
 Pris på vare + totale transportkostnader
 Sammenlign den endelige salgsprisen av A og B

Gjennr. pr. element A1: 2800.00
 Gjennr. pr. element B2: 3000.00

Gjennr. pr. element A1: 2800.00
 Gjennr. pr. element B2: 3000.00

1. Ny element pris av A1
 2. Ny element pris av B2

Prisen på varer på salg, tilbud eller reduserte priser

5. Find the price of goods on sale offers, and reduction prices.

Comparing prices of two items on sales with different sales %

Q5 Tommie would buy a new DVD-player. Find out:
 i) which offer is best?
 ii) how much more it cost the highest price over the lowest price of the DVD-player.
 iii) Explain

Key: Compare the new price of A and B.
 A: Price of item A1 * salg A1 %
 B: Price of item B1 * salg B1 %
 Compare the final sales prices of A1 and B1

Previous price of item A1: kr 2800.00
 Previous price of item B2: kr 3000.00

Previous price of item A1: kr 2800.00
 Previous price of item B2: kr 3000.00

1. New item price on sale for A1
 2. New item price on sale for B2

Prices for goods on sales offer or reduced price

D) Beregn vekst på bankkonto med renter over en periode.

Bankkonto verdi = Beløp i bankkonto + rente
 (Kapital * rente * dager) / 365 = rente

Innskudds/Uttaksbetingelser	
Rentebetingelser	
Konto	
Brukarkonto	Jan til 14. FEB. 0,16 % Først kr 50.000 0,36 %
Hjemsparingskonto	Jan til 14. FEB. 0,10 % Elev. av 14. FEB 0,36 %
Utlåningskonto (30 d. til 14. FEB)	2,15 %
Sparringskonto	0,10 %
ESB1 Sparekonto	3,25 %
JPA	1,50 %
JPA Hjelpekost	1,50 %
JPA Pensjonskonto	2,36 %
Høyrentekonto	Jan til 14. FEB. 0,41 % Først kr 50.000 0,36 %
Elev. av uttak i løst	Først kr 50.000 0,36 %
NB-konto	Først kr 50.000 0,36 %
NB-konto	Først kr 200.000 2,15 %
Bankavgift	Først kr 200.000 2,15 %

Tilbake Neste

D) Find growth on bank account with interest over a period.

Bank account value = Amount in account + interest
 interest on account = (Capital * interest * days) / 365

Innskudds/Uttaksbetingelser	
Rentebetingelser	
Konto	
Brukarkonto	Jan til 14. FEB. 0,16 % Først kr 50.000 0,36 %
Hjemsparingskonto	Jan til 14. FEB. 0,10 % Elev. av 14. FEB 0,36 %
Utlåningskonto (30 d. til 14. FEB)	2,15 %
Sparringskonto	0,10 %
ESB1 Sparekonto	3,25 %
JPA	1,50 %
JPA Hjelpekost	1,50 %
JPA Pensjonskonto	2,36 %
Høyrentekonto	Jan til 14. FEB. 0,41 % Først kr 50.000 0,36 %
Elev. av uttak i løst	Først kr 50.000 0,36 %
NB-konto	Først kr 50.000 0,36 %
NB-konto	Først kr 200.000 2,15 %
Bankavgift	Først kr 200.000 2,15 %

Back

6. Beregn vekst på bankkonto med renter over en periode.

3. Jon hadde 8000 kr i banken for 292 dager. Banken ga han 2% rente p.a.
 a) Finn ut hvordan Jon penger vokser på 2% rente.
 b) Ending rente til 4% p.a. 292 dager og c) 6% rente p.a. på 292 dager. Slutt med alle beløp verdi til a), b) og c) Fordi hva dager til beløp a), b) og c).

Info: Kapital i banken = 8000, rentefoten = 0,02, dager = 292

Capital: kr 8000,00
 Interest: 0,02
 Days: 292

Page 1

Tilbake Neste

6. Find growth on bank account with interest over a period.

3. John has 8000 £ in the bank for 292 days. The bank gives him 2% p.a. as interest.
 a) How much more would he receive after June than after March.
 b) Explain.

Info: Capital in the bank = 8000, interest given = 0,02, days = 292

Capital: £ 8000,00
 Interest: 0,02
 Days: 292

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Takk til...

Anerkjennelse

1. Sparebankinvest: www.sparebankinvest.no accessed 15/08/2010
2. Lila, The BK Oslo: www.lila.no
3. Peanut butter (grove type) Mills Matrum, www.mills.no
4. Hjarard, E. and Pedersen, J. (2007)
5. Opportunity International: http://www.opportunity.org.uk/work/bank-building/ accessed 08/02/10
6. Isee systems: www.iseesystems.com

Tilbake

Appreciation to ...

Acknowledgement

1. Sparebankinvest: www.sparebankinvest.no accessed 15/08/2010
2. Lila, The BK Oslo: www.lila.no accessed using the product on 01/08/2010
3. Peanut butter (grove type) Mills Matrum, www.mills.no accessed using the product on 01/08/2010
4. Hjarard, E. and Pedersen, J. (2007)
5. Opportunity International: http://www.opportunity.org.uk/work/bank-building/ accessed 08/02/10
6. Stella software from Isee systems: www.iseesystems.com

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Appendix Two: Test Items

Appendix 2A Pre-test for DHH and Hearing class pupils

2B Post-test-one and Post-test-two Questions for DHH in English and norsk

2C Pre-test for G1 pupils

Appendix 2A Pre-test Questions for DHH and Hearing Pupils

Kindly answer all questions in Part I and 2 questions in Part II

Part I: Answer all questions in this Section

Q1. Briefly explain the following key words: What is a) high purchase b) price incl., Value Added Tax. c) interest d) bulk purchase/Sales offers

Solution: a) **high purchase:** When a person buys an item on high purchase, he pays an agreed part of the amount at once. The remaining money is paid by instalment.

b) **price incl., VAT:** means that the price is given/quoted with the required Value Added Tax.

c) **bulk purchase/sales offers:** It is different offers given on goods and services. The item is given at a reduced cost including items bought at large quantities.

d) **interest:** The bank pays a percentage on money saved with them or a money borrower pays an agreed percentage on the money the bank gives to the customer.

Q2. a) A silver spoon weighs 25 g. It contains 80% pure silver. How many grams of pure silver is a silver spoon?

b) Find 15% of 550 kr.

Solution: 2a) Silver spoon weight 25 g

80% pure silver $0.8 * 25 \text{ g} = \underline{20}$

2b) Amount = 550 kr

15% of 550 kr = $550\text{kr} * 0.15 = \underline{82.5}$

Q3. Arve bought new furniture for 15 000 kr excl. VAT. VAT is 25%.

a) How much he must pay for the furniture?

b) Explain in your answer in a)

Solution: 3a) The price of furniture 15 000 kr

25% VAT: $0.25 * 15000 \text{ kr} = + \underline{3\ 750 \text{ kr}}$

18 750 kr

3b) VAT is additional money added to the actual price of the furniture. This would increase the furniture price by 3750 kr.

Q4. Simen got a new stereo on sales offer. It actually cost 8500 kr. He received a 10% discount.

- a) How much had he paid to get this stereo system?
- b) How much had he get in the sales offer?
- c) Explain why he paid less than the actual price.

Solution: 4a) The price of stereo is 8500 kr
 10% discount: $0.1 * 8500 \text{ kr}$ $- \underline{850 \text{ kr}}$
 $\underline{\underline{7650 \text{ kr}}}$

4b) He got 850 kr in the sales offer

4c) The sales offer reduced the actual price of the stereo so he paid 850 kr less than 8500 kr

Q5. James has 5000 kr, Klement has 7 000 kr and Bjørg has 11 000 kr all at the bank at interest rate of 4% p.a. Find out the growth of bank account for

- a) James, Klement, and Bjørg. You observe what happens and record the answers for them.
- b) Briefly explain what your observation on the three accounts at the end of the year.

Solution: 5a) ((Interest * deposit*days required)/365 days) + deposit

James = $\frac{0,04 * 5000 \text{ kr} * 365 \text{ days}}{365 \text{ days}}$; Klement = $\frac{0,04 * 7000 \text{ kr} * 365 \text{ days}}{365 \text{ days}}$; Bjørg = $\frac{0,04 * 11000 \text{ kr} * 365 \text{ days}}{365 \text{ days}}$

= 5000 + 200	= 7000 + 280	= 11000 + 440
<u>= 5 200 kr</u>	<u>= 5 280 kr</u>	<u>= 11 440 kr</u>

5b) James, Klement and Bjørg had some interest added to their accounts at the end of the year. James had the lowest (200 kr), lower than the other two because his deposit was small while Bjørg had the highest (440 kr) added to hers because the initial deposit was high. Therefore the higher the initial amount the higher interest you get.

Q6. Lotte had 8000 kr in the bank. As a student the bank gave her 6% p.a. as interest rate.

- a) How much money she gets for 181 days over 90 days if she did not withdraw the money before 181 date?
- b) Explain your answer in 6a)

Solution: 6a) Bank account 8000 kr at 6% for 181 days and 90 days

6% interest rate 0.06 for 181 days = $\frac{0,06 * 8000 \text{ kr} * 181 \text{ kr}}{365 \text{ days}}$; $\frac{0,06 * 8000 \text{ kr} * 90 \text{ days}}{365 \text{ days}}$

= 238,03 kr + 8000 kr	;	118,37 kr + 8000 kr
= 8238,03 kr	;	8118,37 kr

8238,03 kr - 8118,37 kr = 119,36. Therefore 181 days would get 119, 36 kr than 90 days.

6b) The 181 days choice kept the money there for longer days compared to the 90 days. Therefore the interest increased and he got 119, 36 kr more than the 90 days choice.

Q7. Berit puts 6000 kr in the bank. She gets 3% interest on the total amount p.a.

a) If she takes her whole money away from the bank after the first year, how much did she get?

b) If she gave her son half of the money, how much money will she keep for herself?

c) Explain your answers in 7a) and 7b).

Solution: 7a) Berit money in the bank 6000 kr for first year at 3% interest rate each year.

$$(P \cdot T \cdot R) + (P) = (6000 \text{ kr} \cdot 1 \text{ year} \cdot 0.03) + (6000 \text{ kr}) = 180 + 6000 = \underline{\underline{6180 \text{ kr}}}$$

7b) She gave her son half of the total amount = $6180/2 = 3090$ kr. She would keep 3090 kr.

7c) She got 180 kr interests on the money at the first-year. The interest increased the total amount to 6180 kr. She gave half 3090 kr to the son and kept the other half 3090 kr.

Appendix 2B: Post-test one Questions for DHH

Answer all questions in Part 1 and Two questions in Part 2

Q1. Briefly explain the following: What is

a) Value Added Tax b) price excl. Vat. c) Rebate d) p.a.

a) Value Added Tax. On most goods and services we have to pay value added tax (VAT). Value added tax is often referred to as VAT. In 2006, the VAT was 25% on most items and 14% on food items.

b) price excl. VAT means that the price is quoted without VAT.

c) rebate: Discount is off the price. This means that a product is sold for a lower price than the original. The discount is often given in percent.

d) p.a. means per year

Q2. a) In seawater, there some places have 4% salt. How much salt is in 200 kg of this sea water?

2b) Calculate 2.5% of 1200 books


From the fig 222 below the graph show a) that the value of salt in water is 8kg and b) 30 books.

1. Calculate percentages in practical situations.

Q2. a) In seawater, there some places have 4% salt.
How much salt is in 200 kg of this sea water?
b) Calculate 2.5% of 1200 books

Key:
Piece of item * percentage value

Needed information:
i) Piece of item =
ii) Percentage value =
c) How to find percentage value



Piece of item
percent value
percent of item

Q2. a)

percent value: 0.0010 to 1.0000 (0.0400 selected)

Item: 400.00 to 2600.00 (200.00 selected)

percent of item: 15.00

1: Item 1250
2: percent value

Play
Erase

Page 1
Calculating percentages of items

2b)

percent value: 0.0010 to 1.0000 (0.0250 selected)

Item: 1200.00 to 2600.00 (1200.00 selected)

percent of item: 30.00

1: Item 1250
2: percent value

Play
Erase

Page 1
Calculating percentages of items

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Appendix 2; Fig 1.1 Post-test Questions 2a and 2b calculating percentage of a quantity

2a) There are 16 kg of salt in the water; AND 2b) 2.5% of 1200 books = 30 books

Q3. Lisa will buy food items for the cafeteria at school. The items add up to 1500 kr. In addition VAT is 14%

- How much would she pay for food items?
- How much more will she pay than the given price of food?
- Explain your answer in b) Food price VAT

2. Find total cost of goods when prices are without Value Added Tax (VAT).

Q3. Lisa will buy food items for the cafeteria at school. The items add up to 1500 kr. In addition VAT is 14%

a) How much would she pay for food items? b) How much more will she pay than the given price of food? c) Explain your answer in b) Food price VAT

Key: The element price without VAT + (the element price without VAT * VAT in %)

NOTE: Food VAT = 14%, Non-food items VAT = 25%

Needed information:

VAT in %: 0,0000 to 1,0000 (0,1400)

The item price without VAT: 1500,0 to 20000,0 (1500,0)

The item p...without VAT	kr 1500,00
VAT in %	0,14%

1: The item price without VAT: 1500

2: The item price with VAT: 1710

Final price with VAT: 221,40

Buttons: Back, Next

Appendix 2; Fig 2 Calculating the food VAT amount. This increases the first price given

3a) 1710.00 kr

3b) 1710 kr - 1500 kr = 210 kr. Lisa would pay 210 kr more than the price of food.

3c) The food VAT is 14% of the price for the food Lisa bought. The VAT amount is added to the price of food.

Q4. Lotte to buy a new car that cost 250 000 kr as it says in the price list, Value Added Tax incl she gets 25% offer.

- a) How much should he pay for the car?
- b) How much money would she save due to the offer?
- c) Explain your answer in a).

4a) 187 500.00 kr

4b) 250 000.00 kr - 187 500.00 kr = 62 500.00 kr

4c) 25% offer reduced the price of the car to 187 500.00 kr. Lotte saved 62 500.00 kr

3. Find the price of goods on sale offers, and reduction prices.

Q4. Lotte to buy a new car that cost 250 000 kr as it says in the price list. Value Added Tax incl she gets 25% offer.

a) How much should he pay for the car?.

b) How much money would she save due to the offer?

c) Explain your answer in a).

a) Solveig buys a jacket at 5% rebate. The jacket regular price was 420 kr. How much must she pay for the jacket with the given rebate?

b) Martin shall buy a new bicycle with the


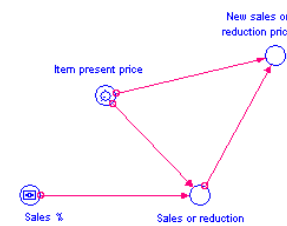
Key: Item present price - (Item present price * sales or reduction %)

Needed information:

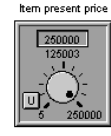
a) Item present price =

b) Sales% or reduksjon % =

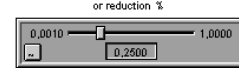
c) Calculate

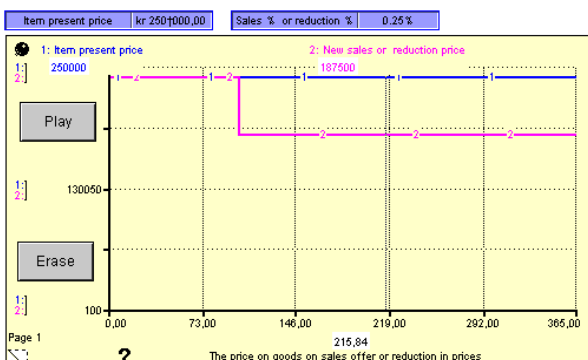
Item present price



Sales % or reduction %



Item present price: kr 2501000.00 Sales % or reduction %: 0.25%



1: Item present price: 250000
2: New sales or reduction price: 187500

Play Erase

Page 1 ? The price on goods on sales offer or reduction in prices

Appendix 2; Fig.3 Calculating sales offer of a vehicle

Part 2 answer two questions from this section

Q5. Hanna has 4000 kr, Inger has 2 000 kr and Bjørg has 6 000 kr at same bank at interest rate of 4% p.a. a) Find out the growth of bank account for Hanna, Inger and Bjørg. b) Explain what your observation from the change in the three persons at the end of the year.

5a) Hanna deposit grows to 4163.24 kr, Inger gets 2081.62 kr and Bjørg gets 6244.86 kr.
5b) Each of them having the same interest, high deposited person gains high interest and low capital deposited gains lower interest.

6. Find growth on bank account with interest over a period.

Q5. Hanna has 4000 kr, Inger has 2 000 kr and Bjørg has 6 000 kr at same bank at interest rate of 4% p.a. a) Find out the growth of bank account for Hanna, Inger and Bjørg.
b) Explain what your observation from the change in the three persons at the end of the year.

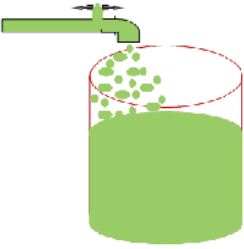
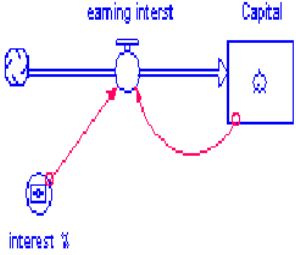
6. Martin has 5000 kr in the bank from January 1st. The bank gives him 2% p.a. as interest.
a) How much more would he receive after June than after March.
b) Explain

Q7. Herman and his friend put 10,000 kr in the bank. They get 5% interest p.a. on their money

Key: $(\text{Capital} * \text{interest} * \text{number of days}) / 365$

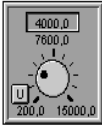
information:
a) Capital in the bank =
b) interest given =
c) days/ 365

How to solve the problem





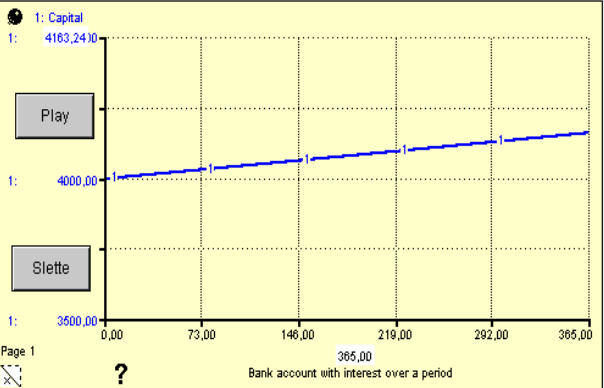
Capital	kr 41163,24
interest %	0.04%

Capital



interest %





Page 1 ? Bank account with interest over a period

Back
Next

Appendix 2; Fig 4 Finding the growth of accounts with same interests but different amount deposits sample

Martin has 5000 kr in the bank from January 1st. The bank gives him 2% p.a. as interest.

- a) How much more would he receive after June (181days) than after March (90days).
- b) Explain

6a) Interest up til March = 5025 kr an interest of 25 while in June is 5050 kr an interest of 52 kr. Therefore he gets 25 kr more in June than in March.

6b) March is longer compared to June therefore he earns 25 kr more than in March.

6. Find growth on bank account with interest over a period.

Q5. Hanna has 4000 kr, Inger has 2 000 kr and Bjørg has 6 000 kr at same bank at interest rate of 4% p.a. a) Find out the growth of bank account for Hanna, Inger and Bjørg.
b) Explain what your observation from the change in the three persons at the end of the year.

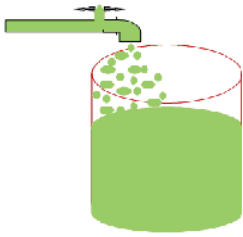
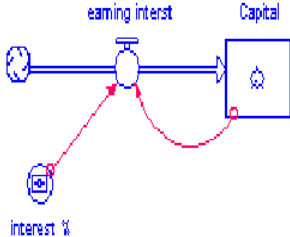
6. Martin has 5000 kr in the bank from January 1st. The bank gives him 2% p.a. as interest.
a) How much more would he receive after June than after March.
b) Explain

Q7. Herman and his friend put 10,000 kr in the bank. They get 5% interest p.a. on their money

Key: $(\text{Capital} * \text{interest} * \text{number of days}) / 365$

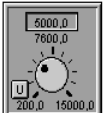
information:
a) Capital in the bank =
b) interest given =
c) days/ 365

How to solve the problem





Capital	kr 51101,01
interest %	0.02%

Capital



interest %



1: Capital

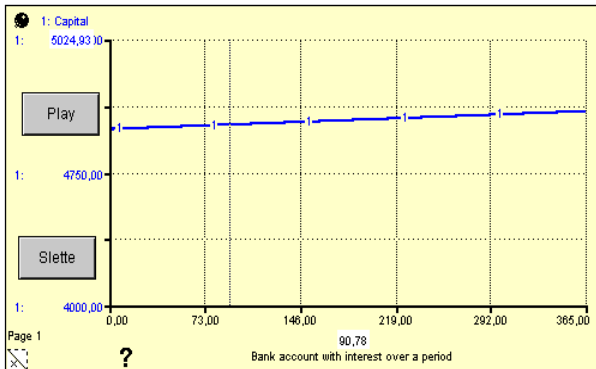
1: 5024,93 10

Play

1: 4750,00

Slette

1: 4000,00



Page 1

90,78

Bank account with interest over a period

Back
Next

Appendix 2; Fig 5 Answering question on calculating growth of bank account compared to two periods

Q7. Herman and his friend put 10,000 kr in the bank. They were get 5% interest p.a. on their money each year. After a year they withdraw and share the money with interest.

- a) How much did they get in total that year?
- b) If Herman got 7000 kr, how much did his friend get?
- c) Explain your answer in b) above.

7a) 10 511.36 kr

7b) 10 511.36 kr -7000 kr = 3 511.36 kr. Herman friend got 3 511.36 kr

7c) Herman got an increase on his bank account and shared it. By taking 7000 kr, his friend got 3 511.36 kr.

6. Find growth on bank account with interest over a period.



Q5. Hanna has 4000 kr, Inger has 2 000 kr and Bjørg has 6 000 kr at same bank at interest rate of 4% p.a. a) Find out the growth of bank account for Hanna, Inger and Bjørg.

b) Explain what your observation from the change in the three persons at the end of the year.

6. Martin has 5000 kr in the bank from January 1st. The bank gives him 2% p.a. as interest.

a) How much more would he receive after June than after March.

b) Explain

Q7. Herman and his friend put 10,000 kr in the bank. They were to get 5% interest p.a. on their

Key: $(\text{Capital} * \text{interest} * \text{number of days}) / 365$

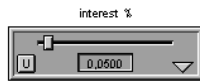
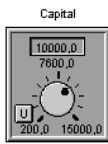
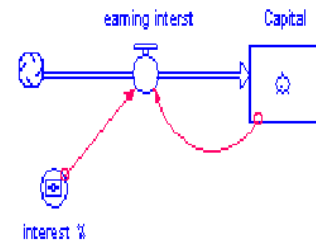
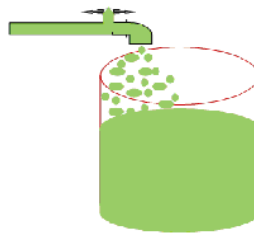
information:

a) Capital in the bank =

b) interest given =

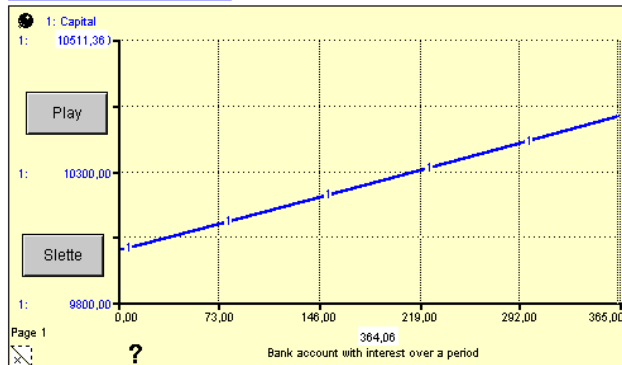
c) days/ 365

How to solve the problem



Capital kr 10†512,71

interest % 0,05 %



Back

Next

Appendix 2; Fig 6 Finding the growth of bank account and sharing it with a friend

Appendix 2B Post-test- two (Regular method) for DHH

Kindly answer all questions in Part one and 2 questions in Part two

Answer all questions on this part

1. a) Three percent of 400 kg of cooking oil in a barrel is suspected contaminated. Find the amount of oil that is contaminated.

b) Find the 5% of 5000 kr.

Solution 1a: $3/100 * 400\text{kg} = \underline{12\text{kg}}$

Solution 1b: $5/100 * 5000 = \underline{250\text{kr}}$

2. Calculate the total cost of a jacket if it costs 400 kr excl., VAT and VAT is 25%.

a) Find the total cost of the jacket.

b) Explain why the price increase on the jacket?

Solution 2a: $125/100 * 400\text{kr} = \underline{500\text{kr}}$ or $(25/100 * 400) + 400 = 100 + 400 = \underline{500\text{kr}}$.

Solution 2b: The 25% VAT on the 400 kr increase the cost of jacket to 500 kr.

3. Jon ordered the food for the weekend. The food amounted to 500 kr excl., VAT.

a) If the VAT is 14% what is the total cost?

b) Explain

Solution 3a: $114/100 * 500\text{kr} = \underline{570\text{kr}}$ or $(14/100 * 500\text{kr}) + 500\text{kr} = 70 + 500 = \underline{570\text{kr}}$

Solution 3b: 14% of the food price adds 70 kr more to the 500 kr.

4. A computer is sold for 6500kr. a) What is the cost if the item was on sales offer, it was reduced by 5%.

b) Explain if the cost is increased or decreased.

Solution 4a: $95/100 * 6500\text{kr} = \underline{6175\text{kr}}$ or $-(5/100 * 6500\text{kr}) + 6500 = -325\text{kr} + 6500\text{kr} = \underline{6175\text{kr}}$

Solution 4b: the cost of the computer reduced because of the reduction by 5%.

Part Two: Kindly answer 2 question in Part two.

5. Grace has 4000 kr, Cynthia has 6 000 kr and Karim has 2 000 kr they saved their money with interest rate at 3% p.a.

a) What is growth of each of their account?

b) Observe the growth according to each of the account looking at the interest rate and explain how their accounts have grown at the end of the year.

Solution 5a: $G = (4000 * 0,03 * 365) / 365$; $C = (6000 * 0,03 * 365) / 365$; $K = (2000 * 0,03 * 365) / 365$.
 $= 120 + 4000 = \underline{4120\text{kr}}$; $= 180 + 6000 = \underline{6180\text{kr}}$; $= 60 +$

$2000 = \underline{2060\text{kr}}$ **Solution 5b:** When the interest is the same, higher capital gives higher growth of money.

6.1a) Inger put 25,000 kr in the bank. She gets 3% interest on the total amount p.a. . a) If she takes all her money from the bank after the first year, how much did she get?

- b) If she gave half the money to his son, how much money she will keep to herself?
c) Explain your answers in 7a) and 7b).

Solution 6a: $(25\,000\text{kr} * 0.03 * 365) / 365 = 750 + 25\,000 = \underline{25\,750\text{ kr}}$

Solution 6b: $\frac{1}{2} * 25\,750\text{ kr} = 12\,875\text{ kr}$ for the son. Inger also gets 12 875 kr

Solution 6c: When Inger gave her son half of 25 750 kr, she gets 12 875 kr

7. Unni had 8500 kr in the bank. As a student, she gets 6% p.a. as interest rate.

a) How much money she gets for 181 days more than over 90 days if she did not withdraw the money before 181 date?

b) Explain your answer in 7a)

Solution 7a: $181\text{days} = ((8500 * 0.06 * 181) / 365) + 8500$; $90\text{ days} = ((8500 * 0.06 * 90) / 365) + 8500$
 $\quad \quad \quad = 252.90 + 8500 = 8752.90\text{ kr}$ $\quad \quad \quad = 125.75 + 8500 = 8625.75\text{ kr}$

The difference between 181days and 90 days is $8752.90\text{ kr} - 8625.75 = \underline{127.15\text{ kr}}$

Solution 7b: 181 days had 127.15 kr more over the 90 days

Tests in Norsk (Pretest, Post-test-one and Post-test-two)

Vennligst svar på alle oppgaver i Del 1 og to oppgaver i Del 2 (Pretest)

Del 1: Svar på alle 4 oppgavene i denne del

1. Forklar følgende med noen få ord. Hva betyr:
a) Avbetaling b) pris inkl. mva. c) rente d) tilbud
2. a) En sølvskje veier 25 g. Den inneholder 80% rent sølv. Hvor mange gram rent sølv er i sølvskjeen?
b. Regn ut 15% av 550 kr
3. Arve kjøpte nye møbler for 15 000 kr ekskl. Mva. Merverdiavgiften er 25%.
a) Hvor mye måtte han betale for møblene?
b) Forklar svaret i a).
4. Simen kjøpte et nytt stereoanlegg. Det koster egentlig 8500 kr inkl mva. Han fikk 10% rabatt.
a) Hvor mye betalte han for dette stereoanlegget?
b) Hvor mye fikk han i rabatt?
c) Forklar hvorfor han betalte mindre enn den faktiske prisen.

Del 2. Velg 2 oppgaver fra denne del

Q5. James har 5000 kr, Klement har 7 000 kr, og Bjørg har 11 000 kr deponert i banken med en rente på 4% p.a. Finn veksten av saldoen for

- a) James, Klement og Bjørg. Regn ut hva som skjer, og registrer svarene for dem.
- b) Forklar kort hva som skjer på tre kontoene ved utgangen av året.

6. Lotte hadde 8000 kr i banken. Som student gir banken henne 6% p.a. i rente.

- a) Hvor mye mer penger får hun etter 181 dager enn etter 90 dager.
- b) Begrunn svaret i 6a)

7. Berit setter 6000 kr i banken for sønnen sin. Hun får 3% rente på den totale mengden p.a.

- a) Dersom hun tar ut alle pengene fra banken etter et år, hvor mye får hun?
- b) Hvis hun ga sønnen sin halvparten av pengene i svar a), hvor mye penger får hun da selv?
- c) Begrunn svarene 7a) og b).

Vennligst svar på alle oppgaver i Del 1 og to oppgaver i Del 2(Post test one)

Del 1: Svar på alle 4 oppgavene i denne del

1. Forklar følgende med noen få ord. Hva betyr:
a) merverdiavgift b) pris ekskl. mva e) salg c) rabatt d) p.a.
2. a) I sjøvann er det enkelte steder 4% salt. Hvor mye salt er det i 200 kg av dette sjøvannet.
b) Regn ut 2.5% av 1200 bøker
3. Lisa skal kjøpe matvarer til kantina på skolen. Regningen kommer på 500 kr. I tillegg kommer 14% mva.
a)Hvor mye må hun betale for matvaren?
b) Forklar svaret i a).
4. Lotte skal kjøpe ny bil som koster 250 000 kr i følge prislisten, mva inkl. Hun får tilbud om 25% avslag.
a)Hvor mye skal hun betale for denne bilen?
b)Hvor mye penger kan hun spare på tilbudet.
c)Forklar svaret i a).

Del 2. Velg 2 oppgaver fra denne del

5. Hanna har 4000 kr, Inger har 2 000 kr, og Bjørg har 6 000 kr i samme bank med rente på 4% p.a.
- a) Finn ut veksten på bankkontoene til Hanna, Inger og Bjørg etter et 1 år?.
 - b) Forklar hva som endrer seg på de tre kontoene ved utgangen av året.
6. Martin har 5000 kr i banken fra 1. januar. Banken gir ham 2% p.a. i rente.
- a) Hvor mye mer har han på kontoen den 30. juni enn den 31. mars.
 - b) Forklar
7. Herman og hans venn satte inn totalt 10 000 kr i banken. De får 5% rente p.a. for pengene sine hvert år. Etter et år tar de pengene sine inkludert rente, og deler dem mellom seg.
- a) Hvor mye fikk de totalt det året?
 - b) Hvis Herman fikk 7000 kr, hvor mye fikk hans venn?
 - c) forklar svaret i a).

Vennligst svar på alle oppgaver i Del 1 og to oppgaver i Del 2 (Post test 2 Norsk)

Del 1: Svar på alle 4 oppgavene i denne del

1. a) Tre prosent av 400 kg med matolje i en tønne er det mistanke om er forurenset. Finn mengden av olje som er forurenset.
b) Finn 5% av 5000 kr.
2. Beregn den totale kostnaden for en jakke hvis den koster 400 kr ekskl. mva. Mva er 25%.
- a) Finn den totale kostnaden for jakke.
 - b) Forklar hvorfor prisen på jakken har økt?
3. Jon bestilte matvarer for helgen. Maten utgjorde til sammen 500 kr ekskl. Mva.
- a) Dersom MVA er 14% hva blir den totale kostnaden?
 - b) Forklar
4. En datamaskin er solgt for 6500kr.
- a) Hva blir kostnaden hvis den løpet av et salgstilbud blir redusert med ytterligere 5%?
 - b) Forklar om kostnadene økes eller reduseres.

Del 2. Velg 2 oppgaver fra denne del

5. Grace har 4000 kr, Cynthia har 6 000 kr, og Karim har 2 000 kr. De har satt inn sine i penger i banken med rente på 3% p.a.

- a) Hva stor vekst i kroner skjer på hver konto.
- b) Følg veksten av kontoene, se på renten og forklar hvor mye kontoene har vokst med på slutten av året.

6. a) Inger setter 25 000 kr i banken. Hun får 3% rente på den totale mengden p.a.

- a) Dersom hun tar alle pengene fra banken etter det første året, hvor mye fikk hun?
- b) Hvis hun gav halv parten pengene til sønnen sin, hvor mye penger vil hun beholde for seg selv?
- c) Begrunn svarene i 7a) og 7b).

7. Unni hadde 8500 kr i banken. Som student sav i banken henne 6% p.a. i rente.

- a) Hvor mye mer penger får hun etter 181 enn etter 90 dager hvis hun ikke tar ut pengene før etter 181 dager?
- b) Forklar svaret i 7a)

Appendix Three: Guided Interview Questions

Brief introduction and information of the interview

1. Use of name of interviewee
2. Question, answering questions and follow-up question
3. Recordings of responses and purpose
 - i) What is your past experience in learning mathematics at school? Tell me what led to is there any reason for this
 - ii) Briefly describe a mathematics class you have attended. What did you make from that class?
 - iii) Were you given a mathematics-word-problem? How do you find mathematics-word problems?
 - iv) Have you been asking your parents, siblings and or friends help for mathematics home assignments? Why did you/ or did not ask them for assistance in your home assignments?
 - v) Share your experience in teaching 'økonomi' and using system dynamics method to learn mathematics. What did you do? How did you go about using system dynamics to solve mathematics problems in class?
 - vi) Which area of the previous method / system dynamics teaching treatment helped you to understand the topic 'økonomi'.

Participants worked on the sample mathematics problem below and questions were asked on them as part of the interview

'Joe has 8000 kr, Klement has 12 000 kr and Bjorg has 16 000 kr all at the same bank at interest rate of 4% p.a. Find out the growth of bank account for
a) Joe, Klement, and Bjørg. You observe what happens and record the answers for them.'

- vii) b) Explain in your own words what you observe on the three accounts at the end of the year.
- viii) Do you have any question on the teaching and any other related item?

Appendix four: Samples of students work

Appendix 4a Sample work of participants in the various test exhibits for DHH

1. Concepts and key words section

1 a) fleks du papper en leieagret som koster 8 mi
du har ikke råd til alt med en gang.
du betaler litt allit hver måned

b) mva 25% det betyr at det er ferdig vi betaler
du ikke mer

c) renter = resten? går til staten?

d) tilbud (fordrag) eller billigere (salg)

Appendix 4A; Fig.4.7a

a) Avbetaling = Man trenger ikke å betale hele
beløpet med en gang, men litt og litt
hver mnd

b) pris inkl. mva = at noen av pengene går
til staten.

c) rente = vot ikke

d) tilbud = da er varene satt ned og
er billigere

Appendix 4A; Fig.4.7b

Fig. 4.7 (a) and (b) are Sample participants' pre-test responses to concepts and key words section of the tests

1. a) merverdiavgift Moms 14% på matvarer
25 på vanligste ting

b) pris ekskl. mva pris uten moms

c) salg Når en gjenskjend ~~billigere~~
Selges billigere enn vanlig

d) p.a. for

Appendix 4A; Fig.4.7c

1. a) merverdiavgift totalt pris med mva eller
uten - ekskl.

b) pris ekskl. mva på en måte ekstra

c) salg 'rabatt' billigere, prosent
eller noe lignende

d) p.a. per år, eller for

Appendix 4A; Fig.4.7d

Fig.

4.7 (c) and (d) Sample participants' post-test-two responses to concepts and key words section of the tests

Calculating percentage of quantity/amount

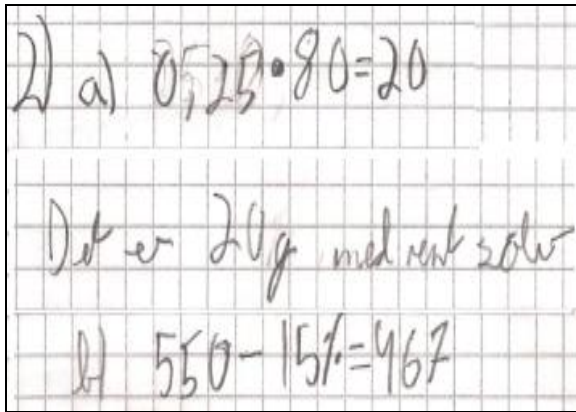
2. a) $25 = 0,25\%$ 20 gram er rent selv

$$\begin{array}{r} 0,25 \cdot 80 \\ \underline{20,00} \\ \underline{20,00} \\ 20,00 \end{array}$$

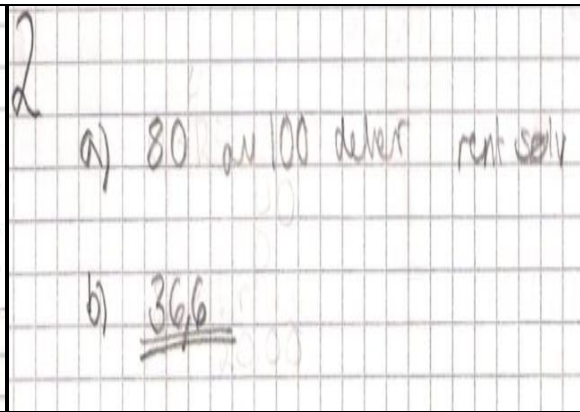
b) $15 = 0,15$

$$\begin{array}{r} 0,15 \cdot 550 \\ \underline{1000} \\ \underline{82,50} \\ 82,50 \end{array} = 82,50 = 15\% \text{ av } 550$$

Appendix 4A; Fig 4.8a Participants pre-test sample work on calculating percentage of quantity/amount

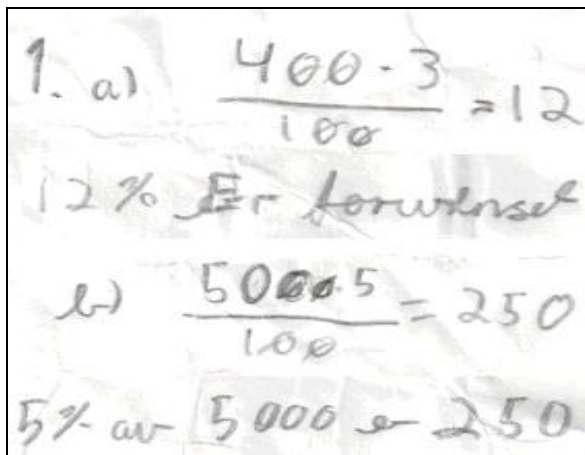


Appendix 4A; Fig 4.8b

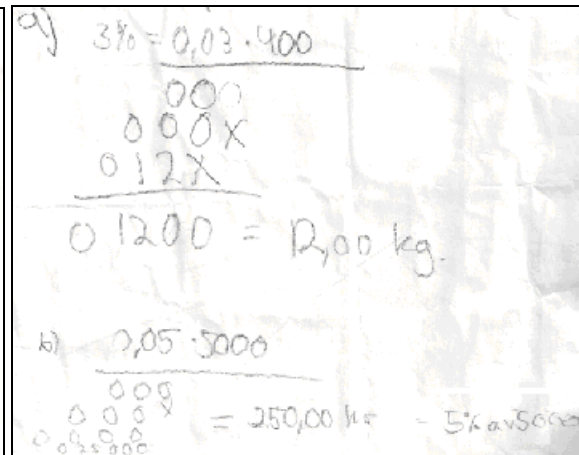


Appendix 4A; Fig 4.8c

Fig 4.8b and 4.8c Participants pre-test sample work on calculating percentage of quantity/amount



Appendix 4A; Fig 4.8d



Appendix 4A; Fig 4.8c

Participants post-test-two sample work on calculating percentage of quantity/amount

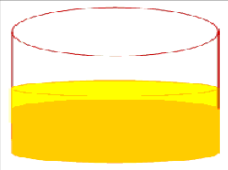
1. Regne ut prosent i praktiske situasjoner (Grupper A og B; to studenter).

a) Litago banan yogurt inneholder 250g. Hvis innholdet av banan er 9%, regn ut hvor mye banan det er i en litago banan yogurt? Oppgave til Gruppe A

b) Litago banan yogurt inneholder mat er 250g. Hvis aprikos er 6%, regn ut hvor mye aprikos er i en litago banan yogurt? Oppgave til Gruppe B

Nøkkel: Elementet * Prosent verdi

Nødvendig informasjon:
 i) Stykke element =
 ii) Prosent verdi =
 c) Hvordan kan jeg regne?



Stykke element

Prosent verdi

prosent av element

Prosent verdi: 0,0010 to 1,0000 (current: 0,0250)

Stykke element: 1200,00 to 7500,00 (current: 3750,52)

1: Stykke element 1200

2: Prosent verdi 0

Play

Slette

Page 1

REGN UT PROSENT AV VOLUM (Student Praktis)

Tilbake

Neste

Appendix 4A; Fig 4.8d MILES section used to solve problem involving percentage of an amount in post test-one

3. Find prices of items given without value added tax (VAT)

2) $25 = 0,25$

$$\begin{array}{r} 15000 \\ \times 0,25 \\ \hline 3750,00 \end{array}$$

$$\begin{array}{r} 18750 \\ - 3750 \\ \hline 15000 \end{array}$$

matte nam betale for møbler

b) Først finder man ud hvor mye 25% er af 15.000, der efter tar du svaret og trækker fra 15.000

Appendix 4A; Fig 4.9a Participants pre-test sample work on finding prices of items shown less of VAT

3) a) $15000 + 25\% = 18750$

Appendix 4A; Fig 4.9b

a) 15600 kr

b) $15000 : 25 = 600$

+ 15000 kr = 15600

Appendix 4A; Fig 4.9c

Fig 4.9b and 4.9c Participants pre-test sample work on finding prices of items displayed without VAT

2) $25\% = 0,25$

$$\begin{array}{r} 0,25 \cdot 400 \\ \hline 100,00 \end{array}$$

$$\begin{array}{r} 400 \\ + 100 \\ \hline = 500 \text{ kr for janken} \end{array}$$

b) siden ekski betyr at mva er ikke med prisen.

Appendix 4A; Fig 4.9d

3 $14\% = 0,14$

$$\begin{array}{r} 0,14 \cdot 500 \\ \hline 70,00 \end{array}$$

$$\begin{array}{r} 500 \\ + 70 \\ \hline 570 \end{array}$$

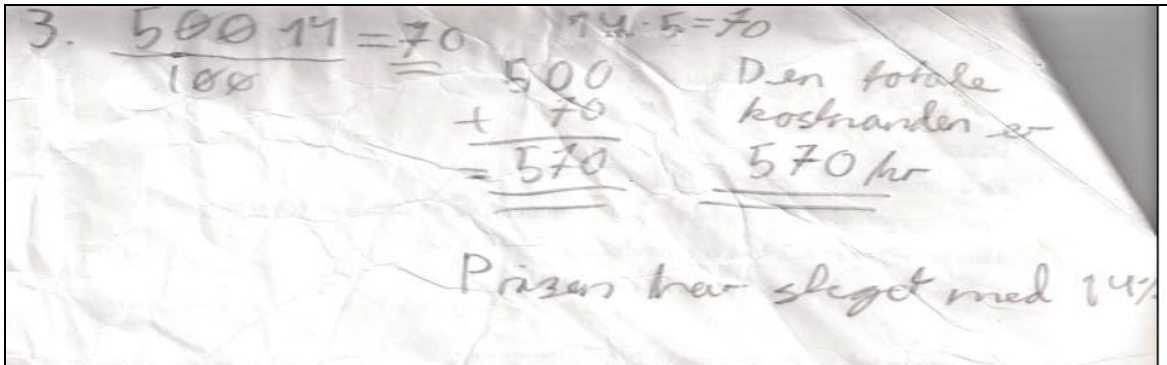
Appendix 4A; Fig 4.9e

2. a) $400 : 25 = 100$

$$\begin{array}{r} 100 \\ + 400 \\ \hline = 500 \end{array}$$

b) Janken har det med 100 kr pga Mva.

Appendix 4A; Fig 4.9f



Appendix 4A; Fig 4.9g

Fig 4.9d, e, and f are participants' post-test-two work on finding prices of items displayed without VAT

2. Beregn totale kostnaden for varen når prisen er gitt uten merverdiavgift

Nøkkelford:
 a) Merverdiavgift eller mva, f) p.a.
 b) pris inkl. mva, g) salg tilbud
 c) avbetaling, h) rabatt
 d) pris ekskl. mva, i) rente

Nøkkel: Stykke element Pris uten mva + (Element Pris uten mva * mva %)

NOTE: Mat mva= 14%, Alle varene mva = 25%

Nødvendig informasjon:
 a) Stykke element pris uten mva =
 b) mva % =

1. Nørtøy kjøper nye motorsykel som koster 10 000 kr. Prisen er ekskl. mva.
 a) Hvor mye skal han betale for den nye prisen hvis mva er 25%?
 b) Forklar hvorfor han betale dette beløp. Eller
 1. Du er en leder av butikk som selger

Stykke element uten mva stykke element med mva

mva % mva i Kr

Stykke el. uten mva: \$10,000.00
 mva %: 0.25%

1: Stykke element pris uten mva: 10000
 2: stykke element pris med mva: 12500

Play Slette

Page 1 Endelige pris med mva (Student evelse)

Tilbake Neste

Appendix 4A; Fig 4.9h Participants post-test-one sample work on finding prices of items displayed without VAT

4. Finding prices of sales/items items on reduces price offers

7

a) $8500 \cdot 10 = 850 \text{ kr}$
 $850 - 8500 = \underline{7650 \text{ kr}}$

b) 850 kr

c) fordi det er inkl mva. slipper å betale mer som (tilsluten)
 + han fikk rabatt...?

Appendix 4A; Fig 4.10a

4) $8500 - 10\% = 850$ $850 - 8500 = 7650$

Han fikk 850, rabatt.

Rabatt gjør at vi får ting billigere.

Appendix 4A; Fig 4.10b

4. a) $10 = 0,10$

$$\begin{array}{r} 8500 \cdot 0,10 \\ 0000 \\ 8500 \times \\ 0000 \times \\ \hline 025000 = 850,00 \end{array}$$

$$\begin{array}{r} 10,10 \\ 8500 \\ - 850 \\ \hline 7650 \end{array}$$

kr betalte han for stereodisken

b) han fikk 850 kr, rabatt

c) han betalte mindre siden han betalte mva som går til staten også kanskje det var salg

Appendix 4A; Fig 4.10c

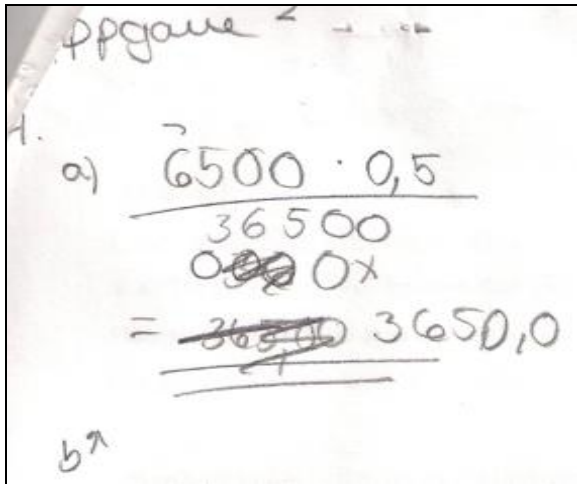
Fig 4.10a, b, and c are participants' pre-test work on finding sales and reduced price offers

4a) $5\% = 0,05$ $0,05 \cdot 6500$

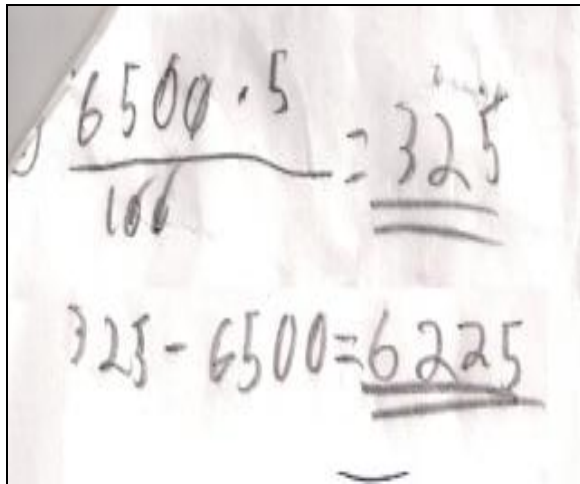
$$\begin{array}{r} 000 \\ 0000 \times \\ 025 \times \times \\ \hline 025000 \approx 275,00 \end{array}$$

b) Hvis den ikke koster det mer, hvis den reduseres er det billigere.

Appendix 4A; Fig 4.10d



Appendix 4A; Fig 4.10e



Appendix 4A; Fig 4.10f

Fig 4.10d, e, and f are participants' post-test-two work on finding sales and reduced price offers

3. Finne prisen på varer på salg tilbud eller reduserte priser.

Q2. En datamaskin er solgt for 6500 kr.
 2a) Hva er kostbæden hvis i løpet av et salgstilbud på 5%?
 2b) Hva skjer til den nye prisen?

Svaret
 2a)
 2b)

Nødvendig informasjon:
 a) Elementprisen nå =
 b) Prosent salg/ % reduksjon =
 c) Beregn

Elementprisen nå + (elementprisen nå) * salg prosent eller prosent reduksjon)

Et element pris nå: 6500,00
 Salg % eller prosent reduksjon: 0,05%

1: Et element pris nå: 6500
 2: Nye salg eller reduksjon pr: 6175

4275

50,00 73,00 140,00 210,00 282,00 365,00

Page 1 155.63 12:33 PM Wed, Sep 22, 2010

Prisen på varer på salg, tilbud eller reduserte priser

Tilbake Neste

Appendix 4A; Fig 4.10g

3. Finne prisen på varer på salg tilbud eller reduserte priser.

Q2. En datamaskin er solgt for 6500 kr.
2a) Hva er kostbuden hvis i løpet av et salgstilbud på 5%?
2b) Hva skjer til den nye prisen?

Svaret
2a)
2b)

Nødvendig informasjon:
a) Elementprisen nå =
b) Prosent salg/ % reduksjon =
c) Beregn

Elementprisen nå +
(elementprisen nå * salg prosent
eller prosent reduksjon)

Et element pris nå
\$6,500.00

Salg % ell. nt reduksjon
0.15%

1: Et element pris nå
2: Ny salg eller reduksjon pris

1: 6500
2: 5525

1: 3550
2: 3550

1: 100
2: 100

Page 1
177.81
12:02 PM Fri, Sep 24, 2010

Prisen på varer på salg, tilbud eller reduserte priser

Tilbake
Neste

Appendix 4A; Fig 4.10h

5. Finne prisen på varer på salg tilbud eller reduserte priser.

Sara vil kjøpe ny DVD-spiller.
i) Hvilken tilbud er best?
ii) Hvor mye mer koster den dyreste spilleren enn billigste spilleren?

A
 Kr 2800
 - 10% rabatt

B
 kr 3000
 - 15% rabatt

Nøkkel: Sammenlign den totale prisen for A og B.
A: Pris item * salg rate. ELLER
Pris på varen + totale transportkostnader.
Sammenlign den endelige salgsprisen av A og B

Gammle pr... element A1
\$6,800.00

Gammle P... element B2
\$7,000.00

1: Nye element prisen av A1
2: Nye element pris av B2

1: 6120
2: 5950

1: 4275
2: 4275

1: 50
2: 50

Page 1
114.81

Prisen på varer på salg, tilbud eller reduserte priser

Tilbake
Neste

Appendix 4A; Fig 4.10i

4. Finne prisen på varer på salg tilbud eller reduserte priser.

Sammenligne prisene på

c) Herman vil kjøpe en ny genser. Den koster 543 kr i nærbutikken og 515 kr på storsenteret. For å komme til storsenteret må han ta buss som koster 18 kr hver vei.

Nøkkel: Sammenlign den totale prisen for A og B.
 Pris på element A =
 Pris på element B =
 Hva er salg % gitt for A eller B
 Hva er den nye prisen for A og B
 Sammenlign A og B
 * Pris vare * salg %. ELLER
 * Kostnaden for kjøp element A & B

Pris av element A: 543.00
 Pris av element B: 515.00

1: Pris av element A: 443
 2: Kostnaden for kjøp element B: 405

134.31

Prisen på varer på salg, tilbud eller reduserte priser

Appendix 4A; Fig 4.10j

Figure 4.10g to 4.10i demonstrates post-test-one exercises done in the interactive environment the simulations

5. Finding growth on bank account over a period

7a) $3\% = 0,03$

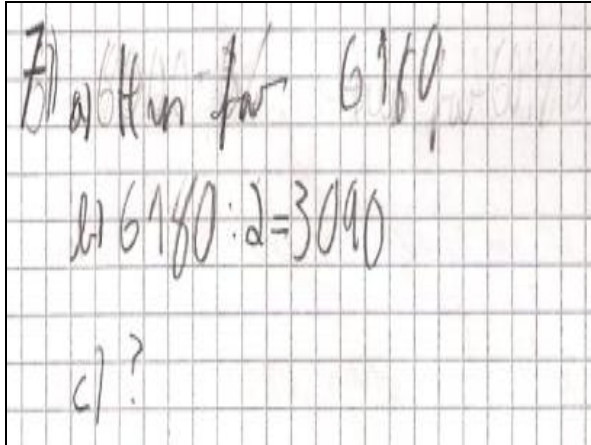
$$\begin{array}{r} 0,03 \cdot 6000 \\ \underline{000} \\ 000 \times \\ \underline{0000} \times \\ 0180 \\ = 180,00 \end{array}$$

$\frac{6000}{+ 180} = 6180$ kr får hun hvis hun tar ut pengene

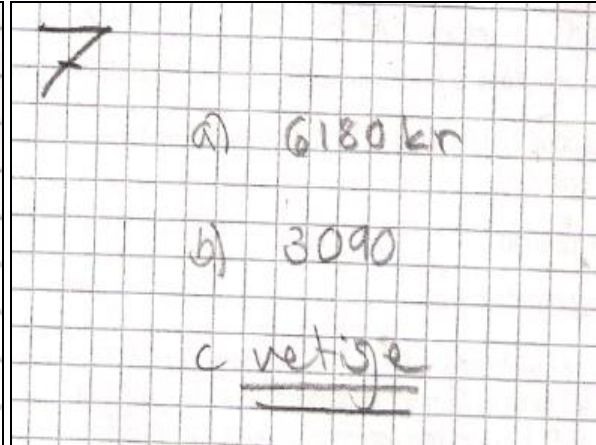
b) $600 \cdot 2 = 300$
 $180 \cdot 2 = 90$ > De får 390 kr hver

d) Fordi, se på utregningen.

Appendix 4A; Fig 4.11a

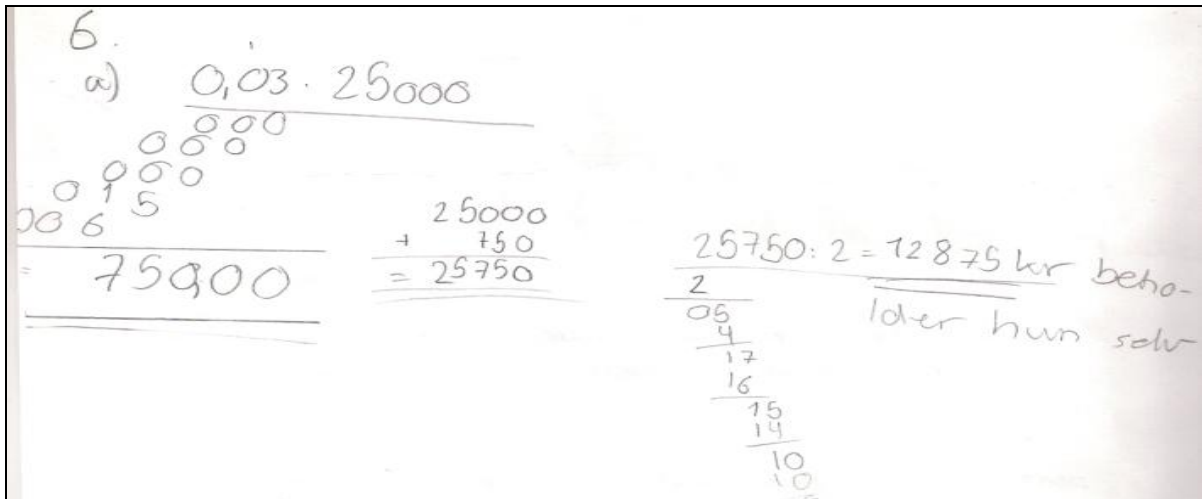


Appendix 4A; Fig 4.11b

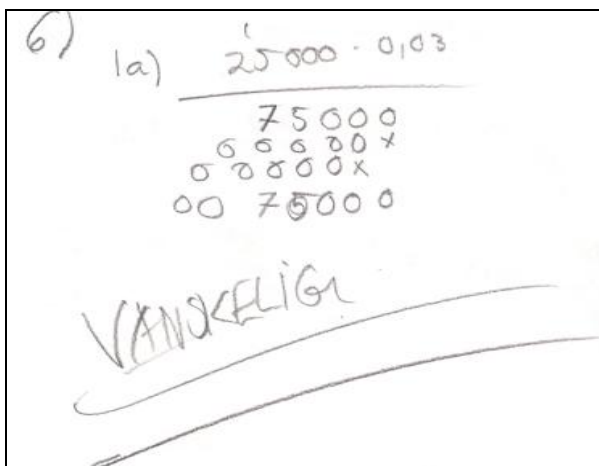


Appendix 4A; Fig 4.11c

Fig 4.11a, b, and c are participants' pre-test work on finding growth on bank account over a period



Appendix 4A; Fig 4.11d



Appendix 4A; Fig 4.11e

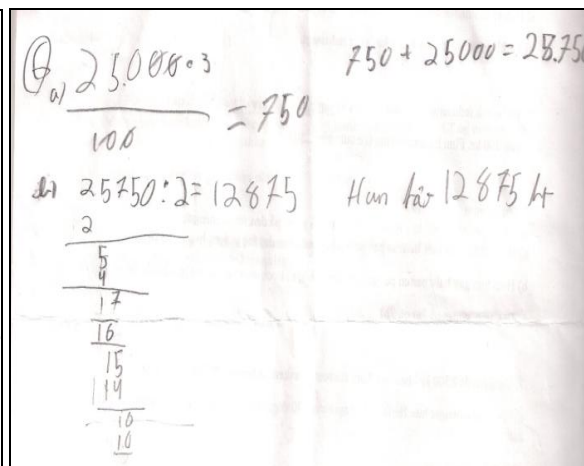


Fig 4.11f

Fig 4.11d, e, and f are participants' post-test-two work on finding growth on bank account over a period

6. Beregn vekst på bankkonto med renter over en periode.

Martin hadde 2500 kr stående i banken fra 4. mai til 15. september. Banken gir 2% rente på beløpet pr år.
a) Hvor mange kroner fikk Martin i renter i perioden?

informasjon:
a) Kapital i banken =
b) rentefoten =
c) dager/ 365

Nøkkel for beregn beløp vekst
(kapital * rente * dager) / 365
SD metod:
Kapital * rente = beløp i bank

Kapital	kr 21550,50
rente %	0,02 %

Page 1

Tilbake

Neste

Appendix 4A; Fig 4.11g

6. Beregn vekst på bankkonto med renter over en periode.

3. Jon hadde 8000 kr i banken for 292 dager. Banken ga han 2% rente p.a.
a) Finne ut hvordan Jon penger vokser på 2% rente.
b) Endring rente til 4% p.a. 292 dager og c) 6% rente p.a. på 292 dager.
Skrive ned alle beløper verdi til a), b) og c)
Forklar hva skjer til beløper i a), b) og c).

informasjon:
a) Kapital i banken =
b) rentefoten =
c) dager/ 365

Nøkkel for beregn beløp vekst
(kapital * rente * dager) / 365
SD metod:
Kapital * rente = beløp i bank

Kapital	\$4,333,02
rente %	0,55 %

Page 1

Tilbake

Neste

Appendix 4A; Fig 4.11h

6. Beregn vekst på bankkonto med renter over en periode.

3. Jon hadde 8000 kr i banken for 292 dager. Banken ga han 2% rente p. a.
 a) Finne ut hvordan Jon penger vokser på 2% rente.
 b) Endring rente til 4% p. a. 292 dager og c) 6% rente p. a. på 292 dager.
 Skrive ned alle beløper verdi til a), b) og c).
 Forklar hva skjer til beløper i a), b) og c).

informasjon.
 a) Kapital i banken =
 b) rentefoten =
 c) dager/ 365

Nøkkel for beregn beløp vekst
 (Kapital * rente * dager) / 365

SD metod:
 Kapital * rente = beløp i bank

Kapital

rente %

Kapital	\$5,101.01
rente %	0.02%

1: Kapital
1: 5049.8930

Play

Slette

Page 1
Bankkonto med rente over periode

Tilbake
Neste

Appendix 4A; Fig 4.11i

Hearing Pupils Score on the pre test								Cumulative marks per hundred					
Pupils/ Require score	8	12	20	24	18	18	100	8	20	40	64	82	100
a	2	11	0	0	5	0	18	2	13	13	13	18	18
b	6	0	9	6	0	0	21	6	6	15	21	21	21
c	1	0	0	24	0	0	25	1	1	1	25	25	25
d	2	0	0	24	0	0	26	2	2	2	26	26	26
e	4	10	13	24	14	10	75	4	14	27	51	65	75
f	2	7	0	18	18	0	45	2	9	9	27	45	45
g	4	0	10	18	10	12	54	4	4	14	32	42	54
h	4	12	9	12	20	10	67	4	16	25	37	57	67
i	7	11	16	20	15	5	74	7	18	34	54	69	74
j	6	8	14	18	16	5	67	6	14	28	46	62	67
k	6	10	12	24	16	18	86	6	16	28	52	68	86
l	7	11	12	18	18	0	66	7	18	30	48	66	66
m	7	10	15	20	15	15	82	7	17	32	52	67	82
n	7	11	12	22	18	16	86	7	18	30	52	70	86
o	6	12	18	22	16	18	92	6	18	36	58	74	92
p	6	11	18	22	15	0	72	6	17	35	57	72	72
q	6	11	17	18	18	18	88	6	17	34	52	70	88
r	8	10	17	16	16	5	72	8	18	35	51	67	72
s	2	10	18	16	12	14	72	2	12	30	46	58	72
t	5	8	11	6	16	16	62	5	13	24	30	46	62
u	7	12	18	15	18	9	79	7	19	37	52	70	79
v	2	8	0	5	16	5	36	2	10	10	15	31	36
w	4	0	0	23	5	0	32	4	4	4	27	32	32

x	7	10	9	5	5	0	36		7	17	26	31	36	36
y	7	10	12	16	13	8	66		7	17	29	45	58	66
z	4	10	10	20	0	0	44		4	14	24	44	44	44
æ	4	6	0	0	5	0	15		4	10	10	10	15	15
ø	4	10	22	24	15	15	90		4	14	36	60	75	90
Avg. scores	4,89	8,18	10,43	16,29	11,96	7,11	58,86	% Avg. score	4,89	13,07	23,50	39,79	51,75	58,86

Appendix 4B; Table 2; Marks and cumulative scores of Hearing pupils who took part of the pre-test

Participants scores			
Participants	Mean Marks	Highest marks	Lowest marks
DHH	53,5	72	33
Hearing Classmates	58,68	90	15

Appendix 4B; Table 3; DHH participants' scores compared with the hearing classmates