

UNIVERSITY OF CAPE COAST

**EFFECTIVENESS OF INTERACTIVE MULTIMEDIA COURSEWARE
AS INSTRUCTIONAL MEDIUM FOR TEACHING MULTIPLICATION OF FRACTIONS**

JAMES USSHER

2008

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FRACTIONS**

BY

JAMES USSHER

**Dissertation submitted to the Centre for Continuing Education of the Faculty
of Education University of Cape Coast, in partial fulfilment of the
requirements for award of Master of Education Degree in Information
Technology**

MARCH, 2008

DECLARATION

Candidate's Declaration

I hereby declare that this dissertation is the result of my own original work and that that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:..... Date:.....

Name : James Ussher

Supervisor's Declaration

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Cape Coast.

Supervisor's Signature:..... Date:.....

Name: Prof. Joseph Ghartey Ampiah

ABSTRACT

The study was carried out with primary 6 pupils at Assin Fosu demonstration school. This study looked at the comparative analysis of the performance of pupils who were taught multiplication of fractions using an interactive multimedia courseware and those who were taught using the traditional method of teaching.

Visual Basic 6.0 and TechSmith Camtasia Studio v5.0.2 software were used to develop the interactive multimedia courseware on multiplication of fractions. An achievement test and questionnaire were used to collect data on multiplication of fractions. The achievement test consisted of pre-test and post-test; the two tests were parallel (that is, both test were at the same level of difficulty). Simple random sampling technique was used to select 72 primary five pupils (36 pupils each from the two primary five classes). Data was analysed using frequencies, percentages, Chi-square and t-test.

The performance of the experimental and control groups, was not significantly different in both pre-test and post-test. However, there was significant difference in pupil's interest in multiplication of fractions in favour of the experimental (83%).

The study was recommended that, pupils should be introduced to computers early enough, teachers should pay attention to the conversion of store problems into mathematical expressions, interactive multimedia courseware should be developed for challenging topics and collaborative method of teaching should be encouraged.

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DEDICATION

I dedicate this work to my wife Mrs Margaret Ussher and my children.

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CHAPTER ONE

INTRODUCTION

Background to the Study

Since the independence of Ghana in 1957 every ruling government has made the effort to improve upon the development of education. The following educational committees, Acts and reforms are the confirmation:

1. 1961: Educational Act- Fee-Free Compulsory Education for all children of school going age.
2. 1969 Russel Committee - to review facilities of Technical and Commercial education and training.
3. 1970 Dowuona Committee - to advise the Government in formulating policy for financial support of University students in Ghana (Students' loan Scheme).
4. 1972 Dzobo Committee - Gave birth to the Educational reform which established the Junior Secondary School (JSS) and the Senior Secondary School (SSS) in 1987.
5. 2003 Anamua-Mensah Committee -- Gave birth to the 2007 Educational reform which established the Junior High School (JHS) and the Senior High School in 2007.

Although, all the reforms were geared towards the improvement of the standard and performance of education, on the average, the performance of students over the years do not justify the effort put in the development of

education. Table 1 shows the summary (National and the Districts Percentage of Candidates with Aggregate 6 to 30) of the performance of pupils in the Basic Education Certificate Examination (BECE) from the year 2004 to 2009, organised by an internationally recognised examination board called The West African Examinations Council (WAEC).

Since 2004 when the Ghana Education Service instituted the grading of performances of the various Districts in terms of the national qualifying admission rate into the Senior High School (SHS) based on aggregate 6 to 30, the number of Districts above the National aggregate has never exceeded 35%. The highest was achieved in 2009, where the national average was 62.42% and out of the 138 districts only 47 (i.e. 34.05%) had above the national average.

Table 1: Basic Education Certificate Examination (2004–2009)

Year	No. of District	% of Candidates with Aggregate 6-30	% of Candidates > 30	National Average (N.Ave)	% of Candidates with Aggregate 6-30 above N.Ave. and District
2004	110	61.2	38.8	61.18	25 (22.7%)
2005	110	61.6	38.4	61.59	24 (21.8%)
2006	113	61.9	38.1	61.91	26 (23.0%)
2007	138	61.3	38.7	61.28	39 (28.3%)
2008	138	62.2	37.8	62.17	42 (30.4%)
2009	138	62.4	37.6	62.42	47 (34.1%)
Average	124.5	61.8	38.2	61.65	34 (26.7%)

(Ministry of Education and Sports [MOES] 2009)

General standard of mathematics at the basic education in Ghana

Trends in International Mathematics and Science Study (TIMSS) are series of studies undertaken once every four years by the international Association for the Evaluation of Educational Achievement (IEA). TIMSS monitor trends in mathematics and science at two levels: fourth grade (primary 4) and eighth grades (JHS2). The goal is to provide comparative information about educational achievement across countries to improve teaching and learning in mathematics and science. The TIMSS mathematics tests for the eighth and fourth grades were designed to enable reporting by five content areas in accordance with the TIMSS mathematics framework. These areas, including their main topics, are:

1. Number (whole numbers, fractions and decimals, integers, ratio, proportion, and percent) “At grade 4, integers are not included and the last topic includes” only simple proportional reasoning
2. Algebra (patterns, algebraic expressions, equations and formulas, relationships “At grade 4, algebraic expressions is not included.”
3. Measurement (attributes and units, tools, techniques, and formula)
4. Geometry (lines and angles, two- and three-dimensional shapes, congruence and similarity, locations and spatial relationships, symmetry and transformations)
5. Data (data collection and organization, data representation, data interpretation, uncertainty and probability) “At grade 4, uncertainty and probability is not included.”

Ghana participated the eighth grade level (i.e. JHS2) in the third and fourth of TIMSS in 2003 and 2007 respectively. Although, Ghana’s performance in

2007 was better than that of 2003, the content area scale averages for both years were below the TIMSS scale average and the low international benchmark (400). This means that Ghana's performance was low across the entire content domain as shown in table 2.

Table 2: TIMSS Grade Eight (JHS2) Mathematics Result for Ghana

Year	Number	Algebra	Geometry	Data	Number. of countries	Rank	TIMSS Scale Average
2003	289	288	262	293	48	48	467
2007	310	358	275	321	56	55	500

Table 3: TIMSS 2007 International Benchmark

Scale Average	International Benchmark
625	Advanced International Benchmark
550	High International Benchmark
475	Intermediate International Benchmark
400	Low International Benchmark

(Mullis, I.V.S., Martin, M.O., & Foy, P. 2008).

Situation of mathematics achievement at the primary school level in Ghana

The National Education Assessment (NEA) is a standardised achievement multiple-choice test conducted countrywide designed for Primary 3 (P3) and Primary 6 (P6) pupils in 3% random sample of all primary schools in Ghana. The test is in English and Mathematics. The broad skill areas tested in NEA for English and Mathematics are:

English

1. Listening,
2. Usage (Grammatical Structure)
3. Reading Comprehension
4. Writing

Mathematics

1. Number and Numeracy
2. Basic Operations
3. Measurement
4. Shape and Space
5. Collecting and Handling Data

Two cut-off scores were established to provide useful information regarding pupils' performance and system effectiveness. Minimum-competency describes pupils reaching 35% and proficiency level identifies those reaching 55% of the total score on the test. The proficiency level of 55% shows that a pupil has learned the curriculum for the grade level (class) to the degree necessary to work at the next grade level.

A sample of four hundred and twenty-three primary schools (423) selected and tested in the 2005 administration of the NEA. The 423 primary schools represented a sampling fraction of 3% of all public primary schools in Ghana. The percentages of pupils meeting the minimum-competency level were higher than those reaching the proficiency level for Mathematics in both P3 and P6. Table 4 shows a summary result of NEA 2005.

Table 4: Pupils Meeting the Minimum Competency and Proficiency Level

Level	Subject	Minimum competency 35%	Proficiency 55%
	English	50.5%	16.4%
Primary 3	Mathematics	47.2%	18.6%
	English	63.9%	23.6%
Primary 6	Mathematics	42.7%	9.8%

(Adu, 2006)

The national results of the NEA demonstrate that the performance of pupils was weak in both Primary 3 and 6 levels in English and Mathematics. The mean scores percent in Mathematics for P3 and P6 were all below that of English except the primary 3 proficiency where, the mean scores percent in Mathematics was 18.6% while that of English was 16.4%. This result seems to indicate that, primary schools in Ghana face some difficulties in the teaching and learning of Mathematics.

Difficulty in learning fractions

According to Gould, P., Outhred, L. N., and Mitchelmore, M. C. (2006); Hiebert, J. (1988); National Assessment of Educational Progress [NAEP] (2005), teachers and researchers typically described the teaching and learning of fractions as a challenging area in the mathematics curriculum. Results of multiple assessments of the US National Assessment of Educational Progress (NAEP) dating from 1978 to 1997 have shown that many children do not seem to possess basic fractional understanding. This assertion about difficulty in fractions among pupils could be general not excluding pupils in Ghana.

It is suggested in the Principles and Standards for School Mathematics (National Council of Teaching of Mathematics [NCTM] 2000), that building number sense requires multiple uses of concrete models that can help bring meaning to students use of written symbols. Indeed, Kato, Y., Kamii, C., Ozaki, K., and Nagahiro, M. (2002) found that Japanese students' deep understanding about quantities are necessary for them to be able to represent those quantities with numerals. Simply knowing numerals does not necessarily translate to learners' understanding that the numerals stand for specific quantities.

It is clear that before students can use abstractions, they need to understand the concepts underlying the representations of those abstractions, since numerical fractions for example, " $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{4}{6}$." are abstract representations of a physical construct. Learners need many primary experiences with physical models of fractions in order for the numeral representations to be meaningful. The acquisition of fraction conceptualisation is complex (Gould, et al (2006). Verbally identifying a half loaf of bread is different from using the numerical symbol $\frac{1}{2}$ to express the same half loaf of bread. Students must traverse through logical stages in order to achieve mastery of using mathematical symbols to communicate fractional understanding.

The value of courseware in education

Managed courseware and electronic portfolios benefit both teacher and student, in terms of motivation and variety of manipulative materials. This promotes learning and self-assessment (Inkrott, 2001). A report titled Idaho Technology Initiative (Penuel, W. R., Means, B., 1999) concluded that there

exists enough evidence to say that technology has significant benefits on educational performance.

Anamuah-Mensah, J., Mereku, D. K. and Asabere-Ameyaw, A. (2004) in their presentation “Comparative analysis of performance of eighth graders from six African countries” on the outcome of the 2003 TIMSS result stated five contextual factors that influenced the poor performance. One of the five contextual factors was “little use of technology (that is, computers and calculators’ in the science and mathematics curricula)”. This meant that an increase in the use of technology will positively influence pupils’ performance in both mathematics and science.

Statement of the Problem

The unimpressive performance of the public basic schools in mathematics is shown in the BECE WAEC summary report (2004 - 2009). It revealed that majority of pupils performed below the national average of 62.42%.

Again, the report on 2005 administration of national education assessment on primary 3 and primary 6 in English and Mathematics (2006) stated that the bulk of effort to improve teaching and learning to enhance learner achievement should be directed to areas with scores below 30% and especially those with scores below 25%.

The national education assessment on primary 3 and primary 6 in Mathematics (2006) drew attention to the areas of the mathematics curriculum in which the pupils are weakest and performed rather poorly. It showed that with the exception of comparing fractions, and changing a common fraction to

a decimal (and vice versa), all the topics under fractions need appropriate remediation for objectives with scores below 31% and below 25%.

Therefore, it is clear that pupils in the public basic schools have difficulty in solving problems involving fractions.

Purpose of the Study

The purpose of the study was to:

1. ascertain the effectiveness of Multimedia Courseware as an instructional medium on multiplication of fractions in primary 6.
2. ascertain the influence of interactive Multimedia Courseware on primary six pupils' performance on multiplication of fractions.
3. investigate pupils interest and satisfaction with the use of an interactive Multimedia Courseware.

Research Questions and Hypotheses

This study was guided by the following hypothesis and research questions:

Hypotheses

1. There is no significant difference in the performance of learners who are taught using the traditional method and learners who are taught using a multimedia courseware on Multiplication of Fraction.
2. There is no significant difference in interest development of learners who are taught using the traditional method and learners who are taught using a multimedia courseware on Multiplication of Fraction.

Research Questions

1. Will learners' be satisfied when courseware is used as instructional medium for teaching multiplication of fraction?

2. To what extent will learners be able to learn multiplication of fraction using multimedia courseware without assistance?

Significance of the Study

The findings of this study are useful to teachers, parents and curriculum developers. This study provided an insight on interactive multimedia courseware used as a learning medium. This study provides curriculum developers and educational administrators an appropriate teaching approach (collaborative method) when Multimedia courseware is used as the teaching and learning medium.

Delimitation of the Study

The purpose of the study was to ascertain the effectiveness of Multimedia Courseware as an instructional medium on multiplication of fractions in primary 6. This study was limited to multiplication of fractions because the Ghana Education Service syllabus direct that multiplication of fractions be taught in basic 6.

Limitation of the Study

The unavailability of computers in most basic schools incapacitated this study to involve more schools. Therefore, only Assin Foso demonstration primary six pupils formed the population for this study. This limits the strength of generalization, because the larger the samples size the better the applicability of the generalization of the findings of the study.

Definition of Terms

The key words under this study are listed below:

1. Multimedia Courseware; It is an electronic learning material that could be an entire "package" consisting of one or more courses bundled

together and used for the various lessons, tests, other material needed and could be displayed in the form of text, video, sound, and various forms of animations.

2. Traditional teaching approach; It is generally teacher-directed and follow cookbook steps of activities and demonstrations.

Organisation of the Rest of the Study

This research study consists of five chapters. Chapter one is the overview of the rationale for the study and it entails nine sub headings: Background to the study, Statement of the problem, Purpose of the study, Research questions and hypotheses, Significance of the study, Delimitation of the study, Limitation of the study, Definition of terms and Organisation of the rest of the study.

Chapter three describes the Methodologies used to investigate the problem. This chapter deals with the research design, description of the population and the sample and sampling method, research instruments, data collection, methodologies and data analysis.

Chapter four encompasses presentation of research results, analysis, discussions and findings.

The chapter five is made up of the summary, conclusions and recommendations. The references made and other documents were presented under the references and appendices respectively.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Overview

This chapter is a literature review for this study. It reviews the following areas related to this study: history of courseware, Historical foundation of courseware in Ghana, Courseware Design, Educational Theories, Studies on the Effectiveness of Courseware, Concept of Multiplication of Fractions, Studies on Cuisenaire rods as a Manipulative tool for teaching Fractions.

History of Courseware

The use of computer hardware and software in education dates to the early 1940s, when American researchers developed flight simulators, which used analogue computers to generate simulated on-board instrument data. An example of such system was the type nineteen synthetic radar trainers, built in 1943. During the period of the World War II to the mid-1970s, educational software was dictated by the hardware, usually mainframe computers, on which it ran. Pioneering educational computer systems in this era included the Programmed Logic for Automated Teaching Operations (PLATO) system, developed at the University of Illinois, and Time-shared, Interactive, Computer-Controlled Information Television (TICCIT), first developed by the MITRE Corporation in 1968 as an interactive cable television (CATV) system. In 1963, IBM in partnership with Stanford University's Institute for Mathematical Studies in the Social Sciences (IMSSS) directed by Patrick Colonel Suppes an American philosopher, to develop the first comprehensive CAI elementary school curriculum, which was implemented on a large scale in schools in both California and Mississippi. In 1967 Computer Curriculum

Corporation (CCC, now Pearson Education Technologies) was formed to market to schools the materials developed through the IBM partnership. The PLATO IV system, released in 1972, supported many features that later became standard in educational software running on home computers. Its features included bitmap graphics, primitive sound generation, and support for non-keyboard input devices, including the touch screen.

The arrival of the personal computer, with the Altair 8800 in 1975, changed the field of software in general, with specific implications for educational software. Users prior to 1975 were dependent upon university or government owned mainframe computers with timesharing, whereas users after this shift could create and use software for computers in homes and schools. The availability of personal computers including the Apple II, Commodore PET, Commodore VIC-20 and Commodore 64 allowed for the creation of companies and non-profits organisations, which specialized in educational software. Broderbund and the Learning Company are key companies from this period, and Minnesota Educational Computing Consortium (MECC), a key non-profit software developer. These and other companies designed a range of titles for personal computers, with the bulk of the software initially developed for the Apple II. Major developments in educational software in the early and mid-1990s were made possible by advances in computer hardware. Multimedia graphics and sound were increasingly used in educational programs. Compact Disc Read-only Memory (CD-ROMs) became the preferred method for content delivery. With the spread of the internet in the second half of the 1990s, new methods of educational software delivery appeared. In the history of virtual learning

environments (VLE) is a system that creates an environment designed to facilitate teachers in the management of educational courses for their students, especially a system using computer hardware and software, which involves distance learning. The 1990s were a time of growth for educational software systems, primarily due to the advent of the affordable computer and of the Internet. Today Higher Education institutions use virtual learning environments like Blackboard Inc and Blackboard LLC to provide greater accessibility to learners.

Historical Foundation of Courseware in Ghana

The use of courseware in homes of Ghanaians started as far back as the 1980s. Very few rich people used this. Most of these software's were games and the others were those that came with textbooks written from the western countries. E-toys & more is an Exclusive Agent of ProMax International Inc., USA, a leading global distributor of computers, educational and electronic products. E-toys & more started operation in 2003 and specialises in the distribution of an exclusive line of award-winning children's interactive educational products. These products encourage learning, develop confidence and tremendously enhance the child's developmental potential. They provide for all the ages and school grades, right from 3 months through to 15 years, that is, from preschool up to junior high Secondary School in Ghana. E-toys & more mainly operate in four cities: Accra, Kumasi, Tema and Takoradi. They function in about 25 private schools in Ghana. They set up computer laboratories and provide educational software and technical assistance.

The vision of the company is to:

1. Make a dramatic contribution towards improving the quality of education in the country
2. Be the leader in kids IT educational products in the West African Sub-region.

The use of technology in education moved to a top gear when the 2007 educational policy made ICT the way to go.

Multimedia Courseware

Courseware is a term that combines the words 'course' with 'software'. Its meaning originally was used to describe additional educational material intended as kits for teachers or trainers or as tutorials for students, usually packaged for use with a computer. The term's meaning and usage has expanded and can refer to the entire course and any additional material when used in reference an online or 'computer formatted' classroom. Many companies are using the term to describe the entire "package" consisting of one 'class' or 'course' bundled together with the various lessons, tests, and other material needed.

The courseware itself can be in different formats, some are only available online such as html pages, while others can be downloaded in portable data files (PDF) or other types of document files. Many forms of e-learning are now being blended with term courseware. Most leading educational companies solicit or include courseware with their training packages. In 1992, a company called SCORE Educational Centres formed to deliver to individual consumers courseware based on personalisation technology that was previously only available to select schools and the Education Program for Gifted Youth.

Courseware Design

The quality of the academic programs relies on the design of the courses within the program (Duffuaa, Al-Turki & Hawsawi, 2003). Good course design is a critical ingredient for developing and supporting deep learning (Ramsden, 1992). Ausburn (2004) found evidence supporting the belief that course design has great impact on students' learning by investigating the most valued course design elements, namely options, personalisation, self-direction, variety and a learning community. This involves formulating the intended learning outcomes carefully, designing learning activities that adequately enable students to achieve the learning outcomes, and implementing assessment activities that adequately measure the learning outcomes. These three aspects of the course design process should be 'constructively aligned', that is to be consistent with each other. Poor course design, on the other hand, will often lead to learner's dissatisfaction and may even hinder learning (Ramsden, 1992). The fast developing computer technologies give the opportunities to teacher to integrate computerised software into learning setting. Students can learn with computers in two ways:

1. where technology is used essentially as tutors and serves to increase student's basic skills and knowledge.
2. where technology is used as a tool that can be applied to a variety of goals in the learning process and can serve as a resource to help develop higher order thinking, creativity and research skills (Ringstaff & Kelley, 2002; Reeves, 1986).

Emphasis has been placed on specification and structuring of the content and its visual presentation. Such connected issues as design, adaptation and

usability has been underestimated to a certain extent until recent times as the researchers were far more concerned about how to educate (with methods of instruction or reasoning over the content) than how to present the object of teaching content specification and knowledge structure (Tatiana, HaiNan, 2008).

Courseware design is a systematic approach to gather, analyse, design and interpret the information content for a particular topic in a specified manner. It involves study of the background of the students, for whom it is intended for, the length and time limits, syllabus identification, content presentation. The study of Salter, Richards and Carey (2004) provides an insight into the complex problem of designing pedagogically sound courseware components that support the creation of a learning environment through a collaborative constructivist approach to courseware learning. To design an effective courseware a number of factors concerning the good practices in education and Learning need to be reviewed. Students' learning styles, the purpose of education, and Mode of delivery of the course etc., are to be chalked out. The designing steps are presented below (Raja, 2005).

1. Definition of Education programme
2. Set Course Goals
3. Select and Analyse Course content
4. Design and Arrange Course Content
5. Understand and estimate student's goals and Characteristics
6. Select effective instructional modes
7. Suggest readings and activities
8. Write the syllabus

9. Get feedback from students

10. Get advice from colleagues and other field experts.

Cronje's (2002) adequacy chart listed five aspects in evaluating courseware, these are;

- i. Instructional Adequacy,
- ii. Curriculum Adequacy,
- iii. Cosmetic Adequacy,
- iv. Technical Adequacy and
- v. Adequacy of the development process

Educational Theories

To understand how the knowledge transforms, how a learner learns and how a teacher teaches, it is very important to know what the psychologists and mind-blowing theorists perceive knowledge transformation. Learning is a hunt for meaning, and it is a personal experience (Driver, 1985). To the constructivist learning is a product of an active process rather than passively waiting to receive it (Colburn, 2007). The purpose of learning is for the individual learner to build her/his own meanings. Piaget, one of the prominent educational psychologists of the constructivist paradigm stressed that learners construct knowledge through a rational combination of internal challenges facilitated by the force of environment (Izzo, Langford & Scott, 2006). The environment causes these internal challenges. Environment encourages us to gain knowledge and understand it through a God given brain. To Piaget, human is always in constant evolution. We learn something by the help of our past knowledge. In the process, we reinvent new knowledge (Kanuka & Anderson, 1999). These informed the researcher to pay more attention to the

prerequisite previous knowledge of the topic to be treated and the user interface of the courseware, as it is the environment that the learner interacts with when using the courseware to learn.

Bruner (1969) of the constructivist paradigm suggests that the learner is active, constructive, collective, goal oriented, investigative and thoughtful. For this study, learning is student-centered and learners construct their own knowledge through the interaction with the courseware. The learner has to take initiative for self-testing and constantly checking her/his progress to make sure that all the goals and objectives of the learning are met successfully. In constructivist learning, when students are allowed to make their own investigations, they gain better understanding (Chuang, 2004). Bruner emphasizes that when children in their early ages, try to roll over, sit down, sit up, walk and fall, they are in fact learning based on their own trial and error. As such, the courseware on multiplication of fractions is to engage learners in a meaningful activities and the teacher is to guide them when necessary.

On the other hand the behaviourist believes that, learning happens only through observable behaviours and is strengthened by reinforcement. The reinforcement can be in the form of rewards or punishments. Behaviorist's theory of rewards deals with the concept of motivation. Its punishment deals with the concept of prevention. This theory is useful as it is a traditional way of teaching by teachers who believe in the concept of rewards and punishments as the only means of education (Qais, Zainab & Hamidah, 2007). To behaviorists, man's actions must be controlled as scientists control and influence other natural phenomena (Vygotsky, 1978). This theory denies the existence of the human mind as a distinct feature between man and animal. To

behaviorists man is like a machine, he can be switched on and off. To behaviorists, man's actions should be controlled (Liu & Mathew, 2005), as scientists control and influences other natural phenomena. The theory of behaviorism is in fact a simple theory with an extraordinary message: animals learn and so do humans. Behaviorists further claim that we learn because we follow certain accepted universal laws of behaviour and discipline. Although, Vygotsky, Jerome Bruner, etc. of the constructivist camp heavily criticised the behaviourist theory of learning but one thing for sure, that influence this study is the emphasis on the concept of rewards and punishments. Therefore, the courseware for this study gives instance feedback on the entire test and the examination to motivate the learner.

Learners construct mathematical structures that are complex, abstract, and powerful actively in a constructivist learning environment. The collaborative learning process allows students to construct a scaffold for critical thinking and provides immediacy of feedback in which peers give and receive help, exchange resources and information, give and receive feedback, challenge and encourage each other and jointly reflecting on progress and process (Curtis, & Lawson, 2001). In such a setting, they explore mathematical ideas by thinking, participating, and reflecting. They take the responsibility of completion of assignment, controlling and creating their own mathematical ideas. Schoenfeld (1994) argues that learning to think mathematically means both developing competence with the tools of the trade and developing a mathematical point of view or as he puts the latter "valuing the process of mathematisation"(p.60)

The role of teacher is to guide and support students' invention of viable mathematical ideas rather than correct expert way of doing mathematics (Battista & Clements, 1990). It is seen as crucial in mathematics education to find a bridge between these two competing demands “‘rote’ learning and relational learning” in the classroom and teachers are being encouraged to champion the cause of thinking skills in the mathematics classroom (Ball, 2002; Pratt, 2002) postulated that when pupils are stimulated with challenging problems it encourages them to think.

Traditional Teaching and Learning Situation

In traditional teaching and learning method, the teacher transmits his knowledge of the subject (or, the knowledge he considers relevant) as an expert to a learners. The teacher is the one who is primarily active, while the learners are the passive recipient of the knowledge offered by the teacher. Their learning progress was examined regularly in tests designed by the teacher. This method was based on the assumption that it is possible for the teacher to determine what his students should know. The teacher assumes that the goals he or she sets can be achieved. For this purpose, the material to be transmitted is analysed and subdivided into units that are to be transmitted to the student's one by one (Gagne, Briggs & Wager, 1992).

Small Group Teaching Method

In this method, students discuss issues in small groups, supervised by the teacher. The advantages include better communication skills and intellectual and professional development (Brown & Atkins, 1988) Particular methods such as buzz groups, snowball groups, and crossover groups have been used to improve effectiveness

This study used the integration of the traditional teaching method and buzz group method. In "buzz groups," students are assigned to groups to discuss a topic or complete an assignment within a short space of time, about 10 to 20 minutes. Giving students the opportunity to debate, and discuss the topic. This method is useful when:

1. It is a relatively large class and the teacher would like to have discussion
2. The teacher wants to encourage participation from students reluctant to speak in larger groups (Svinicki, 2005).
3. The teacher would like to get to know students better.
4. Students would like to compare their understanding and progress with others (Jaques, 2003).

Studies on the Effectiveness of Courseware

In this technological era, educators have turned their attention to the use of technology to enhance and enrich the learning environment (Barker, 2000). The role of technology in the classroom is not to replace traditional educational methods, it does act as an enhancement for teaching students to think critically, communicate creatively and solve problems in analytical way (Cline & Powers, 1997).

Silvinn-Kachala (2000) reviewed 311 research studies on the effectiveness of technology on student achievement. Their findings revealed positive and consistent patterns when students were engaged in technology-rich environments, including significant gains and achievement in all subject areas, increased achievement in preschool through high school for both regular and special needs students, and improve attitude toward learning and increased self-esteem. Linkels, Dording and Meinel, (2006) said that e Learning could

improve school results. Furthermore, a simple multimedia presentation helped the students to better understand a subject without the help of a teacher particularly for shy and weak students.

Whatannarang (2002) investigated and compared the effects of Internet-based teaching and learning systems and traditional instruction on learners in the areas of quality of students' term papers, homework, reference sources, analytical ability, synthesis and summarization of information, and time used for study. The samples were 80 graduate students randomly selected from the class of four subjects registered from the second semester of academic year 2000 to the first semester of academic year 2002. They were divided into 4 control groups and 4 experimental groups. The control groups studied with traditional instruction. The experimental groups studied with teacher-prepared instruction programs on the Internet-based system. Data were analysed by using a one-way t-test for independent samples. The Pretest and Posttest results indicated that there was no negative effect on the learners. The scores of experimental groups were not significantly higher than the scores of the control groups in the area of quality of students' term papers, homework, reference sources, and analytical ability, synthesis and summarization of information. However, the experimental groups spent significantly less time.

According to Ali and Elfessi (2004), the significant role of technology in teaching and learning is limited as an instructional delivery medium and not a key determinant of learning. It can only support the classroom learning.

Mathematics Syllabus for Primary Schools in Ghana

Pupils are expected to read and use numbers competently, reason logically, solve problems and communicate mathematical ideas effectively to other people. Mathematics at the primary school level in Ghana emphasizes knowledge and skills that will help the pupils to develop the foundation for numeracy.

Mathematics Syllabus for Primary Schools in Ghana is structured to cover the first six years of the primary school education. Each year's work is divided into units and not into terms because at that level it is difficult to predict with any degree of certainty the rate of progress of pupils. Each class has 15 units but primary three and five have 11 and 16 units respectively.

The mathematics syllabus specified profile dimensions for teaching learning and assessment.

Table 5: Profile Dimension for Primary Schools

	Primary 1 - 3	Primary 4 - 6
Knowledge & Understanding	40%	30%
Application & Knowledge	60%	70%

Teaching Syllabus For Mathematics Primary School 1 – 6 (2007)

The topic fraction is introduced in primary two. Table 3, shows the class marched with the units and the sub topic of fractions taught at that level.

Table 6: Structure and Objectives of Fractions in the Syllabus

Class	Unit	Topic	Objective
2	8	Meaning, of fractions.	Recognition of fractions
3	4 /11	Equivalent fractions, Addition & Subtraction of fractions	Presentation and comparing, adding and subtraction of like fractions
4	9	Identification & comparison of fraction to decimals	Identification & comparison of fraction to decimals
5	11	Multiplication & Division of whole number by fraction	Multiply whole number by a fraction, Divide a fraction by a whole number and convert fractions to percentages.
6	2	Multiplication and Division of fraction	Multiplication & division a fraction by fraction.

Teaching Syllabus For Mathematics Primary School 1 – 6 (2007)

Concept of Multiplication of Fraction

The domain of skill and knowledge termed as fractions has been analysed in various ways by researchers in the pass years. Tzur, Hagevik, Watson (2004) sees children's initial reorganization of fraction conceptions as falling into three strands:

- (a) Recursive partitioning of parts (splitting).
- (b) Equidivision of wholes into parts.
- (c) Reconstruction of the unit (i. e. the whole).

Recognizing this division, he suggests that teachers deal with one of these concepts at a time in delivering lessons on fractions. He also suggested that,

the following topics should be included in teaching concepts, order, and equivalence of fractions: (a) modeling fractional amounts with more than one manipulative and naming unit and non-unit fractions, (b) generating equivalent fractions, (c) performing concept-of-unit activities and (d) ordering fractions. Moss, and Case, (1999) by their psychological approach stated that, for fractions, children have two natural schemas:

1. global structure for proportional evaluation
2. One numerical structure for splitting/doubling.

They advise, that, teachers need to modify and widened naturally occurring processes as part of learning plan.

Hunting's (1999) study of five-year-old children focused on early conceptions of fractional quantities. He suggested that there is considerable evidence to support the idea of "one half" as being well established in children's mathematical schema at an early age. He argues that this and other knowledge about subdivisions of quantities forming what he calls "pre-fraction knowledge" can be drawn upon to help students develop more formal notions of fractions from a very early age. Similarly, based on her successful experience of teaching addition and subtraction of fractions and looking for a way to teach multiplication of fractions, Mack (1998) stresses the importance of drawing on students' informal knowledge. She used equal sharing situations in which parts of a part can be used to develop a basis for understanding multiplication of fractions; e.g. sharing half a loaf of a bread equally among three children results in each child getting one half of one third. Mack noted that students did not think of taking a part of part in terms of multiplication but that their strong experience with the concept could be developed later.

Taking an information-processing approach (Hecht, 1998) divides knowledge about fractions into three strands: procedural knowledge, factual knowledge, and conceptual knowledge. Hecht's study isolated the contribution of these types of knowledge to children's competencies in working with fractions. He made two major conclusions: (a) conceptual knowledge and procedural knowledge uniquely explained variability in fraction computation solving and fraction word problem set up accuracy, and (b) conceptual knowledge uniquely explained individual differences in fraction estimation skills. The latter conclusion supports the general consensus in current research that a holistic approach to teaching of fractions is necessary with recommendations for a move away from attainment of individual tasks and towards a development of global cognitive skills.

In the first of his three-part session on mastering multiplication and division facts, Lawrence (2000) explores how teachers can use arrays and groups of things as effective strategies to help students understand the concept of multiplication. Lawrence leads teachers through several exercises that teachers can use with their students. These exercises help ensure that students grasp the concept of multiplication prior to their being asked to memorise and recall multiplication facts. In doing so, he carefully moves from the concrete to the iconic, and then the symbolic. He shows that it is important to be sure that students have a firm grasp of a mathematics concept before asking them to memorize the facts related to that concept. In addition, he stresses on the importance of using more than one approach to reach the same end-mastery of the concept.

Studies on Cuisenaire Rods as a Manipulative to Teach Fractions

Reynolds, and Uptegrove, (2007) in his work Using Cuisenaire rods to teach students about fractions. Focused on adult learners who were of two groups:

1. Traditional-age college students
2. Older college students

Reynolds, and Uptegrove, (2007) found that students often have trouble with basics mathematics skills. The following situational statistics were made.

1. Nationwide, over 20% of college freshmen take remedial mathematics courses.
2. About 40% of Felician freshmen take remedial mathematics.
3. About 60% of freshmen at two-year colleges take remedial mathematics.

The research question was “Do Cuisenaire rods have a role in helping adult learners make sense of fractions?”

A sample of 30 students was selected based on the following criteria:

1. Students in developmental classes based on placement test scores (Felician)
2. Students in a mathematics methods class for elementary teachers (Kean) who identified themselves as having difficulties with fractions
3. Students in a math content class for elementary teachers (Felician)

The data sources were:

1. Classroom observations and teachers’ notes
2. Student work

The rationale for the study was to assess students' understanding and to improve students' understanding. The outcome of the study shows that the use of the Cuisenaire rods improved the adult learners' ability to make sense of fractions.

Learning about fractions is one of the most difficult tasks for middle and junior high school children. The results of the third National Assessment of Educational Progress (NAEP) show an apparent lack of understanding of fractions by nine-, thirteen-, and seventeen-year-olds. "The performance on fractional computation was low, and students seem to have done their computation with little understanding" (Lindquist, 1989). Similar trends were observed in the first, the second, and the recently completed fourth National Assessments.

Reynolds and Uptegrove (2007) study shows that, the use of the Cuisenaire rods improved learners' ability to make sense out of fractions with adult, but this study used the Cuisenaire rods as the teaching and learning material to study the effectiveness of Courseware as a supportive medium to the normal Classroom teaching at the upper primary level (primary 6) on Multiplication of fraction.

CHAPTER THREE

METHODOLOGY

Overview

This research was designed to test the effectiveness of an Interactive Multimedia Courseware on multiplication of fractions. This chapter encompasses research design, description of the population, method for selecting the sample, multimedia coursewar and normal classroom teaching. Others are teaching strategy, description of material, data collection procedure, lesson notes on the multiplication of fraction for the normal classroom teaching and learning process, report on lessons on how pupils used the interactive multimedia courseware to learn multiplication of fractions, pilot study and data analysis.

Research Design

The study verified the effectiveness of an interactive multimedia courseware as an instructional medium for teaching multiplication of fractions. This study is an experimental research which employed the static-group comparison design. Two pre-existing groups (i.e. class 6A and B) were compared. Class 6A was used as the control group while class 6B were used as the experimental group. The classification was done through balloting by the class teachers. The control group were taught multiplication of fractions without the use of the interactive Multimedia Courseware. The Experimental group were taught multiplication of fractions using the interactive Multimedia

Courseware. This design is a weak design because the differences may exist for other reasons. This deficiency was corrected by administering a pre-test to establish the entry behaviour of the two groups, before the interventions were applied.

Population

This study took place in a public basic school at Assin Foso a suburban town in the Central Region in November, 2009. Computer availability was highly considered in the choice of the school used for the study. As the proposed policy of “one computer per child” for all basic schools in Ghana has not been fully implemented. Assin Foso College of Education Demonstration Primary School was chosen for the Study. This was to make sure that, the experimental group could get access to the well-equipped computer laboratory of the College.

The target population was Assin Foso College of Education Demonstration Primary School Basic six pupils. The total population of the two streams of primary six was 90 pupils. Of the 90, 53 were females representing 59% and 37 males representing 41%. Each class was made up of 45 pupils. Out of the 45 pupils of the” A” class 28 were females representing 62.2% and 17 males representing 37.8%. For the “B” class 25 of them were females representing 55.6% and 20 males representing 44.4%.

The minimum and maximum age range of the population for the study was 10years to 13years. The mean age of population was 10.8 and the standard deviation was 0.15.

Sample and Sampling Technique

Streams of primary six of Assin Foso College of Education Demonstration Primary School formed the population for the study. Thirty six pupils each, were selected for the control group (that is class 6A) and experimented group (that is class 6B) to make up the total sample of 72. The minimum and the maximum ages were 9 years and 12 years, respectively for both Experimental group and Control group. The mean age of experimental group and control group was 10.5, but the spread of pupil's age around the mean age in the two groups varied. The standard deviation 0.88 of the mean age was wider in the control group than the experimental group standard deviation of 0.74 was by 0.14. The standard error of mean of experimental group and control group were 0.123 and 0.146, respectively. Both standard errors are small, that indicates that the two samples of the experimental group and control group are likely to be an accurate reflection of the population.

The two streams were primary 6A and 6B. The teachers of the two classes balloted to assign the two classes to the control group and the experimental group. Class 6B was considered as the experimental group and class 6A was considered as the control group. The class register was used to identify pupils who were very punctual to school. Forty two and 39 pupils were found to be punctual to school in "A" and "B" respectively. The table of random numbers was used used to select 36 pupils each from the clusters(that is, class 6A and 6B) to make up the total sample of 72. The 36 pupils of the Control group (Class 6A), were made up of 21 females representing 58% and 15 males representing 42%. Out of the 36 pupils of the Experimental group

(Class 6B), 17 were females representing 47% and 19 males representing 53%.

Instruments

The instruments used for the study were test items and questionnaire. The test items were teacher made test. The teacher made tests were of two types, the pre-test and post-test. The pre-test was used to find out the entry level of performance of the two groups. The post-test was used to compare the performance of the experimental group to the control group. The questionnaire was used to verify whether there was any variation between the control group and the experimental group in terms of interest, satisfaction and using the courseware without the assistance of the teacher.

Assessment test : Pre-test and post-test

The pre-test and the post-test were parallel forms and reflected the content of the Pupils Mathematics Book 6 for Ghana (Ashworth, & Wilmot, 2003). Each test was made up of 10 questions. The first two questions were on multiplication of a whole number by a fraction, the next five questions were on multiplication of a fraction by a fraction and the last three questions were story problems on multiplication of fractions by a fraction. The pre-test was used to assess the entry behaviour of pupils before the treatment.

The face and content validity of the test items was established by a mathematics lecturer at the University of Cape Coast, Ghana at the Department of Basic Education. Questions 1, 2, 9 and 10 were adjusted and unit fractions added to the questions. A pilot test was conducted on the 2008/2009 academic year batch of Assin Foso Demonstration Primary School to measure the reliability of the test items. For both pre-test and post-test,

Spearman-Brown prophecy formula was used to calculate the reliability which was 0.60 and 0.65, respectively.

Questionnaire on pupils' impression on effectiveness of courseware

A questionnaire was used to assess the impression of both the Control group and the Experimental group. The questionnaire was made up of 5 items. The first two items assessed the interest of the experimental group in using the courseware to learn multiplication of fractions. The third item on the questionnaire assessed how good the courseware design, content and lesson organisation was to pupils. The fourth item in the questionnaire assessed how satisfied were the control group and experimental group with the teaching activities.

Data Collection Procedure

The researcher sought permission from the headmaster of Assin Foso Demonstration School to use pupils in the school for the study. The headmaster introduced the researcher to the two teachers and the pupils of primary 6A and primary 6B. Primary 6B was tagged the experimental group and primary 6A was used for the control group. The Headmaster in collaboration with the teachers of the two classes scheduled the time for meeting and holding the lesson for both control group and the experimental group. The duration for each lesson was one hour and each lesson commenced at 1:00pm and ended at 2:00pm.

On 12 November 2009, the experimental group was taken through the basic mouse movement skills and typing of numerals. On 13 November 2009, the pre-test was administered to both groups under study. The intervention lasted for two weeks. Both the control and experimental group had one-hour

lessons for five days. The post-test was administered on the Monday 30th of November 2009.

The organisation of the learning process of the experimental group

The orientation and the five lessons of experimental group took place at the Assin Foso College of Education computer laboratory. Each person was assigned to a computer. Pupils were taken through the usage of the entire program. They were taught the navigation tools of the software, and how to navigate through the software, login and registration process, how to play the game and how to take the test. Pupils were given strict guidelines to complete each unit before moving on to the next unit during the lessons. Pupils were advised not to jump the lessons. They were allowed to learn at their own pace. Any pupil who had difficulty in the learning process called for support from the facilitator. Pupils' activities were monitored throughout the lesson and assisted when necessary by the facilitator. Each lesson was concluded with at least 5 minutes peer to peer collaboration and minimum 5 minutes overall discussion of the lesson with the teacher. This encompassed individual difficulties, findings and suggestions

Each pupil was given a copy of the program on compact disk (CD) for keeps. The CD was prepared having in mind that not all pupils could get access to a computer. The CD given to the pupils could also be played on a VCD and DVD deck player. This was to provide pupils the opportunity to practice after the lesson at home.

The initial preparation for the experimental group lesson

The researcher was the facilitator for the experimental group. The researcher installed the interactive multimedia courseware program on the

server, shared the program folder, and installed it on all the computers in the computer laboratory with the support of the ICT tutor of Assin Foso Teacher Training College on the 14th day of November 2009. The researcher lunched the program and registered as the facilitator by typing his user name and password that the program used to reference him (see figure 2). The registration was saved in the database and the form 'Track Learners Performance' was displayed when the 'OK' button was clicked (see Figure 5).

A screenshot of a Windows-style dialog box titled "Facilitator Login". It features a dark title bar with a close button (X) on the right. The main area is light gray and contains two text input fields: "User Name:" and "Password:". Below the password field is a small cartoon icon of a person holding a yellow sign. At the bottom right, there are two buttons: "OK" and "Cancel".

Figure1. Courseware Facilitator Login Form

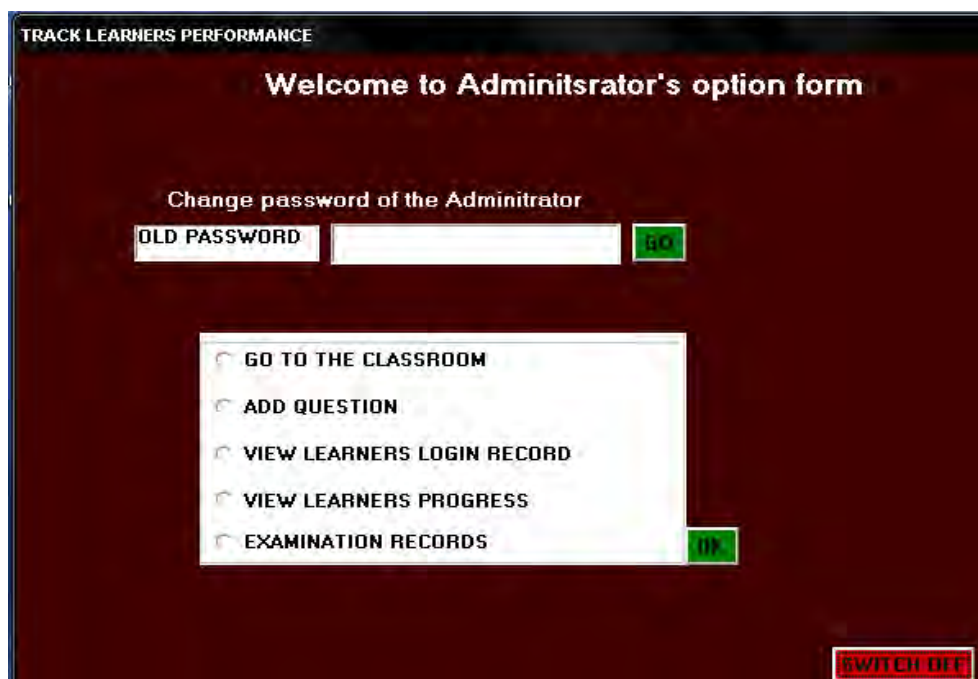
A screenshot of a web application interface with a dark red background. At the top, it says "TRACK LEARNERS PERFORMANCE" and "Welcome to Adminitrator's option form". Below this is a section for "Change password of the Adminitrator" with an "OLD PASSWORD" input field and a green "GO" button. A white-bordered menu box contains several options: "GO TO THE CLASSROOM", "ADD QUESTION", "VIEW LEARNERS LOGIN RECORD", "VIEW LEARNERS PROGRESS", and "EXAMINATION RECORDS", each with a radio button. A green "OK" button is at the bottom right of the menu. A red "SWITCH OFF" button is in the bottom right corner of the main interface.

Figure2. Courseware Track Learners Performance Form

The facilitator introduced pupils to the interactive multimedia courseware, by taking them through the registration process, navigation buttons and the content of the interactive multimedia courseware forms. Thirty minutes was spent on the orientation. Pupil launched the program and registered by typing their name and a password (see figure 4) that the program used to referenced them.

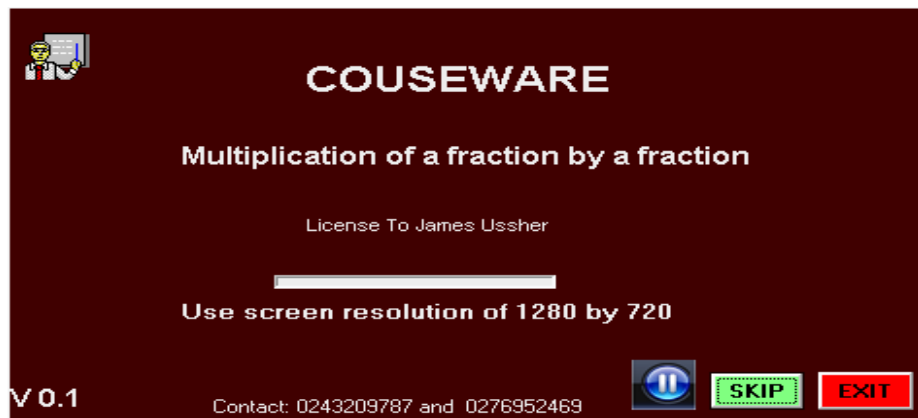


Figure 3. Courseware Splash screen form

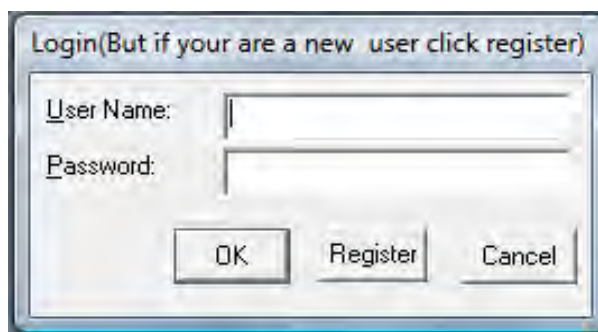


Figure 4. Courseware Login form

With the exception of the facilitator, any person who opens the Program after the facilitator has registered will first display the splash screen for a few seconds before the login form displays. The login form contains three buttons; ok, register and cancel. A click on cancel will close the program, a click on the register button displays the registration form, which also contains three buttons; “Back-opens login forms, Login- opens Navigation form, Cancel-classes the program”.

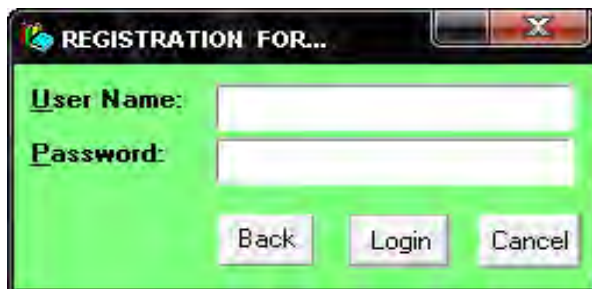


Figure 5. Courseware Registration options form



Figure 6. Courseware Program options form

The “OK” button opens the Program options form (Figure7) that allows the user to select from the following:

- a) Do you want to have a look at your score?
- b) Do you want to continue from where you left off?
- c) Start
- d) Login
- e) Cancel

Progress/performance level, open the last page visited, start afresh, move back to the login form, and cancel. To open any of the options, click the

option and click the button “GO”. Figure 8 is the home page that served as the platform for the other forms and it contained the navigation bottoms.

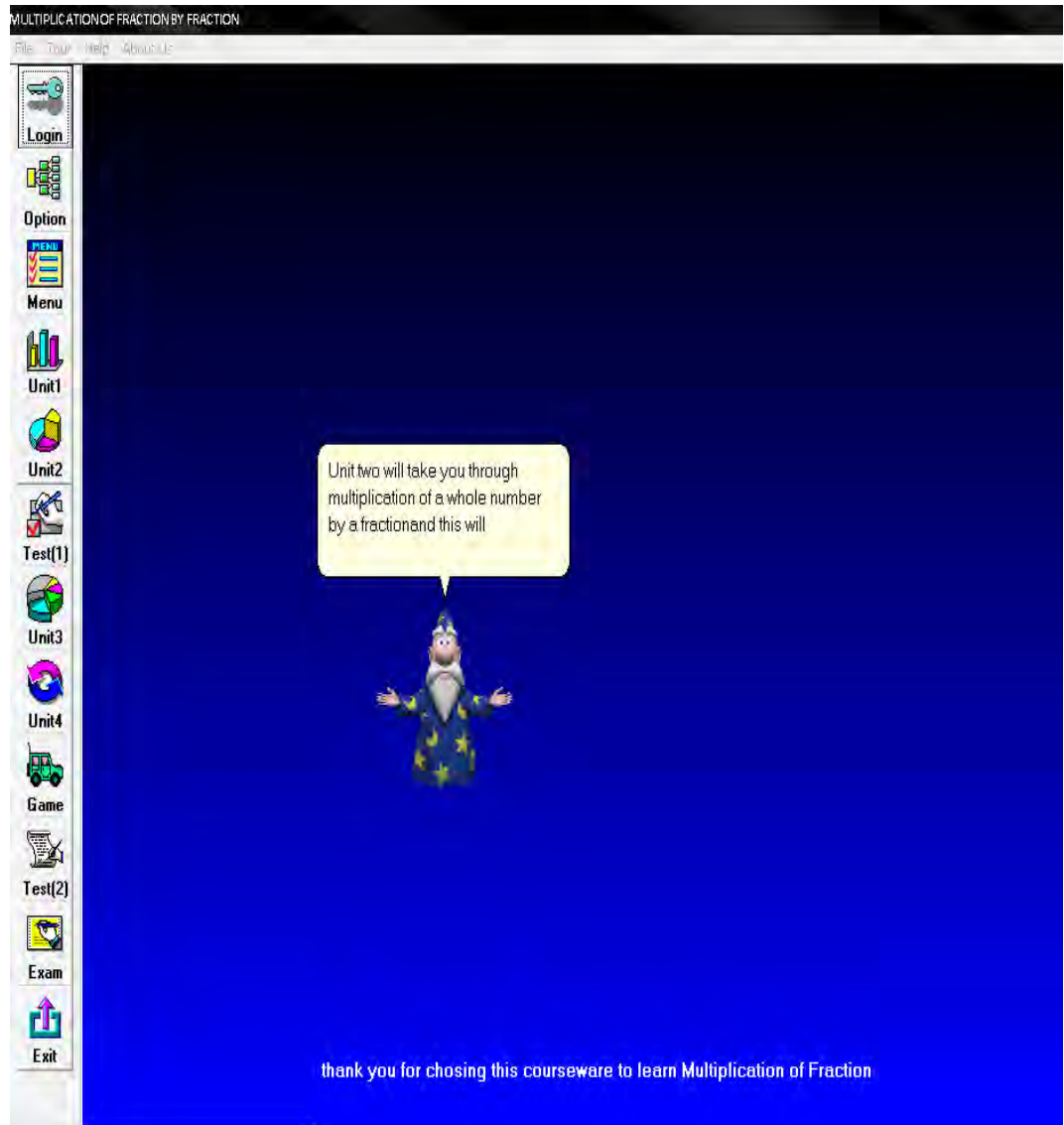





Figure 7. Courseware home page

The home page is captioned “Multiplication of fractions”. These icons, which are vertically aligned to the left of the form, are linked to the pages that bear the name of the icon’s label.   The option and the login buttons are linked to the option and the login pages shown above. A click on this icon  will close the program. Appendix C contains the icons and the interface of the pages and subpages they are linked to.

Lesson Plans on the Multiplication of Fraction for the Experimental Group

Lesson plan one

Day: Tuesday

Date: 17th Novembers 2009

Duration: 1hour.

Time: 1:00pm-2:00pm

Topic: Revision of previous knowledge of multiplication of fractions

1. Meaning of fraction
2. Model fractions
3. Addition of fractions
4. Multiplication of fractions
5. Equivalent fractions.

R.P.K

1. Pupils have an idea of the mining of fractions.
2. Pupils model fractions.
3. Pupils could add and subtract common fractions.
4. Pupils could find an equivalent fraction of another fraction.

Objectives:

By the end of the lesson, pupils should be able to recall;

1. Meaning of fraction
2. Model fraction
3. Addition of fraction
4. Subtraction of fraction
5. Equivalent fraction

Introduction (15 Minutes)

On individual bases, guide pupils to go through Unit 1 of the interactive multimedia courseware which is the pre-requisite previous knowledge of multiplication of fractions.

These are

1. Meaning of fractions
2. Modelling fractions
3. Equivalent fractions
4. Addition and subtraction of fractions

Pupils are allowed to call the teacher/facilitator for support when necessary.

Lesson Review (30 minutes)

Guide pupils to discuss and share ideas on the activities they have gone through with their colleagues. Pupils then discuss the activities with the facilitator to clear all misconceptions.

Lesson Plan Two

Day: Thursday

Date: 19th Novembers 2009

Duration: 1hour.

Time: 1:00pm-2:00pm

Topic: Description of Cuisenaire rods

R.P.K

1. Pupils can explain and measure the length. Between any two points
2. Pupils can identify and differentiate between a cube and a cuboid.

Objectives

By the end of the lesson pupils should be able to;

1. Explain the differences between the Cuisenaire rods in terms of structure and length.
2. Assign numerical values to the Cuisenaire rods.
3. Identify and differentiate between the rods based on colour.\

Introduction (5 minutes)

Guide Pupils to review unit one (pre-requisite previous knowledge) which is the previous lesson.

Activity one (20 minutes)

Under the guidance of the teacher pupils spend 20 minutes to go through the general and detailed description of the Cuisenaire rods using the courseware.

Lesson Review (15 minutes)

Ask pupils to spend 15 minutes to discuss and share ideas on the activities with their colleagues. Pupils then discuss the activities with the facilitator to clear all misconceptions. Drill Pupils on the colours and corresponding values of the Cuisenaire rods.

Lesson Plan Three

Day: Monday

Date: 23th Novembers 2009

Duration: 1hour.

Time: 1:00pm-2:00pm

Topic: Multiplication of a fraction by a whole number.

R.P.K

1. Pupils have an idea of the meaning of fractions
2. Pupils model fractions
3. Pupils could add and subtract common fractions

4. Pupils could find an equivalent fraction of another fraction.

Objectives

By the end of the lesson, pupils should be able to;

1. Explain the meaning of multiplication of fraction by a whole number
2. Model the fraction in question using the Cuisenaire rods
3. Use the Cuisenaire rods to find products of a whole number and a fraction.

Introduction (5 minutes)

Within five minutes, guide Pupils to review the previous lesson by revisiting unit one; detailed description of the Cuisenaire rod of the interactive multimedia courseware.

Activity one (5 minutes)

Guide pupils through the introductory part of unit two of the interactive multimedia courseware which covers the meaning of multiplication of a whole number by a fraction.

Activity two (10 minutes)

Guide pupils through the process of multiplying a whole number by a fraction by going through a simulation of the process of multiplication of a whole number by a fraction using the courseware.

Activity three (15 minutes)

Ask pupils to practice the multiplication of a whole number by a fraction on the practical platform which has six questions and electronically modelled Cuisenaire rods in the courseware.

Lesson Review (10 minutes)

Ask pupils to discuss and share ideas on the activities they have gone through with their colleagues. Pupils then discuss the activities with the facilitator to

clear all misconceptions. Ask pupils to try their hands on questions under the section 'test one' of the courseware which is on multiplication of whole number by a fraction.

Lesson Plan Four

Day: Wednesday

Date: 25th Novembers 2009

Duration: 1hour.

Time: (1:00pm-2:00pm)

Topic: Multiplication of a fraction by a fraction.

R.P.K

1. Pupils model fractions
2. Pupils could add and subtract common fractions
3. Pupils could find an equivalent fraction of another fraction.
4. Pupils could Multiply a fraction by a whole number

Objectives

By the end of the lesson, pupils should be able to:

1. explain the meaning of multiplication of fraction by a fraction
2. model the fraction in question using the Cuisenaire rods
3. use the Cuisenaire rods to find products of two fractions.

Introduction (5minutes)

Guide Pupils to review the lesson on multiplication of whole number by a fraction using the questions on test one of the courseware.

Activity one (10 minutes)

Guide pupils to go through the introductory part of unit three of the interactive multimedia courseware which cover the meaning of multiplication of a fraction by a fraction using the courseware.

Activity two (15 minutes)

Guide pupils to go through the simulation of the process of multiplication of a fraction by a fraction using the courseware.

Activity three (15 minutes)

Guide pupils to practise the multiplication of a fraction by a fraction on the practical platform which has six questions and electronically modelled Cuisenaire rods in the courseware.

Lesson Review (10 minutes)

Ask pupils to discuss and share ideas with their colleagues on the activities they have gone through. Discuss the activities with the pupils to clear all misconceptions. Ask pupils to try their hands on questions under the section 'Test Two' which is on multiplication of fraction by a fraction.

Lesson Plan Five

Day: Friday

Date: 27th Novembers 2009

Duration: 1hour.

Time: 1:00pm-2:00pm

Topic:

An algorithm for finding the product of a fraction by a fraction

R.P.K

1. Define the whole for the two fractions involved using the Cuisenaire rods
2. Use the Cuisenaire rods to find the product of a fraction and a fraction

Objectives

By the end of the lesson, pupils should be able to use an algorithm to find the product of a fraction and a fraction

Activity one (10 minutes)

Guide pupils to review multiplication of whole numbers by fractions under the 'Unit Two' of the courseware.

Activity two (10 minutes)

Guide Pupils to review multiplication of a fraction by a fraction under 'Unit Three' of the courseware.

Activity three (20 minutes)

Guide pupils to develop their own algorithm for multiplication of fraction by a fraction on unit four of the courseware. They also spent five minutes comparing their algorithm to the conventional algorithm for multiplying a fraction by a fraction of the courseware

Lesson Review

Pupils discussed and shared ideas on the activities they went through with their colleagues. 10 minutes was spent on this activity. Pupils then discussed the activities with the facilitator to clear all misconceptions. The facilitator advised pupils to try their hands on questions under the section 'test two' which is on multiplication of fraction by a fraction

Lesson Plans on the Multiplication of Fraction for the Control Group

Lesson Plan One

Day: Monday

Date: 16th Novembers 2009

Duration: 1hour.

Time: 1:00pm-2:00pm

Topic

Revision of previous knowledge of multiplication of fractions

1. Meaning of fraction
2. Model fractions
3. Addition of fractions
4. Subtraction of fraction
5. Equivalent fractions.

R.P.K:

1. Pupils have an idea of the meaning of fractions.
2. Pupils model fractions.
3. Pupils could add and subtract common fractions.
4. Pupils could find an equivalent fraction of another fraction.

Objectives

By the end of the lesson, pupils should be able to recall:

1. Meaning of fraction
2. Model fraction
3. Addition of fraction
4. Subtraction of fraction
5. Equivalent fraction

Teaching and Learning Materials

Cubes, cuboids and balls

Introduction

Put pupils into six groups of five and provide each group with set of cubes, cuboids and a set of Cuisenaire rods.

Ask pupils to list the topics they have studied under fractions.

List them on the chalkboard.

Activity one

Discuss the meaning of a fraction with pupils, by asking them;

1. What is fraction?
2. What is the difference between a fraction and a whole number?

Help pupils to model the following fractions

i. $\frac{1}{2}$

ii. $\frac{1}{3}$

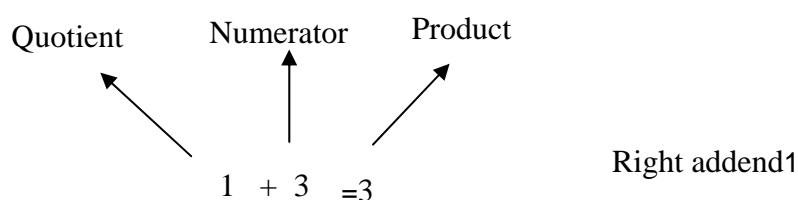
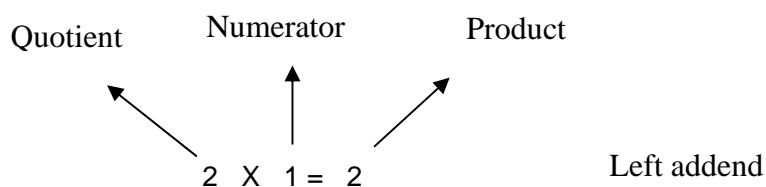
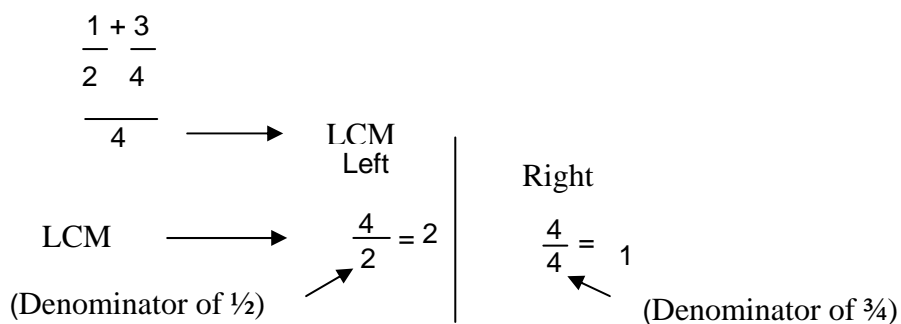
Activity two

Guide pupils to solve the fraction $\frac{1}{2} + \frac{3}{4}$

Multiples of 2 = 2, 4, 6, 8, 10...

Multiples of 4 = 4, 8, 12, 16 ...

The LCM = 4



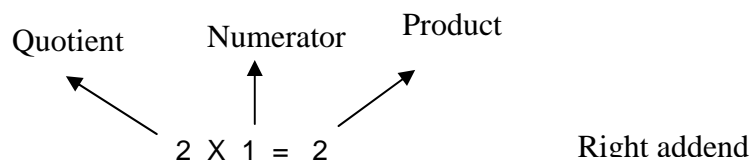
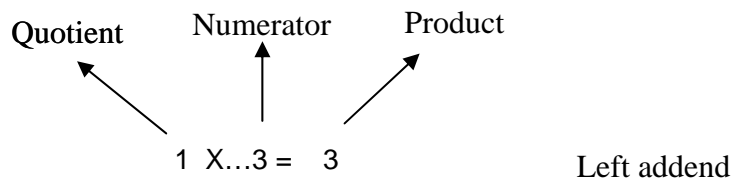
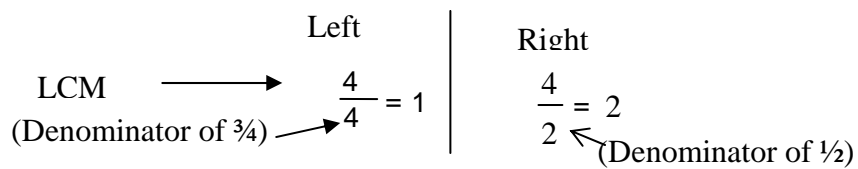
$$\text{i.e.} = \frac{2 + 3}{4} = \frac{5}{4} = 1\frac{1}{4}$$

Activity three

Guide pupils to solve the fraction $\frac{3}{4} - \frac{1}{2}$

4 - 4, 8, 16...

2 - 2, 4, 6, 8... the LCM = 4



$$\text{i.e.} = \frac{3 + 2}{4} = \frac{5}{4} = 1\frac{1}{4}$$

Activity four

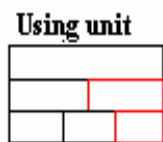
Guide pupils to find two equivalent fractions of $\frac{3}{4}$ by multiplying the numerator and the denominator by the same number.

$$\frac{3 \times 3}{4 \times 1} = \frac{3}{4} \quad \frac{3 \times 2}{4 \times 2} = \frac{6}{8} \quad \frac{3 \times 3}{4 \times 3} = \frac{9}{12} \quad \frac{3 \times 4}{4 \times 4} = \frac{12}{16} \quad \frac{3 \times 5}{4 \times 5} = \frac{15}{20}$$

Core Points

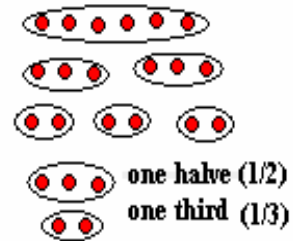
1. Meaning of fraction
2. Model fraction
3. Addition of fractions
4. Equivalent fractions

A fraction is a part of a whole. The whole could be a unit, a group of things of part of a whole. A fraction is an action taken on the whole.



One Whole
Halves
Thirds

Using group of objects



Finding the least common multiple (LCM) of the denominators

Finding the quotient of the denominators and the least common multiple

Multiplying the quotient by the numerator

Sum the products and divide it by the LCM

Finding the least common multiple of the denominators

Find the quotient of the denominators and the least common multiple

Multiply the quotient by the numerator

When one fraction is a factor of another, then the two fractions are equivalent.

To produce equivalent fractions, multiply the numerator and the denominator by the same number to produce an equivalent fraction of the given fraction.

Closure

Supervise pupils to answer the following questions.

1. What is a fraction?

2. $\frac{1}{5} + \frac{2}{3}$
3. $\frac{3}{4} + \frac{2}{5}$
4. Group the equivalent fractions $\frac{1}{2}$, $\frac{3}{5}$, $\frac{1}{4}$, $\frac{3}{6}$.

Evaluation

1. What is a fraction?
2. What is the difference between a fraction and a whole?
3. Model the fraction $\frac{2}{5}$.
4. $\frac{2}{3} + \frac{3}{6}$
5. $\frac{3}{5} + \frac{1}{4}$
6. $\frac{2}{3} - \frac{3}{6}$
7. $\frac{3}{5} - \frac{1}{4}$

Lesson Plan Two

Day: Wednesday

Date: 18th November 2009

Duration: 1 hour.

Time: 1:00pm-2:00pm

Topic: Description of Cuisenaire rods

R.P.K

1. Pupils can explain and measure the length between any two points
2. Pupils can identify and differentiate between a cube and a cuboid.

Objectives

By the end of the lesson pupils should be able to;

1. explain the differences between the Cuisenaire rods in terms of structure and length.
2. assign numerical values to the Cuisenaire rods.

3. identify and differentiate between the rods based on colour.

Teaching and Learning Materials

Cuisenaire rods.

Introduction

Put pupils into six groups of five and provide each group with a set of cubes, cuboids and a set of Cuisenaire rods. Ask each group to answer the following questions;

1. What is length?
2. What is the difference between a cube and a cuboid?

Ask pupils to separate the cubes from the cuboids.

Ask pupils to measure and record the cubes and the cuboids.

Activity One

Ask pupils to arrange the Cuisenaire rods base on their lengths.

Discuss with pupils the similarities and differences between the rods.

Activity Two

Ask pupils to assign numeral value to the Cuisenaire rods based of the differences in length.

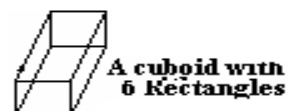
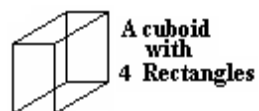
Activity three

Assign the specific colours to the ten rods and ask pupils to identify the rods in terms of colour.

Core Points

Length is the measurement from one point to another.

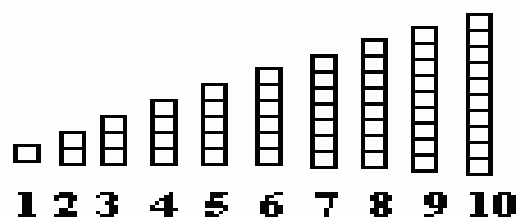
A cube is a solid object bounded by six squares.



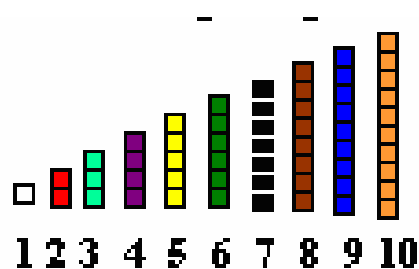
A cuboid is a solid object bounded by six rectangles or four rectangles and two squares.

The Cuisenaire rods are made up of a cube and nine cuboids. The first and smallest Cuisenaire rod is the cube. Two times the length of the first rod is equal to the length of the second rod. The third rod is three times the length of the first rod. Each subsequent rod is longer than the preceding rod by the length of the first rod.

The first and smallest rod is assigned a value of '1'. The second rod through to the tenth rods are assigned the; 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 respectively.



The first rod, second rod, third rod, fourth rod, fifth rod, sixth rod, seventh rod, eighth rod, ninth rod and tenth rod are coloured; white, red, light – green, purple, yellow, dark – green, black, brown, blue and orange respectively.



Closure

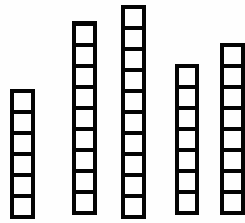
Drill pupils to match the numerical value to the rods on their colours.

1. What is the value of the rod coloured light-green
2. What is the value of the rod coloured black
3. What is the value of the rod coloured orange

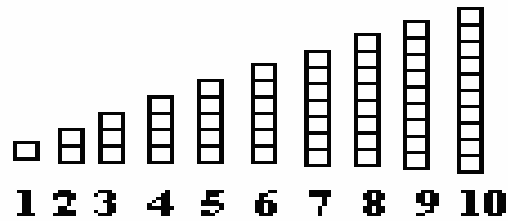
4. What is the colour of the rod with the value 5
5. What is the colour of the rod with the value 9

Evaluation

1. What is the difference in length between a rod and its presiding rod.
2. Assign the appropriate numerical values to the rods below.



3. Colour the rods using the appropriate colour.



Lesson Plan Three

Day: Friday

Date: 20th November 2009

Duration: 1 hour.

Time: 1:00pm-2:00pm

Topic: Multiplication of a fraction by a whole number.

R.P.K

1. Pupils have an idea of the meaning of fractions
2. Pupils model fractions
3. Pupils can add and subtract common fractions
4. Pupils can find an equivalent fraction of another fraction.

Objectives

By the end of the lesson, pupils should be able to

1. explain the meaning of multiplication of fraction by a whole number
2. model the fraction in question using the Cuisenaire rods
3. Use the Cuisenaire rods to find products of a whole number and a fraction.

Teaching and Learning Materials:

Cuisenaire rods

Introduction

Put pupils into six groups of five and provide each group with a set of Cuisenaire rods.

Ask pupils to solve the following questions.

1. What is a fraction?
2. $\frac{1}{2} + \frac{3}{4}$.
3. $\frac{3}{4} - \frac{1}{2}$.
4. Find two equivalent fractions of $\frac{3}{4}$.

Activity one

Discuss the meaning of multiplication of a fraction by a whole number using

$$\frac{3}{5} \times 2.$$

Take $\frac{3}{5}$ two times and sum them.


In short, it means that, what value are 2 of the $\frac{3}{5}$


Help pupils to model the fraction in the question using the Cuisenaire rods.

Using the Cuisenaire rods, guide pupils to define the whole number in which the fraction will be taken from.

Guide pupils to identify a rod that can split another rod into five equal parts.

That other rod is taken as a whole.


 The orange rod is taken as the whole.

 The red rod splits the orange rod which is the 'whole' into five equal parts.


Guide pupils to represent the $\frac{3}{5}$ with the red rods.

 The whole

 Take three red rods out of the five to represent $\frac{3}{5}$

 $\longrightarrow \frac{3}{5}$

Guide pupils to apply the meaning of $\frac{3}{5} \times 2$ to find the product.

 Take two sets of the three rods to represent $\frac{3}{5} \times 2$

Guide pupils to find the value of the three red rods which represents $\frac{3}{5} \times 2$ by;

- i. Joining the two red rods end to end horizontally and compare it to the



One whole and one red rod

- ii. Guide pupils to assign value to the fraction (red rod left)

One whole



The one red rod = $\frac{1}{5}$. So $\frac{3}{5} \times 2 = 1 \frac{1}{5}$

Core Points

Multiplication of a fraction by a whole number means add the fraction the number of times equivalent to the whole number. Where the whole number is the multiplier and the fraction is the multiplicand.

The selected rod representing the whole should be such that another rod could split into a number of equal parts equivalent to the denominator of

the fraction involved. Take a number of rods equivalent in value to the numerator of the fraction from the other rod that was used to split the whole, to represent the fraction in the question.

Take a set of the model fraction a number of times equal in value to the multiplier which is the whole number in the question.

Compare the set of model fraction to the modelled define whole to find out the number of wholes that can be formed from the set of model fractions.

Closure

Pupils to find solutions to the following

1. $1 \times \frac{3}{5}$
2. $\frac{3}{7} \times 4$.
3. Five children were given $\frac{2}{8}$ of loaf of bread each. What is the size of their loaf of bread put together?

Evaluation

1. $1 \times \frac{4}{8}$
2. $\frac{9}{8} \times 5$
3. Kofi sees 3 flies buzzing around his house. If he swat $\frac{1}{3}$ of them, how many flies did he swat?
4. Akosua spent $\frac{1}{5}$ of her time at her cousin's house playing outside. If she was there for 5 hours, how many hours did she play outside?
5. A line of 12 ants carry 12 ant eggs across a grassy field. If a bird flies in and eats $\frac{1}{4}$ of the ants, how many ants are eaten?

Lesson Plan Four

Day: Tuesday

Date: 24th November 2009

Duration: 1 hour.

Time: 1am-2:00am

Topic: Multiplication of a fraction by a fraction.

R.P.K

1. Pupils model fractions
2. Pupils can add and subtract common fractions
3. Pupils can find an equivalent fraction of another fraction.
4. Pupils can Multiply a fraction by a whole number

Objectives

By the end of the lesson, pupils should be able to;

1. Tell the meaning of multiplication of fraction by a fraction
2. Model the fraction in question using the Cuisenaire rods
3. Use the Cuisenaire rods to find products of two fractions.

Teaching and Learning Materials:

Cuisenaire rods

Introduction

Put pupils into six groups of five and provide each group with a set of Cuisenaire rods.

Ask pupils to solve the following questions.

6. $2 \times \frac{3}{4}$.

7. $\frac{1}{2} \times 3$.

Activity one

Discuss the meaning of multiplication of a fraction by a whole number using

$1/2 \times 3/5$. \longrightarrow Take $1/2$ of $3/5$.

In short, it means that, what is $1/2$ of $3/5$

Help pupils to model the fraction in the question using the Cuisenaire rods.

Using the Cuisenaire rods, guide pupils to define the whole number in which the fraction will be taken from.

Guide pupils to identify a rod that can split another rod into five equal parts.

That other rod is taken as a whole.



The orange rod is taken as the whole.

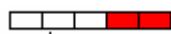


The red rod splits the orange rod which is the 'whole' into five equal parts.

Guide pupils to represent the $3/5$ with the red rods.



The whole



Take three red rods out of the five to represent $3/5$



$\longrightarrow 3/5$

Guide pupils to apply the meaning of $1/2$ of $3/5$ to find the product.



Split the three red rods into two equal parts represent



Take one of the light-green rods to represent $1/2 \times 3/5$

Guide pupils to find the value of the light-green rod by compare it to the whole (the orange rod).



use 3 white rods to split the light-green rod so as to easily compare it to the whole



Guide pupils to assign value to the fraction which is the three white rods

The one red rod = $1/5$. So $3/5 \times 2 = 1 \frac{1}{5}$

Core Points

Multiplication of a fraction by a fraction means that find the value of one fraction (A) of another fraction (B).

The selected rod representing the whole should be such that another rod could split into a number of equal parts equivalent to the denominator of the fraction involved.

Use a rod that split the whole to represent the multiplicand.

Split the multiplicand into a number of equal parts equivalent to the numerator of the multiplier.

Take a fraction of the multiplicand which is equal in value to the multiplier.

Compare the outcome to the whole, to find out the numerical value of the outcome.

Closure

Ask pupils to answer the following questions under your supervision.

1. $\frac{1}{5} \times \frac{2}{3}$
2. Ama has $\frac{1}{2}$ of an orange. She gave $\frac{1}{2}$ of the orange to kofi. What is the fraction given to Kofi?

Evaluation

1. $\frac{5}{3} \times \frac{1}{1}$
2. $\frac{9}{8} \times \frac{2}{3}$
3. Esi's cake calls for $\frac{1}{3}$ of a cup of sugar. How much sugar would Esi use to make $\frac{1}{2}$ of a batch of cake?
4. In Krystal's grade, $\frac{3}{4}$ of the students have a sister, of the students who have a sister, $\frac{1}{2}$ of them have a brother. What fractions of students in Krystal's grade have both a sister and a brother?

5. One seventh of the students on the track team do jumping event, of the students who do jumping events $\frac{3}{4}$ do the long jump. What fraction of the track team does the long jump?

Lesson Plan Five

Day: Thursday

Date: 26th Novembers 2009

Duration: 1hour

Time: 1:00pm-2:00pm

Topic: An algorithm for finding the product of a fraction by a fraction

R.P.K

1. Define the whole for the two fractions involved using the Cuisenaire rods
2. Use the Cuisenaire rods to find the product of a fraction and a fraction

Objectives

By the end of the lesson, pupils should be able to use an algorithm to find the product of a fraction and a fraction.

Teaching and Learning Material: Chalkboard illustration

Introduction

Guide pupils to deduce from the previous activity an algorithm to find the product of a fraction by a fraction.

Activity one

Provide pupils with the conventional algorithm for multiplying a fraction by a fraction.

Let us use $\frac{2}{6} \times \frac{4}{5}$ for this activity

Step I multiply the denominator or find the least common multiple of the denominator. This is the way of finding the defining the whole.

Step II this could be equated to defining the whole, when using the Cuisenaire rod.

Step III divide the product of the numerators by the product of the denominator

Activity two

Find the least equivalent fraction by expanding the numerator and the denominator. Then the common numbers in the numerator and the denominator.

There for; $\frac{2}{6} \times \frac{4}{5} = \frac{4}{15}$

Core Points

1. Multiplication of the denominator
2. Multiplication of the numerator
3. Division of the product of the numerator by the denominator.
4. If necessary, find the least equivalent fraction of the outcome.

Closure

Supervision pupils to answer the following questions:

1. $\frac{4}{5} \times \frac{2}{6}$
2. Victoria owns $\frac{1}{2}$ of an acre of farmland. She grows beets on $\frac{1}{2}$ of the land. On how many acres of land does Victoria grow beets?

Evaluation

Find the quotient of the following

1. $\frac{2}{4} \times \frac{1}{3}$

2. $\frac{3}{5} \times \frac{1}{2}$
3. $\frac{1}{3}$ of the cakes at Lily's bakery have chocolate frosting. $\frac{1}{3}$ of the cakes with chocolate frosting have raspberry filling. What fraction of the cake at Lily's bakery have both chocolate frosting and raspberry filling
4. Esi's cake calls for $\frac{1}{3}$ of a cup of sugar. How much sugar would Esi use to make $\frac{1}{2}$ of a batch of cake?
5. If Kobina had $\frac{1}{6}$ of his cake left and Marie ate $\frac{2}{9}$ of that, what part of the original cake did she eat?

Data Analysis

The data analysis of this study was done according to the research questions and hypotheses. The Software Package for the Service Solution (SPSS 15.0) was used in the analysis of the results. All the data were entered into the SPSS. The frequency distribution on each of the variables in the data files was processed. The outputs were carefully reviewed for missing data and unusual or unexpected entries.

Data for the difference in learner performance in Multiplication of Fraction was analysed using frequency, percentages and t- test. The statistical analysis procedure of the comparison on Performance was partitioned into three main parts.

1. Comparison of the pre-test performance of the control and the experimental groups.
2. Comparison of the pre-test and post-test of the control and the experimental groups.

3. Comparison of the post-test performance of the control and the experimental groups.

The independent t-test was used for 1 and 3 because, two different treatments (traditional teaching and courseware) and two different participants, (control group and the experimental group) were compared while paired t-test was used to compare the pre-test and post-test of the control and the experimental groups, because the pre-test which was compared to the post-test was taken by the same group of pupils (i.e. Control and experimental groups).

The data on difference in learner interest in multiplication of fractions was analysed using frequency, percentages and Pearson's Chi-square. The first item on the questionnaire which sought to elicit responses of the form 'Yes' and 'No' from both control and experimental groups on pupils interest in fractions.

The data analysis on satisfaction was on only the experimental group. Pupil's satisfaction was measured according to the following categories; very much satisfied, not very much satisfied and not satisfied. The categories of variables used were under the ordinal scale. Learners' satisfaction with the use of courseware as instructional medium for Multiplication of Fraction was analysed using frequency and percentages.

The perception of pupils to learn multiplication of fraction using Multimedia Courseware without the support of the teacher was analysed using frequency and percentages. The categories of variables used were classified under the ordinal scale and the analysis was on only the experimental group.

CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

This chapter presents the result, and discussions of findings of the study on the effectiveness of interactive multimedia courseware as an instructional medium for teaching Multiplication of Fractions in primary 6 at Assin Foso Demonstration Primary School. The results, and discussion are organised according to the hypothesis and the research questions as they were stated in chapter one.

Presentation of Results

The results of the performance of the control group and experimental group in the Pre-test and post-test are presented under the following headings: Comparison of the control and experimental group on the pre-test; Comparison of the pre-test and post-test on the control and experimental groups; and Comparison of the control and experimental group on the post-test.

Comparison of the control and experimental group on the pre-test

The Comparism of the control and experimental group on the pre-test result was done by comparing pupils performance on the individual test items under the following categories: multiplication of a whole number by a fraction, multiplication of common fractions, multiplication of improper fractions and story problems on fractions. Finally, the pre-test was examined as a whole.

In the pre-test not a single pupil scored questions under multiplication of improper fractions and story problems on fractions. As such multiplication of improper fractions and story problems on fractions were not discussed under the pre-test. For the post-test both control and experimental groups scored 100% questions under multiplication of a whole number by a fraction, and multiplication of common fractions. Therefore, scores under multiplication of a whole number by a fraction, and multiplication of common fractions were not discussed.

The first two questions of the pre-test were on multiplication of a whole number by a fraction. Table 6 shows that, more than $\frac{3}{4}$ of the control group scored all the two questions on multiplication of a whole number by a fraction while the experimental group scored less than $\frac{3}{4}$ of the two questions. In addition to the high score associated with the control group, a lesser percentage of pupils (5.6%) of the control group scored zero as against the experimental group which was a double (11.2%) of pupils who scored zero in the control group.

Table 7: Pre-test Scores on Multiplication of a Whole Number by a Fraction

Score	Control Group Pre- test		Experimental Group Pre- test	
	Frequency	Percent	Frequency	Percent
0	2	5.6	4	11.1
1	6	16.7	7	19.4
2	28	77.8	25	69.4
Total	36	100	36	100

Although, the result presented shows that pupils of the control group appear to have performed better than pupils of the experimental group on multiplication of common fractions, the independent t-test shows that the performance of pupils in the control group ($M = 1.72$, $sd = 0.57$) was not significantly different from the performance of the experimental group ($M = 2.36$, $s.d = 1.46$, $t(70) = -0.49$, $p > 0.05$) on multiplication of a whole number by a fraction.

In the Teaching Syllabus for Mathematics Primary School 1-6 (2007) it is stated that, multiplication of a whole number by a fraction should be taught at primary 5 at unit 11. So, the good performance on multiplication of a whole number by a fraction, by the control and experimental groups was because pupils already have been taught multiplication of a whole number by a fraction before this study took place.

Table 8: Independent T-Test of Scores on Multiplication of Whole Number by Fraction

Group	N	Max Score	Mean	s.d	Df	t	P
Control	36	2	1.72	0.57	70	0.93	0.35
Experimental	36	2	1.58	0.69			

The third, fourth and fifth question of the pre-test were on multiplication of common fractions. From Table 8, 33.3% of the control group scored all the 3 or 2 questions on multiplication of common fraction while 22.2% of the experimental group scored two or three questions on multiplication of common fractions.

From Table 10, 66.6 and 77.8 % of control and experimental groups scored 0 or 1 out of the three questions on multiplication of common fractions respectively. Out of the 66.6% of the control group who scored 0 or 1 on multiplication of common fractions, 47.2% scored zero while, 52.8% out of 77.8% of the experimental group scored zero. The poor performance on multiplication of common fractions as well as multiplication of improper fractions (0%) was because pupils have not been taught, also, the Teaching Syllabus for Mathematics Primary School 1-6 (2007) stipulates that multiplication of common fractions and improper fractions should be taught at primary six, unit 2 of the content.

Table 9: Pre-test Score on Multiplication of Common Fractions

Score	Control Group Pre- test		Experimental Group Pre- test	
	Frequency	Percent	Frequency	Percent
0	17	47.2	19	52.8
1	7	19.4	9	25.0
2	8	22.2	5	13.9
3	4	11.1	3	8.3
Total	36	100	36	100

Although, the result presented shows that pupils of the control group performed slightly better than pupils of the experimental group on multiplication of common fractions, the independent t-test shows that the performance of pupils in the control group ($M=0.78$, $s.d=0.99$) was not significantly different from the performance of the experimental group

($M=0.97$ s.d= 1.08, $t(70) = -0.80$, $p > 0.05$) on the multiplication of common fractions.

The popular error made by both control and experimental groups was applying the multiplication symbol as addition symbol. Pupils who scored zero lacked the concept of multiplication of fractions so they solved the problems by adding the numerators and the denominators.

Table 10: Independent T-Test of Scores on Multiplication of Common Fractions

Group	N	Max Score	Mean	s.d	Df	t	P
Experimental	36	3	0.97	1.08	70	0.80	0.43
Control	36	3	0.78	0.99			

Table 12 shows that the mean (2.53) of the control group was slightly higher than the mean (2.36) of the experimental group. The minimum and maximum spread of the scores of both the control group and the experimental group pre-test were 1.11 to 3.95 and 0.90 to 3.82, respectively.

The number of pupils in the experimental group who scored between 2 and 5 formed 48% which was 2% less than those who scored above 2 in the control group. The number of pupils in the experimental group who scored below 2 formed 30.6% which was 5% more than those who scored below 2 in the control group. Due to the seemingly high number of pupils scoring between 2 and 5, the score of the experimental group was highly skewed to the right as compared to the control group.

The distribution in terms of percentages of the control group and experimental group shows that, pupils in the control group performed better

than those of the experimental group, but the independent t-test reveals that the performance of pupils in the control group ($M=2.53$, $s.d=1.42$) was parallel to the performance of the experimental group on the pretest ($M = 2.36$, $s. d = 1.46$, $t (70) = -0.49$, $p > 0.05$).

Table 11: Frequency Distribution of the Control and Experimental Groups on Pre-test

Score	Experimental Group		Control Group	
	Frequency	Percent	Frequency	Percent
0	4	11.1	3	8.3
1	7	19.4	6	16.7
2	8	22.2	9	25.0
3	9	25.0	8	22.2
4	5	13.9	7	19.4
5	3	8.3	3	8.3
Total	36	100	36	100

Table 12: Independent T-Test of the Control and Experimental Groups on Pre-test

Group	N	Max Score	$\bar{(\chi)}$	d.	t	df	P
Experimental	36	10	2.36	1.46	-0.49	70	0.62
Control	36	10	2.53	1.42			

This means that the entry level of knowledge on multiplication of fractions of the control group was not significantly different from that of experimental group. This was expected as the sample for the control and

experimental groups were selected from the same population who uses the same syllabus.

Comparison of Pre-test and Post-test scores of Control and Experimental Groups

Table 11 shows that the minimum and maximum scores of both the pre-test and the post-test were 0 and 5, and 5 and 10, respectively. The mean (7.44) of the post-test was higher than the mean (2.67). of the pre-test. The paired t-test also shows that the control group performance on pre-test (M=2.67, s.d=1.41) was significantly different to the performance on the post - test (M=7.44, s.d= 1.50, $t(35) = -28.99$, $p < 0.05$).

The positively skewed post-test and the negatively skewed pre-test, means that, pupils of the control group had a positive change in performance on multiplication of fractions.

Table 13: Paired T-Test on the Pre-test and Post-test of Control Group

Group	N	Min.Score	Max. Score	Mean	s.d	Df	t	P
Pre-test	36	0	5	2.67	1.41	35	-28.99	0.01
Post-test	36	5	10	7.44	1.50			

Table 13 shows that the minimum and maximum scores of both the pre-test and the post-test were 0 and 5, and 5 and 10, respectively. The mean (8.17) of the post-test was far higher than the mean (2.36). of the pre-test. The paired t- test also shows that the experimental group performance on pre-test (M=2.36, s.d=1.46) was significantly different to the performance on the post-test (M=8.17, s.d= 1.48, $t(35) = -42.39$, $p < 0.05$).

Table 14: Paired T-Test on Pre-test and Post-test of Experimental Group

Group	N	Min.Score	Max.Score	Mean	s.d	Df	t	P
Pre-test	36	0	5	2.36	1.46	35	-42.39	0.01
Post-test	36	5	10	8.17	1.48			

The positively skewed post-test scores and the negatively skewed pre-test scores shows that there was an improvement in the performance on multiplication of fractions by the experimental group.

Comparison of Control and Experimental Groups on Post-test scores

The post- test of control and experimental groups were compared in two ways: comparison of the control and experimental groups on the individual post-test items, and comparison of the control and experimental group's general performance on the post-test.

Table 16 shows the data on pupils' performance in terms of multiplication of improper fractions. Two questions (question 6 and 7) were used to assess pupil's ability to solve multiplication of improper fractions. The performance of the experimental group was on the higher side than the control group; because more than $\frac{3}{4}$ of the experimental group scored all the two questions on multiplication of improper fractions while a little over $\frac{1}{2}$ of the control group scored all the two questions. The percentage number of pupils who scored zero in the control and experimental groups was 11.1 and 8.3, respectively.

Table 15: Post-test Score on Multiplication of Improper Fractions

Score	Control Group Post- test		Experimental Group Post- test	
	Frequency	Percent	Frequency	Percent
0	4	11.1	3	8.3
1	7	19.4	3	8.3
2	25	69.4	30	83.3
Total	36	100	36	100

The independent t-test show that the performance of pupils in the control group (M=1.58, s.d=0.69) was not significantly different from the performance of the experimental group on multiplication of improper fractions (M=1.75, s.d= 0.60, $t(70) = -1.09$, $p > 0.05$).

Table 16: Independent T-Test of Scores on Multiplication of Improper Fraction

Group	N	Max Score	Mean	sod	Df	t	P
Control	36	2	1.58	0.69	70	-1.09	0.280
Experimental	36	2	1.75	0.60			

The results presented show that, pupils of the experimental group performed better than pupils of the control group on multiplication of improper fractions, but the difference in performance between the control and experimental groups was not significant. Therefore, on the average, the performance of the two groups in terms of multiplication of improper fractions was the same. From observation, majority of pupils on both sides, that is the

control and experimental groups, had difficulty in multiplication of large numbers and simplification of improper fractions.

The eighth, ninth and tenth questions of the pre-test were story problem on multiplication of fractions. The performance of the experimental group was better than the control group, because 33.3% of the control group scored two or three questions on multiplication of common fraction while 22.2% of the experimental group scored two or three questions on multiplication of common fractions.

Table 17: Post-test Score on Story Problem on Multiplication of Fractions

Score	Control Group Post- test		Experimental Group Post- test	
	Frequency	Percent	Frequency	Percent
0	18	50.0	8	22.2
1	8	22.2	12	33.3
2	6	16.7	9	25.0
3	4	11.1	7	19.4
Total	36	100	36	100

The independent t-test shows that the performance of pupils of the control group ($M=0.89$, $s.d=1.06$) was significantly different from the performance of the experimental group ($M=1.42$, $s.d= 1.05$, $t(70) = -2.12$, $p < 0.05$) on story problems on multiplication of fractions.

Table 18: Independent T-Test on Story Problems on Multiplication of Fractions

Group	N	Max Score	Mean	s.d	Df	t	P
Control	36	2	0.87	1.06	70	-2.12	0.04
Experimental	36	2	1.42	1.05			

The basic problem with the control group was the conversion of the story problems into mathematical expressions. That was why 50% of the control group did not score the story problem, but a lot more of pupils in the experimental group (77.8%) were able to solve at least one out of the three story problems. The experimental group had the advantage of going through several exercises with immediacy of feedback, courtesy the technology of the computer, that help ensure that students grasp the concept of multiplication prior to the post-test (Lawrence, 2000).

The minimum and maximum scores of both the control group and the experimental group on the post-test were 5 and 10. Table 18 shows that the mean (8.17) of the experimental group was 0.63 higher than the mean (7.44) of the control group. The number of pupils in the experimental group who scored above 7 represented 77.7% of the entire number of pupils in the experimental group. The 77.7% was 33.5% more than the percentage of pupils who scored above 7 in the control group.

Although, the minimum and maximum scores of the two groups were close, more pupils of the experimental group score higher marks than those of the control group. This was the reason why the experimental group data was highly skewed to the right than the control group.

Table 19: Frequency Distribution of Post-test Outcome of the Control Group and Experimental Group

Score	Control Group Post- test		Experimental Group Post- test	
	Frequency	Percent	Frequency	Percent
5	4	11.1	3	8.3
6	6	16.7	3	8.3
7	9	25.0	2	5.6
8	8	22.2	12	33.3
9	5	13.9	9	25.0
10	4	11.1	7	19.4
Total	36	100	36	100

The performance of the experimental group in the post-test (M=8.17, s.d= 1.48), was significantly different from the performance of the control group on post-test (M=7.44, s.d=1.50, $t(70) = -2.05$, $p < 0.05$). The hypothesis; “there was no significant difference in the performance between those who were taught using the normal classroom teaching and learning to those who used the Multimedia Courseware to learn” was therefore rejected. This supports Josefine,s (2008) claim that courseware is an effective alternative instructional medium.

Table 20: Independent T-Test of Post-test Outcome of the Control Group and Experimental Group

Group	N	Max Score	Mean	s.d	Df	t	P
Experimental	36	10	7.44	1.50	70	-2.05	0.04
Control	36	10	8.17	1.48			

The post-test shows an improvement in performance of both experimental and control groups. Although, the entry level of knowledge in multiplication of fractions of the control group was not significantly different from the experimental group, after the intervention the performance of the experimental group was better than that of the control group. Therefore, it confirms the assertion that the use of technology enhances and enriches the learning environment Barker (2000). Teaching and learning is not only the presentation of technology or teaching and learning aid to learners, as stated by Ali and Elfessi, (2004) that the significant role of technology in teaching and learning is limited as an instructional delivery medium and not a key determinant of learning but can enhance learning.

Interest in Multiplication of Fractions of Control and Experimental Groups

The initiation and sustainability of interest in a lesson is one of the key principles in the teaching and learning process. After the intervention, the researcher issued a questionnaire to both control group and the experimental group. One of the item in the questionnaire requested pupils to respond ‘Yes’ or ‘No’ to whether the lesson was interesting.

From Table 22, 69.4% and 88.9% of the control and experimental groups respectively, indicated that the lessons were interesting. There was significant difference in interest in lessons taken by the control and experimental groups $X^2 (1, N=72) = 4.13, p < 0.05$. Therefore, the hypothesis; that “there was no significant difference in interest in lessons taken by the control and experimental groups.” was rejected.

Table 21: Pupils Interest in Multiplication of Fractions

Response	Control		Experimental		df	D	P
	Frequency	Percent (%)	Frequency	Percent			
Yes	25	69.4	32	88.9	1	4.13	0.04
No	11	30.6	4	11.1			
Total	36	100	36	100			

By observation, the control group found the lessons interesting, but those of the experimental group showed more interest in their lessons than the control group. It was inferred from the results that, experimental group interest was higher than that of the control group due to the use of the computer.

Satisfaction Derived by the experimental group

The result on Table 15 shows that, 21 of the pupils which formed 58.3% of the experimental group agreed that they were very much satisfied with the teaching and learning process. This meant that, 41.7% of the experimental group were not fully satisfied with the teaching and learning process. Out of the pupils who were not fully satisfied, 33.3% of them were not at all satisfied and the 66.6% were not very much satisfied. On the average, with the

exception of the 13.9% who were not satisfied at all, 86.1% of the experimental group were satisfied with the teaching and learning process of multiplication of fraction in the experimental group. When learners are allowed to learn at their own pace with a step by step break down of the topic into manageable units and instant feedback of the courseware, it reduces the difficulty in learning (Polya, 1945).

Table 22: Frequency Distribution of Experimental Group’s Satisfaction on the usage of Courseware as instructional medium for multiplication of Fractions

Satisfaction level	Frequency	Percent (%)
Very Much	21	58.3
Not Very Much	10	27.8
Not at All	5	13.9
Total	36	100

Experimental Group Perception on Assistance Required for Courseware

Item four on the questionnaire was to find out whether pupils can use a similar courseware without assistance. Words 52.8% of experimental group felt that they could use a similar interactive courseware without any support from the teacher. About 47.3% of the experimental group indicated that they will need support from the teacher in other to use a similar courseware. Out of the 47.3% who needed support, 16.7% of them wanted full support from the teacher and 30.6% indicated that, they will need little support to use a similar courseware. With the exception of the 16.7% of the experimental group who agreed that they will need the full support of the teacher to use a similar

courseware, 83.4% of the experimental group indicated that, they did not need full support.

During the first two introductory lessons with the experimental group, almost every learner called for support. The number of pupils that called for support reduced drastically during the third and subsequent lessons. This indicated that the experimental group had gotten used to the courseware.

Table 23: A Frequency Distribution on Perception on Assistance needed to Use Courseware

Assistance	Frequency	Percent (%)
Full Assistance	6	16.7
Little Assistance	11	30.6
No Assistance	19	52.8
Total	36	100

Majority (83.4%) of the experimental group indicated that, they would not need full support to learn with a similar courseware. It was inferred that, the self-directional design elements of the courseware, and the, sequential broken down manageable units had great impact on pupils' confidence to use the courseware with little or no assistance (Ramsden, 1992).

DISCUSSION

The discussion on findings of the performance of the control group and experimental group in the Pre-test and post-test are Summarised below.

Performance of pupils who used the Multimedia courseware as an instructional delivery medium was a shade ahead of pupils who were taught with the traditional teaching method. The differences in performance occurred in the story problem. The control group (50%) had problem in converting the story problems into mathematical expressions, but the experimental group (77.8%) could do the conversion. It was inferred that because the experimental groups' learning environment was a personal interaction by the learner with the courseware so they were stimulated with challenging problems, which encouraged them to think to understand the problem on their own (Polya, 1945). Again, the experimental group experienced individual attention as the teacher (facilitator) was call upon when the learner faces challenges they cannot overcome.

It was inferred that, the physical presence of the computer coupled with the simulation, animation of the activities of the presentation of multiplication of fractions and the ease to navigate through the courseware were the factors that caused the difference in interest in the lessons of the control and experimental groups. It was not out of place when 83.3% of the experimental group indicated that they found their lessons interesting. This study support Linkels, (2006) assertion that e - Learning could sustain interest and improve learner performance.

In the experimental group, pupils took the responsibility of completion of lessons, controlled and created their own mathematical ideas. The

courseware provided immediate feedback and the teacher also provided swift assistance to pupils. The collaborative learning process allowed students to exchange information, give and receive feedback, challenge and encourage each other and jointly reflecting on progress and process (Curtis & Lawson, 2001). This contributed to the reason why the experimental group were satisfied with the use of the courseware as an instructional medium for multiplication of fraction.

The fact that 67% of the pupils of the experimental group indicated that they needed assistance, implies that educators who have turned their attention to the use of technology to enhance and enrich the learning environment (Barker, 2000), must bear in mind that, technology in teaching and learning should be the instructional delivery medium at the center of collaborative method of teaching.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

The purpose of the study was to ascertain the effectiveness of multimedia courseware as an instructional medium for teaching multiplication of fractions in basic '6'. The research design for this study was an experimental research, which employed the quasi-experimental design. Seventy-two pupils of primary six were selected for this study and were divided into two groups (experimental group and control group). The experimental group used the interactive multimedia courseware to learn, while; pupils in the control group were taught multiplication of fractions using the traditional method of teaching. The effectiveness of the courseware was studied in line with the following checked list:

1. Pupils' performance on multiplication of fractions
2. Pupils' interest in the lessons
3. The satisfaction pupils' derived using the courseware to learn multiplication of fractions.
4. Pupil's perception on assistance needed to use a similar courseware.

Five hours was spent on the intervention of each of the two groups. This was over two weeks, where each lesson lasted one hour. The instruments used for this study were two sets of 10 items of written test developed by the researcher for the pretest and posttest, and a questionnaire of five questions.

Key findings

The main findings of this study were the following:

- 1a. Both control and experimental groups performed excellently well on multiplication of a whole number, by a fraction and multiplication of common fractions.
- 1b. The experimental group could better solve story problems on multiplication of fractions than the control group.
- 2a. Pupils of the experimental group developed more interest in multiplication of fractions than those of the control group
- 2b. Pupils of the experimental group confidently participated in discussions and were prepared to compare their understanding and progress with others
3. Pupils of the experimental group were satisfied with the use of courseware as an instructional delivery medium for Multiplication of Fraction.
4. Learners needs some form of assistance when courseware is the instructional delivery medium for teaching.

Conclusion

This study assessed the effectiveness of an interactive multimedia courseware as an instructional delivery medium for multiplication of fractions. This was achieved by comparing the courseware to the traditional teaching method.

Recommendations

Based on the key findings, these three main recommendations.

1. During the research it was realised that pupils have difficulty in converting story problem into mathematical expression. It is recommended teachers should pay much attention to helping pupils to convert story problem into mathematical expression.
2. The poor performance of Ghana's eight grade in TIMSS 2003, was attributed to the less usage of technology in the classroom by Anamuah-Mensah, Mereku & Asabere-Ameyaw (2004), should be taken seriously and an attempt to integrate computer technology in education should be a priority of education policy makers.
3. It was observed that pupils in the school uses only text books and a few non-interactive teaching and learning materials in the teaching and learning process. It is recommended that all approved textbooks should be accompanied with an interactive multimedia courseware on challenging topics in the textbook.
4. Teachers who use courseware as instructional medium should apply the collaborative method to help learners to exchange ideas, challenge other pupils submission, encourage each other and jointly reflecting on progress and process (Curtis, 2001) . This recommendation is made due to the positive outcome during the research.
5. Technology in teaching and learning should be limited as an instructional delivery medium and not a key determinant of learning (Ali & Elfessi, 2004).

6. The use of an interactive multimedia courseware as the instructional medium in the classroom should not be done in isolation but with the presence of a teacher (Cline, 2007).

Suggestion for Further Research

This study, investigated the effectiveness of multimedia courseware as an instructional medium for multiplication of fractions in primary six at Assin Foso Demonstration primary school. Based on the information gathered from the study, it is suggested that a further research on the effectiveness of an interactive multimedia courseware as an instructional medium for teaching division of fractions, at different grade levels and a larger sample size should be carried out. This would provide good bases for educators to make an informed decision on the use of an interactive multimedia courseware in the delivery of Fractions.

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APPENDICES

APPENDIX A

CENTRE FOR CONTINUING EDUCATION
(UNIVERSITY OF CAPE COAST)

Tel No: 042 - 36946
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University Post Office
Cape Coast

Our Ref. No: CCE/143/Vol.1/07

20th February, 2008

Your Ref. No:

TO WHOM IT MAY CONCERN

This is to certify that **Mr. James Ussher** with registration number

ED/TTP/05/0020 is pursuing a two year **Masters Degree Programme** in Education (**Information Technology**) at the University of Cape Coast.

He is conducting a research on the Topic "**The Effectiveness of Multimedia Courseware as a supportive medium to class tuition in the Upper Primary in Ghana.**"

We will strongly appreciate any courtesy extended to him.

Thank you.

CENTRE FOR CONTINUING EDUCATION
UNIVERSITY OF CAPE COAST
for **Palmas Anyagre**

(Programme Facilitator)

APPENDIX B
TEST ITEMS AND QUESTIONNAIRE

Pre- test Questions

1. $4 \times \frac{3}{4}$

2. $\frac{5}{6} \times 2$

3. $\frac{3}{7} \times \frac{4}{9}$

4. $\frac{12}{5} \times \frac{9}{8}$

5. $\frac{2}{8} \times \frac{3}{5}$

6. $\frac{5}{6} \times \frac{1}{2}$

7. $\frac{3}{5} \times \frac{7}{8}$

8. Kwame has a dog who weighs 12 pounds. Her cat weighs $\frac{7}{10}$ as much as the dog. How many pounds does her cat weigh?

9. $\frac{1}{2}$ of the students in the band play a brass instrument. Of the students who play a brass instrument, $\frac{1}{5}$ plays the trumpet. What fraction of the students in the band plays the trumpet?

10. $\frac{1}{2}$ of the students on the track team do jumping events. Of the students who do jumping events, $\frac{3}{4}$ do the long jump? What fraction of the students on the track team does the long jump?

Post- test Questions

1. $2 \times \frac{5}{1}$

2. $\frac{6}{8} \times 6$
3. $\frac{1}{3} \times \frac{1}{4}$
4. $\frac{1}{5} \times \frac{3}{4}$
5. $\frac{7}{8} \times \frac{9}{12}$
6. $\frac{3}{4} \times \frac{11}{9}$
7. $\frac{13}{5} \times \frac{7}{9}$
8. Emily spent $\frac{5}{11}$ of her time at her cousin's house playing outside. If she was there for 22 hours last week, how many hours did she play outside?
9. In Guadalupe's grade, $\frac{2}{5}$ of the students have a sister. Of the students who have a sister, $\frac{4}{5}$ also has a brother. What fraction of the students in Guadalupe's grade has both a sister and a brother?
10. Jessie's lemon cookie recipe calls for $\frac{1}{3}$ of a cup of sugar. How much sugar would Jessie use to make $\frac{1}{2}$ of a batch of cookies?

Questionnaire

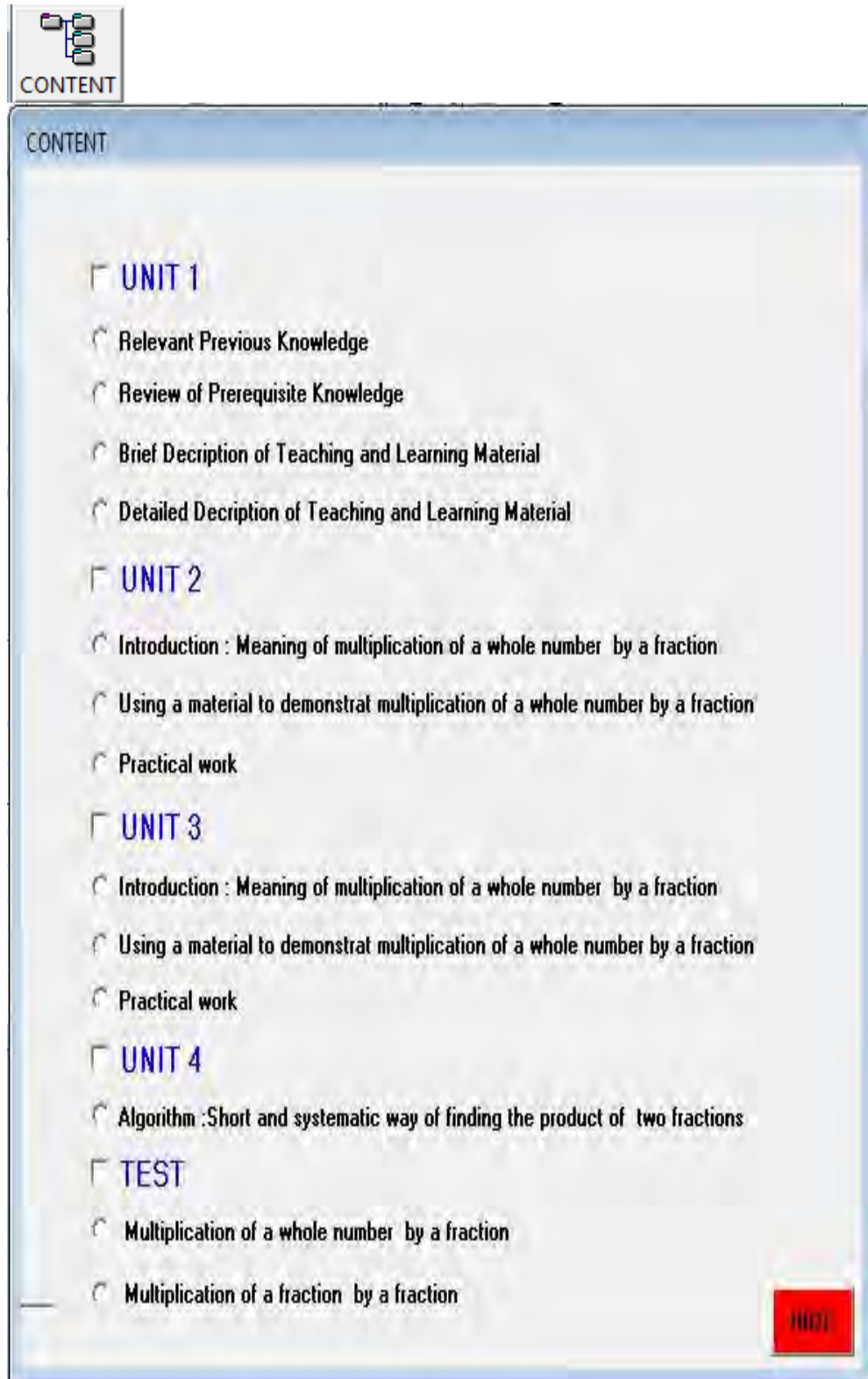
(Tick the box that matches your response to the question.)

Question Item	Yes	No
1. Do you find the lesson interesting?		

Question Item	Very much	Not very much	Not at all
2. Were you satisfied with the lessons?			
3 Can you use a similar courseware to learn without supervision?			

APPENDIX C

INTERFACE OF THE STAGES IN THE INTERACTIVE MULTIMEDIA COURSEWARE



RELEVANT PREVIOUS KNOWLEDGE

UNIT 1 CONTENT

RELEVANT PREVIOUS KNOWLEDGE

DISCRPTION OF MATERIAL

UNIT 1

Pause Next Back Exit

RELEVANT PREVIOUS KNOWLEDGE

UNIT 1 CONTENT

RELEVANT PREVIOUS KNOWLEDGE

The most important previous knowledge required before learning multiplication of a fraction by a fraction are:

the meaning of fractions.

representation of a fraction with a material.

equivalent fractions.

addition of fractions.

subtraction of fractions.

RELEVANT PREVIOUS KNOWLEDGE

Pause Next Back Exit

UNIT 1 - DESCRIPTION OF THE TEACHING LEARNING MATERIAL

UNIT1 CONTENT

CUISENAIRE RODS

RELEVANT PREVIOUS KNOWLEDGE

DISCRPTION OF MATERIAL

- White-Rod
- Red-Rod
- Light Green-Rod
- Purple-Rod
- Yellow-Rod
- Dark Green-Rod
- Black-Rod
- Brown-Rod
- Blue-Rod
- Orange-Rod

The Cuisenaire rods are made of ten sets of coloured rods. All the rods have equal width. The length of a rod, determines its numerical value. The ten set of rods are of different colours. Each coloured rod has a specific value.

UNIT 1 - DESCRIPTION OF THE TEACHING LEARNING MATERIAL

UNIT1 CONTENT

Detail discription of the CUISENAIRE RODS

RELEVANT PREVIOUS KNOWLEDGE

DISCRPTION OF MATERIAL

Each subsequent rod is longer than the preceding rod by the length of the white rod. The fourth rod, fifth rod, sixth rod, seventh rod, eighth rod, ninth rod and tenth rod are coloured purple, yellow, dark green, black, brown, blue and orange respectively.

DISCRPTION OF MATERIAL

THE MULTIPLICATION OF A WHOLE NUMBER BY A FRACTION

UNIT2 CONTENT

The Concept of Multiplication of whole number by a fraction

THE MULTIPLICATION OF A WHOLE NUMBER BY A FRACTION

UNIT2 CONTENT

The Concept of Multiplication of whole number by a fraction

Introduction

Using Cuisenaire Rod

Auto Demonstration

Practical Work

Next Back Exit

THE MULTIPLICATION OF A WHOLE NUMBER BY A FRACTION

UNIT2 CONTENT

THE CONCEPT OF MULTIPLICATION OF FRACTIONS

What is the meaning of $2 \times \frac{3}{5}$?

Please write your answer in the text box provided below

The Concept of Multiplication of whole number by a fraction

Approach every Mathematical problem by understanding the problem.

For example; what is the meaning of $2 \times \frac{3}{5}$?

Write your answer in the box and click the green button at the lower left corner for the expected answer.

Answers

Next Back Exit

The Concept of Multiplication of whole number by a fraction

Introduction

THE MULTIPLICATION OF A WHOLE NUMBER BY A FRACTION

UNIT2 CONTENT

THE CONCEPT OF MULTIPLICATION OF FRACTIONS

The best way to easily define the whole is to make sure that the whole could be divided into a number of times equal to the value of the denominators of the fraction without a remainder. In this case, the whole should be such that it could be divided into 5 equal parts without a remainder.

- The orange rod is used as the WHOLE .
The red rod divides the whole into 5 equal part
- The Whole
Three (3) of the five (5) red rods are taken to represent the $3/5$.
- Two sets of the three (3) red rod are taken to represent the " $2 \times 3/5$ ".
- The whole is compared to the 2 sets of three red rods
The two "2" sets of three "3" red rods are joined end to end horizontally.
- From the above it is clear that the two sets are equal to 1 whole and 1 red rod.
The one red rod left is $1/5$ of the whole. Therefore, $2 \times 3/5 = 6/5 = 1 \frac{1}{5}$

The Concept of Multiplication of whole number by a fraction

Next Back Exit

THE MULTIPLICATION OF A WHOLE NUMBER BY A FRACTION

UNIT2 CONTENT

TRY THE FOLLOWING QUESTION USING THE CUISENAIRE RODS

- $4 \times 2/5$?
- $8 \times 3/4$?
- $4/6 \times 7$?
- $6 \times 5/8$?
- $4/5 \times 5$?
- $3 \times 6/9$?

The Concept of Multiplication of whole number by a fraction

Form1

Practical Work

Next Back Exit

UNIT 3

UNIT2 CONTENT

The Concept of Multiplication of a fraction by a fraction

UNIT 3

UNIT 3

UNIT2 CONTENT

The Concept of Multiplication of a fraction by a fraction

Introduction

Using Cuisenaire Rod

Auto Demonstration

Practical Work

Pause Next Back Exit

Pause Next Back Exit

Introduction

UNIT 3

UNIT2 CONTENT THE CONCEPT OF MULTIPLICATION OF FRACTIONS

What is the meaning of $1/2 \times 3/5$?

Please write your answer in the text box provided below

The Concept of Multiplication of a fraction by a fraction

Answer

Pause Next Back Exit

Using Cuisenaire Rod

UNIT 3

UNIT2 CONTENT THE CONCEPT OF MULTIPLICATION OF FRACTIONS

Find the product of $1/2 \times 3/5$?

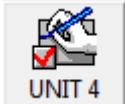
The fractions are $1/2$ and $3/5$.

The denominators are 2 and 5.

1) Always consider both denominators of the fraction involved before defining the whole.
2) In this case the two fractions involve are $1/2$ and $3/5$. The denominators are 2 and 5.
3) The whole should be such that 3 of the 5 equal parts of it could be divided into 2 equal parts.

The Concept of Multiplication of a fraction by a fraction

Pause Next Back Exit

 **UNIT 4**

Practical Work

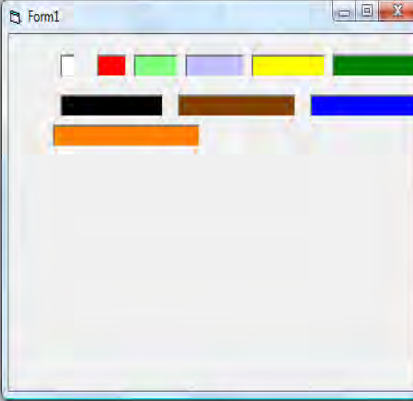
UNIT 3

UNIT2 CONTENT TRY THE FOLLOWING QUESTION USING THE CUISINAIRE RODS

1. $\frac{3}{4} \times \frac{2}{5} ?$
2. $\frac{1}{8} \times \frac{3}{4} ?$
3. $\frac{4}{6} \times \frac{5}{7} ?$
4. $\frac{5}{3} \times \frac{7}{8} ?$
5. $\frac{1}{2} \times \frac{5}{11} ?$
6. $\frac{2}{10} \times \frac{1}{3} ?$

The Concept of Multiplication of a fraction by a fraction

Form1



UNIT 4

DEVELOPING AN ALGORITHM FOR MULTIPLICATION OF FRACTIONS

$$\frac{2}{6} \times \frac{4}{5} = \frac{2 \times 4}{6 \times 5}$$

= $\frac{8}{30}$

$$= \frac{2 \times 4}{2 \times 15}$$

$$\frac{2}{6} \times \frac{4}{5} = \frac{4}{15}$$

Multiplying the denominators is a way of defining the whole

The product of the numerator, divided by the denominator is equal to $\frac{2}{6}$ of $\frac{4}{5}$

Expand the numerator and the denominator then cancel out the common numbers in the numerator and denominator.

Another way is to find the least equivalent fraction

1. Multiply the numerators.
2. Multiply the denominators.
3. Divide the product of the numerators by the product of denominators.
4. If necessary find the least equivalent fraction of the outcome.

Test(1)

MULTIPLICATION OF FRACTION (BY FRACTION)

File Tour Help About Us

and denominator

TEST ONE

TEST 1 Write your answer in the form a/b

1) $11 \times \frac{4}{8} = \frac{\quad}{\quad}$

2) $5 \times \frac{9}{8} = \frac{\quad}{\quad}$

3) Kofi sees 3 flies buzzing around his house. If he swats $\frac{1}{3}$ of them, how many flies did he swat? =

4) Akosuwaa spent $\frac{1}{5}$ of her time at her cousin's house playing outside. If she was there for 5 hours last week, how many hours did she play outside? =

5) A line of 12 ants carry 12 ant eggs across a grassy field. If a bird flies in and eats $\frac{1}{4}$ of the ants, how many ants are eaten? =

START
SUBMIT
REPORT

END

Test(2)

MULTIPLICATION OF FRACTION BY FRACTION

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If you want me to leave right click on me, do not left

TEST 2

TEST 2 Write your answer in the form a/b

1) $\frac{9}{1} \times \frac{8}{10} = \frac{\quad}{\quad}$

2) $\frac{5}{3} \times \frac{1}{1} = \frac{\quad}{\quad}$

3) Esi's cake calls for $\frac{1}{3}$ of a cup of sugar. How much sugar would Esi use to make $\frac{1}{2}$ of a batch of cakes? =

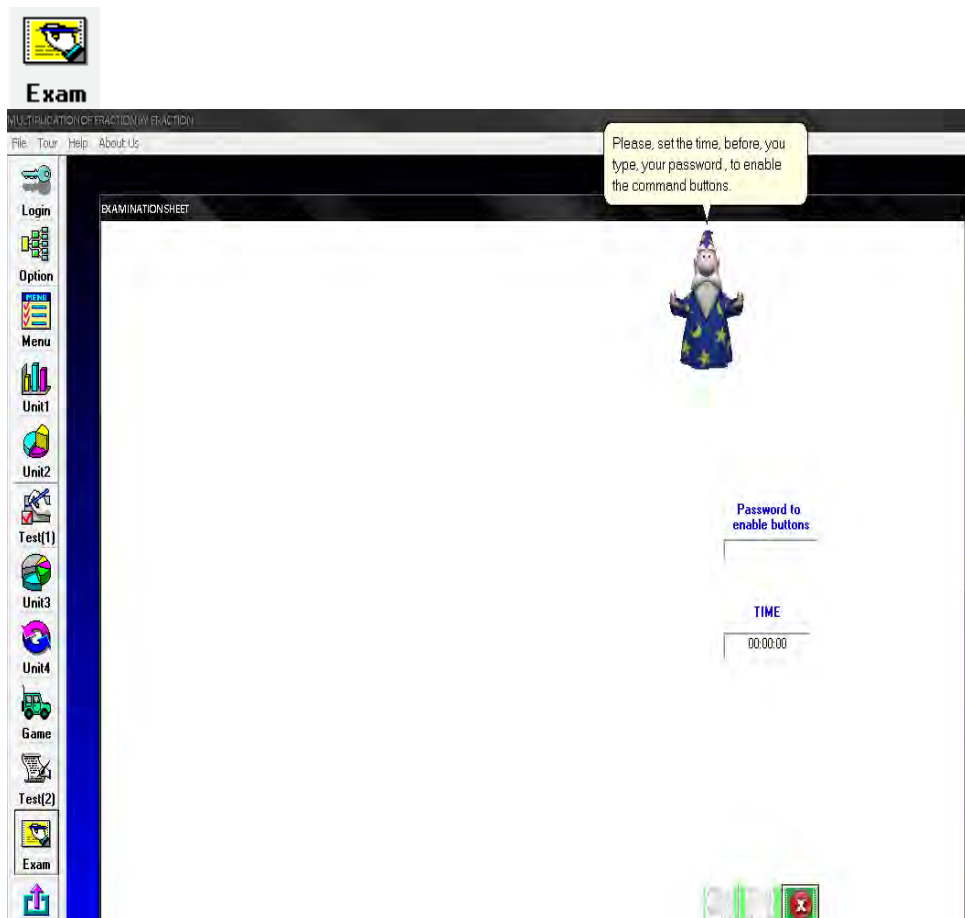
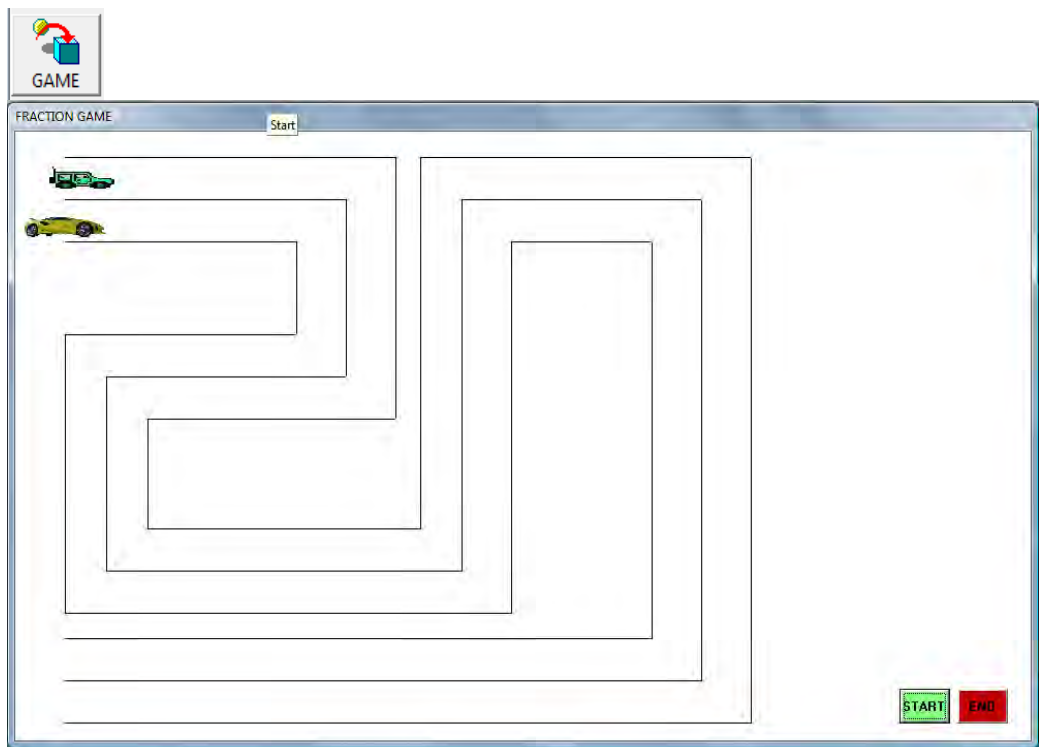
4) In Krystal's grade, $\frac{3}{4}$ of the students have a sister. $\frac{1}{2}$ also have a brother. What fraction of the students in Krystal's grade have both a sister and a brother? =

5) $\frac{1}{7}$ of the students on the track team do jumping events. Of the students who do jumping events, $\frac{3}{4}$ do the long jump. What fraction of the students on the track team do the long jump? =

START
SUBMIT
REPORT

END

r thank you for choosing this courseware to learn



MULTIPLICATION OF FRACTIONS BY FRACTION

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Login

Option

Menu

Unit1

Unit2

Test11

Unit3

Unit4

Game

Test12

Exam

Exit

EXAMINATION SHEET

QUESTIONS

1 $\frac{3}{4} \times \frac{8}{2}$

2 $\frac{10}{9} \times \frac{4}{7}$

3 $\frac{1}{4} \times \frac{4}{2}$

4 A line of 2 ants carry 3 ant eggs across a grassy field. If a bird flies in and eats 1/2 of the ants, how many ants are eaten?

5 Maria found 3 grapes in the refrigerator and ate 1/4 of them. How many grapes did she eat?

6 Kwame had 6 sports cards. If she traded 1/3 of them on a used toy, how many sports cards did the used toy cost?

7 Yaa had 1/3 of a pound of blueberries. Yaa let his friend Bridget eat 1/3 of the blueberries. How many pounds of blueberries did Bridget eat?

8 Steven had 1/4 of a pound of blueberries. Steven let his friend Brittany eat 1/2 of the blueberries. How many pounds of blueberries did Brittany eat?

9 1/7 of the students on the track team do jumping events. Of the students who do jumping events, 3/4 do the long jump. What fraction of the students on the track team do the long jump?

10 2/8 of the cakes at Elian's Bakery have chocolate frosting. 6/12 of the cakes with chocolate frosting have raspberry filling. What fraction of the cakes at Elian's Bakery have both chocolate

Write your answer here

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SCORE

0

100

Very Weak

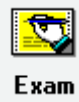
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Password to enable buttons

TIME

10:00:00

Start Submit Exit



Exam