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PERCEPTIONS OF TEACHERS ON THE USE OF COMPUTERS TO TEACH MATHEMATICAL HYPERBOLIC GRAPHS AT GRADES 10 TO 12

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ABSTRACT: *This study explores the perceptions of teachers on the use computers in the teaching and learning of graphs in Mathematics. A comprehensive review of extant literature showed that there are multiple benefits of using computers in the study of Mathematics. This qualitative study involved the soliciting of research data from participating teachers through use of the interview schedule. 9 teachers integrating computers in teaching were purposively selected from the sampled schools owing to their possession of rich information for the treatise. Findings indicated that learners and teachers enjoy using computers in the teaching and learning of Mathematics. The study recommends that the Ministries of Higher Education and Basic Education collaborate to ensure computers are integrated in all possible subjects, to particularly benefit Mathematics as a subject and that teaching Mathematics using computers be an established culture from early grades.*

KEYWORDS: Computer, Hyperbolic Graph, Mathematics, Technology

INTRODUCTION

Background

Educational focus, the world over appears to have long paid much attention to learner progress and achievement in Mathematics related fields. In spite of this, the subject has continued to permeate the thinking of all those concerned with the learning paths of graduates from schools. The Centre for Development and Enterprise (CDE) (2004) confirms that learners find Mathematics, as a subject, difficult to learn. One possible reason for the difficulty may be the use of outdated methods in classrooms. According to Tarmizi, Ayub, Bakar and Yunus (2010), teachers teach Mathematics through the traditional paper and pencil approach. The paper and pencil approach is the manual procedure used to plot graphs in Mathematics (Waits, 1997), and this poses difficulties to learners. The pressure to find a solution to this problem grows by each day as Mathematics has become a crucial subject for admission in certain degree programmes in tertiary institutions. The use of computers evidently has turned out to be the most chased after strategy in the teaching and learning of Mathematics in secondary schools with the aim of raising learner achievement.

It is noted with concern that the way learners go about plotting the hyperbolic graphs tends to be laborious and time-consuming. Learners perform repeated algorithmic computations and determine the points and then plot the graph. Gebrekal (2006) and Mogari, Kriek, Stols & Ogbonnaya, 2009) contend that the construction of graphs using paper and pencil has not only hindered learners' progress in understanding graphs, but also fostered in them negative attitudes towards Mathematics in general and graphs in particular. This method has proved to be ineffective as learners do not perform well in graphs. Lin (2008) points out that pre-service teachers generally express the desire to integrate the use of computers in their classroom

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instruction as a way of boosting learner performance. The teaching of Mathematics using textbooks has often created a dull classroom. Involving learners in hands-on activities, where they use computers as resources, leads to learners understanding the taught content. Raines and Clarke (2011) support the use of computers over traditional methods of teaching Mathematics when they insist that learners are generally attracted to computers. They further point out that learners are eager to participate in classroom activities in computer-intensive classes.

According to Dunham and Dick (1994), graphing technologies have the potential to affect the teaching and learning of Mathematics, particularly in the area of graphs. Many authors recommend the use of technology at all levels of Mathematics instruction (Yushau, Mji & Wessels 2003; Johannesen, 2007; Goos & Bennison, 2007; Naatanen, 2007). Researchers the world over have been striving to establish better methods of teaching and learning of Mathematics by integrating new technological methods (NCTM, 2000; Berger, 2010; Liu, 2010).

Moila (2006) argues that the use of Mathematics software promotes learners' higher order thinking skills, helps learners to apply mathematical ideas to problem situations, develops learners' computation and communication skills, introduces learners to the collection and analysis of data, facilitates learners algebraic and geometric thinking and presents the role of Mathematics in an interdisciplinary setting. Integrated Mathematics packages allow learners the opportunity to explore problem-based learning. Effective use of computers can ultimately improve the learning and achievement in Mathematics (Raines & Clarke, 2011; Alper & Gulbahar, 2009; Isikal and Askar (2005). This owes to the fact that learners are attracted to computers, which further stimulates them to participate actively in the subject (Ng & Gunstone, 2002; Rowlett, 2013). Computers increase accuracy and speed in data collection and graphing, real-time visualisation, computation and analyses of large volumes of data, learner collaboration and more varied presentations of results (Suharwoto, 2006; National Council of Teachers of Mathematics (NCTM), 2003). Problems in Mathematics which are difficult can be solved by pressing a few keystrokes using a computer. According to Thomas, Bosley, Santos, Gray, Hong and Loh (2006), computers are used for both investigations and skill development.

Raines and Clarke (2011) further argue that teachers need to be provided with opportunities to become knowledgeable with computers and various softwares for teaching Mathematics, in order to dispel their doubts regarding the use of these technologies. Teachers need to ensure proper use of computers in order to optimise their potential benefits. They have often complained about the amount of time they spend on lesson preparations. According to Yushau, Mji and Wessels (2003), this challenge can be addressed through effective use of computers which can be utilised to organise Mathematics instruction, thereby, making teachers spend less time preparing presentable material for their classes. Agyei and Voogt (2012), argue that there is a need to develop technological pedagogical content knowledge for pre-service teachers so that these can be able to integrate Mathematics and technology in practice. Kim, Lee, Spector and De Meester (2013) indicate that in education, teachers are concerned with how to integrate computers into instruction to improve the quality of Mathematics instruction and also enhance learners' performance. The role of teachers ideally shifts into that of facilitators instead of being the source of all knowledge. The learners assume the lead in the construction of knowledge while the teachers manage the learning discourse.

Cuban (2002) argues that in some schools teachers do not use computers because of unconducive conditions. The unchanging school structures, obsession to finish the prescribed syllabus on time through reliance on teacher-centred instructional approaches constitute some

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of the conditions. At times teachers are not given sufficient and suitable training on how to use computers in the teaching and learning of Mathematics (Smith-Gratto and Fischer, 1999). This is considered as the main problem in using computers in teaching and learning in schools. Moila (2006) further cite the issue of inadequate teacher development programmes focusing on the use of computers in teaching and learning as an additional variable in curtailing computer use in instruction.

Great emphasis has been put on learners' thinking, active learning, discovery learning and interest in Mathematics (Andrew, 1995; Ahuja, Lim-Teo & Lee, 1998; Choike, 2000). This has shifted focus in the teaching of Mathematics from teacher-centred traditional classrooms to learner-centred contexts which are considered more effective (Ahuja and Jahangiri, 2003). According to Raines and Clark (2011), when learners are actively involved in the learning process, there is an increase in learning and persistence, higher grades and more thorough questioning.

Studies have investigated the use of computers in the teaching and learning of mathematics (Berger, 2010; Inan & Lowther, 2010; Liu, 2010). Berger (2010) focused on the use of a computer algebra system (CAS) to solve Mathematics tasks. Liu (2010) used a simulation-based computer-assisted learning (CAL) to correct misconceptions about the concept of correlation in statistics while Inan and Lowther (2010) examined factors affecting the integration of laptops into classroom instruction. Goos and Bennison (2007) and Alper and Gulbahar (2009) interrogated the effects of computer use on learners' achievement in Mathematics and their understanding of mathematical concepts. Jeffries (1989) noted that numerous meta-analyses in the use of computer-aided learning (CAL) of Mathematics have resulted in learners demonstrating a more favourable attitude towards learning with computers than with direct instruction.

The use of computers in the teaching and learning of Mathematics is also faced with some challenges. Bradley, Notar, Herring and Eady (2008) found that when teaching a computer-intensive class there are learners who may become proficient in the use of computers and mathematical software, without grasping the main concepts of focus in the lesson. The learners who encounter difficulties in using computers may also be disadvantaged in the learning of Mathematics effectively (Bradley, *et al*. 2008).

Statement of the problem

According to Mufflin (2000), the hyperbolic graph is composed of two curves that exhibit symmetry on the system of axes. When using paper and pencil to plot such a graph on the system of axis, learners have to, among others things, determine the asymptotes and ensure that the graph approaches the asymptotes without touching them. A great deal of circumspection is required of the learners to do this.

The National Curriculum Statement (NCS) (2003) also states that after learners have drawn hyperbola graphs, they should generalise the effects of the parameters on the drawn graphs. Judging from what normally happens when learners plot the hyperbolic graph, it would seem that traditional paper and pencil method which learners use to plot the hyperbolic graph is tedious, takes longer and affords learners little time to check the effects of the parameters. A report from the Centre for Development and Enterprise (CDE, 2004); also note the existence of high performing schools, which produce many quality Mathematics learners. It is against this background, therefore, that the study explored the perceptions of teachers on the use of

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computers in the teaching and learning of Mathematical hyperbolic graphs at Grade 10 to 12 in Vhembe District.

Purpose of the study

The purpose of the study was to explore the perceptions of teachers on the use of computers in the teaching and learning of Mathematical hyperbolic graphs in Grades 10 to 12, with a view to improve the achievement of learners. The study sought to address the following questions:

- What views do learners and teachers have in the use of computers to learn and teach Mathematics?
- How are computers used in the teaching and learning of hyperbolic graphs?
- What are the advantages and disadvantages of using computers to teach and learn hyperbolic graphs?

RESEARCH METHODOLOGY

The study adopted a case study design of the qualitative approach as the interest was on determining how computers were used in the teaching and learning of hyperbolic graphs using the Autograph and Heymath software. Litchman (2006) states that a case study is often recognized as one vital approach to qualitative research. The entity used could be a small as one individual or as large as an entire school or community. Rule and John(2011) concur observing that a case might be a person, classroom, programme, process, an institution or even a country. This strategy allows for the collection of data that can be presented through themes and statistical analysis (Creswell,2005).The case study design is intended to afford the researcher to study of contemporary phenomena within its real life context and to use multiple sources of evidence (Yin,1984).Case studies also offer richness and depth of information not usually offered by other methods (Warnock,2003; Thomas and Nelson, 2001. In this study, the population consisted of Grade 10 to 12 teachers in the Vhembe District in Limpopo Province.

Nine schools constituted the population of focus while participants were chosen out of personal judgement of their worth for the study (Maree,2007). An interview schedule was used to collect data from teachers. Interviews offered an opportunity to understand the lived worlds of the participants (Punch, 2009). The discursive (narrative) method was employed to analyse and interpret the sourced data. The Miles and Huberman framework (1994) with its three components of data reduction, data display and conclusions informed the analysis technique.

Findings of the study

These are the findings pertaining to an analysis and interpretation of teachers of Mathematics' responses to research questions.

How teachers teach graphs in Mathematics

The responses of teachers to this question reflected that teachers integrate many methods in teaching graphs. Teachers pointed out that they use the table method, graph paper and pencil, the Heymath and Autograph programmes. Literature supports the use of computers in mathematics classroom. This is confirmed by Bagui (1998) who indicates that computers play an increasing role in assisting teachers in the classroom. The responses to this question is an evidence that the integration of methods in the teaching and learning of graphs. Mc-Donald

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and Trutman (2005) of the opinion that teachers grapple with how to integrate computers into Mathematics instruction to improve its quality and the enhancement of learner performance. Two participants indicated their views as follows:

> *T1: I use the table method, I give learners x values and they compute the values of y. At times I even make use of graph paper or even plain paper to sketch the graph.*
>
> *T2: Point plotting manually using graph papers and pencil. Also I make use of the Heymath and the Autograph programme.*

The above responses indicate that teachers expose learners to a variety of methods in the computation of hyperbolic graphs in Mathematics. This further reveals that at times teachers resort to using ineffective traditional methods which are prone to errors, uninspiring learners and consequentially limiting their achievement potential. Gebrekal (2006) contends that the construction of graphs using paper and pencil has not only hindered learners' progress in understanding graphs, but also fostered in them negative attitudes towards Mathematics in general and graphs in particular.

Experiences of teaching hyperbolic graphs using paper and pencil

The responses of the teachers to this question indicated that the use of the paper and pencil method in Mathematics has constricted usefulness. This method sufficed in traditional classrooms but has ceased to be the choice in modern settings due to its short comings. It was reported that the process takes long to complete the drawing of graphs which at times will be lacking in clarity and accuracy. The final shapes of plotted graphs rest on the accuracy of individual learners and their ability to work out the Cartesian. Two participants revealed that:

> *T7: The shape of the graph is not clear; it depends on how accurate you are. Shapes are not clear if the Cartesian plane is not properly done and the learners miss it. It is another point where learners confuse the effects of a negative sign and when they plot some points get lost.*
>
> *T6: It takes time to make the table. Mostly when learners make mistakes in computing, it is difficult for them to trace their mistakes after drawing the graph. There is lack of accuracy in sketches, that is, smoothness of curves.*

The responses further showed that the method is prone to computation errors, with learners also experiencing difficulties in tracing mistakes that they make in the process. In some instances the learners confuse the effects of a negative sign. In view of these setbacks, (Mogari, Kriek, Stols & Ogbonnaya, 2009) observe that the negative attitude of learners towards Mathematics may be a consequence of the way in which it is taught.

Importance of computers in teaching hyperbolic graphs

Teachers indicated that computers are essential in the teaching of hyperbolic graphs as they speed up the process, thereby saving on time. They pointed out that computers are amusing and tend to motivate learners to enhance their performance and achievement profile. It was pointed out that the mere act of entering an equation would result in the graph coming out fast. According to Yushau, Mji and Wessels (2003), working with appropriate computer software can result in one gaining a large amount of graphing experience in a relatively short space of time. Participants in the study expressed that:

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T5: One thing for sure, it is amusing and learners gain more experience. You need just to enter an equation and the graph comes out very fast.

T9: It is time-saving. Learners can work individually .Heymath is motivating and can be followed since there is audio.

The sentiments raised by participants that using computers to teach hyperbolic graphs motivates learners, saves on time and motivates individual practice relates to the conclusion of research studies that they need to be embraced in classrooms(Goos & Bennison, 2007; Naatanen, 2007 Berger, 2010).

Experiences of teachers in teaching hyperbolic graphs using computers (Autograph or Heymath software)

Teachers' revealed that their work was normally covered quicker in teaching Mathematics with the aid of computers in a computer laboratory. Computers instilled interest and joy which enabled learners increased and focused engagement in the lesson content. Teachers further indicated that their usual burden of meticulous structuring of content and instruction was lightened with their role shifting to that of guiding and monitoring of student learning. The task was to specify the types of graphs learners were to focus on and then the computer would give them the desired graph at the press of buttons. Teachers also alluded to the fact that computers are accurate tools for drawing graphs. Yushau, Mji and Wessels (2003) concur with the view, stating that computers, especially in the area of graphs, can be an accurate tool of drawing the graphs.

T2: From experiences, I would say we are blessed to have computers as they have taken over the burden of structuring the lesson content. They enable us to cover specific work plans. Our task is just to make learners distinguish between hyperbola, parabola and trigonometric graphs.

T4: Learners enjoy using the computers. There are no mistakes and learners get accurate graphs faster.

These responses precisely indicated that computers enable teachers to be faster and to cover a lot of work in a short space of time. Computers also evoke excitement in learners and ease the role of teachers in the structuring of lesson content. Yushau, Mji and Wessels (2003) also argue that computers can be utilised to organise Mathematics instruction.

Advantages of using computers to teach graphs

The teachers indicated that computers are very fast and limit the amount of time needed to teach graphs. It also emerged that computers are able to show different types of graphs in a short space of time to enable learners to glean through prior to focusing on those for study in a particular lesson. Computers attract learner attention, are swift and precise. One participant said that:

T8: Computers are very fast and make the learning even of abstract things simple and interesting such that learners concentrate more. There are no mistakes in graphing, learners are actively involved in learning and they possess audio and visual impact.

The excerpt buttresses the view that there is an increase in learning and persistence, higher grades and more thorough questioning when learners are actively involved in the learning

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process (Raines and Clark, 2011). According to Tarmizi, Ayub, Bakar and Yunus (2010), computers can enhance understanding of abstract mathematical concepts. This occurs when interest to learn is activated in learners through the use of computers so that they are enabled to engage their innate potentials to construct desired knowledge.

Disadvantages of using computers when teaching graphs

Teachers pointed out that the overdependence on computers by learners could be detrimental. The use of computers with related online services may lead to internet abuse which, in most instances distracts the attention of learners towards educational attainment. The teachers noted that not all the steps are shown when one is using a computer in graphing and that learners tend to be lazy, sitting back and expecting the computer to do all the work for them. The advice is that the knowledge and skills required in the teaching and learning of graphs should be mastered for use by individuals instead of purely relying on programmes installed on the computer. This is also supported in literature by Thomas, Bosley, Delos Santos, Gray, Hong & Loh (2006) who indicate that teaching concepts without sacrificing skills is an important way of using computers. Participants responded on this aspect pointing out that:

> *T3: Not all the steps are done or shown resulting in learners missing the basic principles needed on how to plot points.*
>
> *T6: Promotes laziness as learners do not really get to understand how the graph came about. Learners also abuse the internet facility if not closely monitored during the lesson.*

The responses above indicated that learners using computers can be lazy to draw graphs on their own, fail to master basics of graphic computation and prone to internet abuse. According to Person (2011), learners using technology have less of understanding of concepts compared to those using paper and pencil. Gomati (1991) add that learners who do not use graphic technology understand graphical transformations and curve sketching better than those exposed to the use of graphic technology.

Challenges teachers face in using computers to teach Mathematics

Teachers' responses suggested that learners need to be empowered with computer skills before teachers can make use of computers in teaching. Teachers further indicated that they also needed training on computer usage as it is a challenging area. They recommended that the department of education should train them on the programmes they give to schools, in order for them to implement them effectively in the teaching and learning of Mathematics. Some teachers mentioned electricity cuts as another challenge in using computers in the teaching of Mathematics. The shortage of computers for use in schools was further cited as a challenge.

> *T1: Electricity can interfere with the lesson when it goes. Learners need to be empowered with computer Literacy, so they need to have such lessons before they come to the lab. Teachers need to be trained on computer usage as this is an area of concern.*
>
> *T6: Some classes are too big, and with the limited amount of time, not all learners may get the chance to use the few computers. The Heymath programme provides limited examples.*

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The responses to question 7 indicate the need to train teachers to use various programmes in the teaching graphs in Mathematics. This is supported by Smith-Gratto and Fischer (1999) who indicate that lack of appropriate teacher-training is often considered as the main problem in implementing computers in classroom instruction.

DISCUSSION

This study showed that teachers strongly support the use of computers in the learning of Mathematics. There is conviction that using computers in the teaching and learning of Mathematics can assist teachers to develop a classroom situation that provides the necessary tools to stimulate learner creativity. Having access to a computer appears to be the greatest advantage a teacher can have due to its versatility as an instructional resource. The computer can organise Mathematics instruction, resulting in teachers spending less time preparing presentable materials for their classrooms. Butler (2008) observes that computers have revolutionised the way classrooms operate, making them interactive and participatory context with teachers' roles having shifted to that of being guides and facilitators of learning.

Agyei and Voogt (2012), propose for the need to develop technological pedagogical content knowledge for pre-service teachers so that these can be able to integrate Mathematics and technology in practice. Kim, Lee, Spector and De Meester (2013) further indicate that in education, teachers are concerned with how to integrate computers into classroom practice to improve the quality of Mathematics instruction and the subsequent enhancement of learners' performance. A teacher who is deficient in computer skills may not be able to plan and structure the lesson accordingly. In particular, the activities, facets and stages of a lesson cannot be properly organised and coordinated to yield a flowing and well-articulated lesson. This relates to the views of teachers that the use of computers has heightened the effects of visual, audio, hands-on and integrative element in the learning of Mathematics.

Computers facilitate and encourage learners to have a positive attitude towards Mathematics in general. Raines and Clarke (2011) insists that the use of computers in modern classrooms, a feature which was absent in the traditional methods of teaching Mathematics is yielding positive gains as learners are generally attracted to computers. The interest of learners in computers stimulates them to participate actively rather than being passive receivers of knowledge in the subject (Rowlett, 2013). In a similar sense, participants in the study revealed that the use of computers brought joy and amusement in the teaching and learning of Mathematics.

The findings of the study on the effects of integrating computers in Mathematics teaching coincided with the views expressed in extant literature. Moila (2006) posits that computers enable learners to share views with their peers, encourage them to work in groups and motivate them to work independently. Learners are empowered to work on real life problems which are a subsequent and practical application of the skill of creativity. Mji and Wessels (2003) argue for the promotion of creativity in learners who use computers during instruction. Suharwoto (2006) adds that the benefits of using computers include increased accuracy and speed in data collection and graphing as well as real time visualisation. This suggests that learners working with appropriate software can work on more graphs in a short space of time (Raines and Clarke, 2011). Effective use of computers can ultimately improve the learning and achievement in Mathematics (Raines & Clarke, 2011; Alper, 2009; Isikal and Askar (2005). Tarmizi, Ayub,

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Bakar & Yunus (2010) again contend that it seems more effective to integrate mathematical content and computers in a manner that would enable learners to do playful mathematical discoveries.

According to Tarmizi, Ayub, Bakar & Yunus (2010), computers help learners to learn differently, assist those with difficulties in learning, facilitate inter-communication and inspire active participation. In a computer-oriented lesson, learners actively generate process and manipulate knowledge. The use of computers enables more learners to process knowledge, to appropriately sort out the given knowledge and to find time to analyse concepts. Ruthven, Deanery and Hennessy (2008) state that the use of graphing software to draw graphs allows learners time to check the effects of parameters on the graph. It helps with overarching issues and accentuates important features, through assisting to bring out the effects of altering particular coefficients or parameters in an equation on the properties of its graph, and through facilitating comparison of gradients and examination of limiting trends. The emerging view, therefore, is that computers can help learners by reducing laborious written work, increase immediacy of processes and avail time to evaluate classroom tasks.

Moila (2006) insists that teachers should prioritise the goals and purpose of their lessons and make the selection of appropriate computer programmes to use in the teaching of Mathematics. The focus should not be on the preference or otherwise of computers but the learning opportunities and difficulties that tend to go with the use of computers (Rowlett, 2013).This could eliminate inappropriate use of technology or their application in a less than successful manner in the classroom. The key strategy would be to provide teachers with relevant training and one which is cognisant of the latest models of computers and computer software.

While computers can be useful, they can also make learners lazy. At times computers jump some steps in the plotting of a graph, and only produce a finished product. According to Bradley, Notar, Herring and Eady (2008), teaching a computer intensive class can produce learners who are proficient in computer usage without grasping the Mathematical concepts. In addition to computers being a scarce commodity in some schools, most class sizes in practice are too large to enable effective use of computers by individual learners. Moila (2006) concludes that even though there are benefits in using computers in teaching Mathematics there is need to check how teachers and learners use computers, as well as the effect computers have in the Mathematics teaching and learning environment.

Research Implications

The paper provides a rich platform for educators to enhance their employ of computers to teach hyperbolic graphs. Teachers need to be creative and innovative in integrating computers to teach graphs in Mathematics. It is essential that learners be monitored and encouraged to make profitable use of computers in drawing hyperbolic graphs. Parents whose children study Mathematics also have to provide the means for them to access computers for plotting the desired graphs. School management teams should strive to enliven Mathematics learning by procuring computers fitted with softwares designed to plot hyperbolic graphs. Finally, Mathematics curriculum advisors should be people who are imbued with skills for structuring practical activities for teaching hyperbolic graphs through computers.

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CONCLUSION

The study concludes that the use of computers has a positive impact on learners' achievements, problem-solving skills or exploration of mathematical ideas, motivation, attitude and the classroom environment. Learners can analyse graphs quickly, represent graphs in different ways and solve real life problems using computers. Learners are encouraged to explore the nature and properties of graphs on their own, work in a group, discuss concepts, make conjectures and verify their findings using computers. Thus computers encourage learners to be active in the Mathematics classroom than they would be in an environment where the traditional paper-pencil method is used. The computers ease the work load of teachers in the preparation of teaching materials as they are a complete package resource in terms of provision of learning tools, instruction and content knowledge.

Recommendations

It is recommended that:

- Computers should continue to be used, not only in the teaching of graphs but other topics as well in Mathematics.
- School Mathematics curriculum designers and teachers should be made aware of the benefits of using computers in the teaching and learning of hyperbolic graphs in Mathematics.
- Teachers need regular training on how to use computer software which is available in their schools to make the exercise effective.
- School Management Teams and Heads of schools should make efforts to purchase computers with the necessary functions for use in the teaching of Mathematics classes.
- Computers literacy skills of learners should be facilitated prior to their enrolment into the Grade 10 to 12 band.
- Vibrant computer centres should be established at cluster levels to open access to computer service to all learners.

REFERENCES

Agyei, D.D. & Voogt, J. (2012).Developing technological pedagogical content knowledge in pre-service Mathematics teachers through collaborative design. *Australian Journal of Educational Technology*. 28(4), 547-564.

Ahuja, O.P. & Jahangiri, J.M. (2003). An integrated approach to teaching and learning college Mathematics: Research in Mathematical Education. *Journal of the Korea Society of Mathematical Education series D*.7 (1).11-24.

Ahuja, O.P.; Lim-Teo, S.K. & Lee, P.Y. (1998).Mathematics teachers' perspective of their students' learning in traditional calculus and its teaching strategies. *Journal of the Korea Society of Mathematical Education*: Research in mathematical education 2(2), 89-108.

Alper, A. & Gulbahar, Y. (2009). Trends and issues in educational technologies: A review of recent research in TOJET. *The Turkish online journal; of* educational *technology*,8 (2).

Andrew, G.E. (1995). The irrelevance of calculus reforms. Ruminations of a sage on the stage. *UME Trends* 6(6), 17-23.

ISSN 2055-0219(Print), ISSN 2055-0227(online)

Berger, M. (2010).Using CAS to solve a mathematics task: A deconstruction. *Computers & Education,* 55:320 – 332.

Butler, M. (2008).Professional Development for Teachers Using Technology. Proceeding of the 7t WSESS International Conference on Education and Educational Technology. Venice.

Centre for Development and Enterprise (CDE) (2004). From Laggard to World Class:

Choike, J.R. (2000). Teaching strategies for Algebra for all. *Mathematics Teachers* 93(7), 556-563.

Cohen, L., Manion, L & Morrison. 2007. *Research Methods in Education*. London: Rout ledge

Creswell, J. W. (2005) Educational Research, Planning, Conducting and Evaluating Quantitative and Qualitative Research. 2nd edition. Pearson Education International. New Jersey.

Cuban, L. (2001). Oversold and underused: Computers in the classroom. Cambridge, Massachusetts, USA: Harvard University Press.

Department of Education (2003).*National Curriculum Statement Grades 10-12. Mathematics.*

Dunham, P.H. & Dick, T.P. (1994).Research on graphing calculators. *The Mathematics Teacher*, 87(6): 440-445.

Gebrekal, Z.M. (2006). The Influence of the Use of Computers in the Teaching and Learning of Graphs in School Mathematics. University of South Africa, Pretoria.

Giamiti, C.M. (1991). The effect of graphing calculator use on students' understanding of variations on a family of equations and the transformations of their graphs. Dissertation Abstracts International, 52(1): 103 A.

Goos, M. & Bennison, A. 2007.*Technology-Enriched Teaching of Secondary Mathematics Factors Influencing Innovative Practice Mathematics*: Essential Research, Essential Practice, 1: 315-324.

Hannock, B. (2002). *Trend Focus for research and development in Primary health care: An Introduction to Qualitative Research*. University of Nottingham: Division of General practice.

Inan, F.A. & Lowther, D.L. (2010). Laptops in the K-12 classrooms: Exploring factors impacting instructional use. *Computers & Education* 55: 937 – 944.

Isikal, M. & Askar, P. (2005).The effect of spread sheet and dynamic geometry software on the achievement and self-efficiency of 7th grade students. *Educational Research*. 47(3), 333-350.

Jeffries, M.G. (1989). The effects of three levels of feedback on anxiety and academic performance during computer –assisted instruction. PhD thesis, University of Florida.

Johannesen, I. (2007). 10th International conference on engineering education. *Increasing the learning outcome in mathematics by use of computer programs like mathematical*. September 3-7.

Kim, C.; Lee, C.; Spector, J.M. & De Meester, K. (2013).Teacher Beliefs and Technology Integration. *Teaching and Teacher Education*, 29: 76-85.

Liu, T.C. (2010). Developing simulation-based computer assisted learning to correct students' statistical misconceptions based on cognitive conflict theory using 'correlation' as an example. Educational Technology and Society 13(2): 180 – 192.

Mehmet, E. (2002). *Integrating science and mathematics education research into teaching conference Maine* University. Application of computer aided mathematics teaching in a secondary school, 1-6.

Mogari, D., Kriek, J., Stols, G. & Ogbonnaya, U.I. (2009).Lesotho's students' achievement in the mathematics and their teaching background and professional development. *Pythagoras*, 70, 3 – 15.

ISSN 2055-0219(Print), ISSN 2055-0227(online)

Moila, M.M. (2006). The Use of Educational Technology in Mathematics Teaching and Learning: An Investigation of a South African Rural Secondary School. Faculty of Education, University of Pretoria.

Mufflin, H. (2000). The American Heritage Dictionary of the English Language. Boston Publisher, Houghton.

Naatanen, M. (2007). The mathematics education into the 21st century project: *Enriching mathematics teaching with computers*. Johor Bahru, 169-171.

National Council of Teachers of Mathematics (NCTM) (2000).*Standards and Principles in School Mathematics: An Overview*. Reston, VA: NCTM.

NCTM National Council of Teachers of Mathematics (NCTM). (2003). *The use of Technology in the Teaching of Mathematics.* Reston, VA: NCTM.

Ng, W. & Gunstone, R. (2002).Students' perceptions of the effectiveness of the world wide web as a research and teaching tool in science learning. *Research in Science Education*, 32(4), 489-510.

Punch, K. F. (2009). Introduction to Research Methods in Education. London: Sage.

Raines, J.M. & Clark, L.M. (2011). A brief overview on using technology to engage students in mathematics .*Current issues in education,* 14(2).

Reforming Mathematics and Science Education in South Africa. Report No 13, Johannesburg

Rowlett, P. (2013). Developing a Healthy Scepticism about Technology in Mathematics Education. *Journal of Humanistic Mathematics*, 3(1): 136-149.

Ruthven, K., Hennessey, S., & Deany, R. (2008). Construction of dynamic geometry: a study of the interpretative flexibility of educational software in classroom practices of teachers. *Computers and Education*, 51(1), 297-317.

Smith-Gratto, K., & Fisher, M.M. (1999). An aid to curriculum and computer integration: prototypes of teachers. *Computers in the Schools*, 15(2), 16-71.

Suharwoto, G. (2006). Secondary Mathematics Pre-service Development of Technology Pedagogical Content Knowledge in Subject-Specific. *Technology-Integrated Teacher Preparation Program.* A Dissertation submitted in partial fulfilment of Doctor of Philosophy. Oregon State University.

Suharwoto, G. (2006). Secondary Mathematics Pre-service Teachers Development of Technology Pedagogical Content Knowledge in Subject-Specific, Technology – Integrated Teacher Preparation Program. A Dissertation submitted in partial fulfilment of Doctor of Philosophy. Oregon State University.

Tarmizi, R., Ayub, A., Abu Bakar, K, & Yunus, A. (2010). Effects of Technology Enhanced Teaching on Performance and Cognitive Load in Calculus. *International Journal of Education and Information Technologies, 2*(4), 109-120.

Thomas, J. R. and Nelson, J. K. (2001).*Research methods in physical activity*.4th Ed. London: Longman

Thomas, M., Bosley, J., Delos Santos, A., Gray, R., Hong, Y.& Loh, J. (2006).Technology Use and the teaching of mathematics in the secondary classroom. *Teaching & Learning Research Initiative* tlri@nzcer.org.nz.Accessed on 21 November 2015.

Waits, B.K. (1997). The merging of calculators and computers: A look to the future of technology enhanced teaching and learning of Mathematics. Columbus, Ohio USA.

Yin, R. (1984).*Case Study Research: Design and Method (1st Ed*). Beverly Hills, CA: Sage.

Yushau, B., Mji, A. & Wessels D.C.J. (2003).*Creativity and Computer in the teaching and learning of mathematics*. Technical report series TR 311.

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