Chapter 2

Advantages and disadvantages of using computers in the mathematics classroom

2.1 Introduction

The introduction of computers into education can be both advantageous and disadvantageous for both instructors and learners. Although introduction of computers is often a positive experience. there are also problems and dangers in using computers in the classroom. Any instructor who considers the introduction of software packages into the classroom should be well aware of these. and should also be able to distinguish between valid concerns and prejudices.

2.2 Advantages of computers

2.2.1 Visualisation.

Williams [41. p1] says that. "computers offer a potential for visualising complex and abstract processes". Thus. by using computers. learners can visualise mathematical concepts through graphical representations. This may enable learners to understand concepts better. which could in turn lead to their feeling successful in learning the course material. and hence develop a positive attitude towards math-

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ematics. Walker [34. p652] is of the opinion that. "visualisation of mathematical phenomena increases the rate of assimilation. learners acquire basic knowledge more quickly and develop mathematical intuition". Successive graphs in animation style can improve understanding further. It is said that a picture is worth a thousand words. It is now easy to see what has before. in many cases, only been spoken of. The presentation of information in a pictorial form may leave learners free to put their own structure on that information. so that they can learn it in their own way.

2.2.2 Calculations and manipulations

Learners can make complex calculations quickly and accurately using computers. The burden of tedious calculations then is no longer a threat. This is especially true in processes where a computer can do impressive successive calculations in virtually no time. In situations where a lot of standard calculations have to be done before learners come to a conclusion. the use of computers can be very effective. Even if these calculations can in principle be carried out by hand. the fact that they are time-consuming and may lead to calculational errors may be demotivating. and may obscure the real aspects of the problem. Where previously. the concept often got lost because it was obscured in calculations. this no longer needs to be the case. Quoting Kelman [20. p3]. "learners can probe problems. store and retrieve information. test out solutions and calculate results". According to [45. p1]. "the power to compute rapidly. to graph relationships instantly. and to systematically change one variable and observe what happens to other related variables help learners become independent 'doers' of mathematics".

2.2.3 Patience

Instructors often work under restrictions such as large groups and a work overload. They could thus find it difficult to grant repeated explanations. There is a danger of learners taking this as a personal rejection which could in turn affect their self-confidence. On the other hand. the learners may not want another long explanation. but may want more time to explore and assimilate the new concepts.

The learners may also not want to admit that they still do not understand. In this regard. the computer has all the time and patience necessary. Computers. contrary to instructors. are available all the time and at any time the learner wishes to work. They are never tired and never 'lose their temper'. The learners may repeat the same activity many times and so improve their understanding. Engelbrecht [11] says that. "with its infinite patience the computer can assist in bringing home the use of certain techniques". It is. of course. necessary to have the right software for the circumstances.

2.2.4   Logical thinking

Bajpai [3. p83] suggests that. "one approach towards using the computer requires learners to write their own programmes". This can be a useful exercise as it encourages learners to think logically. and reinforces their understanding of the method or algorithm. One only develops an understanding of an algorithm or method when one has to write a programme for it. This forces one to take ownership of the method and to instruct the computer on how it should 'think'. It is also true that the skill of programming has become less common because of all the excellent software packages available. These packages are good for saving time. but nevertheless. the value of programming should not be underestimated.

2.2.5   Individual instruction

Engelbrecht [11] states that. "computers can handle each learner individually". This increases the rate of learning by allowing learners to proceed at their own pace. This may promote self-confidence because it gives the learners a feeling of control over what they are learning. Instructors are able to determine the weak points of the learners and pay attention to the specific weak points of the learner concerned.

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2.2.6 Enhanced problem-solving skills

According to Dubinsky [9]. "the use of computers as a thinking aid and an intellectual tool enriches learners' mathematical exploration. facilitates learners' growth of mathematical understanding. and improves their problem-solving skills and concept development". When solving problems with computers. learners may be given a chance to focus on the process of problem solving instead of focusing on the answer. Learners may be able to explore problems and not simply obtain answers. By exploring they may reveal a range of solutions rather than a single answer. Quoting Bishop [6. p243]. "access to numerical computation tools enhances learning and extends the problem-solving power of most learners".

2.2.7 Enjoyable learning

A computer is seen by many learners as a source of entertainment. This may be because there are so many computer games that attract learners. Most of the learners do indeed seem to find pleasure in using the computer. Ruthken [27. p279] maintains that. "learners demonstrating high computer motivation find that computers make learning more enjoyable. and will spend more hours at a computer to complete a task. They enjoy testing out new ideas on the computer".

2.2.8 Fear of exposure

Any verbal discussion normally requires good eye contact. a necessary social skill. between the parties involved. Ball [4. p74] is of the opinion that. "learners who do not feel confident about the topic being discussed could feel exposed and so could feel threatened by too much eye contact". Since the screen presents images around which the discussion is centred. the problem of eye contact between the instructor and the learner no longer exists. Learners can approach the topic without fear of exposure.

2.2.9 Improved understanding of geometry and trigonometry

Geometry is traditionally a difficult topic to master. The use of appropriate software packages could aid in the process of understanding. Ball [4. p26] says that. "excellent software packages are available to help learners master geometry and trigonometry by moving and changing angles. recognising and combining shapes to appreciate properties". Such packages offer the opportunity for experimenting which makes the subject more alive. This is of course also true for many other topics in mathematics.

2.2.10 Immediate feedback

When working problems using pen and paper. learners may make repeated mistakes before discovering that they have problems. Learners may get immediate feedback when using a computer and mistakes may be immediately brought to their attention. This may keep learners from wasting a lot of time by avoiding repetition of the same mistake.

2.2.11 Remediation

Engelbrecht [11] states that. "the computer can do a thorough. objective diagnosis and remedial teaching of specific learning problems in a scientifically dependable manner". The computer can do so by letting learners repeat the same activity several times. at the learner's own pace and in his/her own time.

2.2.12 Utilisation of instructor time

Engelbrecht [11] is of the opinion that. "the computer relieves the instructor of the burden of correcting numerous work problems. and gives him/her chance to respond to learners immediately". This gives the instructor the opportunity to utilise his/her time more effectively by attending personally to learner problems. This also frees the instuctor to do the important work of human interaction.

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2.3   Problems, dangers and disadvantages of computers

2.3.1   Cost

According to Klooster [22. p1]. "education budgets consist mainly of salaries. building and administration costs. with little expenditure being made on equipment". It is true. therefore. that schools may not have sufficient funding to set up an effective computer lab. It is also true that the issue of cost can be used as an excuse for not embarking on computer-assisted instruction. This excuse could hide a dislike of technology or inexperience. There may be a way out on the issue of cost. Schools may embark on fund-raising. If members of the community are aware of the importance of computers. they may be willing to assist.

2.3.2   Threat to novices

Williams [41. p2] is of the opinion that. "computers may be threatening to novices". Instructors who are exposed to computers for the first time may feel threatened if they find themselves in a situation in which they have to use computers in their classrooms. They know that they may make mistakes at any time and may not like such an embarrassment. Because of this. they may decide to abstain from using computers.

2.3.3   Lack of free dialogue

When learners are working on the computer. there may be a lack of human interface. and hence no free dialogue between the learners themselves. Walker [39. p487] maintains that. "there is no free dialogue between the learner and the computer". The computer is unable to answer questions from the learner who asks for explanations on difficult points. In this case. the presence of the instructor is necessary in order to clear up any misunderstanding between the learner and the computer as well as to overcome difficulties in understanding concepts.

2.3.4   Dependence

Learners may become dependent on computers. They may see the software package as an end in itself rather than as tool to be used to further their understanding of the topic. They may not want to do any task in the absence of the computer. Burns [8. p1] is of the opinion that. "computers may also eliminate basic skills such as spelling. simple arithmetic. and grammar".

2.3.5   Lack of documentation

There is a large number of computer software packages available on the market. According to Williams [41. p2]. "it is time-consuming for instructors to discover what is available and to have to choose packages that they feel are worth using". It may be possible that software packages selected by instructors do not have clear operating instructions for use in the classroom and do not run on available computers. To minimise this problem. instructors should consult the relevant people with information on how to operate a particular software package. Instructors can. for example. consult software companies or other instructors. It may be useful for instructors in a particular area to exchange information about packages they have used.

2.3.6   Substitutes for books and instructors

Computer packages should not be seen as substitutes for books. Williams [41. p2] maintains that. "if learners are required to read and analyse substantial texts. they should be given a book". Many learners may not prefer spending hours reading text on the computer screen. When the computer is used in the teaching process. one must always remember that the computer is a piece of equipment. an aid. and that the role the computer plays in the learning process is always of secondary importance to the real aim of learning. Quoting Engelbrecht [11]. "the task to familiarise the learner for the first time with concepts still remains the instructor's privilege and duty. and must under no circumstances be substituted by a computer system".

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2.3.7 Distraction

Walker [36. p425] argues that. "if the computer comes in action too early. it may distract learners' attention from the mathematics and it may result in an attitude of pushing the button to get the answer". So. instructors should integrate software packages in the right way at the right time. When novice software developers design software packages. they may use multiple media elements simultaneously in the belief that more variety leads to better learning. The danger here is that some elements may act as distractors. For example. if learners are presented with concurrent text. audio and video elements. they may not know which media element to pay attention to. Some learners may concentrate on video and some on audio. which may distract their attention from the aim of the software package.

2.3.8 Impersonal

Computers are impersonal. Burns [8. p1] maintains that. "there is a lack of physical interaction between the learner and the computer". Learners may get frustrated when working with the computer if the need arises to discuss a specific point with another learner. Learners may feel alienated because computers cannot meet their emotional needs and cannot motivate them to love learning.

2.3.9 Inexperienced instructors use it wrongly

When instructors have to use computer software packages for teaching. they need to gain experience similar to what they need when using any other aid. If they are inexperienced. they may not know when to integrate a particular software package in the classroom. They may. for example. rely on software packages for passing all the information they need on to their learners. which is typical of the wrong usage of computers in the classroom. Computer software packages need an experienced instructor for them to be used effectively.