

Challenge of effective technology integration into teaching and learning



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Abstract

South African teachers are faced with challenges in integrating technology effectively into a coherent framework at school level. There seems to be little evidence of technology integration into classroom activities such as systematic planning and implementation of lessons that require learners to think critically, work collaboratively, and use technology in support of learning. A study was undertaken to investigate the challenges faced by senior secondary school teachers and learners in integrating technology effectively into teaching and learning activities. In-depth and group interviews were conducted with curriculum specialists, teachers and learners. Observations and document review were also used to collect qualitative data. Qualitative data analysis strategies were used to analyse data. The findings revealed unavailable technology policy, insufficient technology equipment, a lack of teachers qualified in technology integration, and maintenance and technical problems as the major challenges affecting the effective integration of technology at school level. Integrating technology effectively requires planning, sufficient time, dedication and enough resources.

Keywords: information and communication technologies, technology, technology integration, teaching, learning

Introduction

Integration of information and communication technologies (ICTs) into teaching and learning has risen on the South African education agenda, particularly

with the release of the White Paper on e-Education in 2003 (Wilson-Strydom, Thomson and Hodgkinson-Williams, 2005:72). According to Wilson-Strydom et al. (2005), the adoption and integration of technologies is a challenging and complex process for schools, particularly where there is limited previous experience in the use of ICTs to support teaching and learning. They further maintain that at many schools that have access to ICTs, the focus has tended to be on learning about ICTs rather than learning with or through the use of ICTs.

South African education is in a state of change. In the normal classroom, where the role of the teacher is that of a dispenser of knowledge, technologies are used mainly for word processing and drill and practice exercises. This notion made the education authorities aware of the importance of technology. The subsequent White Paper on e-Education (2003) states that, every South African learner in the General Education and Training and the Further Education and Training bands will be ICT-capable by 2013. This has raised a concern for South African schools in view of the fact that technology is a relatively new approach currently being included in the school curriculum (Tanui, Kibbos, Walaba and Nassiuma, 2008).

South African teachers are therefore faced with various challenges in integrating technology into a coherent framework at school level. There seems to be little evidence of technology integration into classroom activities such as systematic planning and implementation of lessons that require learners to think critically, work collaboratively, and use technology in support of learning. The reasons why teachers are not integrating technology into their teaching activities are not well known. It has therefore become important to address the question: what are the challenges faced by senior secondary school teachers and learners in integrating technology effectively into teaching and learning?

This article reports on research conducted to investigate the challenges faced by both senior secondary school teachers and learners in integrating technology into teaching and learning. It is important to identify such challenges affecting the integration of technology into teaching and learning in order to find a plan that will assist teachers in integrating technology effectively into their teaching activities. In this article a literature review relating to technology integration is presented. The qualitative approach used in the research is described and finally, the findings and conclusion regarding the barriers to technology integration are put forward.

Literature review

It was deemed necessary to explore what is meant by technology integration within the context of teaching and learning in senior secondary schools. Redmann and Kotrlik (2004:2) define technology integration as ‘employing the Internet, computers, CD-ROMs, interactive media, satellites, teleconferencing, and other technological means in instruction to support, enhance, inspire and create learning’. Shelly, Cashman, Gunter and Gunter (2008:327) define technology integration as the combination of all technology parts, such as hardware and software, together with each subject-related area of the curriculum to enhance learning. For the National Centre for Education Statistics (2003), technology integration is the incorporation of technology resources and technology practices into the daily routine, work, and management of schools. According to Woodbridge (2004), technology integration means viewing technology as an instructional tool for delivering subject matter in the curriculum already in place. Drawn from the above-mentioned definitions and for the purpose of this study, technology integration is described as bringing together or combining technology with teaching and learning strategies in order to meet the curriculum standards and learning outcomes of each lesson, unit, or activity.

Several authors (Benson et al, 2001; Butzin, 2001; Osin, 1998; Rice, Wilson and Bagley, 2001; Russell, Finger and Russell, 2000; Yee, 2000) have mentioned reasons for using technology in the classroom. According to these authors, computers were introduced into the school systems of developing countries in response to parents’ demands that learners become computer literate. Reasons put forward by leaders and parents for the integration of technology into education are discussed below.

According to Yee (2000:291), learners are prepared for full participation in future society by acquiring computer literacy skills that include learning of common business tools, such as word processing, spreadsheets and databases. Computers are required for instructional support. They can manage data, reinforce instruction in a random learning environment, promote multimedia concept learning that addresses multiple learning modes, and deliver on demanding learning programs over multiple types of e-systems (Benson et al., 2001:121).

Educational systems are resistant to change, and a transformation that purports to accelerate the solution of the problems requires the support of educational technology (Osin, 1998:2). Technology can therefore be more effective when used in a transformed learning environment than when used in a traditional

learning environment (Butzin, 2001:372). This will help teachers to enjoy using technology and to improve their skills in teaching (Russell et al., 2000:158). In support of this view, Rice et al. (2001:211) state that the use of computers helps to bring changes in classroom practice in order to improve subject matter teaching.

These potential advantages led developing countries to adopt technology to enhance teaching and learning in the classroom. South Africa, together with other African countries, has followed the footsteps of the developed countries and introduced technology into its education system. Literature shows that South Africa has transformed its education curriculum based on social needs as part of a globalised world. It is driven and shaped by technology which brought with it the need for new knowledge, skills and values (Gauteng Department of Education, 2005:3). Every day, computers help many individuals accomplish job-related tasks more efficiently and effectively. For teachers, computers and other technologies serve as the tools needed to implement new and evolving teaching strategies. Teacher involvement with technology is a trend that has shifted from learning how to use technologies to seeking ways to support learning with technologies. Teachers therefore, need to guide their learners towards engaging in activities of technology.

Technology integration depends on the understanding and the commitment of teachers. What they find may challenge their educational philosophy and practice in expected ways – some good and some not so (Olson, 2000:1). Tondeur, Van Braak and Valcke (2007:13) highlight the need for South African schools to develop a school-based ICT curriculum that will translate the national ICT-related curriculum into an ICT policy. This ICT plan will make ICT competencies visible for all parties involved, and stimulate the dialogue among school managers, teachers and parents about ICT use in the local curriculum.

Theoretical framework

In the world of education new movements, frameworks and theories to explain how learning occurs or how it should be conducted, are emerging. The changes that are taking place in today's teaching and learning are being brought about by a wide range of tools, and by the Internet itself that has created a new paradigm in the delivery of learning (Papert, 1998:141). The study on which this article is based was informed by the constructivist theory. Constructivists believe that knowledge and truth are constructed by people themselves and do not exist outside the human mind (Duffy and Jonassen, 1991:9). This is in opposition to behaviourist beliefs that learners should be told about the

world and are expected to replicate its content and structure in their thinking (Jonassen, 1996:6).

Jonassen (1996) describes four principles of constructivist learning: the principle of knowledge construction; the principle of active learning; the principle of social interaction and cooperative learning; and the principle of situated learning. According to the principle of knowledge construction, knowledge is not simply transmitted to learners, but constructed by learners themselves using their own interactions and experiences with those phenomena in meaningful learning environments. Teaching is not seen as a process of transmitting, imparting or mapping the teacher's knowledge onto the learner, but as helping learners to construct their own knowledge and to reflect on it by guiding them in the meaning-making process. Knowledge building also includes opportunities for learners to articulate, express and represent what they have learned in a verbal, written, visual or auditory format (Jonassen, 1996:3–5).

The principle of active learning states that knowledge construction results from the activity. Constructivists believe that knowledge of phenomena cannot be separated from experiences and interactions with those phenomena. The implication is that the meaning constructed of phenomena emerges from the interactions with them (Jonassen, 1996:3).

Social interaction among individuals plays an integral part in how people learn. From a constructivist perspective, learner-learner and learner-teacher interactions are important ingredients of learning. Peer interaction is a source of experience that evokes cognitive conflict (disequilibrium) in children, and human beings all have a tendency to reduce this conflict and re-establish equilibrium at a higher level (Piaget, 1970). Humans are social creatures who rely on interactions with fellow humans to determine their own identity and the viability of their personal beliefs (Jonassen, 1996:5).

According to the principle of situated learning, part of the meaning of a phenomenon is embedded in its context. Learning and cognition of phenomena should be situated in the social and physical context from which the phenomena originate. The knowledge of phenomena that learners construct and the associated skills they develop include information about the context in which they experience those phenomena. The more directly and interactively learners experience phenomena in a meaningful context, the more meaning they are likely to construct. The implication is that teaching and learning a new concept should always take place in its real-life context, the context in which the concept is embedded and from which it originates (Jonassen, 1996:3–4).

The integration of technology in the classroom practice is a new way of transforming pedagogy. Shifts in pedagogy include a move to problem-based or investigative learning, which not only requires learners to assume increasing responsibility in the learning process, but also requires teachers to surrender the type of control over the learning process that they have in conventional pedagogy. Learning is not simply an event that happens naturally; it is also an event that happens under certain observable conditions.

Research design, sampling and data collection methods

The research was focused within the interpretive paradigm and aimed at describing the challenges faced by teachers and learners involved in teaching and learning with technology (Greenhalgh and Taylor, 1990:740). A qualitative approach was followed in this research to explore areas about which little is known and to gain information about phenomena such as attitudes and thought processes, that are difficult to extract through more conventional research methods (Strauss and Corbin, 1998:11). The research was done in the form of a case study of senior secondary schools in Gauteng. A case study helps the researcher to learn more about little known and poorly understood situations (Leedy and Ormrod, 2005:135).

The research techniques used were interviews, focus group discussions, observations and document review (McMillan and Schumacher, 2001:428). Semi-structured instruments were designed and used to generate data from curriculum specialists, principals, deputy principals and technology teachers of three core research sites (Bell, 1993:33), and the researcher conducted focus group interviews with learners (De Vos, Strydom, Fouché and Delpont, 2002:306). These interviews were complemented by lesson observations and document reviews. The documents that were reviewed include the technology lessons, textbooks, learners' activities and records of learners' progress. Observations were negotiated with individual teachers and conducted once per subject lesson during normal teaching hours.

Sampling was purposive and involved two senior secondary (one public and one private) schools situated in the northern part of Tshwane District, Gauteng, South Africa. The schools were selected for this study to provide an in-depth picture of technology integration in teaching and learning (Drever, 1995:7). Three teachers from each school were selected to participate in the semi-structured interviews, and 16 learners participated in the two focus group discussions. These participants were purposively selected to participate in the study based on their experience relating to the use of technology for teaching

and learning (Cohen, Manion and Morrison, 2005:103; Maree, 2007:257). The focus was on a number of people who work together but have different roles, and the aim was to understand them as a group, with their different but interdependent functions and ways of thinking (Drever, 1995:7).

Data was manually processed and rigorously and systematically analysed based on empirical evidence gathered through interviews, observations and document review. After leaving the research sites, the researcher continued to make contact with the study participants using e-mail and the telephone to clarify issues that arose. Thus, data analysis was a recursive process that occurred across all phases of the investigation rather than a distinct final stage of research. Qualitative coding that generally adhered to the process suggested by Neuman (1998) was used. Following these strategies, data were examined, sorted, categorised, evaluated, compared, synthesised, and presented to different points (Neuman, 1998:240). These strategies allowed the examination of patterns of relationships and the creation of new concepts and theory by blending together empirical evidence and abstract concepts in order to come to terms with their diversity for the interpretation of data.

To ensure trustworthiness, research protocols such as credibility, dependability and confirmability were followed. Ethical consideration was foremost in the selection of participants. The selection of participants was informed by consent from the respondents, emphasising the voluntary nature of participation, addressing concerns regarding privacy, anonymity, confidentiality, and offering feedback to participants. The sampling method ensured that the results would be applicable to the specific population of senior secondary school teachers and learners. The supporting literature that was studied, the information that was obtained by means of in-depth interviews, and the observations and document study helped to ensure relevancy and clarity. The research design and methodology were aimed at making the study replicable and therefore ensured trustworthiness. Bias was avoided by means of a well-planned sampling strategy and the study of relevant recent literature to guide the design of the interviews, observations and the document analysis schedules.

Findings and discussion of the empirical data

Patton (1990:172) suggests that in using the case format for reporting qualitative research, 'important shared patterns that cut across cases derive their significance from having emerged out of heterogeneity'. The participant groups in this study were heterogeneous. Both males and females participated in the interviews. All the participants in the semi-structured interviews had

more than three years' experience in teaching and had used technology for certain reasons. Their schools, varying in size from 987 to 1,110 learners, were located in a township and in the suburb of the geographical area. The schools were also in different stages in the process of technology integration.

The objective of the study was to explore the challenges faced by teachers and learners when integrating technology into teaching and learning. The findings revealed major challenges such as unavailability of policy on technology, technophobia, insufficient resources, a lack of qualified technology teachers, maintenance and technical problems, risks and security problems, poor parental involvement, insufficient time, and computer jargon. These challenges are discussed below.

Unavailability of policy on technology

The findings from both the interviews and the document reviews showed that there was no common policy on technology integration into teaching and learning, and there were no well-structured procedures to be followed to guide schools on the implementation process. Therefore, it appears that schools do not know what is permissible and implementable. This raises a concern as e-Learning is a new concept which was introduced in 2003. Participants indicated that the only policies available were the e-Education White Paper (2003) and the White Paper 7 (2004). This was also evident from the observations and the document review. From the list of documents reviewed, there was no indication of a policy on technology designed by either the national or the provincial education departments. The only policy available – and the one that was used frequently by teachers – was the White Paper on e-Education. Based on this challenge, it seems that schools have to devise their own policy according to the guidelines of the White Paper. An ICT policy seems to be an important incentive to foster the integration of ICT use in the classroom, but only when teachers are aware of its content. In other words, successful ICT integration becomes much more likely when teachers share the values expressed within the school policy and understand their implications (Tondeur, Van Keer, Van Braak and Valcke, 2007:975).

Technophobia

It was found that teachers who were deemed qualified had a problem with using technology. Some were afraid of using technology and claimed that they were too old to master the new technology and to apply it in their teaching. This raises the concern of technophobia. One of the participants explained:

There are people who have a phobia of using computers. This type of educators would only touch a computer whenever there is a demand of some kind, for example, if submission of marks is required. Educators also get trained and at the end they do not implement.

This finding was supported by what was observed during the lessons. In all the lessons observed, all the teachers who tried to integrate technology were more or less middle-aged. There were no older teachers who prepared a technology-integrated lesson. From the interviews, it was discovered that all the teachers who were active in the technology integration processes had relevant qualifications in some technological fields and they had been trained by some companies like Telkom. Under-qualified teachers who lack technology knowledge and skills do not bother using the computer in their lesson preparation and implementation. The training of teachers in the use of computers could be a step forward in motivating them to change their beliefs about the use of computers and help them to utilise computer technology more effectively in teaching and learning (Odera, 2005:337).

Insufficient resources

Data obtained from the observations revealed that the schools did not have sufficient equipment such as computers, printers and relevant educational software to utilise technology in their teaching. This poses a challenge to these schools, as learners have to work in groups of six on one computer, and a class of 40 learners has to use one printer in a teaching period of 35 minutes. This problem has arisen because of the large student enrolment; two or three printers cannot accommodate all the school's printing work. Consequently, long queues are experienced and learners cannot print their work within the allocated time.

In the interviews participants highlighted the poor printing quality and mentioned that the printers often jam, causing time to be wasted. Participants also cited a lack of funding from the education department as a factor contributing to insufficient resources. As stated, the only budget allocated to schools is for learner support material. Consequently, schools have to devise their own means of equipping their computer laboratories with computers and other related technologies. Another aggravating factor might be that schools do not budget adequately for maintenance of their computers. Moreover, the costs remain hidden unlike in the commercial sector where the capital costs of personal computers represent only one fifth of the yearly cost of running the computer (Howell and Lundall, 2000:47).

From the focus group interviews it also became apparent that connection to the Internet was an obstacle. Participants mentioned that this barrier compelled them to resort to using textbooks which sometimes contain outdated information.

A lack of teachers qualified in technology integration

Many schools lack teachers qualified in technology integration who can drive the technology 'wagon' and assist other teachers in integrating technology effectively into their teaching and learning activities. According to the Employment of Educators Act teachers who are presently teaching technology as a subject are not qualified in terms of integrating technology into teaching and learning. One of the participants highlighted the shortage of teachers qualified in technology integration as negatively affecting the process of technology integration. For effective technology integration to take place, sufficient numbers of teachers need to be trained first, so as to equip the learners with the technological skills to meet the skills required in the twenty-first century. Teacher training is therefore crucial to promoting learners' successful manipulation of multiple literacies (Merkley and Schmidt, 2001:220). In some countries projects focus on training for the implementation and sustainability of ICT-based interventions in education (Shakifa, Broekman and Mogale, 2004:1). Some of these teachers see pre-service training as essential, while others consider in-service training to be the appropriate response.

Maintenance and technical problems

Maintenance and technical problems are challenges experienced by schools. In the case of maintenance, the findings from the interviews revealed that there were no qualified technicians on the school premises to solve maintenance problems. The schools have to employ outside technicians who must travel from far, which is costly for the schools. Schools experienced maintenance and technical problems that sometimes disrupted the smooth running of teaching and learning. From the observations, it was discovered that some of the computers were not functioning properly and some were not even connected to the Internet.

Risks and security problems

A major challenge to technology integration in schools is theft and vandalism. Computer equipment like hardware is stolen by outsiders, and some learners also steal software. This can leave the school without any equipment as most equipment is donated by companies. One of the participants explained this problem clearly:

Twice we had all our computers stolen, while the second time the guard was seriously injured and almost killed. Inside stealing is also a problem; learners would steal a mouse or software.

Poor parental involvement

Poor parental involvement was also identified as one of the challenges to effective technology integration. In view of their depressed economic status, many parents could not afford to buy their children computer hardware or software to make it easier for them to do their homework, projects and assignments at home. Parents play a critical role in developing their children's interest in the use of computers by influencing them through both their own actions and the amount of encouragement they give to them (Torres, 2002:8).

Insufficient time

The findings showed limited time is a contributory challenge to teaching and learning with technology. This challenge is particularly relevant to the training of the teachers. They are sometimes required to do training in the afternoons (after school hours), which raises the issue of fatigue as they have often spent half their work day involved in classroom activities before attending training. Moreover, the teachers are reliant on different types of transport after school as most commute from different areas. Finally, there is the possible conflict of interest between work and family-related issues in the afternoons. Some of the teachers are parents with young children who need care and attention and assistance with homework.

Learners also experience time as a challenge since they cannot fully access the required technology, especially the Internet. The observations revealed that learners are not allocated enough time to work with technology; consequently they cannot complete their set activities and submit their work at the required time. This problem also affects teachers, as they cannot proceed according to their plan. Instead of making progress, teachers have to give learners a chance to complete previous work before proceeding with new content.

Computer jargon

Participants in the focus group discussions highlighted computer jargon as one of the barriers they experienced. They emphasised that both teachers and learners experience a problem in understanding some of the concepts used in the technology textbooks. If teachers were familiar with the terminology, then teaching and learning with technology would be easier.

To overcome all these challenges, a technology integration planning (TIP) model could be a helpful strategy for increasing effectiveness of integrating technology in teaching and learning. Roblyer (2006:53) proposes a five-phase TIP model (see Figure 1) in which each of the five phases outlines a set of planning and implementation steps that ensure effective technology integration in the classroom activities. He emphasises that when planning for a technology integration lesson, teachers have to consider the following questions that go hand in hand with the phases of integration discussed below: Why should I use a technology-based method? How will I know students have learned? What teaching strategies and activities will work best? Are essential conditions in place to support technology integration? What worked well? What could be improved? This process is summarised in Figure 1.

Firstly, teachers have to look at their current teaching problems and identify technology-based methods that may offer good solutions. Secondly, they have to decide on the skills they want students to learn from the technology-integrated lessons and design ways to assess how well students have learned and how effectively the activity has been carried out. Thirdly, they have to decide on instructional strategies and how to carry them out. When they create an instructional design for technology integration, it is necessary to consider the characteristics of their topic and the needs of their students and decide on an instructional course of action that addresses both within the constraints of their classroom environment. Fourthly, they have to organise the teaching environment so that technology plans can be carried out effectively. Lastly, they have to review outcomes data and information on technology-integrated methods and determine what should be changed to make them work better next time.

Everybody is talking about technology integration, but few practising teachers profess to know exactly how to proceed. The fact is that real integration requires change. This model will guide teachers through the necessary changes they will need to make to be successful in integrating new technology into their classroom activities.

Conclusions

The aim of this article was to report the challenges faced by senior secondary school teachers and learners in integrating technology into teaching and learning. It is clear from the advantages of technology integration into teaching and learning as elucidated in the literature that teachers cannot continue teaching as was done in the Industrial Age when knowledge was limited and

controllable. There is a need for transformation, meaning that we have to move to the Information Age where knowledge has exploded and is uncontrollable. Moreover, ICT tools enable us to perform much more powerful tasks and be much more productive.

In this article a new approach to technology integration, the TIP model, has been recommended. The model suggests that teachers have to plan accordingly before attempting to use technology in their lessons. Several questions that teachers need to ask before attempting to use technology for teaching and learning has also been highlighted. ICT can change teaching and learning by being a source of knowledge, a medium for transmitting content, and an interactive resource furthering dialogue and creative exploration. ICT is thus considered to be both the cause of change and a major means of achieving it. Having reviewed literature and given the findings from the empirical study the research highlighted the following recommendations that will invite other researchers to investigate more on this subject:

- The Department of Education should design, develop and help schools to implement a common policy regarding the integration of technology in education.
- The Department of Education should identify skilled facilitators who can provide training and support to teachers at school levels.
- Enough resources and a sufficient number of teachers in the field of technology should be equally distributed to schools. Additionally, all schools should have access to the Internet to allow teachers and learners to do research.
- Schools should allocate enough time for technology integration in teaching and learning as the concept is new to schools.
- Schools must have at least one technician in full-time employment to deal with maintenance and technical problems. This person should be appointed by the education department and be paid an appropriate salary to maintain the centre.
- Security systems should be implemented to minimise theft and vandalism of technological assets.
- The community should be well informed about the advantage of technology for teaching and learning.

Despite the trend to integrate technology into teaching and learning, the integration process has not yet effectively been accomplished in classroom practice. While there is more technology in classrooms, there is little evidence that these technologies are integrated effectively into the teaching and learning. Although technology is increasingly available at schools, it does not necessarily mean that it is implemented successfully. It is hoped that this article will trigger technology specialists and teachers to reflect on how they might integrate technology effectively into their classroom activities. Integrating technology effectively into the curriculum requires planning, time, dedication, and resources.

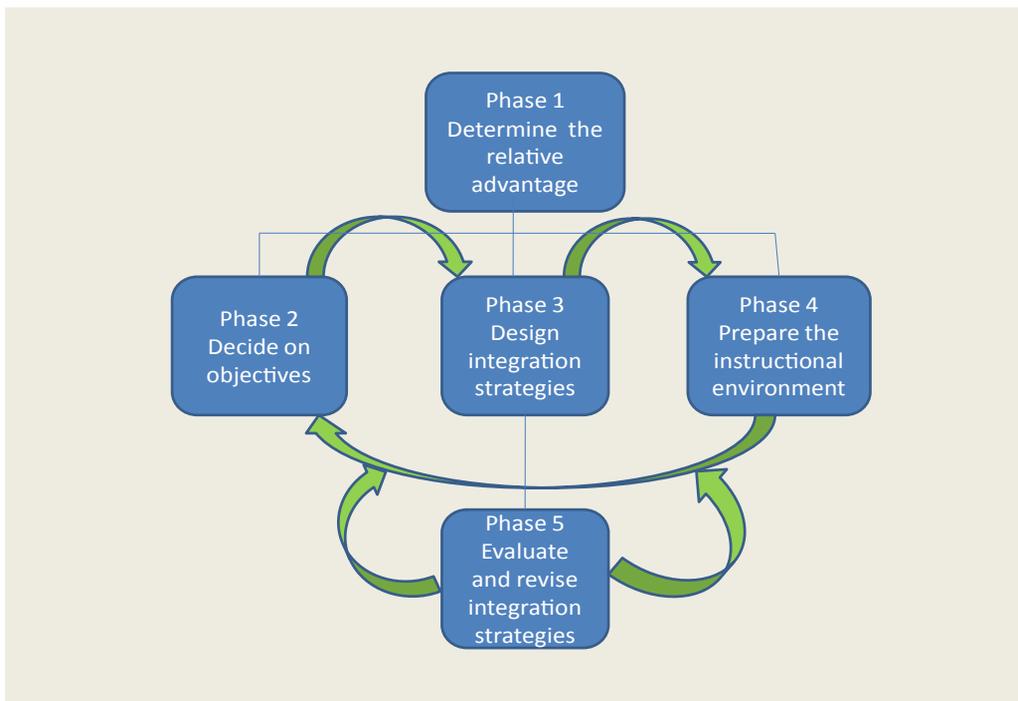


Figure 1: Technology Integration Planning Model (Roblyer, 2006)

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