

Abstract

The problem of integrating technology into teaching and learning process has become a perennial one. Common excuses for the limited use of technology to support instruction include shortage of computers, lack of computer skill and computer intimidation. While these could affect the success of technology integration, it should be acknowledged that the degree of success teachers have in using technology for instruction could depend in part on their ability to explore the relationship between pedagogy and technology. The article shows that technology integration is narrowly perceived and that such a perception might hinder teachers' understanding of the scope of technology in education. Technology integration should be considered along with issues involved in teaching and learning. Such issues include developing learning objectives, selecting methods of instruction, feedback, and evaluation and assessment strategies including follow-up activities. Technology used for teaching and learning should be considered an integral part of instruction and not as an object exclusive to itself. Viewing technology integration from a wide perspective will provide teachers with the necessary foundation to implement technology into the classroom more successfully.

Introduction

This article discusses the narrow perception of the term "technology integration" and considers that such a perception is likely to result in a poor use of technology for instructional purposes. The scope of technology integration is examined with a view of showing its relationship with pedagogy. It should be noted that technology, which is used to facilitate learning, is part of the instructional process and not an appendage to be attached at any convenient stage during the course of instruction. Technology integration not only involves the inclusion of technical artifacts per se, but also includes theories about technology integration and the application of research findings to promote teaching/learning. It is not restricted to the mechanical application of various new computer hardware and software devices during the process of instruction. It should include the strategies for selecting the

desired technologies, skill to demonstrate how the selected technologies will be used, skill to evaluate such technologies, as well as the skill to customize the use of such technological skills in a way that addresses instructional problems. The decision on the selection and use of technology for instruction should be made at the onset – when the instruction is being prepared, not in the middle or at the conclusion of the instruction. The objective and method of instruction including technology and outcomes of instruction should be specified at the planning stage. This point is illustrated by Diaz & Bontemba (2000):

Using technology to enhance the educational process involves more than just learning how to use specific piece of hardware and software. It requires an understanding of pedagogical principles that are specific to the use of technology in an instructional settings...Pedagogy-based training begins by helping teachers understand the role of learning theory in the design and function of class activities and in the selection and use of instructional technologies. (pp. 2 and 6)

The relationship between instructional technology and pedagogical concepts is considered with a view of assisting teachers to recognize the impact of such a relationship in an educational inquiry. Technology integration is complex and is made up of processes of interconnected activities. The essence of this article is to explore those processes and to encourage teachers and those connected with technology integration to be reflective practitioners.

The Scope of Instructional Technology

Technology in education is commonly defined as a technical device or tool used to enhance instruction. According to Lever-Duffy, McDonald, and Mizell (2005) "educational technology might include media, models, projected and non-projected visual, as well as audio, video and digital media." These authors claim that some "educators may take a narrower view" and are likely to "confine educational technology

primarily to computers, computer peripherals and related software used for teaching and learning” (pp. 4, 5). This definition does not take into consideration the pedagogical principles upon which the application of various technologies into educational inquiry are based. Such a definition is narrow because it isolates technology from pedagogical processes that it is intended to support. It does not connect instructional technology with the learning objectives, methods of instruction, learning style and pace of learning, assessment and evaluation strategies, including follow-up procedures. Specifically, technology integration should incorporate the technological skill and ability to use pedagogical knowledge as a base for integrating technology into teaching and learning. This implies that teachers should develop strategies to motivate students to keep them focused as the instruction progresses and to consider that different students prefer different learning styles and that they learn at different rates.

It is important that teachers use a variety of teaching methods, and students must be taught to use the newly acquired knowledge and skill as well as to critically evaluate and modify such knowledge. In other words, teachers should be able to engage students in an exploratory learning experience which is designed to stimulate thinking. According to Bruner (1966), the essence of teaching and learning is to help learners acquire knowledge and use the knowledge they have acquired to create other knowledge. Bruner eloquently states:

To instruct someone ... is not a matter of getting him to commit results to mind. Rather, it is to teach him to participate in the process that makes possible the establishment of knowledge. We teach a subject not to produce little living libraries on that subject, but rather to get a student to think mathematically for himself, to consider matters as an historian does, to take part in the process of knowledge-getting. Knowing is a process not a product. (p. 72)

This can imply that teaching software skills without consideration to the basic foundation knowledge that justifies their application is likely to result in rote memorization of disjointed information on various technologies used. Ausubel (1978) claims that this type of teaching method is likely to lead to forgetfulness.

In a broad sense, technology integration can be described as a process of using existing tools, equipment and materials, including the use of electronic media, for the purpose of enhancing learning. It involves managing and coordinating available instructional aids and resources in order to facilitate learning. It also involves the selection of suitable technology based on the learning needs of students as well as the ability of teachers to adapt such technology to fit specific learning activities. It calls for teachers’ ability to select suitable technology while planning instruction. It also requires teachers to use appropriate technology to present and evaluate instruction as well as use relevant technology for follow-up learning activities. Such a broad definition of technology in education will help teachers develop a rational approach toward technology integration.

Problems of Technology Integration

The study of Leh (2005) reveals that teachers admitted “they did not resist technology per se but agreed that they could not fully integrate it into their own practices because of the organizational, administrative, pedagogical, or personal constraints” (p. 19). Leh claims that the teachers acknowledge, “technology was more of a problem with multiple facets rather than a solution ...” (p. 19). Defining instructional technology in broad spectrum helps educators, especially inexperienced teachers, understand the pedagogical issues to be considered when using technology to enhance the process of teaching and learning. Leh also calls for the “the national organizations involved in teacher standards to recognize that teachers need to ... develop a foundation upon which to build their understanding of technology integration (p. 46).

Bosch & Cardinale (1993) maintain that while it is important for teachers to be provided with technological skill, it is also important to educate them on how to use that skill to support learning. Infusing technology into a curriculum is less likely to make an impact on students’ learning if technology is not considered as a component of instruction. Technology should not be treated as a separate entity but should be considered as an integral part of instructional delivery. The teacher should be able to assess the appropriateness of any technology used for teaching and learning in relation to specific instruction. The teacher should also consider how the technology selected fits into the objective of the lesson, methods of instruction, evaluation,

feedback and follow-up initiatives. Such consideration will provide teachers the opportunity to reflect on their practice and reduce the tendency to integrate technology into teaching and learning in a mechanistic way. Fletcher (1996) has provided an interesting scenario to show that technology integration should be grounded in sound educational practices:

When you go to the hardware store to buy a drill, you don't actually want a drill, you want a hole, they don't sell holes at the hardware store, but they do sell drills, which are the technology used to make holes. We must not lose sight that technology for the most part is a tool and it should be used in applications which address educational concerns. (p. 87)

In teaching and learning, technology should be applied as a process rather than as a single, isolated and discrete activity. The *American Heritage Dictionary* defines process as "a series of actions, changes, functions bringing about a result." Technology in education is not a mere object to be introduced into teaching and learning activities at will without considering basic principles of learning and sound teaching methodology. Therefore, to assume that educational technology is an object that can be used and detached at any time is a false assumption because educational technology is not applied in a vacuum. It is guided by learning principles about how individuals learn and how they retain the knowledge and skill they have acquired. It is also based on the students' expectations of the outcome of learning and how the outcomes could be applied to enrich practical life experiences. Therefore, technological application should be based on sound teaching and learning principles to avoid teaching hardware and software technologies in an isolated manner. Technologies used for instructional delivery should form part of the cohesive components of instruction; they should not be detachable objects.

An ongoing action research project has shown that most in-service teachers have a narrow view of technology integration. When they were asked to briefly state why they need to apply technology in their teaching, most of the student teachers (70%) maintain that it is a tool for instruction; they fail to relate it to pedagogy or identify how it will help them to improve their teaching or facilitate learning. An educator

who does not understand the purpose of technology integration or how it could be applied is less likely to achieve success in a technology-based learning environment. Eby (1997) warns that "technology could not support learning without teachers who know how to use it and integrate it into subject-specific area." Means (1994) points out that technology training must go beyond focusing on the acquisition of technical skills but attention should be given "to the instructional strategies needed to infuse technological skills into the learning process" (p.92). Yao and Quang (2000) argue that technology training tends to focus on computer applications such as word processing, spreadsheets and databases. Technology for teaching and learning should be part of the instruction milieu and not be added as an afterthought activity. Sprague et al. (1998) argue that using technology for instruction should include mastery of the techniques to apply it to teaching.

Relationship between Technology in Education and Pedagogy

A major part of the problem related to technology integration is that most educators have not addressed the pedagogical principles that will guide their use of technology for teaching and learning. The intricate relationship between technology and pedagogy has not been adequately explored. As teachers explore the process of technology integration and search for ways that it can be effectively accomplished, they will develop the rationale to examine the appropriateness of the technologies they are using and whether such technologies are compatible with their lesson plan and learning outcomes. The process of exploring the relationship between technology in education and pedagogy will encourage critical thinking on the part of teachers as they practice technology integration. Mezirow (1990) argues:

That thinking critically involves our recognizing the assumption underlying our beliefs and behaviors. It can give justifications for our ideas and actions. Most important, perhaps, it means we try to judge the rationality of these justifications. (p. xvii)

The words of Alfred Kyle, a Dean of Engineering, are very insightful in discussing critical and reflective teaching (in Schon, 1987). Dean Kyle maintains that "we know how to teach people to build ships but not how to figure out what ships to build" (p.11). Accordingly

Ripley (2001) explains that what the Dean of Engineering is conveying is for “students to learn how to determine which ships to build while they master shipbuilding skills. He hopes that students will progress toward becoming reflective practitioners who think and rethink their positions and assumptions . . .” (p. 19). By the same token, it is hoped that instructors will develop similar awareness by becoming critical thinkers and reflective teachers as they engage in technology integration.

The authors of this paper have observed that during the course of their teaching, education students were asked to discuss why they would like to use technology for teaching and learning. A great majority of them said that they use technology (more specifically computers) for instruction because it helps teachers to teach and students to learn. This response is too general and does not convey an in-depth understanding of technology integration. These students fail to articulate in any meaningful way how technology can be used to improve learning. Their response does not capture the intricate relationship between pedagogy and technological resources. Lack of appropriate guidelines limit teachers’ use of technology for instruction, and limits their desire to explore the use of technology beyond basic applications. Weizenbaum (1976) argues that “computers can be a powerful metaphor for understanding many aspects of the world.” However, he states “it enslaves the mind that has no metaphors and few resources to call on—the mind that has been educated with only facts and skills” (p. 51). It is important that practicing teachers and in-service teachers recognize that technology in education is considered part of pedagogy.

Bazeli (1997) is critical of the way technology is used for instruction. She believes implementing technology in the classroom is time-consuming and teachers do not have the time to involve students at the planning stage of technology integration. Bazeli asserts that when students participate in the planning and implementation stages of technology integration “the burden is lifted from the teachers and the learning process becomes collaborative, with the teacher assuming the role of facilitator rather than a disseminator of information. Further, as students are actively involved in planning and implementing technology production, they gain critical thinking and problem-solving skills along with curricular learning.” She maintains that

“unfortunately, the computer is often perceived as a separate entity, not an integrated part of the curricular areas of the school” (p. 201).

Technology should be implemented in the classroom only if its role in a given instruction is determined along with pedagogical issues related to a given instructional task. The role of technology in education can only be determined if teachers who implement technology at the classroom level are involved in technology decision-making because teachers have the responsibility of facilitating instruction. Okojie et al. (2005) argue that school administrators make decisions about technology training without consulting teachers who will integrate technology into instructional process. Teachers who are in a better position to articulate their needs and identify their weaknesses have minimal input in planning the technology training they receive. Thus, technology integration training becomes a general identification of various hardware and software technologies, which does not address specific learning problems nor pinpoint the way technology can be used to improve instruction (p. 5). Pierson (2001) recognized that “society has embraced computer technology and allowed it to reinvent the ways in which we create, find, exchange, and even think about information. Unable to ignore such deeply permeating innovation, school districts often bow to societal pressure to fund technology without having a thoughtful plan for implementation” (p. 413). Gunter (2002) argued that students learn computer skills in isolation of the curriculum structure. Topper (2005) believes that “for teachers to use technology in support of their teaching, and to see it as a pedagogically useful tool, they must be confident and competent with the technology they are planning to use (p. 304).

It is important that teachers recognize that a relationship exists between technology in education and pedagogical decision-making. According to Anderson and Borthwick (2002) research evidence shows that “participants whose technology instruction was integrated in their methods course reported more frequent use of technology for both teacher productivity and student projects during both on-campus courses and their first year of actual classroom teaching” (p. 5). There is no blueprint for technology integration, however, it is suggested that effort be made to link technology for instruction to all levels of pedagogical processes and activities as described next.

- Identifying learning objectives in a technology-based instruction requires teachers to select and/or adapt instructional technology to match the objectives based on the students' needs.
- Presenting instruction using technology as part of the instructional process requires teachers to choose the methods that are relevant to the objectives, the technology selected, learning styles, modes and pace of learning.
- Evaluating technology-based instruction requires teachers to select appropriate evaluation techniques that are relevant to the objectives, methods of instruction, and to technologies that have been used.
- Designing follow-up activities using technology requires teachers to select appropriate follow-up materials that are relevant to the objectives of the instruction and technologies that are accessible to the students as well as easy to use.
- Developing course enrichment materials using technology requires teachers to provide opportunity for students to explore issues related to the course materials and to provide them with the opportunity to select and analyze course enrichment materials using technology in ways that broaden their problem-solving skills.
- Locating sources for additional instructional materials using technology requires teachers to use the internet and multimedia networks to develop additional learning materials and expand instructional resources aimed at broadening the knowledge and the skill gained.
- Designing a dynamic classroom using technology requires teachers to provide a learning environment that is colorful, engaging, exciting, interactive and energetic as a way of encouraging students to venture into the world of technology and to discover knowledge for themselves.

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Conclusion

The essence of this article is to provide insight on how teachers can improve their use of technology to support instruction. It explores pedagogical issues that are relevant and need to be considered in order to successfully apply technology into teaching and learning. It is important that educators perceive technology in education as part of the pedagogical process. This article also recognizes the relationship between pedagogy and technology in education. It is necessary that teachers understand the pedagogical principles that govern the application of technology into teaching and learning. Suggestions are made on how to improve technology integration. Educators are encouraged to view technology integration from a wider perspective and be reflective in their teaching as they use technology to support and facilitate instruction. Technology integration should be considered as part of the process of instructional preparation. Instructional technology should be identified at the planning stage just as the students' readiness is assessed, lesson objectives identified, methods of presenting are established, and evaluation strategies are determined. Follow-up activities should also be established at the planning stage. Poor implementation of technology integration is likely to affect the desired outcome.

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