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Nexus between Teaching and Technology: A Model for Technology Adoption

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ABSTRACT

In this research, we looked at the reasons why technology hasn't had a positive influence on education in the past and listed the prerequisites for its future successful application. Teachers must go past Familiarisation and Utilisation and into the Reorientation, Integration, and Evolution stages of technology usage if they are to employ concept and product technologies successfully. Teachers may rethink their duties in the classroom after learning how to use technology. Teachers may design spaces where students actively participate in cognitive partnerships with technology by drawing on research results from cognitive psychology and other relevant fields.

Introduction

Teaching in a classroom is a hard profession. Although instructors are in charge of numerous duties that are not directly related to classroom instruction, most individuals outside of the education field undoubtedly think that teachers devote the majority of their time teaching. Teachers are required to serve as managers, psychiatrists, counsellors, caretakers, community "ambassadors," and entertainers in accumulation to organising and carrying out lessons. If teaching seems like a crazy, almost impossible profession, it could be. It is simple to see how a teacher may encounter frustration and disappointment. The large number of educators start their careers with the goal of inspiring their pupils to love learning. Regretfully, the other requirements of the classroom are very consuming and distracting. In order to restore the importance and function of the individual classroom teacher, we see technology as a liberator for educators. Two things need to occur in order to execute this. The first step is to shift the classroom's viewpoint to one that is learner-centred. Second, in order to establish a "community" that fosters, supports, and promotes the learning process, educators and students must collaborate or partner with technology (Cognition and Technology Group at Vanderbilt, 1992).

It is crucial to remember that this research focusses on educational technology rather than technology in education. A distinction exists. The number of videocassette recorders or computers in a classroom and how they may be used to supplement conventional classroom activities are common misconceptions about technology in education, but this is risky and inaccurate. In addition to giving hardware an unwarranted amount of attention, it ignores other potentially helpful "idea" technologies that come from applying one or several knowledge bases, such as learning theory. In order to provide students the greatest learning environments possible, educational technology applies concepts from a variety of sources. Another concern that educational technologists pose is how integrating computers into the curriculum may alter or adapt a classroom. Due to this convergence, the curriculum and environment may also need to adapt to take use of the potential presented by the technology.

This paper has four objectives. We'll start by looking at a few distinct phases of technology adoption. We will next go over the traditional roles that technology has fulfilled in the classroom. Third, we'll look at what an instructional technology-focused classroom may look like. Fourth, we will provide a few concrete instances that integrate modern educational concepts. Given the state of classrooms today, this essay will attempt to illustrate how educational technology may benefit educators and how it might impact the future direction that many schools choose to take.

Model for Technology Adoption in the Classroom

It is a common misconception that educational technology and instructional innovation are interchangeable. By definition, technology is the use of existing knowledge towards a beneficial goal. As a result, technology leverages growing information—whether it be about a classroom or a kitchen—to modify and enhance the system to which the knowledge pertains (e.g., instructional computers or a microwave oven in a kitchen). Innovations, on the other hand, solely reflect change for the sake of change. Given this contrast, one may argue that educators should embrace instructional technology, but they are right to oppose simple innovation. Unfortunately, this theory is not supported by the history of educational technology (Saettler, 1990).

The system of education has hardly transformed in the last fifty years, even though education has seen a plethora of innovation and technology (Reiser, 1987). Few would contend that dentists and physicians from fifty years ago would be qualified to work with modern technology. However, given that the majority of the innovations and technology brought have been abandoned throughout this era, a teacher from fifty years ago would likely feel completely at home in the majority of classrooms today. Over the last 50 years, breakthroughs and technology in education have been rapidly abandoned, a phenomenon that is hard to explain. Has the educational system advanced to the point that it is impossible to anticipate further advancements from the technologies used today? Have all Educational technology has been nothing more. than innovative fads that educators have rightly criticised as needless and inappropriate? In both situations, we believe not. In order to comprehend the traditional and contemporary roles of educational technology, it would seem reasonable to take these issues into consideration. To enhance comprehension of the patterns of teacher adoption after their first exposure to educational technology, we will use a simple model. We may be able to make more accurate predictions about which technologies will be adopted or abandoned in the future if we are aware of these previous adoption tendencies.

Understanding the patterns of adoption in the field of education has been the focus of a number of different projects (Dalton, 1989; Dwyer, Ringstaff, & Sandholtz, 1991). In order to better comprehend both traditional and modern uses of technology in education, we provide a simplified version of one such paradigm in this section. The five stages or phases of the model are a)Familiarisation, b)Utilisation, c)Integration, d)Reorientation, and e)Evolution, as shown in Figure 1. Only when teachers go through all five stages can educational technology reach its full potential; otherwise, it is likely to be abused or thrown away (Rieber & Welliver, 1989; Marcinkiewicz, in press, 1991). While modern perspectives offer the potential to reach the Evolution phase, the conventional function of technology in the classroom is unavoidably limited to the first three phases.

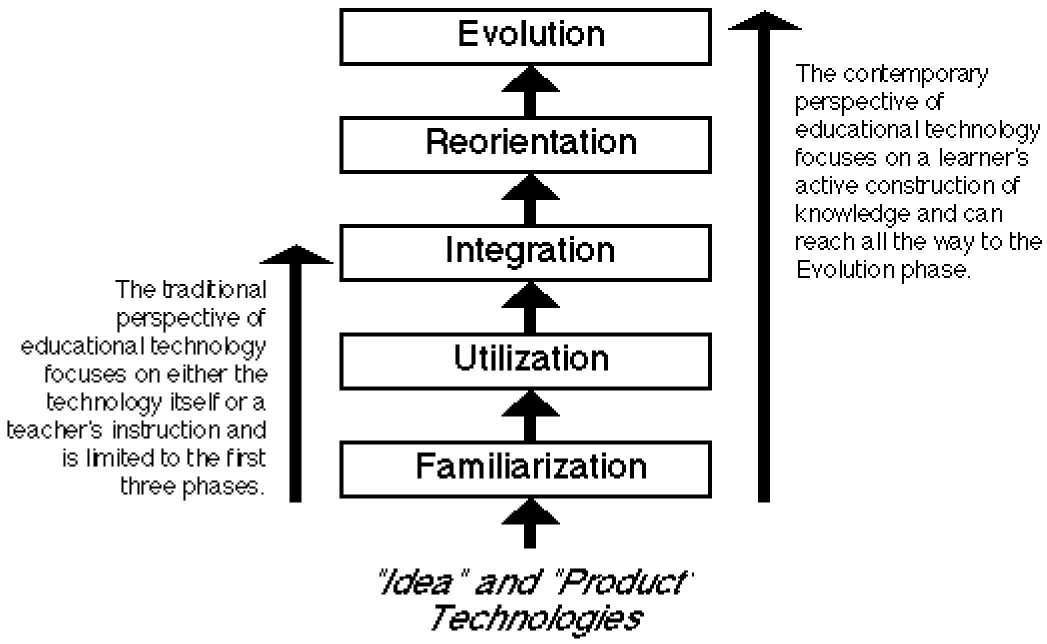

Figure 1. A model of adoption of both "idea" and "product" technologies in Education

Familiarization

The first introduction to and experience with a technology is the focus of the familiarisation phase. A teacher attending an in-service session that covers the "how to's" of a technology, such as word spreadsheets, processing, cooperative learning, assertive discipline, motivating techniques, etc., is a typical example of familiarisation. During this stage, the instructor only learns how to use the technology. The teacher's experience and development with the technology stops with the workshop. A recollection of the event is all that is left. Even with a certain amount of power, the instructor may talk about the experience and the concepts it represents, but nothing more happens. This stage exhibits the start and finish of a lot of innovation in teaching.

Utilization

On the other hand, the teacher tests out the innovation or technology in the classroom during the Utilisation phase. A social studies instructor utilizing role-playing simulations they had learnt at a graduate course or workshop is one example. Teachers that make it to this stage have undoubtedly advanced beyond Familiarisation, however, they run the risk of being too satisfied with their limited access to technology. "At least I gave it a try" mentality will probably prohibit any sustained as well as long-term adoption of the technology. Because they haven't made a commitment to the technology, teachers who merely go to this stage are likely to abandon it at the first hint of problems. For the majority of instructors who utilise computers and other modern instructional media, this is most likely the highest adoption stage. On Tuesday, very few people would notice if the technology were removed on Monday.

Integration

The "break through" phase is represented by integration. This happens when a teacher intentionally chooses to assign certain duties and obligations to the technology; as a result, the instructor is unable to carry out the lesson as intended if the technology is abruptly taken away or unavailable. It is the book and its offspring, which include worksheets and other handouts that are the most obvious examples of technology that has progressed to this point of application in the field of education. It would be impossible for the majority of teachers to carry out their duties without the support of such print-based technologies. The blackboard is another example, but it could be funny to some. Without it, teaching would be quite challenging for the majority of instructors. Therefore, the most important quality or feature of this stage is the technology's "expendability" (Marcinkiewicz, in press, 1991). For many, integration marks the conclusion of the adoption model, but in reality, it is only the start of a deeper knowledge of educational technology. Some instructors experience a professional "metamorphosis" during the Integration phase, on the other hand, this is contingent upon their adoption pattern continuing to progress.

Reorientation

Teachers must reevaluate and rethink the classroom's role and goal throughout the Reorientation phase. Among its numerous traits, the most significant is likely that the emphasis of the classroom has shifted from the teacher's teaching to the learning of the students. A teacher who has progressed to the Reorientation phase does not consider content delivery—that is, the "acts" of explaining, controlling, or inspiring—to be successful teaching.
Establishing a learning environment that encourages and supports students as they create and mould their own knowledge is the teacher's job instead. During this stage, the student is no longer the goal of instruction but rather the topic.

Teachers in the Reorientation phase are not afraid of being "replaced" by technology and are receptive to the tools that facilitate this process of knowledge development. In actuality, these educators are likely to integrate technology into their lessons without feeling the need to be "experts" themselves. They are interested in the ways that technology enables their pupils to interact with the material. It wouldn't be out of the ordinary for pupils to possess more technological proficiency than their instructors. For instance, a history instructor may find that students would rather construct HyperCard stacks than complete a conventional term paper project (Hoffmeister, 1990). If a teacher adopts a student-centered perspective, they will pay more attention to how deeply a student has interacted with the material rather than how effectively the stack is "programmed." The instructor will highlight (and assess) how the student has developed into a researcher and explorer as a result of the computer tool's availability. It makes no difference whether the instructor is more or less technically proficient with HyperCard than the student. Along with the student, the instructor also gains knowledge about HyperCard and history. Naturally, the more broad knowledge of the instructor acts as a significant resource and mentor to the student along the course of their education. During the Reorientation phase, a teacher would encourage and anticipate students to adapt the technology in unexpected ways. This is in contrast to the traditional view of technology, which is that it is something that must be learnt in advance and presented to pupils in a controlled and systematic manner.

Evolution

The last stage, Evolution, serves as a reminder that in order for the educational system to continue to be successful, it must adapt and change. There will never be a definitive answer or conclusion, therefore looking for one would be a waste of time. In order to address the challenges and opportunities presented by new insights into human learning, the classroom environment should be continuously modified. As was previously said, educational technology is defined by the right application of fundamental knowledge for a beneficial goal, and the Evolution phase is characterised by its adherence to this concept.

Technology in Education the Traditional Role

We have decided to call the two primary categories of technology used in education "product technologies" and "idea technologies." Among the product technologies are: 1) hardware, or machine-oriented, technologies that people most commonly associate with educational technology, like the variety of audio-visual equipment, both modern (like videocassette players/recorders, laserdiscs, computers, and CD-ROM) and traditional (similar movies, film strips, and audiocassette players/recorders); 2) software technologies, like computer software (like computer-assisted instruction) and print-based materials (like books, worksheets, and overhead transparencies). Idea technologies, on the other hand, lack such physical manifestations.

It goes without saying that concept technologies are often embodied in or via product technologies. Simulations, for instance, are mostly concept technologies.

Through simulations, individuals may experience things that are not often feasible (like travelling back in time), likely (like riding on the space shuttle), or desired (like the greenhouse effect) in real life. A product, like computer software, is required to make the simulation concept a reality. In this sense, the product supports or facilitates the concept. The assembly line used by Henry Ford is a prime illustration of the difference between concept and product technologies.

One technological innovation that revolutionised American manufacturing was the assembly line concept. On the other hand, the factories, labour stations, and conveyor belts seen in vintage images demonstrate the product technologies that were used to support the initial concept.

Historically, most initiatives to integrate technology into education have focused on product innovations, including teaching machines, instructional television, and films, as well as more contemporary developments, computers—it is crucial to distinguish between concept technologies and product technologies (Reiser, 1987). As a result, the function and worth of these commercial technologies were to reinforce the conventional wisdom and methods of classroom educators. These long-standing procedures were mostly based on behavioural models that prioritised the delivery and transmission of preset material. These methods are prime examples of the "student as bucket" metaphor, which emphasises "pouring knowledge" into students' heads via the creation and delivery of well thought-out and regulated teaching. Learning is seen as a result of being exposed to the knowledge. We think that this approach to teaching and learning must be far apart from modern ideas of educational technology. Although few make much headway so far, teachers who embrace technology without taking into account the ideology into which these items and concepts are introduced are inevitably restricted to the third phase of integration.

Take the handheld graphing calculator as an example of a product technology that has advanced to the integration stage of adoption. Graphing calculators are used by many math instructors in high school. Actually, a clear liquid crystal display (LCD) is used by a number of manufacturers on the market to enable the calculator to be seen on an overhead projector. For many instructors, using these calculators readily passes the criteria of expendability: Removing the calculators would cause a major disruption to their instruction. If they were abruptly returned to the static medium of the blackboard or above, they would be unable to communicate the same information.

To ascertain if a teacher is about to reach the Reorientation phase, it is crucial to consider how much the graphing calculator has changed the instructor's lesson. The teacher has started to reconsider and consider the relationship between how idea and product technologies can support a student's learning if the calculator enables them to concentrate on the students' conceptual grasp of the mathematical function, possibly due to the calculator's real-time animation capabilities for drawing graphs. The way that technology was used to empower pupils to comprehend and apply mathematical concepts would provide the instructor a sense of accomplishment. The Reorientation phase is about to begin for this instructor. Such a teacher would most likely try to provide the kids access to the technology (calculator) so they may start building mathematical structures.

However, since nothing has changed or improved other than the mode of delivery, it is highly likely that the teacher's adoption of the technology will end with integration if the instructional strategies they use are essentially the same as those they used prior to the introduction of the graphing calculator. In this instance, even if the calculator's product technology has been merged, the fundamental concept of "present, practise, and test" technology is unaltered and uncontested.

A mystical line on a "instruction/construction" continuum best describes the difference between educators who enter and stall at the Integration phase and those who are "transformed" and enter the Reorientation phase (Figure 2). This continuum may be used to describe how any one technology is used and integrated. A computer spreadsheet, for instance, integrates only the product technology without altering the philosophical foundation upon which it is based when it is utilised solely by the teacher for grade management or as part of an instructional presentation of, say, the principle of averages in a math class. An instruction-centered classroom, where a teacher oversees the presentation and practice of planned and preselected curriculum, would serve as the example's philosophical foundation.

Instead, think of a teacher who assigns pupils to create their own knowledge using the same spreadsheet, whether it's a variety of "what if" links in history or economics or the mathematical average principle. In this instance, the notion of a "microworld"—where students live and experience the material rather than just study it—is explicitly supported by the spreadsheet's product technology (Dede, 1987; Papert, 1981; Rieber, 1992).

Contemporary Role of Technology in Education

Three cognitive outcomes—the ability to retain, comprehend, and apply information—are among the various educational objectives (Perkins, 1992). One of these results is apparently exceedingly hard to get. Many pupils leave school unable to apply much of what they have learnt after more than 10 years of education.

The superficial processing that often takes place in the classroom is the cause of students' incapacity to apply what they have learnt. Lesson material organisation and memorisation are often the main goals of schoolwork, but information meaning is seldom the emphasis. Making external links between new and current knowledge results in meaningful learning. Three phases of learning—selection, organisation, and integration—have an impact on meaningfulness, according to Mayer (1984). First, information has to be chosen. If information is to be moved to long-term memory, it must first be arranged in working memory. Unstructured information has no use.

The level of meaningfulness depends on the organization's character. Information that is incorporated into previously acquired knowledge or experiences is more resilient than information that is unrelated to past experiences. Students choose material in class that they remember and arrange well enough to allow them to score well on exams, but they often neglect to connect the material to prior experiences or long-term memory.

Therefore, it seems that one result of schooling is a large store of inert knowledge that is ultimately forgotten (Cognition and Technology Group at Vanderbilt, 1992). How many of us, for instance, can still calculate a triangle's sine?

How may technology-assisted instruction promote more profound and significant cognitive processing? Furthermore, what structure need to guide these choices? There isn't much of a difference between teaching using technology and teaching in general. The ability of instructors to create lessons based on sound instructional concepts is more likely to lead to effective technology-based teaching than the technology itself (Savenye, Davidson, & Smith, 1991). Therefore, the research on successful teaching in general should serve as the foundation for recommendations for creating technology-based classrooms that work.

A number of guidelines for successful teaching have recently been established by researchers (Koschman, Myers, Feltovich, & Barrows, in press). The concepts are applicable to various teaching activities even though they were mainly created for education in intricate and unstructured domains. The majority of work in the actual world lack organisation. "Well-structured" problems often only arise in school environments. Three concepts will be discussed in the section that follows, along with their implications for the use of technology in the classroom.

Principle 1: Effective learners actively process lesson content.

Our ideas of successful learning and teaching have changed over the last 30 years due to the transition from behaviourism to cognitivism. The idea that learning is an ongoing process is among the most recurring concepts to come out of the shift. This means that pupils must do more than just react to stimuli in order to learn well. Rather, students need to actively look for and create connections between the material covered in class and what they already know.

A prevalent misconception is that product innovations enhance learning by boosting engagement. It is not difficult to identify the cause of this view. Research on students' attitudes towards using technology, particularly computers, has shown generally favourable outcomes (Martin, Heller, & Mahmoud, 1991). Additionally, studies seem to back up the idea that product technologies enhance education (Kulik, Bangert, & Williams, 1983). However, learning is not guaranteed by product technology alone (Clark, 1983). In fact, they may sometimes hinder learning by reducing the amount of work a student puts in.

Generally speaking, learning necessitates a significant mental investment from the pupils. However, it seems that students' judgements of themselves and their ideas about the difficulty of learning from various media influence the amount of effort they put forth throughout the learning process. According to Salomon (1984), kids who thought they were good learners put out more effort when they thought a job was difficult than when they thought it was simple. However, when learning was seen as more achievable rather than difficult, kids with low self-efficacy put forth more effort. To put it another way, high ability learners could put in more mental energy on a difficult job—like reading a book—than on a task that seems simple, like watching TV. Students with lower skill levels could put more effort into a task they think is doable than one they think is difficult.

By no means do we oppose the use of product technology in the classroom. The significance of combining concept and product technologies into "technological partnerships" is acknowledged, nonetheless. A musical symphony serves as an illustration of a good technical marriage. The perfect balance of musical instruments (product technologies) and musical compositions (concept technologies) is what makes a good symphony.

Undervaluing the musical score's creation or abusing the instruments' potential may diminish the symphony's ultimate performance. In a similar vein, a combination of concept and product technologies is needed for efficient technology utilisation in education. When combined, they create settings that bring together pedagogical requirement and technical capacity, fusing what can be done with what should be done.

We have far too often failed to identify the ideal combination of technology in education. Specifically, the product technologies' capabilities are overstated. Product technologies, for instance, are often employed to boost cost efficiency by delivering teachings to bigger audiences via satellites and telephone lines, or by replacing the classroom instructor. These methods are often misguided. Reproducing preexisting resources is unlikely to increase educational quality, despite the fact that expanding access to education is important and should not be undervalued. Instead, using technology as a medium of delivery might prolong or even worsen already-existing issues.

The advantages of technology extend beyond its capacity to mimic current teaching methods; it also enables the integration of concept and product technologies to promote deeper cognitive engagement among students.

Principle 2: Instruction is more durable when it is presented from a variety of viewpoints.

While studying particular topic has always been the main emphasis of teaching, a large portion of curriculum development in the modern era is centred on problem-solving, which calls on students to build constantly changing networks of facts, ideas, and processes. For instance, the National

Council of Teachers of Mathematics (1989) recommended that instead of wasting time on laborious computations, students should be given more opportunities to solve open-ended "real world" problems in small groups, make connections between mathematics and other subject areas, and use computer-based tools to speculate and investigate the relationships between ideas. In order to accomplish these objectives, learning should occur in settings that highlight the connections between concepts from many subject areas and support students in creating adaptable networks of propositions and outputs (Gagné, 1985). The intricacy of many topics is unlikely to be reflected when material is presented from a single viewpoint. On the other hand, learners may develop the interrelationships required to mediate deep processing and successful recall of instructional ideas by repeated exposure to material from diverse viewpoints.

Hypermedia and cooperative learning are two examples of technologies that have a lot of promise for fostering the development of diverse viewpoints. Through exposure to other points of view, cooperative learning is a concept technology that fosters the development of alternate views. Cooperative learning and conventional education vary in two significant ways. First, the instructor does not impart knowledge for the pupils to acquire. Rather, students instruct one another in small groups of two to five people. Second, students are held accountable for one another's education. Students have to make sure that everyone in their group meets the goals of the class. Students of all skill levels seem to gain from these encounters. Less capable students benefit from the individualised attention provided by group members, while more capable students gain from the cognitive restructuring involved in instruction. Additionally, groups seem to foster settings where everyone gains from exposure to a range of viewpoints and attitudes that are often not accessible in a typical classroom.

A change in perspectives on how knowledge should be presented to and accessible by students is reflected in the product technology known as hypermedia. Computer programs that arrange information nonsequentially are referred to as hypermedia. Associative linkages bind a number of nodes that make up the structure of information. An information chunk recorded in the hypermedia software is referred to as a node. Text, images, or audio may all be used to represent the information in a node. The primary distinction between hypermedia and conventional computer information presentation methods is associative linkages, which enable users to move between nodes (Jonassen, 1991).

In contrast to conventional training, which often offers material in a linear manner to facilitate comprehension, hypermedia enables users to explore an information base and create connections between the lesson and their own experiences. It is often said that learning gains more significance when students create networks of logically and semantically connected material that suit their own knowledge structure rather than that of the instructor or creator. Although students may be given knowledge in a sequential fashion via hypermedia environments, with proper design, users can establish a variety of paths through a lesson that result in numerous cognitive representations of the topic. Allowing students to explore encourages them to find material that suits their requirements and to uncover linkages that are sometimes overlooked in typical lesson content presentations. When users are encouraged to explore a database, connect information nodes, and even alter a knowledge base based on fresh insights into content organisation, hypermedia works particularly well (Nelson & Palumbo, 1992).

Cooperative learning and hypermedia are examples of technology that may enhance the significance of learning. To get the desired results, both must be properly handled. In cooperative learning, failure to preserve individual responsibility often results in potentially harmful societal implications. In a similar vein, hypermedia initiatives seldom live up to their potential as knowledge creation kits and instead concentrate on displaying information. Additionally, while though each may be taken alone, combining them may increase the learning effects. Despite the fact that most computer classes are designed for lone users, group usage seems to increase the advantages (Hooper, 1992).

Principle 3: Good teaching should be based on relevant settings and build on students' prior knowledge and experiences.

Philosophical perspectives on the best ways to accomplish educational objectives have changed from a concentration on curricular material to one that emphasises students' experiences and knowledge (Pea & Gomez, 1992; Tobin & Dawson, 1992). Curriculum initiatives that emphasised the structural analysis of material received a lot of attention in the 1960s and 1970s. The educational materials created by these programs focused on assisting students in comprehending the topics covered in class. For many years, the approach to education was curriculum-centered. Analysis of learning activities and the development of methods to attain certain learning outcomes were the main focusses of instruction.

The focus of study has recently changed from analysing the curricular materials' structure to figuring out the learner's cognitive state. Nowadays, education focusses more on expanding students' existing knowledge than it does on imparting the "optimal" structure of instructional material. This viewpoint has consequences for technology-assisted instruction. The first goal of education should be to expand on each student's prior knowledge. A student's past knowledge greatly influences what they learn in school. Therefore, bridging the gap between formal education and personal experiences is one function of technology. Additionally, technology should be adaptable enough to meet kids' ongoing learning demands. The capacity to identify and correct pupils' misconceptions is one of the characteristics of a skilled teacher. Therefore, technology-based training should be sufficiently adaptable to adjust to students' experiences when learning issues develop.

The idea that education should be based in familiar circumstances is closely tied to the idea of drawing on students' prior knowledge and experiences. In order to promote transfer and increase instructional efficiency, teachers often decontextualise their lessons (Merrill, 1991). But according to recent study, these techniques actually make transfer more difficult. They contend that education need to be grounded on situations where people are really addressing problems. Before creating rules, one such method, called contextual cognition (Brown, Collins, & Duguid, 1989), teaches in a variety of circumstances. It seems that there are cognitive and emotional advantages to establishing education in relevant situations. Learning happens by building on previously learnt experiences, according to one of the tenets of cognitive psychology. It seems that students are better able to connect new material to experiences when they are taught in familiar settings.

Additionally, contextualisation seems to have a powerful motivating element. Compared to decontextualised learning, learning in a familiar setting may be more personally meaningful (Keller & Suzuki, 1988). By enhancing students' experiences and offering a relevant learning environment, microworlds serve as an example of how technology may enhance meaningfulness. A microworld is a unique learning environment that precisely simulates a phenomena and modifies the degree of teaching complexity to correspond with the learner's comprehension level. In order to explain Newton's Laws of Motion, Rieber (1992) created the computer microworld Space Shuttle Commander. Students get a visceral knowledge of the connections between the instructional themes by investigating the microworld. Microworlds provide students the chance to analyse and work with topics in ways that would not be feasible otherwise, as well as to apply what they have learnt to the actual world. By employing the scenario of flying across frictionless space on a space shuttle, the microworld incorporates a fantasy aspect to inspire learners and offers many difficulty levels to fit different user skill levels.

Conclusion

The job of teaching in a classroom setting is a challenging one. There is little question that the majority of people who are not in the area of education assume that teachers spend the bulk of their time teaching, despite the fact that teachers are responsible for a variety of responsibilities that are not directly linked to classroom instruction. In this article, we have investigated the reasons why technology has not been able to have a positive influence on education in the past, and we have established the criteria that must be met in order for technology to be used successfully in the future. Teachers need to go past the Familiarisation and Utilisation stages of technology usage and into the Integration, Reorientation, and Evolution phases of technology use in order for it to be utilised successfully. Idea and product technologies need to be unified. It's possible that educators who learn how to incorporate technology into their lessons would eventually rethink their positions in the classroom. Teachers are able to build settings in which students actively participate in cognitive partnerships with technology by using the results of research from cognitive psychology and other relevant fields as a guide.

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