Factors influencing technology integration in teaching: a Taiwanese perspective

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Although the use of computer technology in classrooms is an innovative approach to teaching, teachers with creativity might not use technology as intensively as they use other creative strategies in the classroom. Eight teachers who won an award for creative teaching were interviewed in order to identify the factors affecting their use of technology in creative teaching. Teachers’ perceptions about technology use were studied. Two major issues were explored. First, we studied how teachers integrated technology into creative teaching; we then identified the factors that influenced teachers’ use of technology in teaching. The identified factors were classified into four categories: environmental, personal, social and curricular issues.

Introduction

Recommendations for the transformation of schools and for innovative teaching practices have been expressed in many countries—such as Japan, the USA, and various European countries. Further details can be found in the review by Storm and Storm (2002). Helping students to perform well in the realm of creative behaviour requires change in both educational policy and teaching practices. For example, in Taiwan, the Ministry of Education has fostered curriculum reform that requires student teachers to learn in diversified, autonomous, flexible settings (Ministry of Education, 2003). Teachers are thereby encouraged to use various materials and diverse teaching strategies to facilitate students’ creativity.

Originally, creativity was perceived as in integral aspect of intelligence that was largely hereditary and possessed primarily by only a few highly endowed individuals (Galton, 1869). However, as multidimensional theories of intelligence and the concept of diverse human abilities evolved (Guilford, 1956; Sternberg, 1988), creativity came to be viewed as a construct that bears some relationship to intelligence (Esquivel, 1995). Creative actions are oriented towards the acquisition of new and useful ideas, discovery, and production. A classroom environment that

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enhances creativity provides students with choices, acquires different ideas, boosts self-confidence, and focuses on students' strengths and interest (Fleith, 2000). Incorporating cognitive strategies into activities that allow students to explore, create and express ideas reinforces the importance of creative processes and productions.

Fostering creativity often requires the use of an unconventional learning environment that can facilitate active participation and involvement by learners (Ai-Girl, 2001). Moreover, creative teachers should also encourage students to become creative thinkers, and try to help them to view the complexity of a new task as a challenge. In addition, they should help students to sustain concentration when confronted with multiple options, and accept the temporary incompleteness of some tasks (Storm & Storm, 2002).

As technological developments accelerate in educational settings, connecting academic learning with modern technology can help students gain more opportunities and stimulate interest in exploring learning content (Wright, 2001). Teachers must be willing and able to use technology effectively in their teaching in order to realise the benefits that it can offer (Luan et al., 2005). The role of a teacher should be to lecture less and, instead, guide students in directions that will allow them to discover as they work (either independently or with other students) and to understand instructional content (White, 2002).

Although teachers may be taught about new technologies, they might not totally agree on how these technologies can be used to improve their teaching or their students' learning (Zhao, 1998; Sugar et al., 2004). In addition, some educators might be concerned about whether students actually use technology to foster higher thinking skills (Wright, 2001; Posner, 2002). In addition to teachers' personalities and beliefs on teaching, experience with the use of technological tools, support from the school, colleagues, the community, and students' parents might have potential impact on technology integration. More planning effort should therefore be used before implementation (Robertson, 2000).

In order to understand the use of computer technology in innovative teaching, teachers' perceptions about technology need to be further studied. The study reported in this paper has investigated how teachers integrate technology into creative teaching. It has also identified some of the factors which influence their use of technology in teaching.

Method

Subjects and settings

The subjects for the study were teachers who had won a Createach Award. This award is sponsored by the Chinese Creativity Development Association (CCDA) in a nation-wide contest held annually in Taiwan to reward creative teachers in primary and secondary schools. The award serves as an impetus to creative education in Taiwan. The realisation of this goal requires innovations in active learning, team teaching, independent learning, co-operative learning and individualised instruction.

The eight participants who took part in this study were each winners of a Createach Award in 2002. These teachers were from different schools and involved various teaching domains. These included mathematics, language arts, information technology education (teaching about computers), arts and humanities, social studies, science and technology, and integrative activi-
ties. Of the eight participants, four were primary school teachers and four taught at the secondary school level. Their teaching experience ranged from two to 23 years. All data collection took place in the participants’ schools. Since the aim of the study was to investigate the factors that influence teachers’ use of technology in creative teaching, purposeful sampling from these winners was likely to more appropriately reflect the key issues involved.

**Data collection techniques**

In this study, several data collection techniques were used. These included field notes, interviews, classroom observations (based on video-tape) and audio-tape recordings. In addition, students’ creative work in specific classes was also gathered. The use of various sources of data in the research study enabled us to gain a deeper understanding of the meanings that participants ascribed to their own and each other’s actions (Stake, 1988).

In observing classroom activities, field notes were taken in order to record details of what happened during lessons. More frequent classroom visits were scheduled if a teacher planned a technology-intensive approach to a specific topic. Interviews with teachers were conducted through semi-structured, open-ended questions. All interviews were recorded and transcribed for further analysis. The interviews were designed to collect descriptive data in the subjects’ own words and to develop insights about the subjects’ perceptions and experiences.

The framework that was used for assessing teachers’ perceptions about technology integration is illustrated schematically in Figure 1.

The interview protocol that was used included the following topics: teachers’ backgrounds, strategies used to encourage thinking and activities, ways to obtain ideas for creative teaching, belief in use of technology, and whether or not technology is used. If a teacher had experience

![Diagram](image-url)
in using technology, questions regarding its use for different purposes were asked. For example, we asked: how computer technology had been integrated into the teacher's daily life (such as being used as a personal tool), how it was used for teaching and how it was being used for encouraging creative ideas among students. Issues concerning the depth of a teacher's involvement were also probed—such as practical approaches in the classroom, different ways of using technology in the classroom, ways of using technology to foster thinking and creativity, and factors that enhance and inhibit its use.

Analysis

All the interview data were transcribed and coded. Data coding and grouping were ongoing processes along with the data-collecting process. Re-coding and re-grouping of data were therefore conducted whenever necessary. For example, in analysing one of the teacher's responses towards the use of technology, a coding schema that followed the structure of the interview guidelines was first used. Subsequently, the data were analysed in further detail for explicit and implicit factors. Teachers' points of view were also translated into implications. As the process of re-coding and grouping proceeded, the analysed data was re-clustered. In the final stage, key issues relating to integrating technology into creative teaching were identified and duplicated items were eliminated.

Results

Integration of computer technology into classrooms

The results of this study show that computer technology was used to a greater or lesser extent by each of the eight creative teachers involved in the study. Most teachers considered that creative teaching did not necessarily have to be involved with technology; however, technology might extend their use of creative teaching strategies. With the exception of the information technology classes, since each class had limited access to computers, the integration of computers into the classroom had certain boundaries.

We found that all of the teachers involved in the study knew how to use computers for presenting instructional materials, planning lessons and preparing handouts. Microsoft's PowerPoint was the most frequently used tool for presenting learning content. The use of computer technology in the classroom reflects different levels of integration—with some teachers using it more intensively than others.

Integration of computer technology by these teachers varied—partly due to the differences in their teaching domains. In a mathematics classroom, computers were used for presenting animation to help students learn concepts of geometry. Computers were also used as a tool to share thoughts and ideas. Individual student's problem-solving strategies were projected and discussed among the class. In learning social studies and science/technology, project-based learning approaches were employed in classrooms, and students were encouraged to explore knowledge outside the classroom. A task-oriented approach was employed in order to encourage students to select topics that were of interest to them, gather information for their research, organise what they obtained from the Web and other resources, create their own knowledge, and present and show their findings to the class.
In arts and humanities classes, artwork presented from specific web sites was used as an incentive to stimulate students' creativity. Students had the chance to see and reflect on other people's artwork before actually making their own creations. Students' creative works were gathered and compiled as portfolios and stored on CD-ROMs. In counselling classes, PowerPoint was used as a tool to present stories and metaphors, encouraging students to react to the questions presented at the beginning of the class regarding social relationships with people. In other integrative activities, students' performance and activity records were video-taped and transformed into digital form. These records were often used for sharing and stimulating students' creative ideas.

Among the teachers' subject domains, the information technology class had the most frequent access to computers. In this class, students were taught how to design web pages and use various multimedia tools. In order to encourage students' own creation and integration of different knowledge domains, the class used collaboration with other faculty members as content experts. Students were asked to work as a team to develop a web site for presenting information about an issue, a place, or a person. Through active participation in this work, students were encouraged to consolidate their understandings of the content area. At the same time, they re-packaged knowledge, and gave new form to what they knew.

Concerns about technology integration

Although most teachers valued the use of computer technology in their classroom, some negative attitudes were also reported. The use of technology in teaching requires a more creative approach, a view reiterated by some teachers.

There is too much information on the Web. Students were more involved in copying and clicking rather than analysing and integrating information into a meaningful form. To be creative, you have to think it yourself, and do it yourself. Students need the ability to think critically, to gather data, to formulate models, to create knowledge of their own, and to invent artworks and products with their own ideas. (T4)

As reflected by most teachers, their attitudes toward the integration of technology into classrooms tended to be based on a 'tool' approach. Teachers used computer technology to plan lessons, prepare handouts, develop test items, and assess students' performance. Using this tool with their teaching, however, was only a part of their classroom activity. Since they wanted their teaching to be diverse and creative, various strategies and activities were used in the classroom. Like other strategies and activities, the use of computers should encourage students' curiosity, participation, involvement, and different approaches to a question or an issue.

Through the use of various Web-based resources, projects related to specific topics were presented to students. Before actually creating, students often need to obtain an idea about what they should accomplish. Then they must start their own, make their own plan, and develop their own ideas. (T5)

Computer technology might also serve as a self-monitoring tool to encourage more creative efforts among students. One teacher (teaching art and humanities) had her own web sites to post students' artwork and share ideas for creation. Putting students' artwork on the Web gave students a chance to see their peers' creations through electronic access. By comparing their own creations with those of other students, they learned how to improve their own work. Similar reactions were also obtained from the teacher who taught information technology (teaching about computers).
The use of technology stimulates students’ curiosity and motivation to learn a subject area, and to view the creation of knowledge in a different way. Students have flexible directions and chances to obtain brainstorming ideas. (T1)

However, it takes time to be more creative. Strategies that foster creativity require more time and collaborative effort for planning and implementing. Understanding how to use technology to foster students’ cognitive processes and creative thoughts is crucial to technology integration.

To make technology become a creative tool, we need to learn how to use it in teaching, as well as how to make students use it in a way that promotes their own thinking ability and creativity. (T3)

When promoting technology integration into students’ learning activities, concerns also came from students’ families. One teacher reflected that students from remote urban areas or from low-income families might not have a Web-connected computer at home. Since time for accessing a computer was limited for every individual student at school, most students needed to have a computer at home to work on their assignments. Some parents complained about the difficulties associated with accessing computers at home.

Factors affecting technology integration

Teachers used different strategies to encourage students to learn creatively, and the use of computer technology was one of the various strategies. Although most teachers were positive about using computer technology as a creative teaching strategy, there were some concerns regarding its actual implementation. Some teachers were concerned about the supportive resources available, while others were concerned about whether the technology could be used in a creative way. After analysing the data, various factors that influenced the teachers’ approaches to integrating technology into creative teaching strategies emerged. These were categorised into four major aspects: environmental, personal, social and curricular factors (see Table 1). Each of these aspects is discussed in further detail below.

Of the environmental factors, issues related to computer facilities (hardware, software, and bandwidth of network system) were the most frequently mentioned. Whether a school had a sufficient budget to support the use of technology influenced teachers’ willingness to try innovative teaching methods. When integrating technology into a subject area, it is likely that students would need to practice at home, so the availability of a computer and the Internet at home was essential. Teachers were also concerned about the available support and management of resources and manpower provided by their schools, as well as the allocation of time for using the computer lab by different teaching subjects. Moreover, whether schools provided opportunities for in-service training, or had a policy to reward technology integration and creative teaching, might influence a teacher’s initiative.

Personal factors relating to a teacher’s personality and beliefs also had potential impact on the use of technology and creative teaching from the teachers. Teachers’ beliefs about teaching, their experience in using technology and interest in trying new things affected their willingness for technology integration.

I don’t think what I have done makes me become a creative teacher. I just did what I think and believe that most teachers should do to make children more involved in learning in our classrooms. (T1)
Table 1. Important factors that influence the integration of technology into teaching

<table>
<thead>
<tr>
<th>Identified category</th>
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<tbody>
<tr>
<td><strong>Environment factors</strong></td>
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<tr>
<td>Computer facilities (hardware, software and bandwidth of network system)</td>
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<tr>
<td>Budgets for support of technology and creative teaching from schools</td>
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<tr>
<td>Availability and access to computer and Internet at home</td>
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<tr>
<td>Availability of support and management of resource and manpower</td>
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<tr>
<td>Allocation of time for using computer lab</td>
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<tr>
<td>Opportunity provided by school for in-service training</td>
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<td>Rewarding policy for integrating technology and creative teaching</td>
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<tr>
<td><strong>Personal factors</strong></td>
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<tr>
<td>Personal belief about teaching and teaching with technology</td>
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<tr>
<td>Personal experience in using technology and trying new things</td>
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<tr>
<td>Integration of computer technology with personal lifestyle</td>
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<tr>
<td>Interest in using computers</td>
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<tr>
<td>Interest in the teaching domain</td>
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<tr>
<td>Support from family</td>
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<tr>
<td>Need for personal growth</td>
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<tr>
<td><strong>Social factors</strong></td>
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<tr>
<td>Support from peers (working companions, co-workers, colleagues)</td>
</tr>
<tr>
<td>Attitudes towards using technology from authorities (the principle or supervisor)</td>
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<tr>
<td>Students' learning achievement, attitudes and responses toward specific approach</td>
</tr>
<tr>
<td>Reactions from students' parents, or actions of support from students' families</td>
</tr>
<tr>
<td>Resource supports from community</td>
</tr>
<tr>
<td>Technology trend and social change</td>
</tr>
<tr>
<td>Social value in using computer technology</td>
</tr>
<tr>
<td><strong>Curricular factors</strong></td>
</tr>
<tr>
<td>Curricular objectives should be achieved</td>
</tr>
<tr>
<td>Skills and literacy needed to be enhanced</td>
</tr>
<tr>
<td>Assessment of students' performance</td>
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<tr>
<td>Considerations about integration of existing teaching strategies</td>
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<tr>
<td>Teaching load: time and effort to prepare classes</td>
</tr>
<tr>
<td>Nature of the learning subject: use of technology and its relation to learning</td>
</tr>
<tr>
<td>Control of using technology: easy or difficulty to handle</td>
</tr>
</tbody>
</table>

It was also observed that when teachers' personal lives were closely related to using computers, they were more likely to integrate technology into their classrooms. Some teachers had a strong interest in using computers and new technology, relying strongly on technology to solve their own personal problems and looking for new breakthroughs in instructional implementation. They also had great interest in their teaching domains, and used technology to support their learning of domain knowledge. Most teachers considered that learning about new technology and integrating new ways of teaching helps them in their personal growth. However, involve-
ment in integration of technology into classrooms required much more effort and time than regular teaching.

Social factors that influence an individual's effort in the use of technology and creative teaching in classrooms might also play an important role in the process and production of creative teaching outcomes. Some teachers felt that they were lucky to have wonderful colleagues to work with as a team in trying creative efforts. On the other hand, some teachers felt that if they had had supportive working companions, they would have done a better job in integrating technology into creative teaching. In supporting teachers' creative efforts, the attitudes of management (such as the principle and the supervisor) were critical. Most teachers agreed that a principle who was open to and supported using technology encouraged teachers to take the initiative in technology integration. An open atmosphere within a school society also inspired teachers to be creative. Social factors that affected technology integration also came from the reactions of students, their parents and the community. Students' achievements, encouragement from parents, and resource support from the community helped in supporting teachers' innovative approach to teaching. Other social factors such as technology trends and social change also gave a powerful push to the integration of technology into creative teaching. Social values in preparing students with technological ability for their future had potential impact on teachers' attitudes towards the use of technology.

The curricular factors that we identified involved issues related to the goals and instructional setting within particular courses. In particular, the use of technology should help cope with the achievement of course objectives. Considerations about the skills and literacy required from classroom activities and how students should be assessed for their performance were of most concern to teachers. When planning for a technological approach, teachers were also faced with the problem of integrating new strategies with existing strategies. Those teachers who were not very 'technology oriented' were likely to need extra time and effort to learn new skills, and to plan and prepare for activities with computers.

Another concern came from the nature of learning objectives. In some learning tasks, technology might not be so essential. For example, in abstracting concepts or the actual production of artwork or writing, the process of analysing, thinking, and generating were considered more important than learning to use computers.

The level of control in relation to the use of technology was another concern expressed by some teachers. The use of technology might not be as easy as its integration with other strategies used in classrooms. Even if teachers could partially integrate computer technology with other class activities, the fixed class schedule and intensive use of a computer lab might limit the level of integration. Since most computer labs were predominantly used for information technology classes, limited opportunities were provided for other courses. As a result, students' active participation in computer activities in classes (other than information technology) was very limited.

When deciding to try integration of technology, teachers might initially simply have wanted to see examples of technology use in practice along with general information about how these ideas might work in their own setting. If they then decide to use technology in an innovative approach, teachers could then address more specific concerns relating to employing the ideas in their own classrooms. The key issue surrounding the use of computer technology in their classrooms was to make students learn better.
Technology is only a tool. (T2)

If I cannot actually help students learn better with the use of technology, I prefer using other strategies. (T2)

Discussion

Studies related to teachers' behaviours on fostering creativity have been reviewed by Esquivel (1995). It was noted that teachers' personality characteristics had an influence on the creative development of students. Also, as viewed by Dacey (1989), one of the most important characteristics of effective teachers is their attitude towards creativity and their ability to be accepting, open, and flexible in their own teaching. In our study, we observed how the teachers who possessed creative behaviours reacted to the use of technology in their classrooms. Using a qualitative study, creative ways of approaching technology integration and factors influencing on implementation were identified.

Since the use of technology has become a new trend for learning, teachers seem to have accepted the rationale for using technology in schools. Teachers expressed their experiences in introductory training on general computer teaching tools. This and other recorded facts indicate that for many teachers competency in using technology means, primarily, to know about the basics of computers. According to the findings of Demetriadis et al. (2003), it remains unclear as to how exactly computer technology is going to be used for teaching and what kind of skills and knowledge will be necessary. Many teachers therefore set their main objective to be what is already clearly identifiable (that is, technology knowledge and skills at a basic level).

In this era of rapid change, educators increasingly recognise that in order to teach creatively, they need to shift from traditional lesson formats (based on transmitting information) towards approaches that help students to construct meaningful understanding. However, such transformation of curriculum and pedagogy is a complex task for teachers who must develop new knowledge, skills and beliefs (Wiske et al., 2001). Although much effort has also been expended in preparing teachers to use technology with learning and teaching (Farnsworth et al., 2002), teachers might approach technology with different perspectives, due to the consideration of school settings, personal beliefs, experiences, and the need for professional development. Also, social and curricular issues, such as support from peers and community environments, are all important concerns.

So, how can the use of technology become more creative? As reflected by many of the teachers involved in our study, creative teaching does not necessarily have to be technologically oriented: technology is only a tool, a tool which can be used in different ways, depending upon how classroom activities are arranged to achieve intended purposes. Teachers with creative teaching techniques are supposed to be more explorative and positive about how technology is used in classroom situations. However, most of the teachers still felt that incorporating new technology into classroom settings needed suitable training. Technical and administrative support and/or systematic incentives from schools is also essential. Naturally, teachers worry about their ability to overcome possible technical problems and to handle technology effectively, which in turn, makes them feel insecure and reluctant to use technology in teaching.

In a school setting, a rewarding policy (such as reducing class contact hours) is the most practical incentive for technology adoption. Demetriadis et al. (2003, p. 27) emphasise this point:
'teachers are reluctant to participate in seminars outside of their timetable, as this would be a significant additional workload for them'. We obtained similar comments from the teachers in our study. Teachers would be more willing to invest time in innovative approaches to technology integration if class hours could be reduced.

In order to integrate technology into creative teaching, opportunities for providing professional development to support teachers in their transformational process is important. Wiske et al. (2001) have criticised learning opportunities for teachers because they tend to be short-term workshops that are focused on general topics rather than deep knowledge of the subject matter and pedagogy. Our study reflects similar concerns by teachers. Teachers anticipated more innovative approaches and more opportunities for in-service training; but at the same time, they were also concerned about what could be actually fitted into the pedagogy. From the teachers' perspectives, content expertise and teaching competencies are necessary, so it is also important that teachers should develop the ability to transfer these competencies to their encounters with students and to the learning environment in the form of creative behaviour.

In their analysis of learning, Putman and Borko (2000) applied a 'situational perspective' for cognition in order to understand how physical and social contexts affect teachers' professional development. The challenge of situating professional development in teaching contexts requires striking a balance between helping teachers to break out of old ways of thinking, while also maintaining a strong connection to real practice. Social support for professional development and social issues related to working colleagues, and support from the community are all important facilitators to teachers' approach in technology. Teachers who are isolated from ongoing support from their colleagues will be limited in their willingness to use technology.

Conclusion

In the study described in this paper, teachers' reactions towards integrating technology into creative teaching were assessed using a group of winners of a creative teaching award. Since creativity is a unique and integral aspect of human experience as well as an important educational goal, its development and use are of potential value and of benefit to others and society. Teachers play a significant role in fostering the development of creative abilities through their attitudes, practice, and their relationship and behavioural interaction with students. From our study, a list of factors that affect teachers' technology integration has been identified (Table 1). These research-based findings reflect that the factors influencing the integration of computer technology with creative teaching are not solely from the teaching environment and personal factors; there are also social factors and curricular factors surrounding teaching and learning issues. These factors can be used as a basis for future assessment of teachers' perceptions. Further assessment of how these environmental, personal, social, and curricular factors are viewed by other teachers is required in future research.

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