

A STUDY TO DETERMINE THE SUPPORTING TOOLS OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN CREATIVITY AMONG STUDENT TEACHERS OF A PUBLIC UNIVERSITY IN SABAH, MALAYSIA

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ABSTRACT

Creativity is an essential competence through which people can develop their potential to use their imagination to express themselves, and make original and valued choices in their lives. The growing interest and concern in cultivating creativity has prompted much education reforms being undertaken in a number of countries, particularly Malaysia. Creative teaching and reflective practice are the two most important milestones that teachers aspire to attain. This study explores the role of Information and Communication Technology (ICT) in supporting the creativity process of a group of student teachers in a public university in Sabah, Malaysia. The use of ICT includes collecting relevant information or knowledge to scaffold the revision of existing ideas and development of innovative concepts and hence, possible innovations and inventions. The researchers identify ten most important tasks for the student teachers where ICT application is most appropriate. This is to identify what ICT software is most frequently used and important for the creativity work of each student teacher. Then, the usage of ICT is mapped to the Loveless's Model of Five Elements of Creativity. Results showed that ICT plays an important role, as specified in the Model, in supporting the creativity process of student teachers while completing the ten important tasks. The study suggests that the Ministry of Education, universities or institutions of higher learning stress the importance of computer literacy education for secondary school students. The training should focus on data/information searching strategies via the Web, data arrangement, sorting and analysis

(computational software) and graphical as well as presentational software. The training should preferably be completed prior to the students entering the universities for further studies.

Keywords: creativity support tools, ICT, models of creativity, usage of ICT

Introduction

The last three decades of educational research and development have led some educationists to suggest that man prefers to learn in creative ways through creative and inquiry-oriented activities (Torrance 1990). This has motivated many researchers to seek and explore ways of teaching and learning (T & L) in a creative manner.

However, teachers have to be creative first before meeting the challenges of creative T & L. In order to respond to these creative needs of the learner, the teacher would be required to recognize and acknowledge the learner's potentiality. Creativity is latent in every person although this can remain as a suppressed potential in many people. Just how one can discover the inner abilities to perform every task creatively is just as challenging.

In other words, creativity of a person can be fostered and improved, especially his creative thinking skills and abilities. The rapid advancement of Information and Communication Technology (ICT) has created societal transformations and improvements in the quality of life. Thus, it can play a significant role in fostering creativity. Traditionally, creativity potentials of people are fostered via face-to-face training such as the "PO" programme for lateral thinking by DeBono (1990). Many of these creativity trainings today have been utilizing face-to-face session (Treffinger and Isaksen 2001). Therefore, in what way can ICT play its role in supporting creativity training?

The implications of ICT to educational reform are deemed inevitable which leads to changes in instructional, curricular, administrative, and research aspects (Fetterman 1998; Lesgold 1993). How does ICT facilitate and improve learning? According to constructional learning approach, learning is inherently active, reflective, self-regulated, social, collaborative, and problem-oriented in nature. This form of learning can be enhanced using ICT.

Examples of ICT roles in learning are computer-supported collaborative learning, e-mail, Internet Relay Chat (IRC), and video conferencing for sharing ideas and solving problems collaboratively (Dillenbourg 1999).

Furthermore, the internet serves as an extensive database for users to extract useful information.

This research is designed to investigate the supportive role of ICT in fostering creativity. The respondents are university undergraduates pursuing a degree in Education. For example, a creative student teacher needs to present his/her assignments or projects creatively with the assistance of ICT. In this regard, the research focuses on how ICT can help to fulfill these needs. It also defines the student teachers as people or researchers, who need to go through a process of getting data/information, process them into presentable format, and then present and share them with their peers and friends.

Research Questions

This research is designed to provide answers to the following questions:

1. What are the most frequently used softwares that help student teachers to present their assignments/projects creatively?
2. To what extent do the student teachers' use of ICT comply with Loveless's Model of Five Elements of Creativity that emphasises the four features of ICT (provisionality, interactivity, capacity or range, and speed or automatic functions)?

Literature Review

According to the book "*Poetry About Creativity*" authored by Alfreda, creativity is, "delicate combination of elements that result in new ideas and innovations" (Alfreda, 2007). This definition is closely related to innovation—the process by which new ideas, practices and methods of organisation are generated. But creativity is more than just innovation for its own sake. To exercise creativity we have to be able to understand and respect the parameters of an existing practice, and to go beyond it. Torrance Test of Creative Thinking (TTCT) says that creative thinking ability is, "*constellation of generalized mental abilities that is commonly presumed to be brought into play in creative achievements*" (Torrance et al. 1992,1).

Creativity, therefore, has to be able to articulate the kind of value it is helping to generate, although this value might be expressed in many different

ways. Creativity involves the exercise of *imagination*. Creative learning often involves finding ways to generate a new perspective on an existing question or practice, and therefore, to understand it more deeply.

The process of creativity that was first described by Wallas (1926) has four stages. The first stage is the *preparation stage* where the problem is investigated from all directions. Secondly, in the *incubation stage*, the individual is termed as not consciously thinking about the problem. In the subsequent stage, the *illumination stage*, “the happy idea” emerges. The last stage is the *verification stage* where the validity of the idea is tested and reduced to exact form.

Follow-up researches on Wallas’s model of creativity and its processes had produced many more theoretical models which are more or less the combination, break-up, or a modification of the basic model. Stein (2004) defines creativity as a three-stage process, namely, hypothesis formation, hypothesis testing, and communication of results. It combines the preparation, incubation, and illumination stages of the Wallas Model into *hypothesis formation stage* and adds another stage for communication of results. Stein (2004) views the publication and sharing of the creative work in the *communication of results stage* as vitally important to the research communities.

Rhodes’s (1961) theoretical model of creativity is in the form of *Person*, *Process*, *Product*, and *Press* or familiarly known as 4Ps. It describes creativity in terms of components. The *Product* and *Press* components are quite similar to Stein’s *hypothesis testing* and *communication of results* while the *Person* and *Process* resemble the first three stages of the Wallas’s Model.

On the other hand, Gardner’s Model of Multiple Intelligences features creativity in a form of pluralistic theory of mind, recognizing multiple intelligences in individuals and differing a person’s creativity through his/her innate abilities (Gardner 1983, 1993). For example, a gifted person with musical talent can display his creativity best with this special inner ability.

Creativity can also be categorised with a model by Amabile (1982) in different interacting components. It involves an individual that possesses domain-relevant knowledge, creative skills and intrinsic motivation that interacts with the external social environment that resulted in his creativity. In addition, creativity can also be studied as a system approach (Csikszentmihalyi 1996). Csikszentmihalyi describes an individual operating within a domain, presenting his work to be judged by a panel of judges on the other side of the system for acceptance as a creative contribution.

Shneiderman (2000, 2002a, 2002b) understands creativity in a form of genex framework in which there are four activities for generating excellence. The *Collect stage* involves learning or exploring previous work stored in libraries (or the Web) while the *Relate stage* involves collaboration of ideas with peers and mentors. In the *Create stage*, a person explores, composes and evaluates possible solutions. The last stage is the *Donate stage* where the results are contributed and shared in a form of publications in reports or journals.

Loveless proposed a model with five elements of creativity (Loveless 2002). The elements are *using imagination*, *fashioning process*, *pursuing purpose*, *being original*, and *judging value*. These five elements can be fostered with the appropriate use of ICT. The *using imagination stage* is the process of supposing and generating original ideas and providing an alternative to the problem under investigation. The *fashioning process stage* is the skills where an idea is shaped, refined, and managed. The *pursuing purpose stage* is where the motivated person uses his imagination to produce tangible outcomes from purposeful goals.

In the *being original stage*, the person displays originality in his work in relation to his previous work, peers, and historically (completely new and unique). The last stage, the *judging stage*, is where evaluation takes place when other individuals and peers give reflective reviews and comments on the accomplished creative work.

Loveless (2002) also suggests four features of ICT that can be mapped with the five characteristics of creativity. They are provisionality, interactivity, capacity or range, and speed or automatic functions. The definitions for these four features are as below:

- a. **Provisionality:** users can make changes or edit ideas, try out alternatives and keep track of the development of ideas.
- b. **Interactivity:** engage users at a number of levels.
- c. **Capacity or range:** provide access to vast amount of information in various geographical locations (in databases).
- d. **Speed or automatic functions:** technology for storing, transforming, interpreting, analyzing, synthesizing, and displaying information at the highest level.

Table 1 summarises the relationship between creativity and ICT with examples of possible ICT application that can be used.

Information and Communication Technology (ICT) refers to both computer and communication technology. IT (Information Technology) is defined as any equipment or interconnected system (subsystem) of equipment that includes all forms of technology used to create, store, manipulate, manage, move, display, switch, interchange, transmit or receive information in its various forms. Information can be in the form of business data, voice conversations, still images, motion pictures, multimedia presentations, and other forms including those not yet conceived. The meaning of communication refers to a system of shared symbols and meanings that binds people together into a group, a community, or a culture. The word communication is added to IT so as to make a network of the usage of Information Technology (Merriam Online Dictionary 2006).

TABLE 1: Relationship between creativity and ICT and examples of ICT application

Features of ICT	Characteristics of creativity	Examples of ICT application
Provisionality	Using imagination Being original	Word processors (editing, storing, retrieving data)
Interactivity	Fashioning process Pursuing purpose Judging value	Educational software or multimedia learning systems that supports interactive functions (created with authoring tools or Database Management System)
Capacity or Range	Pursuing purpose	World Wide Web (Internet, e-mail, chatting, online forums, digital library)
Speed or automatic functions	Pursuing purpose Being original	Technology for storing (databases, etc.), computational (spreadsheets, etc.) and presentational tools (MS PowerPoint, digital slides, etc.)

Research Methodology

The researchers used the survey method to elicit data from the subjects. The respondents were student teachers who took the Computer in Education (TT1012) and Multimedia (TT2072) courses in the School of Education and Social Development of a public university in Sabah, Malaysia. Purposive sampling procedure was used to select subjects for this study. Out of 210 randomly selected respondents, only 203 of them returned the questionnaire and furthermore, another five subjects were disqualified due to incomplete information needed for this research. As a result, the final number of subjects for this study was 198.

The respondents were given the questionnaire during one of the lecture by the Course Lecturer (for both courses). They were required to listen to the five minutes briefing by the researcher to clarify terms used in the questionnaire that might be difficult to understand. The filling up of the questionnaire required only 15 minutes. The completed questionnaires were then collected for further analysis.

Instrument and Data Analysis

The main instrument used in this research was the questionnaire to survey the type of software student teachers used to complete their assignments or academic writing. In Section A, respondents were required to provide their background. In Section B, ten most frequent tasks related to creativity that required the use of ICT software in their work were identified. The ten tasks were then mapped to the features of ICT in the Loveless Model as shown in table 2.

It is therefore clear that ICT plays an important supportive role in the creativity processes. For example, in the Shneiderman's Genex Framework's *Collect stage*, World Wide Web or the Internet has a vast amount of ideas and information in regard to a problem under investigation. This saves the researcher a great deal of time and cost as searching relevant materials in the libraries needs extensive travelling, energy, and financial cost. The internet technologies such as the browsers provide all the interfaces needed to accomplish the work.

In the *Relate stage*, internet communication tools such as e-mail, IRC, online forums, and video conferencing technologies provide users the means to consult and collaborate with peers and mentors to ensure speedier solutions. In contrast to this, without ICT, a user will need to get a big research funding to finance his travel to various destinations to get materials and confirm findings with his peers or mentors. In other words, nowadays, ICT contributes greatly to the creation of creative products.

In the *Create stage*, users have the choices of various ICT tools to achieve different purposes. For example, Microsoft Office has word processor (MS Word) for preparing reports, spreadsheet for computational work (MS Excel), presentational tool for creative presentation of the work done (MS PowerPoint) and data management purposes (MS Access). In the *Donate stage*, again MS Office provides all the necessary software for the storage and distribution of the work. For wide distribution of the work, internet technology such as network storage and personal websites on servers help greatly in achieving the sharing purposes of the work with the international research communities.

ICT skills are usually taught in secondary schools as discrete skills. The individual software that they learned is often for general use (word processing, spreadsheets, and presentational tools) and not specializing in educational software development. Nevertheless, Wheeler *et al.* (2001) find that the focus of computers is as an effective mind tool which can liberate and foster creativity in students. This study will likely provide answers that ICT supports creativity.

TABLE 2: The ten creativity tasks identified for the four features of ICT

Features of ICT	Items
Provisionality Types of software: MS Word, MS Excel, MS PowerPoint, MS Access	Task 3: Analyse and organise data (figures) or concepts/ideas into tables/charts/diagrams for presentation purposes. Task 9: Modify, categorise and synthesise data or information for improving my assignments/projects/academic writing.
Interactivity Types of software: MS Word, MS Excel, MS PowerPoint, MS Access, Macromedia Flash, Macromedia Authorware/Director, Asymetric Toolbook, MS Frontpage/Macromedia Dreamweaver, Internet, e-mail and online forums	Task 6: Prepare computer-based Teaching and Learning modules for ICT projects/Teaching Practicum. Task 10: Create simple database for standalone operation or online learning.
Capacity/Range Types of software: Internet, e-mail, online forums and digital library	Task 1: Search for new ideas or information for assignments/projects/academic writing on the internet. Task 2: Download charts, drawings, graphics or simple animations for assignments/projects. Task 7: Search for useful references in digital library for constructive or meaningful arguments (literature review) in assignments/reports/dissertation/academic writing. Task 8: Send/receive information/ideas/knowledge from my friends (course mates) for sharing using ICT.
Speed/Automatic functions Types of software: MS Word, MS Excel, MS PowerPoint, Macromedia Flash, Macromedia Authorware/Director, Asymetric Toolbook and MS Frontpage/Macromedia Dreamweaver	Task 4: Present assignment/projects creatively. Task 5: Present Teaching and Learning materials in a form of notes or simplified diagrams or modified/self-drawn graphics or cartoons or animations.

Source: Adapted from Loveless 2002,12.

The inter-item reliability of the four features of ICT using Cronbach's Alpha is shown in table 3.

Task 3 and 9, which represent *Provisionality*, focus on word processing type of software (typing, editing, storing, and retrieving) while Task 6 and 10, which represent *Interactivity*, focus on the type of software that can create educational system or multimedia application. Task 1, 2, 7, and 8 (*Capacity/Range*) focus on software that is used for data or information gathering and sharing using the Internet while Task 4 and 5 (*Speed/Automatic functions*) focus on computational and presentation types of software.

Each of the four ICT features for the creativity model (Loveless) is given a score. If a respondent uses one type of software to accomplish a task, he is given one point. If he uses more software, for example three types of software to accomplish Task 1, he will score 3 points. The maximum score for each ICT feature is shown in table 4.

The score for each ICT feature for each respondent ($n = 198$) will be compared. For comparison purposes, each respondent's score is first converted to 100 per cent. The conversion formula is the following:

$$\text{Usage of software (\%)} = (\text{Score} / \text{maximum score respectively}) \times 100$$

For example, if a respondent scores 6 for *Provisionality*, his percentage for usage of software is 66.67 percent $([6/9] \times 100)$. The mean percentage for usage of software for each ICT feature is therefore *the sum of all "percentage for usage of software" for all the 198 respondents and then divided by 198*. After calculating the means, the number of respondents (f) who have *scores more than the mean of each ICT feature* is recorded and converted to percentage ($\text{Percentage} = [f/n] \times 100$ where $n = 198$). If the percentage is high, it indicates high usage of ICT for that particular feature and vice versa.

TABLE 3: Cronbach's Alpha for four features of ICT

Features of ICT	Questionnaire Items	Cronbach's Alpha
Provisionality	Task 3 and 9	.73
Interactivity	Task 6 and 10	.77
Capacity/Range	Task 1, 2, 7, and 8	.70
Speed/Automatic functions	Task 4 and 5	.78

TABLE 4: Features of ICT and maximum score for software used

Features of ICT	Maximum Score
Task 3 and 9 (Provisionality)	9
Task 6 and 10 (Interactivity)	6
Task 1, 2, 7, and 8 (Capacity/Range)	16
Task 4 and 5 (Speed/Automatic functions)	6

Results and Discussion

The survey data yielded findings for the most frequently used software for the creativity process based on Loveless Model (Loveless 2002). The result is revealed in table 5.

The most frequently used software is MS Word with a total score of 1005 with MS PowerPoint coming up next at 650. This is due to the fact that MS Word and MS PowerPoint are commonly used by student teachers to accomplish given assignments and projects. MS Word is most suitable for typing and editing information and to create reports or dissertations. To present their work, MS PowerPoint is normally used to prepare the presentation slides. Both MS Word and PowerPoint were taught to all student teachers when they were in secondary schools prior to their university education.

Internet (browser) and MS Excel are third and fourth with total score of 477 and 397 respectively. Student teachers normally search the web for information to finish their assignments or projects. As for MS Excel, most student teachers have some knowledge because it is taught during their secondary schooling days. The knowledge helps them to keep data in numerical format for further analysis or graph creations.

Next on the list is the usage of Macromedia Flash with a total score of 304. Flash is taught in this faculty as part of the computer literacy programme to produce student teachers who can create useful animations for educational purposes (teaching and learning activities).

The result also revealed that other software is not so frequently used by the student teachers to accomplish the ten identified tasks. Although e-mail and digital library are also sources of information besides the internet, the result indicated that their usage is only at medium level. Other software such as Asymetric Toolbook and Authorware are rarely used because these authoring tools are not badly needed by the student teachers for their assignments or projects.

TABLE 5: Total usage of software for creativity according to types

Types of Software	Frequency of usage (Total Score)
MS Word	1005
MS PowerPoint	650
Internet	477
MS Excel	397
Macromedia Flash	304
E-mail	269
Digital library	186
Online forums	62
Asymetric Toolbook	44
MS Frontpage or Macromedia Dreamweaver	22
MS Access	22
Macromedia Authorware/Director	9

The Role of ICT in the Loveless's Model of Five Elements of Creativity

Table 6 shows the role of ICT in the Loveless's Model of Five Elements of Creativity. The overall mean percentage usage of ICT by student teachers for producing creative assignments or projects is considered average (less than 55%) with *Speed/Automatic functions* having the highest mean percentage for the usage of software at 54.97 ($SD = 12.19$), followed by *Provisionality* at 50.95 ($SD = 13.15$), *Capacity/Range* at 46.40 ($SD = 9.66$), and *Interactivity* at 36.45 ($SD = 16.37$).

According to table 6, the percentage number of respondents with scores more than the mean percentage usage for *Capacity/Range* is the highest at 70.20 percent. This is because the web serves as the greatest data and information provider, and also the internet which makes collaborative sharing (such as e-mail and online forums) highly available and accessible.

The next on the list is *Provisionality* at 55.56 percent. The high usage of ICT for *Provisionality* in producing their creative works is because

most of them use word processors (such as MS Word) to arrange, analyse and present data and information creatively in their assignments and projects. The evidence of tables, charts, useful arguments, and all type of data analysis found in the assignments/projects lend proof to this finding.

The software usage for features such as *Interactivity* and *Speed/Automatic functions* are the least with only 38.38 percent and 38.89 percent respectively of the number of respondents with scores more than the mean. *Interactivity* feature requires student teachers to create or use software that provides interactive functions such as those created with multimedia authoring tools such as Toolbook or Authorware. However, data in table 5 proves that the usage of these two authoring software is quite limited. Educational programmes are also quite difficult to create because authoring tools are not easy to master and it requires some programming basics. Another possible reason for this is the fewer assignments or projects that are related to the use of these tools, and thus, the low percentage of usage as compared to other features.

As for *Speed/Automatic functions* feature, it requires student teachers to present and share creative work with peers and friends at the university. It is worthwhile to take note that most of their presentations and quality of displayed information (analysed data) are given marks by their course lecturers and therefore, ample use of ICT tools are needed to accomplish the tasks creatively. The low percentage of usage may be due to fewer assignments or projects that require the use of authoring tools and hence, the low score for usage under this feature.

The conclusion for this section is that the pattern of ICT usage as mapped to the four features of ICT clearly shows that ICT supports the five elements of creativity—*using imagination, fashioning process, pursuing purpose, being original, and judging value*. It helps to promote creativity to a higher level. This is to say ICT improves the student teachers' work (assignments/projects) tremendously in creative ways such as to be able to display data/information tables, charts, and graphics. They are also able to analyse and present data creatively.

TABLE 6: The percentage of software usage for features of ICT in the Loveless's Model of Five Elements of Creativity

Characteristics of creativity	Features of ICT	Usage of software (Mean Percentage)	SD	Number of respondents (f) with score more than the mean (n = 198)	Percentage number of respondents with score more than the mean ($f/198 * 100$)
Using imagination Being original	Provisionality	50.95	13.15	110	55.56
Fashioning process Pursuing purpose Judging value	Interactivity	36.45	16.37	76	38.38
Pursuing purpose	Capacity / Range	46.40	9.66	139	70.20
Pursuing purpose Being original	Speed / Automatic functions	54.97	12.19	77	38.89

Limitations and Suggestions

The first limitation of this study is the sampling technique used. There are six programmes in the faculty. However, as a result of purposive sampling, only two groups (two cohorts of students taking two undergraduate courses) of student teachers were selected. Therefore, the findings cannot be generalised to the population of this study.

The next is the assumption that the student teachers' answers to the survey are accurate. However, there exist possibilities where a student teacher may not give accurate answers due to factors like lack of cooperation, honesty, etc.

This study also makes some suggestions to the Ministry of Education (MoE), universities, or institutions of higher learning where similar situations are applicable. The results indicate that the high usage of ICT to produce creative work (which includes presentation and collaborative sharing via

e-mail, etc.) are featured in the four features of ICT in the Loveless Model. Therefore, it is recommended that the MoE, universities, or institutions of higher learning produce learning modules that utilise computer skills in projects or learning activities. The training should focus on data/information searching strategies via the web, data arrangement, sorting and analysis (computational software), and graphical as well as presentational software.

The study also clearly demonstrates that the student teachers' pattern of ICT usage in the creativity process as featured in Loveless's Model of Five Elements of Creativity is indeed in accordance with the four features of ICT (*Provisionality, Interactivity, Capacity/Range, and Speed/Automatic functions*). As a result, the role of ICT in the creativity process cannot be singled out. In other words, ICT plays an important and supportive role in creativity. The suggestion here is that schools or colleges must ensure that every student teacher has attended some minimal computer literacy training, preferably prior to entering the universities to further study so that creativity and innovations can be further enhanced with ICT skills.

Conclusion

This study has proven that ICT features are also important in the creativity process (Loveless Model). The data shows that ICT is an important supportive tool for the basic creativity process or cycle. ICT is used in the data gathering or searching stage through the help of the Web, and further helps in providing software for typing or keeping data. The data is then further processed or manipulated through data arranging (in tables), sorting and analysis (computational), and create presentable charts via presentational software. The final creative product (assignments or projects) is then shared with peers and friends via internet (e-mail, online forums, etc.). This confirms previous studies (Loveless 2002) that ICT has a big supportive role in creativity.

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