Developing higher-order thinking with ICT.

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Introduction

Educators have faced the challenge of developing higher-order-thinking skills (HOTS) among people, so that they will become more disposed to problem solving, raising complex questions, developing consistent arguments and expressing their opinions from critical perspectives. One way these attributes can be developed among students, is for teachers to present learning tasks that will influence students to pursue inquiries from different perspectives, assess the sources of their information, reflect on their findings, exchange ideas and adopt personal positions based on rational thinking.

ICT-mediated learning environments now possess the tools to support these activities and in particular, the Web 2.0 tools, which support inquiry, creativity, critical reflection and dialogue. This paper, presents approaches for using ICT-based learning tasks to develop higher-order thinking skills among students using Web 2.0 tools.

Web 2.0 ICT tools

According to Tinio (2003), ICT refers to Information Communication Technologies which include a range of technologies and other resources that are used to create, communicate, store, disseminate and manage information. Solomon and Schrum (2010) regard Web 2.0 as a second generation of the World Wide Web (WWW) that exploits the ability of people to collaborate and share information online. Blogs, wikis, and social networks some of the main components of Web 2.0 that support interactivity because they allow users to take action and respond to feedback from their actions in an iterative chain of action-response-modified action.

Higher Order Skills

Barak and Dori (2009) explained that higher-order thinking can be viewed as a complex mode of thinking that often generates multiple solutions, without reliance on the application of specific sets of procedures. Some of these skills are included at the upper end of Bloom's taxonomy of the cognitive domain, such as synthesis, application and evaluation. Other writers include critical thinking, creating, and problem solving. Miri, Ben-Chaim and Zoller (2007) explained that HOTS involve complex thinking, multiple solutions, uncertainty, application of multiple criteria, reflection and self-regulation. Although the literature describes many elements of higher order-skills, here we will focus on critical thinking, creating, problem solving and evaluating.

Barak and Dori (2009) regarded critical thinking as a skill that that requires taking responsibility and control of one's own mind. It involves logical and reflective thought prior to deciding what to believe and what action to take. Phiters and Soden (2000) found that critical thinking meant being able to judge the validity and reliability of one's assumptions and also the various sources of information that are available. Coronado (2011) added that critical thinking focuses on revealing poor reasoning and confronting the power structures that are in control of information, to ensure that the users are not misled.

Creative thinking requires the thinker to reorganize recalled knowledge, but reorganizing in a manner that would result in the creation of new knowledge. Creative thinking can therefore

produce new knowledge that moves beyond what is accepted knowledge to what is novel or original. (Iowa Department of Education, 1989).

According to Vockell (2001), problem solving is a process of finding information; a strategy to achieve a goal, or to overcome an obstacle. Problem solving involves describing the problem, anticipating the desired result or solved condition, generating alternative approaches to a solution, selecting likely solutions, testing the possible solutions, evaluating the results of these tests and revising the steps for continuous improvement of the solution. Creativity is often linked with problem solving because the realization of a solution often requires original thinking.

Evaluation requires critical review and reflection on one's positions, viewpoints and arguments, from which informed judgments can be made. One may have to evaluate the internal logic of the information to establish whether the information is valid, and also evaluate whether the information is an objective position, or whether the creator's personal beliefs and prejudices intervened.

Now we will consider how Web2.0 ICT tools can be used to facilitate the development of HOTS through appropriately designed authentic learning tasks.

Learning tasks

A learning task must be designed that will incorporate aspects of the respective school curriculum and also address the HOTS to be developed. These tasks must be based on real-life situations that can integrate the skills, knowledge and attitudes that are targeted in the curriculum. Cram (2009) explained that authentic learning tasks are whole-task experiences based on authentic tasks that integrate skills, knowledge, attitudes and social context. Instruction is organized around the whole task, usually from the easier to the more difficult.

For example, the learning task might be to review a newspaper report, plan a trip for a foreign visitor, or prepare a report on an environmental problem. The tasks should be allocated to groups of students in an ICT-mediated learning environment. In such an environment, groups of students can perform learning tasks with the support of ICT tools for facilitating inquiry, activity, realism, reflection, collaboration and discussions.

The use of Blogs in developing HOTS

Lever- Duffy and McDonald (2011) explained that bloggers post information on the web, and readers respond to postings either by direct comments, or by means of other blogs. Because these postings can be read by anyone in the network, blogs often facilitate sustained discussions. Aggan (2009) observed that a blog is similar to a journal entry that is frequently updated and is intended for the general public.

A typical learning task -
Prepare critical response to the front page newspaper article in today's newspaper that supports the resumption of hanging.

An initial position may be posted by the teacher and students in the class to which students can respond. The blog can incorporate links to the online newspaper article and to other resources, such as articles and relevant statistics.

Higher-order-thinking-skills that may be developed

Zawilinski (2009) explained that as members of the group gather information from various sources to respond to the initial blog, they have to evaluate the sources to ensure that they are credible and relevant. Quite often students have to synthesise content from various articles, and elicit opinions from others, some of whom may be experts from the wider world. As they engage in these activities learners become more motivated because they are interacting with a live and authentic audience. Critical thinking is also exercised when the blogger has to select and attach appropriate links to support or critique a position.

Wikis

Lever-Duffy and McDonald (2011) describe a wiki as a site in which content is written collaboratively so that anyone with access to the Internet can edit and add or modify the information that is provided. The wiki software creates collections of inter-linked pages that can be viewed, and linked to other pages which can be edited by those with the required permission. Any changes made are immediately incorporated into the pages, and the software can record each change so that the status at a given point in time can be viewed. Members are kept abreast of changes as the most recent changes are often displayed. Some wikis incorporate a negotiation space where participants can discuss proposed changes (Pifarre & Staarman, 2011).

Users will have to select a wiki provider, determine the privacy level, that is, whether the wiki will be open to the world or to members of a group to view and edit. At the public level, the wiki is open to all, protected- anyone can view, but only approved members can edit, private- pages can only be viewed or edited by members. In general group members can edit each other's work without special permission. The authority for the wiki and the purpose of the wiki should be explicit, with an indication of the scope and the expected depth of coverage.

Typical Task

Prepare a set of policies that can be applied to reduce marine pollution in a particular location.

Higher-order-thinking-skills that may be developed by wikis

Berger and Trexler (2010) explained that wikis allow students to participate in collaborative activities where the authors have to select material, establish the relevance of the material, write, revise, reflect, edit and publish information and ideas to their collaborative wiki site. These operations help to develop critical thinking skills. Furthermore, as students review previous versions of a document produced by collaboration, they can reflect on, and evaluate the decisions that were taken in previous versions.

When students work collaboratively with others the sense of community within the particular group can be strengthened. In addition group members with similar ideas may be able to collaboratively build on each other's work. Collaborative engagement with wikis produces

documents that reflect multiple viewpoints within a short period; hence wikis contribute to creativity in that a new perspective may emerge from multiple viewpoints. Ducate, Anderson and Moreno (2011) observed that when students work with wikis, they serve multiple roles such as, writers, and editors, which help to make them more critical and imbues them with a greater sense of responsibility.

Snodgrass (2011) reported a situation where wikis were used in a blended instructional approach to develop clinical reasoning among health professional students. Clinical reasoning is the development of a diagnosis from knowledge, cognition, metacognition and reflective inquiry. The process is patient-centered, collaborative, hypothesis-oriented process that incorporates the best judgment into decision-making. In this case groups of undergraduate physiotherapy students presented a patient case to their colleagues on a wiki. Students developed their wiki and presented results every two weeks. This is similar to clinical reasoning with a client, where a practitioner must accept or reject various clinical hypotheses based on information gained from client assessment. Thus the wiki provided a vehicle to practice clinical reasoning in an authentic environment without time pressure or other stresses related to treating a patient. It was found that Wikis compelled students to engage in learning, rather than being passive recipients of information. The high level of student engagement in the current study suggested that collaborative learning using a wiki is potentially more successful when combined with face to face activity and assessment, than if the wiki was used alone.

Jones (2010) described how wikis were used in a distance education mode where social work students completed their final year's work in a subject using a wiki, in attempt to provide alternative and more cost-effective course delivery methods. The wiki was based on development of particular assessment topics of the course and students researched the topic and collaboratively developed a response.

McPherson, Wang, Hsu & Tsuei (2007) found that online learning communities where learners collaborated to produce book reports using wikis could improve students' critical thinking. In these tasks small groups were used and each member had a specific role, such as, guiding the discussion and locating pictures related to the reading. Each member had to examine what they intended to contribute, as well as carefully review what others contributed in respect of the book on which they were reporting.

Social Networks

Human beings have a social need to maintain relationships and to communicate with others. Shah (2010) explained that in a social network each person has a specific network of direct relationships with other users. In order to work with other persons who may be outside of this network, the user must first establish relationships with those outside. According to Green and Hannon (2007) social networking is an aspect of Web 2.0 that allows users to create links between their online presence, such as a webpage, by either joining online groups, or by establishing direct links to other users through lists of friends or contacts.

First one must join a social network. Upon joining, several names may be displayed of those who are linked to other networking sites, who would also like to be one's friend, that is, to interact with one. In schools, it has been found that students are more inclined to display interest in the

social networks when they were involved in developing the site. Ellison, Steinfield and Lampe (2007) observed that one of the main benefits of using SN sites is the accumulation of social capital, which is the capacity to draw resources and assistance from personal relationships with others.

Students in an SN environment expect to critique others' views and contribute to group discussions blending their ideas and experiences with others to create learning. This is quite different from traditional instruction where the teacher lectures and students complete their assignments independently. Furthermore, Brady, Holcomb and Smith (2010) found that SN sites in instruction helped to foster social presence, so that students felt less isolated and experienced a greater feeling of community than when than when they used course management systems.

In collaborative learning using SN systems, as students work together they create new knowledge by sharing ideas and experiences, evaluating ideas and concepts, and building or creating new ideas and new ways of working. Thus collaborative learning with SN sites takes place in a structured social environment where groups of students work in teams assisting group members with their learning tasks. Teachers can use a range of instructional strategies that are influenced by learning theories in designing appropriate learning tasks that will result in the benefits of collaboration.

Malita (2011) observed that registered Facebook users can make use of features such as, creating profiles with (or without) photos, lists of personal interests, affiliations, contact information, and other personal information such as photos and video sharing. Communicating with friends and with other users can be done through providing information about their status, sending private or public messages, chat, or through instant messaging.

A typical task-
Prepare a plan for achieving the career goals of a group of students in your class who are interested in a career in visual arts, by interacting with appropriate individuals and associations.

Higher-order-thinking-skills that may be developed by Social Networks

A wide range of higher-order-thinking skills may be developed by students through the use of Social Networks. Students are likely to develop critical thinking when invited to comment on their own group's work or on the work of others. They may use ICT tools to illustrate alternative views and create new ideas in response to comments from others. They may reflect on materials to appraise their suitability to the topic of concern, and appraise comments from others to gauge their personal capabilities. They may also reflect upon and their own personal experiences in the light of comments received to assess their relevance. Over time students can gain confidence and will be able to defend their positions, although these may be different to the general consensus.

Conclusion

Very often the general preoccupation with ICT in education resides in its novelty and the embellishments inherent to the technology. We have found that carefully designed learning tasks

in an ICT-based learning environment can facilitate the performance of operations that can foster higher-order-thinking skills.

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