Cultivating Critical Thinking Through E-learning Environment and Tools: A Review

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Abstract

Critical thinking is one of the main goals of higher education to train dependant and reasonable thinker as an efficient citizenship in modern society. Researchers and instructors in the world attempt to assess the level of students’ critical thinking in order to foster it as a vital ability. Also, researchers use different learning approaches and theories along with the technological progress to nurture critical thinking of students. On the other hand, the advent of e-learning in education facilitates the difficulties through the learning and teaching paths. Researchers provided models and strategies for developing critical thinking by e-learning tools with their specific characteristic and applications. This paper presents a review on e-learning approaches and models which are used to cultivate critical thinking with the aim of highlighting the importance of critical thinking and the role of e-learning. We also present a taxonomy of existing e-learning models based on their applications and efficiencies as well as presenting similarities and differences in such approaches and discuss open research issues.

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1. Introduction

Cultivating critical thinking (CT) is an important goal of higher education, as it is necessary for students to become a competent citizenship in modern society. To achieve this goal, students should have

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abilities to evaluate evidence, distinguish false, true and incomplete information and draw conclusions. The importance of CT now is a global issue, therefore some countries in the world such as the United Kingdom, the United States, and Australia in the western world and Hong Kong and Japan in Asia attempt to assess and foster it. Although researchers agree with the cultivating CT as one of the main purposes of higher education, teaching for CT has not been a simple task (Ku, 2009). There are two main approaches for fostering CT: (1) the general skills approach, in which educators design special courses for instructing CT skills, and (2) the infusion approach (Swartz, 1987), in which educators develop these skills by embedding them in the teaching of the set learning material (Aizikovitsh-Udi & Amit, 2011).

Regards to the vital role of the Internet in everyday life of recent years, educators use the advantages of online learning to develop students’ CT. In accordance with the educational approaches for CT and the advent of e-learning in different environments, instructors used various methods or tools such as mobile, laptop, video or discussion forums to develop CT which they have different applications. E-learning can be applied in two different environments based on the use of online tools which are synchronous and asynchronous environment. Also, in these environments, some educational approaches are used such as web-based approaches and collaborative learning. This paper presents a review on e-learning approaches to cultivate CT with the aim of highlighting the importance of CT and the role of e-learning. In addition, taxonomy of existing e-learning methods with the basic significant parameters such as different applications in the various environments is provided. Also, this paper investigates similarities and differences in such approaches and discusses open research issues.

The rest of the paper is organized as follows: section 2 describes the critical thinking, the related skills and dispositions. In section 3, e-learning is explained and the role of e-learning to cultivate CT in different environments is expressed in section 4. Section 5 provides a comparison of e-learning environments and the features of them. Finally, section 6, conclusion and future works are described.

2. Critical Thinking

Critical thinking is a reflective and reasonable thinking which is based on being true or false final decision (Ennis, 1989). One of the most important aim of higher education is improving CT of students and prepare them to be a competent citizenship and efficient in their workplace. Therefore, some researchers and educators have been working on this area and defined CT in their views.

CT is described by Facione (1990) as “a purposeful and self-regulatory judgment which is concluded to interpretation, analysis, evaluation, and inference as well as explanations of different types of arguments based on logical judgment”. Although, researchers have a different description about CT, some of them agree that the definitions of CT and instruments for its measurement are common in the ideas of analysis, evaluation, inference, and interpretation of CT. Teaching CT needs to know its skills and dispositions which are described by most researchers. Critical thinking skills (CTS) are as follows: (i) Interpretation: is included categorization and understanding the meaning of the questions; (ii) Analysis: is the identification of arguments or question; (iii) Inference: is included evidence, observations, opinions and drawing a conclusion; (iv) Evaluation: is evidence, observations, opinions and drawing a conclusion; (v) Explanation: is expressing results, validate procedures and presenting arguments; and (vi) Self-regulation: is controlling on the emotions to do self-correction and self-examination.
Also, critical thinking dispositions (CTD) are being open-minded and fair-minded, having the propensity to seek reason, being inquisitive, having the desire to be well-informed, being flexible and respect for, and willingness to entertain, others’s viewpoints (Facione, 1990).

3. E-learning

E-learning is a new educational concept by using the internet and technology tools that are either web-based, web-distributed or web-capable for the purposes of education. Indeed, e-learning makes a revolution in distance education in which it transfers the digital content and provides a learner-oriented environment for the teachers and students. The e-learning heightened the structure of lifelong learning ideas and learning society (Senge, 2013).

E-learning is a means of education as opposed to a method of education. In other words, e-learning involves the use of technological tools that can be applied in various contexts; it is not a distinctive education system in itself. Therefore, e-learning cannot be compared with face to face delivery or distance education because it can be used within either of the models (Eisenstadt & Vincent, 2012). Also, it is possible to apply different educational philosophies using e-learning for instance computers was applied in behaviourist modes who favoured teacher-centred education and constructivist mode who supported learner’s role in education (Ravenscroft, 2001).

Instructors by using the advantages of online learning encourage many trainers to continue their education. It is shown that students feel self-esteem when they use e-learning systems and familiar with technological skills. Educational centres also take advantage of technological equipment to foster active and creative learners in preparing them to go to the work places (Yang, Chuang, Li, & Tseng, 2012).

4. The role of e-learning to cultivate critical thinking

Today, internet and online tools play a vital role in various domains such as health systems, educational field, workplaces, and even in daily life. The significance of internet in educational systems and its effects on the teaching methods and learner’s curriculum are obvious. On the other side, CT has been well-known as one of the key skills in the 21st century, which results in success, and competence in academic and employment responsibilities.

E-learning accompanied CTS encourage students to be ready for modern society. Some researchers insist on being students-based e-learning system because they believe that it save students’ time and they can think deeply when they have to answer to the questions and do their assignments (Benson & Samarawickrema, 2009).

Synchronous and asynchronous learning are two educational approaches based on the leader in the learning procedure. Synchronous learning is instructor-led and it occurs in real-time with all participants, while asynchronous learning is a self-paced approach and it can be happen every time when students want to share their opinions without necessity to attend at the same time. The synchronous learning environment can be included chat rooms or virtual classrooms where everyone is working or studying at the same time and asynchronous learning environment involves email, blogs and discussion boards besides web-supported textbooks (Hrastinski, 2008).
E-learning can be applied in two different environments based on the level of usage of the internet; blended and distributed learning environment. Some researchers propose models to cultivate CT in these environments such as project-based and electronic curriculum for the blended learning environment; and conference systems and online discussion for distributed learning environments. Furthermore, several approaches are used in e-learning environments to cultivate CT which includes collaborative learning and web-based. The taxonomy of e-learning based on the tools/approaches and environments are provided in Figure 1.

4.1. Blended learning environment

Blended learning is a combination of strengths of face-to-face and online learning in a cooperative manner to create a unique learning experience to achieve educational goals. It is a new and different philosophical approach to learning, an incorporating classroom and communications technology with the capability to transform higher education in a better quality. It provides deeper insight of learning and CT through the integration of online courses and traditional classrooms (Garrison & Vaughan, 2007). In the other words, blended learning is the third generation of distance education systems which maximize the best advantage of face-to-face learning and multiple technologies after correspondence education via mail and radio and distance education through a single technology such as computer-based and web-based learning (Phipps & Merisotis, 1999; as cited So, Brush). Some researchers used blended learning environment to develop or teach CT for instance:

Akyüz and Samsa (2009) examined the effects of blended learning environment on the CTS of students and they showed that if students had enough time and computer access, the blended learning environment which students used to discuss influences in a good way on students’ CTS. In the other study, Yang et al. (2012) worked on the effectiveness of integrating CT into individualized English listening and speaking instruction by using Moodle, a virtual learning environment. The values of this study were CTS, CTD, English listening, and speaking proficiency. Researchers found that attending participants in the treatment improved their English listening and speaking as well as CTS sub-scales and made a little change in the students’ CTD except open-mindedness.

Project-based learning: project-based online learning (PBOL) is one of the e-learning model which is used by Kurubacak (2007) to promote learners’ CTS through reusable learning objects (RLOs) from global online resources. PBOL can provide online learners with powerful digital reusable learning resources, and also engage them complex reusable activities by thinking and solving problems critically. In the PBOL environments, therefore, these learners can discover new logical strategies and
specific procedures for producing RLOs. Besides, they can equip themselves with the critical thinking skills that they need to deal with unexpected communication pitfalls in practical. To sum up, PBOL is one of the best methods to develop powerful RLOs by providing their durability, interoperability, accessibility and re-usability.

**Electronic curriculum:** In the other research which was done by Yuce et al. (2011) to design an electronic curriculum to improve learning process. The values which were measured were about the behaviors of the students regarding the course, the relationship between gender and their success and their ability to use the knowledge that they had learned. The results showed that, the electronic curriculum which is used affects students’ long-term learning success in an affirmative way and also, the students who are more responsible for the course had succeeded with higher grades in this blended learning environment.

### 4.2. Distributed learning environment

Distributed learning use multi-media tools for educational purposes that includes web-based instruction, streaming video conferencing, face-to-face classroom time, distance learning through television or video, or other combinations of electronic and traditional educational models. In the other words, it uses blended or hybrid learning components in an online format completely (Bates & Poole, 2003). Educators and researchers attempt to use distributed learning environment in order to teach courses and encourage participants to be well-educated and critical thinker as well.

**Conference system:** Designing the electronic conference systems to support and teaching CT is one of the most important goals of Duffy et al. (1998). They found that computer-based systems can prepare synchronous or asynchronous context for learning and also, discussion is able to occur in real-time or not. Therefore, these researchers proposed complex computer-based conference systems in design and use to promote CT. The results showed that if students are forced to focus on issues and consider how their contributions relate to these issues, they will be succeed. Also, it was revealed hat the asynchronous conferencing environments afford the opportunity for students to engage in CT in the domains, to participate in the rational and professional discussions. In addition, asynchronous conferencing environments provides the contexts to understand the intellectual goals of higher education and exchange information to find the facts.

**Online discussion:** Another e-learning model was designed by De Leng et al. (2009) to promote CT about basic science topics in online communities of students during work placements in higher education. They used Garrison’s Practical Inquiry Model of Cognitive Presence (GPIMCP) to evaluate the quality of the discussion and content analysis. The results showed that the GPIMCP is a useful instrument for procedural facilitation of online discussion among small groups of students. Also, the structure of the e-learning model was useful in making easy a sustained on-topic discourse involving CT in a group of peers.

### 4.3. Collaborative learning

Collaborative learning is a method of teaching and learning in which students join in groups to work as a team to explore a significant question or create a meaningful project (Gokhale, 1995). Collaborative learning can be done in two types: cooperative and problem-based learning.

**Cooperative learning:** cooperative learning is a kind of collaborative learning but with smaller groups of participants than the collaborative learning. In cooperative learning, teams have
less than five members and they discuss and work together by teacher’s supervision. In practice, they think critically and develop their problem-solving skills.

*Problem-based learning*: One of the most widely discussed models for supporting collaborative inquiry in the classroom is problem-based learning (PBL). In PBL, students working with a facilitator in teams of about five who presented a problem or issue that they must analyze and gather data to reach the goal and the solution. The teacher plays a facilitator role and coach students in order to ask questions from students and make students to gather information and analyze them to draw conclusions. The important point for learners is to be able to understand whether or not they are active contributors to their group’s conversation. PBL is a learning model to foster CT which is used by educators and researchers. Unfortunately, PBL lacks a formal process or notation system for addressing the analysis of the problem, though such analysis does arise as part of the problem-solving process (Duffy, et al., 1998).

Sendang and Odabasi (2009) worked on the online PBL approach for undergraduate students’ CTS and content knowledge acquisition. Researchers found that learning in the online PBL group had a significant effect on increasing the CTS. Moreover, it was revealed that the online PBL group improves instructor-led group in terms of CT. Online PBL can be an effective alternative approach implemented in distance education practices.

To enhance students’ CT in an undergraduate general science course Kim et al. (2013) designed and implemented active to examine the levels of CT in individual reports and students’s CT over time to find the. The results showed that the active learning strategies are helpful to promote students CT. Due to the nature of PBL, ill-structured problems or multiple answers, are opportunities for students to thinking critically, seeking solutions and considering other points of views (Jonassen, 1997).

4.4. *Web-based Learning*

E-learning can be the synonym of web-based learning, computer-based learning and online learning. In order to develop student’s CT, design models or propose solutions in the web environment such as:

*Web-based simulation*: Web-based simulation is an online tool which was designed by Honebein (1996) to foster CTS. Afterwards, the other researchers Salleh et al. (2012) examined the effectiveness of simulations on Students’ CTS and the results showed that the implemented web-based simulation learning framework has a positive impact on students’ CTS.

*WebCT*: Another model used by Burgess (2009) to examine possible findings of developmental students’ CT and motivation to read when WebCT as an online learning community was implemented. It showed that online communication methods such as chat and discussion board are more attractive than electronic communications. They have the potential to be a key means to increase motivation and the desire to learn and to think critically.

5. **Comparison of e-learning models to cultivate CT**

Researchers and educators propose different online models to improve CTS and CTD of participants
In various positions which they have differences and similarities that are provided in table 1.

In the blended learning environment PBOL model and electronic curriculum are presented. These models which these models have positive impacts on CTS rather than CTD. PBOL is able to discover new strategies for producing RLOs and electronic curriculum is useful for student’s long-term learning. If students have enough time and access to computers, these models can efficient to cultivate CTS. Instructors use these environments to foster CT according to their needs and facilities.

Table 1. Comparison of e-learning models to cultivate CT

| E-learning environment | Models                  | Features            | CTD | CTS | Synch. | Asynch. | Advantage                                      | Disadvantage                        |
|------------------------|-------------------------|---------------------|-----|-----|--------|---------|-----------------------------------------------|-------------------------------------|
| Blended Learning       | Project-based online    | Student-centred     | No  | Yes | Yes    | Yes     | Discover new logical strategies              | Time computer access                |
|                        | (PBOL)                  |                     |     |     |        |         |                                               | Time limitation                     |
|                        | Electronic              | Student-centred     | No  | Yes | Yes    | No      | Useful for students’ long-term learning      |                                    |
|                        |                         |                     |     |     |        |         | Afford the opportunity for students to engage in CT | Practical for small groups         |
|                        |                         |                     |     |     |        |         |                                               | Practical in a small group         |
| Distributed Learning   | Conference system       | Instructo-centred   | No  | Yes | No     | Yes     | Useful in a group of peers                    |                                    |
|                        |                         |                     |     |     |        |         |                                               |                                    |
| Collaborative Learning | Online discussion       | Instructor-centred | No  | Yes | Yes    | No      | Enough time                                   | Lack of formal process for analysis the problem |
|                        | Cooperative             |                     |     |     |        |         |                                               | Complex in design                   |
|                        | Problem-based           | Students-centred    | Yes | Yes | Yes    | No      | Resource access                               |                                    |
|                        | Web-based simulation    | Student-centred     | Yes | Yes | Yes    | Yes     | Maintaining and learning instructions         | Time-consuming                     |
|                        | WebCT                   | Student-centered    | Yes | Yes | Yes    | Yes     | Increase motivation                            |                                    |

For distributed learning environment, researchers proposed their models to nurture CT. Although, conference systems afford the opportunity for students to engage with CT. Students, they are complex in design and use and useful for CTS rather than CTD. Online discussion is another tool to faster students’ CTS that is effective for groups of peers due to the nature of it in small groups.

PBL can be another learning environment that is one of the learning types of collaborative learning. In PBL, students in small groups join with each other to solve the problem that is given by teachers as a facilitator. Students play key roles in PBL and they can use online tools to evaluate evidence and judge them to conclude, in addition they are able to contact face-to-face relationships and share their experiences. In the web-based learning environment, web-based simulation and WebCT are proposed as online tools which they are helpful to increase learner’s motivation and interest as well as CTS despite of needs to much time and complexity in design of web-based simulation.

6. Conclusion
The modern world and higher education need to have dependant and critical citizenships and efficient workforce for work places. To reach this goal, researchers design models to teach and cultivate CT by using various approaches such as embedding CT in the other course for different grades or assign a specific course to teach CT. Recently, distance education makes learning and education procedure easy in the world by using online devices such as laptop, mobile and discussion forums or video conferencing and virtual classes. Teachers prefer to teach and foster CT to the students by applying the strength of online learning facilities in different environments such as blended, distributed, problem-based and web-based learning. Blended learning is useful for participants who tend to communicate face-to-face more than participants in a distributed learning environment. Furthermore, in a blended learning environment, participants used online tools likewise virtual classroom or chat room while distributed learning environment is online completely and it is good for busy participants who cannot present at the real time. Web-based is a widespread phenomenon as a result of effective role of the Internet in our life. PBL is a helpful environment where students are able to use the direct contact with peers with enough time to think, discuss, evaluate and solve problems to draw conclusion. PBL is a very applicable approach to cultivate students’ CT due to the nature of its environment and some instructors recommend it as a good model to develop CT. Considering the progress in the technological instruments in the education field, using mobile as a general device is growing quickly therefore, it is suggested to study the role of mobile in developing CT by mobile and design a model based on this theory.

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