The Online Project-based Learning Model Based on Student's Multiple Intelligence

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Abstract

Project-based learning (PjBL) has been found to be effective to increase student learning achievement, acquiring knowledge through active learning, gaining interdisciplinary and multidisciplinary knowledge, taking responsibility for the learning, acquiring communication skills and methods of decision-making, and also enhancing student self-esteem, but PjBL can be conducted in a variety of discipline areas, meanwhile Multiple intelligence (MI) is a psychological theory that addresses what the human brain does with information. It defines intelligence as the capacity to solve problems or fashion products that are of value. Understanding what MI are and how they work can help students take advantage of their unique knowledge and skills. This study introduces an online project-based learning model based on student's Multiple Intelligence, and it presents the synthesized model by using the focus group discussion from ten experts. This model consisted of five modules as: 1) multiple intelligence test module, 2) multiple intelligence classification module, 3) PjBL & KM module, 4) online learning module, and 5) rubric evaluation module. The results of the synthesized model on empirical evaluation by experts showed that they accepted the model at a very good level (Mean = 4.53, S.D. = 0.50). In conclusion, this can be used to synthesize models to complete the project-based online learning successfully.

Keyword: project-based learning (PjBL), multiple intelligence (MI), think-pair-share (TPS), collaborative learning, rubric evaluation

Introduction

Project-based learning (PjBL) is an instructional technique in which meaningful tasks, often in the form of problems, serve as the context and the stimulus for knowledge-building and critical thinking. Students work in teams to set goals, acquire information, and make informed decisions. They apply the knowledge they gain through their research not only to solve the problem, but also to communicate the results of their findings. Teachers act as facilitators as they model inquiry, scaffold use of cognitive and metacognitive strategies, and provide resources, support, and guidance (Howard, 2002). The definitions found in numerous research papers on project-based learning are as follows: 1) projects are complex tasks, based on challenging questions or problems, that involve learners in design, problem-solving, decision making, or investigative activities, 2) projects give learners the opportunity to work relatively autonomously over extended periods of time and, and 3) projects culminate in realistic products or presentations (Jones, Rasmussen, & Moffitt, 1997). Other defining features of the project-based learning paradigm include authentic content, authentic assessment, teacher facilitation but not direction, explicit educational goals (Moursund, 1999), cooperative learning, reflection, and incorporation of adult skills (Diehl, Grobe, Lopez, & Cabral, 1999). Traditionally, the old-school model of passively learning facts and reciting them out of context is no longer sufficient to prepare students to survive in today's world.

Solving highly complex problems requires that students have both fundamental skills (reading, writing, and math) and 21st century skills (teamwork, problem solving, research gathering, time management, information synthesizing, utilizing high tech tools). With this combination of skills, students become directors and managers of their learning process, guided and mentored by a skilled teacher. These 21st century skills include the following: 1) personal and social responsibility, 2) planning, critical thinking, reasoning, and creativity strong communication skills, both for interpersonal and presentation needs cross-cultural understanding visualizing and decision making knowing how and when to use technology and choosing the most appropriate tool for the task (Mishra & Kereluik, 2011).

Thus, it is necessary for teaching systems to help students gain new skills in both learning and using new technology particularly for bringing 21st century skills into the school. Therefore, those involved in education are required to study and find out the best ways to stimulate students to have creativity and enjoy studying. However, it is found that the current teaching systems emphasize knowledge or ability in terms of improvements, focusing on learning by heart, rather than thinking skills, e.g. analytical thinking, synthetic thinking and critical thinking. Their thinking skills will be helpful for the students when they begin to work. So, students should mainly be taken into account when considering any teaching system. The students should be encouraged to use various tools so that they would be more interested in learning. Besides, the need, the interest and the differences of any individual should be well satisfied. Thereby, the teachers are acting as advisors who suggest to the students how to use the tools as efficiently as possible (Malitong, 2000). Teaching via the internet helps support "Community of Learner" (Anderson, 2007), allowing the students to study and receive knowledge by themselves and by means of learner interaction (Kahler, 2000). The characteristics of the said teaching method, therefore, are appropriate to project-based learning because: 1) the project-based learning is originated from philosophy of education emphasizing learner center, 2) the project-based learning supports cooperative learning through communication, exchange of information, knowledge and opinions among learners, and 3) the project-based learning enables the students to create concrete products, showing that the students have successfully gained knowledge (Hargis, 2005).

Meanwhile, Gardner's Multiple Intelligence (MI) concept is a psychological theory that addresses what the brain does with information. It defines intelligence as the capacity to solve problems or fashion products that are of value. It states that there are nine different ways to demonstrate as follows: 1) kinesthetic intelligence, 2) existential intelligence, 3) interpersonal intelligence, 4) intrapersonal intelligence, 5) linguistic intelligence, 6) logical and mathematic intelligence, 7) musical intelligence, 8) naturalistic intelligence, and 9) spatial intelligence. These intelligences with each having its own unique characteristics, tools, and processes that represent a different way of thinking, solving problems, and learning. Its use in the classroom has been significant (Campbell & Campbell, 1996), but its application to project-based learning is still undergoing research. Therefore, once understanding the strength and weakness of their learners, the instructors can help them meet with successes. This is because project-based activities requires systematic and step-by-step operation in which the learners has to practically study and figure out what they want to know by their own, moreover project-based activities can be performed within class working with the instructor, or outside the class/school working with external educators or researchers; can be individual or group activities. Types of the projects can be single-case or multiple case mentoring, workshop training, media production, computer-based instruction or web-based instruction, and research activities (Liu & Richmond, 2005).

From these reasons, the author has an idea to incorporate multiple intelligences into the system. What is added herein will act as a learner guidance system, allowing the learners to do projects-based learning based on student's multiple intelligence. The system is expected to replace the class instructors by synthesizing a new learning model. Then, the said synthesized model will be applied by developing an online project-based learning and recommendation for learners based on student's multiple intelligence. This will support differences among individuals and provide them with utmost benefits. Thus, this paper aims to synthesize an online project-based learning model based on student's multiple intelligence as a new learning model for an online project-based learning to enable student-centered teaching approaches, because every student has their own way of learning that works best for them. Some learn visually others do better when they "learn by doing", and increases student interaction and the diversity of opinion, because everyone gets a say, not just the most talkative, moreover, using the online learning with technologies that will be critical to workers in the 21st century community that works with colleagues globally.

Review of related literatures

1. Project-based learning

Project-based learning as a student-centered approach, is developing skills and content by engaging in logical tasks that involve the skills and content to be learned, have personal relevance for students, and provide real world context for learning (Warlick, 1999). Project-based learning is an instantiation of education theory, research and practice in constructivism. The constructivist view considers what real people in a knowledge domain and in a real-life context typically do, and PjBL guides students to assume a real life role and apply the tools of a knowledge domain in creating a project. Project-based learning provides a context in which students move toward thinking as an expert in the knowledge domain might think, and now it is gaining widespread interest in higher education. An underlying principle of project-based learning is that a theme or problem to be solved is established and students gradually explore the problem from different perspectives, adjust their goals and strategies to new insights gathered during the project. Student projects offer an ideal situation to provide problem-solving opportunities that present real world problems that are scaled back, it can be thought of as learning through a series of theme related activities that are based in authentic, real world problems in which the learner has a certain amount of control over the learning environment and the design of the learning activities (Morgan, 1987). For teachers in particular, project-based learning has the potential to support specific learning goals while serving as an induction process that models for teachers how they can teach children using a project-based approach (Cavannaugh, 2004). Benefits of project-based learning for teachers include: 1) Gaining knowledge across the domains of child development, learning theory, curriculum, community relations, assessment, and professionalism, 2) Learning to integrate information in meaningful ways to create similar learning experiences for children, 3) Multiple opportunities to practice collaboration while working, and 4) Strengthening dispositions desired of professional educators through autonomous work (DeJong, 1999).

In term of online learning, some of strategies for online learning in general are reviewed with collaborative learning and teaching, particularly in project-based learning settings. The process of project-based learning with the internet is generally composed of online questions and answers, online report, online discussion by using the bulletin board, e-mail, instant message, etc. In the project-based learning, the students learn by problem solving process based on the given problem of the project (Yang, 2002). Therefore, teaching strategies such as reflection and summary of what students earn from project, and small group activity in the class which are often used in the traditional class can be more effectively occurred in online learning space when collaborative interaction mechanism are applied. Recently, educational environment and learning process are moved toward the performance centered evaluation, portfolio, cooperative learning task. Teaching methods and strategies for collaborative teaching between or among teachers in project-based learning through the web were examined by some case studies. The based framework of teaching process is based upon previous research including a study of Robert Bernard et al. entitled "Collaborative online distance learning" (Bernard, 2000), that the authors conclude that using new technologies in combination with a collaborative online learning approach in distance learning may prove to be highly effective when learner characteristics and the learning context are considered carefully.

2. Collaborative learning

Collaborative learning is an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product. Theory of the collaborative teaching can be derived from Piaget's constructivism and growing social constructivism Vygotsk's socio-cultural theories, and situated cognition. Teacher collaboration requires a dynamic involvement of individuals working together to construct knowledge. Knowledge construction occurs through social and intellectual interaction with peers and experts (Wang, Hinn & Kanfer, 2001). Teacher collaboration is oriented towards designing the syllabus, carrying out common teaching activities and so on. In some situations, collaboration may consist of a teacher offering his/her peers a well-tested teaching module and assisting them in carrying out related classroom activity. In collaborative teaching, the distinction between power over others and power with others is useful. While teachers will always have some form of power not held by students, this power can be used to shape the collective experience in a way that empowers everyone that enhances power with others, that is, collaboration (Richards, Elliot, Woloshyn & Mitchell 2001). Other types of collaboration include: collaboration between teachers and experts, collaboration between students and teachers, collaboration between students, collaboration between students, teachers and experts (Trentin, 1999).

In term of the think-pair-share (TPS), is a collaborative learning technique used in traditional classrooms. Traditionally, students think about a problem or question individually, they pair with another student to orally discuss their ideas, and then they share their results with others. In this manner, the student generates an idea him/herself then is able to extend that idea by collaborating with a peer. The learning is enhanced via the dialogue between individuals (McCarthey, 1994). Sharing the student's answer in a public venue forces the student to organize the new information gathered from the dialogue with peer in a comprehensible manner. This further instills the new learning in the individual's mind, the collaboration online becomes much easier. It is as if the students were sitting down next to each other and editing their work, that the students would not only gain a deeper understanding of their own literacy terms through pairing with their partners, but would also understand those terms posted by their group members as they themselves edited and collaborated with their partners. Finally, the students share their finished product by sending the link to the instructor (Barnhill & LeSage-Clements, 2012). As a collaborative learning technique, think-pair-share also benefits students in the areas of peer acceptance, peer support, academic achievement, self-esteem, and increased interest in other students and school.

3. Rubric evaluation

A rubric evaluation is a scoring guide that provides students with a clear description of proficient student work. It lists the criteria for what counts in an assignment, and provides gradations of quality from excellent to poor for each criterion (Andrade, 2005). Rubrics are also not easy to use. Andrade points out students need to learn how to use and apply a rubric. Rubrics are not self-explanatory, and need to be introduced within the context of the broader instructional objectives. Rubrics are also subject to issues of validity, reliability, and fairness. In general, rubrics should be devised that align with reasonable standards and the curriculum being taught. Ratings based on rubrics should be similar when they are used by different instructors, and ratings should not be influenced by the student's gender, race, ethnicity, or socioeconomic status. According to Heidi Andrade, "rubrics improve when we compare them to published standards, show them to another teacher, or ask a colleague to co-score some student work". Rubrics appeal to teachers and students for many reasons. Firstly, they are powerful tools for both teaching and assessment. Rubrics can improve student performance, as well as monitor it, by making teachers' expectations clear and by showing students how to meet these expectations. The result is often marked improvements in the quality of student work and in learning. Thus, the most common argument for using rubrics is they help define quality (Marcus 1995). Lastly, teachers appreciate rubric evaluation because their accordion nature allows them to accommodate heterogeneous classes.

Methods

This study consists of two stages.

1. The synthesis of the model

1.1 The studying and drafting

The method started with studying articles, documents and researches about educational innovation, project-based learning, online learning, think-pair-share collaborative learning, social network, instrument tools and software tools used to develop relevant systems and theories, after that the primary model was drafted based on the data derived from the study of relevant articles, documents and researches. The author set up four issues as research scopes as: 1) project-based learning, 2) analysis of student's multiple intelligence, 3) objectives and functions of model, and 4) measurement and evaluation, expecting mainly to satisfy the personal differences among the students.

1.2 The focus group discussion

The drafted model was presented as a guideline to the experts, after that the model was performed by using focus group discussion which helped to create an instrument tools to evaluate the appropriateness of the synthesized model.

2. The evaluation of the model

The evaluation of the synthesized model used a five-scale questionnaire by five experts which aided improvements to the stated model according to the experts' discussions and suggestions by mean and standard deviation.

Results

1. The synthesized model

The online project-based learning model based on student's multiple intelligence consists of five modules as shown in Figure 1.
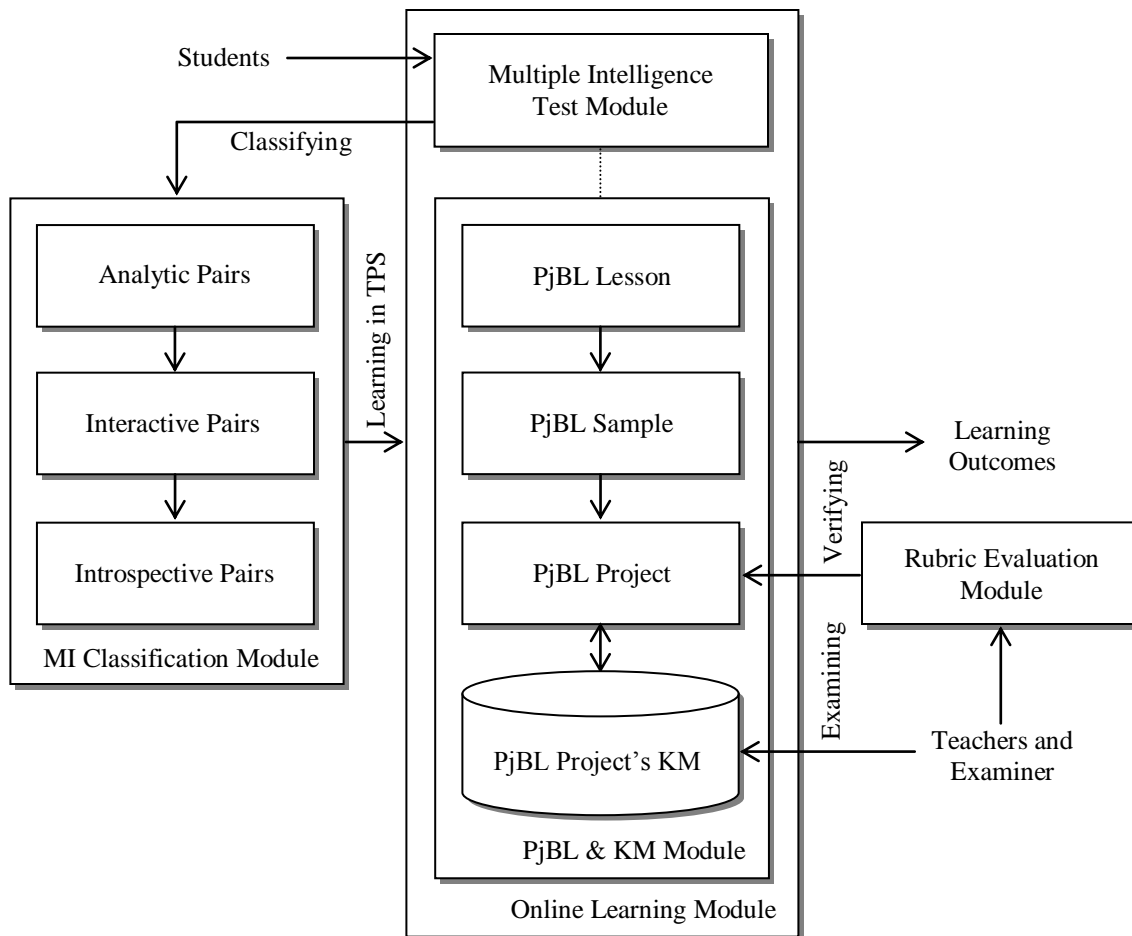
Figure 1. The online project-based learning model based on student's multiple intelligence

In Figure 1, the synthesized model consists of five modules as follows:

1. The multiple intelligence testing module is for classifying the learners into three multiple intelligence groups; that is, analytic, interactive and introspective. Upon the enrollment of learners, the system will have them input basic information and take a multiple intelligence test (ninety items) of Howard Gardner.
2. The multiple intelligence classification module is for categorizing the learners, by means of think-pairs-share, in mixed groups based on the results that the instructors derived from the Multiple Intelligence analysis of three student groups.
3. The PjBL & KM module is a guideline to carry out different projects as to the results of Multiple Intelligence analysis of the students; and to accumulate the works evaluated by the instructors and the experts in order to create knowledge; the said module is composed of the following four elements.

   3.1 PjBL lesson - guiding steps of the projects such as step-by-step suggestions, media, materials, publication, evaluation or other recommendation via website.
   3.2 PjBL sample - showing samples of each project that the instructors prepared in accordance with multiple intelligence of the students; i.e., Analytic (projects on exploration), Interactive (projects on experiment), and Introspective (projects on research), all of which are in the form of web database.
   3.3 PjBL project - accumulating the projects of learners, according to their categories, in the form of web database, waiting for evaluation by the instructors or the experts.

3.4 PjBL project's KM - collecting and presenting the learners' projects already evaluated by the instructors or the experts, which then are uploaded onto the system to create a project database, in which the amount of data will increase and be a deep source of knowledge via the internet about projects in the future.

4. Online learning module is for combining the functions of module 1 and module 3 to be online or website based learning. The online tools for communication between learners and learners or between instructors and learners include webboard, e-mail, facebook and search engine, all of which are appropriate according to the researches and experts.

5. Rubric evaluation module is for creating a system of evaluating the projects of the students who have been learning online by means of rubric. In this study, the author applied analytic rubric assessment to define scoring criteria of three rating scales, dividing evaluation into three parts: work plan, work process, results and presentation. Meanwhile, teacher and examiner are external parts for the instructors to evaluate the learners' projects, and then upload them into the online learning system in order to create a database of projects, classified as to student's multiple intelligence. The said database is also a channel for the instructors to keep track of students' learning activity and to inform the students about the results of evaluation as well as further suggestions.

4.2 The results of the synthesized model

The results of the online project-based learning model based on student's multiple intelligence evaluated by five experts in terms of module elements, objectives, functions, and proper application; and the results are shown as below.

Table 1. Results of the model evaluation in terms of module elements

Aspects	Mean	S.D.	Interpretation
1. Multiple intelligence test module	4.60	0.55	very good
2. Multiple intelligence classification module	4.60	0.55	very good
3. PjBL & KM module	4.60	0.55	very good
4. Online learning module	4.60	0.55	very good
5. Rubric evaluation model	4.40	0.55	good
6. Overview of the model	4.40	0.55	good
Total	**4.53**	**0.50**	**very good**

In Table 1, it is found that the experts accepted the appropriateness of the model in term of module elements at a very good level (Mean = 4.60, S.D. = 0.50).

Conclusion and Discussion

Basically, online learning has the potential to revolutionize higher education. Students will be able to learn at their own pace and solve other problems at the same time. Public colleges and universities simply cannot build new facilities to accommodate all those who need credits in higher education. In addition, credit hours taken online particularly at a community college are often less expensive. It therefore makes good financial sense for a student to take core courses online at a community college, moreover online learning is effective as it has the ability to offer just-in-time student assessment and evaluation. This capability has two effects. First, it provides instructors with data regarding the progress of the class and whether the objectives are being met. Second, it provides reinforcement of the concepts taught and provides opportunity for remediation, and sometime more effective than traditional classroom learning (Russell, 2001). Meanwhile project-based learning is an increasingly popular method for teaching students to solve problems, think critically, master science and engineering principles, and learn teamwork, collaboration, communication, and project management skills. In much the same way that students work and learn, students go through an extended process of inquiry in response to a complex question, problem, or challenge. By implementing best practices and careful methodology, teachers can offer rigorous projects that help students learn core academic content and 21st century skills (Markham, 2003). Therefore, this paper introduces an online project-based learning model based on student's multiple intelligence, and it presents the synthesized model by using the focus group discussion from ten experts.

This model consisted of five modules as: 1) multiple intelligence test module, 2) multiple intelligence classification module, 3) PjBL & KM module, 4) online learning module, and 5) rubric evaluation module. The results of the synthesized model on empirical evaluation by experts showed that they accepted the model at a very good level (Mean = 4.53, S.D. = 0.50).

In conclusion, this model can be used to complete the project-based online learning successfully, particularly for undergrad student in computer and information technology areas. The learning model synthesized from this study will be developed as an online project-based learning system with a knowledge management system by analyzing student's multiple intelligence so that it would be most helpful to the students, thus the educational institutes that will apply this learning model should prepare instructors for the project-based learning as to the student's multiple intelligence in order to support differences among individuals in terms of student-centered learning and 21st century skills, that is an important new concept in education is that literacy is always changing, and need to adapt to new methods of teaching. Instead of just teaching students how to read and write, teachers need to prepare the students for a world beyond the classroom in order for them to become successful in all aspects of their lives. Also, leadership and responsibility provides lots of opportunities to take responsibility and exercise leadership-skills important to future employers. Teaching students responsibilities will strengthen their work ethic when they have a job or career. It will continue to help them succeed in the job market and learn even more skills in the future.

References

Anderson, L. (2007). E-Learning at Augsburg College, [Online] Available:
    http://www.augsburg.edu/eteam/report.pdf (May 18, 2011).

Andrade, H. (2005). *Teaching with rubrics: The good, the bad, and the ugly.* College Teaching 53,   (Winter 2005), pp.27-30.

Barnhill, A. & LeSage-Clements, T. (2012). Wikis: A Virtual Think, Pair, Share Strategy for the Classroom. In P. Resta (Ed.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2012,* (pp.135-138). Chesapeake, VA: AACE.

Bernard, M.R., & et al. (2000). Collaborative online distance learning: Issues for future practice and research. *Distance Education,* 21(2), pp.260-277.

Campbell, L., Campbell, B., & Dickinson, D. (1996). *Teaching and Learning through Multiple Intelligences.* Allyn & Bacon.

Cavanaugh, C. (2004). Project-based Learning in Undergraduate Educational Technology. In R. Ferdig et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2004*, (pp.2010-2016). Chesapeake, VA: AACE.

DeJong, L. (1999). Learning through projects in early childhood teacher education. *Journal of Early Childhood Teacher Education.* 20(3), pp.317-326.

Diehl, W., Grobe, T., Lopez, H., & Cabral, C. (1999). *Project-based learning: A strategy for teaching and learning. Boston,* MA: Center for Youth Development and Education, Corporation for Business, Work, and Learning.

Hargis, J. W. (2005). Collaboration, Community and Project-Based Learning-Does It Still Work Online, *Instruction Media,* 32(5), Dec 2005.

Howard, J. (2002). Technology-Enhanced Project-Based Learning in Teacher Education: Addressing the Goals of Transfer. *Journal of Technology and Teacher Education*, 10(3), pp.343-364. Norfolk, VA: AACE.

Jones, B. F., Rasmussen, C. M., & Moffit, M. C. (1997). *Real-life problem solving: A collaborative approach to interdisciplinary learning.* Washington, DC: American Psychological Association.

Kahler, H. (2000). Constructive interaction and collaborative work, Introducing a Method for Testing Collaborative Systems. *Interactions,* 7(3), pp.27-34.

Liu, L. & Richmond, A. (2005). Project Based Learning in Information Technology Courses. In C. Crawford et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2005,* (pp.3282-3287). Chesapeake, VA: AACE.

McCarthey, S.J. (1994). Authors, text, and talk: the internalization of dialogue from social interaction during writing. *Reading Research Quarterly,* 29, pp.200-31.

Malitong, K. (2000). *Education Technology and Innovation*, Chulalongkorn University Press, Bangkok, Thailand.

Marcus, J. (1995). *"Data on the Impact of Alternative Assessment on Students."* Unpublished manuscript. The Education Cooperative, Wellesley, MA.

Markham, T. (2003). *Project Based Learning Handbook: A Guide to Standards-Focused Based Learning for Middle and High School Teachers,* The Buck Institution for Education, QuinnEssentials Books andPrinting, Inc., Hong Kong.

Mishra, P. & Kereluik, K. (2011). What 21st Century Learning? A review and a synthesis. In M. Koehler & P. Mishra (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2011,* (pp.3301-3312). Chesapeake, VA: AACE.

Morgan, A.R. (1987). *Project work in open learning.* In M. Thorpe & D. Grugeon (Eds.), Open learning for adults (pp.245-251). Harlow, London: Longman.

Moursund, D. (1999). *Project-based learning using information technology.* Eugene, OR: International Society for Technology in Education.

Richards, M. , Elliot, A. , Woloshyn, V. & Mitchell, C. (2001). *Collaboration uncovered: The forgotten, the assumed, and the unexamined in collaborative education.* Bergin & Garvey.

Rusell, T. (2001). The No Significant Difference Phenomenon. [Online] Available: http://www.teleeducation.nb.ca/nosignificantdifference/(June 18, 2011).

Trentin, G. (1999). Network-based collaborative education. *International Journal of Instructional Media,* 26(2).

Wang, X. C., Hin, D. M. & Kanfer, A. G. (2001). Potential of computer-supported collaborative learning with different learning styles. *Journal of Research on Technology in Education,* 34(1).

Warlick, D. (1999). *Raw materials for the mind*. Raleigh, NC: The Landmark Project.

Yang, Y.S. (2002). A Case Study for Promoting Collaboration on Online Project-Based Learning. In P. Barker & S. Rebelsky (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2002,* (pp.2107-2112). Chesapeake, VA: AACE.