B. Chang et al. (Eds.) (2010). Joint Proceedings of the Work-in-Progress Poster and Invited Young Researcher Symposium
at the 18th International Conference on Computers in Education. Putrajaya, Malaysia: Asia-Pacific Society for Computers in Education.

The Effects of Programming Using Collective Intelligence on Problem Solving Ability and Programming Attitude

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Abstract: A programming education has a favorable influences on creative and logical thinking and problem solving abilities of students. However, students typically have spent too much effort in learning basic grammar and using the model of programming language, which negatively affect their eagerness in learning. In this respect, the purpose of this study is to investigate learner's programming attitude towards collective intelligence in the context of secondary school students' programming classes and to verify the possible application of a new instructional method.

Keywords: Collective Intelligence, Programming Attitude, Problem Solving Ability

Introduction

Information has become the most important element in knowledge-based societies. The Internet which was brought about by the development of information and communications technology has caused many changes all over the world particularly in the educational environment. Interests on computers have increased because it can change the traditional learning environment. Learning how to use computers has been developed differently compared with traditional face-to-face learning in which teachers and learners share limited time and space[7]. The emergence of Internet in the change of educational environment had become a system of administering knowledge which is implemented and eventually brings a significant change inside the classroom. In the Center of cultural phenomenon, a new paradigm of Web 2.0 has been created and called "User participation in the open space". The Web 2.0 provides the foundation that users can interact directly, and have a variety of sharing and spreading of knowledge by a direct connection. The aforementioned phenomenon can be explained by "*Collective Intelligence*"[1].

1. Literature Review

1.1 Collective Intelligence(CI)

The *Collective Intelligence*(CI), also called "The wisdom of crowds", or "swarm intelligence"[5], has been recognized as a new value with the advent of Web 2.0.
Collective Intelligence is a shared or group intelligence that emerges from the collaboration and competition of many individuals. *Collective Intelligence* can also be defined as a form of networking enabled by the rise of communications technology, namely the Internet. Web 2.0 has enabled interactivity and thus, users are able to generate their own content. Further, The *Collective Intelligence* draws on this to enhance the social pool of existing knowledge[2]. Pierre Lévy (1994) has defined *Collective Intelligence* as "distributed

everywhere, and is given the value of continuous, real-time adjustments, and the practical ability to bring intelligence"[1]. Lévy and de Kerckhove consider *Collective Intelligence* from a mass communications perspective, focusing on the ability of networked ICT's to enhance the community knowledge pool[2]. Also, James Surowiecki(2004) has defined the *Collective Intelligence* as a moving power in the economy and society. In some situations, a smart group discussion will lead to a wise decision and is better than it could have been made by any single member of the group[3]. According to Don Tapscott and Anthony D. Williams(2008), *Collective Intelligence* is mass collaboration. In order for this concept to happen, four principles need to exist. These are openness, peering, sharing and acting globally[6][9].

1.2 Design of Collective Intelligence Programming

In this study, the content of *Design of Collective Intelligence Programming* is based on the *Problem-Based Learning model*. The following Table 1 is *Collective Intelligence programming* contents.

Table 1: *Collective Intelligence Programming* contents

Sessions	Subjects	Contents and Tools	
1	How to use Web2.0 Tools	Wiki, Mind Map tools, Messenger Program et al.	
2	How to use Scratch	Block, Sound, Motion, et al. (Scratch)	
3	Problem recognition	Learning Objectives and Problem Set (Wiki)	
4	Problem solving planning	Current contents arrangement (Mind manager), The establishment of a plan to solve the problem.	
5	Searching	Data Searching and Data Saving	Wiki, Messenger Program, Scratch's Web
6	Solution	Creative ideas and programming	
7		Programming Analysis and Exchange	
8		Applications of Programming	
9	Presentation and Evaluation	Discussion, Sharing, Review	
10	Publication	Online Publication and Print (Scratch's Web site)	

Also, *Collective Intelligence Programming Learning* has the following effects[8].

- Learners can solve problems by implementing algorithms.
- Teachers are facilitators in programming learning.
- Interaction between learners for effective problem solving.

2. Methodology

2.1 Design

They were divided into a Treatment Group (G_1), which consisted of students using the *Collective Intelligence programming learning* and Control Group(G_2),which had students using the *Traditional Programming Learning* for comparison. Table 2 illustrates the design of the study.

Table 2: Design

Treatment Group(G_1)	O_1	X_1	O_3
Control Group(G_2)	O_2	X_2	O_4

O_1, O_2: Pre-test (Problem Solving Ability, Programming Attitude Test)
X_1: Collective Intelligence Programming Learning
X_2: Traditional Programming Learning
O_3, O_4: Post-test (Problem Solving Ability, Programming Attitude Test)

2.2 Test items

- *Programming Attitude* test items was conducted by Cho (2008) in the attitude of programming[10]. We were used modify and supplement. Programming attitude test items were verified by the expert group. The result of the pilot test reliability was Cronbach's alpha = .921(n=73).
- *Problem Solving Ability* test items was conducted by the OECD PISA(Program for International Student Assessment) in 2003[11]. Problem solving ability test items had 19 questions in the area of public. We were used modify 12 questions. Question has been verified of expert group. The result of the pilot test reliability was Cronbach's alpha = .824(n=73).

3. Conclusion and Discussion

Web 2.0 has attained attention in terms of the flexibility and diversity providing users with various teaching and learning materials. Programming education has favorable influence on creative, logical thinking and problem solving abilities of students. However, students typically have to spend too much effort in learning basic grammar and the usage model of programming language, which negatively affects their eagerness in learning. In this respect, the purpose of this study is to investigate learner's programming attitude of the *Collective Intelligence programming learning* on Secondary school student's programming classes and to verify the possible application of this now instruction method. Through this research, the researcher findings to be bases for a more active participation of student's in computer field.

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