A Study on the Development
of Learning Model for Improving Collaborative
Creativity Based on CPS

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As the educational paradigm has shifted from the traditional knowledge oriented instruction learning to the knowledge product oriented instructional learning, the development of student's creativity becomes one of the most important educational goals, because the ability that can produce the knowledge creatively is required in the digital information knowledge based society. The purpose of this study is to make a basic direction and strategy for the instructional design to develop an on and off line blended instructional design which will help a learning community to be a more collaborative and creative learning community. This research has investigated the concept and the characteristics of collaborative creativity and creative problem solving as the theoretical basis of the design. After that, on the basis of the theories connected with the collaborative creativity theory, the direction and the strategies for the development of collaborative creativity was designed. The design was applied into the real learning community and finally proved the effectiveness of the learning model for the development of the collaborative creativity by the quantitative evaluation.

Keywords : Collaborative Creativity, Creative Problem Solving, Online and Offline Blended Learning, Instructional design

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Introduction

Today, the world has been facing the shift of the educational paradigm from the traditional knowledge oriented instruction learning, which was emphasized in the industrial society to the knowledge product oriented instructional learning which emphases the creative thinking and problem solving ability required in the informational society.

Accordingly, the development of student's creativity becomes one of the most important educational goals, because the ability that can produce the knowledge creatively is required in the digital information knowledge based society. Therefore, it is a very outstanding and important educational issue to build the instructional design and the learning environment for developing collaborative creativity that carries share, the product of knowledge and information.

Therefore, it is urgent to make the learning model for improving the collaborative creativity and the learning environment that emphasizes students centered communication and collaboration to improve student's creativity and problem solving ability in the educational field.

If the theoretical and experimental research of instructional design utilizing computer medicated communication, which shares and produces knowledge and information in learning community according to the educational paradigm shift, we will be able to make the instructional design for the development of collaborative creativity in the online and offline blended learning community, and then we can make the autonomous learning culture through the collaborative creativity among the group members in the learning community, as well as individual's unique talent and ability will be enhanced in the learning community.

With this problem perception, this research deducted the basic direction and strategy for the instructional design on the collaborative creativity, and then developed the online and offline blended instructional design that helps the learning community be the collaborative and creative learning community.

Theoretical Background

Collaborative Creativity

For this purpose, this study examines and describes the concepts and the characteristics of the collaborative creativity. Collaborative creativity is the mental ability, which enables the group members to establish creativity by interacting between various groups and group members, while the individual intelligence, cognition, personality, and motivation are doing essential roles to enhance individual creativity. These days many organizations have been interested in the collaborative creativity and the group creativity which emphasizes on the development of the various techniques and knowledge of the group members.

Group creativity is an alternative plan for the competitive and individual learning and it's been researched since late 1970's. It organizes the learning community in order to have the group members collaborate and perform the task with mutual interaction and individual responsibility. As a result, the collaborative learning community has equipped with the power of explosive ideas so that the group creativity may be increased and the various individual learners may have more mutual interactions on the other members' various intellectual ability and attention. The representative scholars who maintain the characteristics of collaborative creativity are Osborn, Miliken, Bartel, Kurtzburg, Smith, Nemeth and Brown(Paulus, P. B. & Nijstad, B. A., 2003), and Ricchiuto(1997).

CPS (Creative Problem Solving)

Creative Problem Solving is defined as the effort to think creatively in order to solve the problems that happen to the group or the individual. It is required for anybody to equip the thinking process that can define and solve the problems on daily basis (D. J. Treffinger, S. G. Isaksen, K. B. Dorval, 2000). Therefore the ability

of creative problem solving could be a useful tool to treat the problem, the opportunity and the challenge in daily lives.

This research uses the CPS as a tool for improving collaborative creativity that improves group and individual creativity simultaneously. In order to draw out the essential learning process of the design, this research, first, analyzes Treffinger and Feldhusen's 'Creative Problem Solving', which has the purpose of developing critical thinking and flexible creative thinking skill.

Treffinger(2000) insists that finding, analyzing and stating the problem is very important to use CPS, and it should be decided in advance that whether CPS is the most effective problem solving method for the problem. Treffinger suggested 3 steps and 6 elements that include the structure and the components of CPS to help the decision and process making like the following:

* Problem Sensing: To solve the problem it is very important to have the correct cognition and the statement of the problem. It has the 3 elements: mess finding, source finding, and the problem finding.
* Idea Producing: After deciding the focus and the direction, it should produce the ideas, which has the potential for the solution as many, novel and variable as possible.
* Practice Preparation: After stating the problem and analyzing, redefinition and the development for the useful resolution, in order to decide the performance that is available for acceptance and practice we should make up the practice plan for action including the following 2 steps, solution finding and acceptance finding.

Feldhusen(1980) also suggested the Creative Problem Solving model that is very effective to teach problem and solving ability for the students. This model could be used widely for problem solving in the various subjects such as English, Social Study, Science and etc, it has the following steps:
* Problem Producing: The learners in the small group find the problems within the

curriculum structure. At this time they can find the mess and evaluate to find the most important problem using 'brainstorming'.

* Problem Clarification: The learners discuss the cause of the problem together.
* Problem Definition: The learners decide and state the problem clearly.
* Idea Finding: The learners produce the ideas using the creative tools.
* Solution Finding: The learners synthesize solutions using the ideas that were produced in the advanced steps.
* Practice: The learners make a plan for action to implement the solution.

The direction and the strategies for instructional design to improve collaborative creativity

This study outlines blueprint of agenda for the design, the Learning Model for Developing Collaborative Creativity, after investigating the main theories both on collaborative creativity and 'Creative Problem Solving' by Treffinger and Feldhusen.

The blueprint of agenda for improving collaborative creativity reflects the characteristics of group collaboration, blended learning and creative problem solving and draws out directions and various strategies: interactive heterogeneous groups, material sharing, facilitating reflective thinking process, selecting actual problem and developing creative problem solving ability. The detailed direction and strategies of the design is like the following:

Group collaboration learning

The purpose of this research is to draw out the instructional design which can be used in the learning community to improve the collaborative creativity. The purpose of the learning community is to support the knowledge growth of each member as the accumulated knowledge of all group members supports each member's knowledge growth, expands the range of diverse view point and understanding and internalizes in the learning community. Therefore, the essence of the learning

community is a collaborative pattern that emphasizes the mutual dependence and interaction.

Blended Learning

This research utilizes the computer mediated communication as a cognitive tool for developing the thinking skill. This includes an online learning that allows using the internetworking in any place, with any people and any time they want. And it also includes an offline learning that gives mental stability in the class.

The instructional media using a computer improves creativity and problem solving ability as it has the learner practice researching, selecting, analyzing and synthesizing the information and producing new knowledge. Using communication media makes it possible have the learners communicate and share the thinking so that it helps the sophisticated thinking and creative idea producing as the result of the interaction among the students.

Creative Problem Solving

The basic direction of the instructional design reflects the characteristics of creative problem solving and selecting the actual problem related real life is one of the important strategies of the instructional design besides the following strategies: critical thinking development, offering the opportunity of the individual learning, developing talents and strong intelligence, equipping knowledge information and encouraging self directed learning.

The actual problem is the problem that is related with the specific subject and the content or common problems that anyone can face in the daily lives. As the learners use the process to solve the problems that have the complicate and various solutions, the learners can be guided and facilitated to exchange one's view and accept the other person's viewpoint more actively to solve the problems through the steps of presentation and the reflection. These steps might bring the process of synthesis and creativity. Table 1 shows the learning module blueprint for improving collaborative

creativity that shows learning process and structure. And the figures show the tools for supporting the learning instruction, which the students can use in their activities for developing collaborative creativity.

Table 1. Learning module blueprint

| Step | Core Learning Task | Learner's Core Activity | Facilitator | | Supporting | | Learning Environ-ment |
			Triggering Question	Facilitating Activity	Tool	Info	
1	Mess finding	Problem range K-W-L	How do we set the range of the problems?	Summarizing the ideas and thinking	K-W-L	Learning manual	Group discussion room
	Problem finding	Facing the problem	What kind of authentic problems are there?	Trigger the diverse ideas and thinking	Brain-storming	Learning manual	Brain-storming
	Problem setting	Deciding the problem	What is the most urgent and appropriate problem?	Encourage the team activity	Sticker vote	Learning manual	Group discussion room, Media room
2	Information collecting	Strong point related information collecting	What information can you collect in connection with the strong points?	Online information searching, Individual assignment using literacy	Information collecting record	Internet information searching, Literacy	Media room

| Step | Core Learning Task | Learner's Core Activity | Facilitator | | Supporting | | Learning Environ-ment |
			Triggering Question	Facilitating Activity	Tool	Info	
2	Interview with the professionals	Have the advice from the others	What do the professionals think about this problem?	Interview records, Group assignment, Online sharing	Shooting		Field trip
	Group discussion	Finding out the similarities among the information on this problem	Finding out the similarities between this problem and the related information	Explaining the tool of round robin, Summarizing the students' ideas and thinking	Round robin	Online	Group discussion Room
3	Problem causing	Finding problem causing	What causes the fundamental problem?	Explaining the tool of fish bone diagram	Fish bone diagram	Learning manual	Group discussion room, Media room
	Selecting the problem priority	Finding the most urgent and available problem	What problem should be solved with priority?	Selecting the problem through the evaluation	Evaluation matrix	Learning manual	Group discussion room
	Problem statement	In what ways may I solve this problem?	How can we state the problem?	State the clear problem	Problem statement	Learning manual	Group discussion room

| Step | Core Learning Task | Learner's Core Activity | Facilitator | | Supporting | | Learning Environ-ment |
			Triggering Question	Facilitating Activity	Tool	Info	
4	Idea finding	Say all the ideas for problem solving individually	What are the possible solutions for this problem?	Introducing nondinominated group activity	Post-it brain-storming	Learning manual, Online information search	Group discussion room, Media room, Website
	Composing ideas	Combine the ideas for problem solving	How are the ideas related? Could the better ideas come out if they are combined?	Summarizing the diverse ideas of the team members	Mind map	Learning manual	Group discussion room
	Setting the priority problem solving	Selecting the most effective problem solving ideas	What is the best priority problem solving idea?	Setting the proper priority standards	Priority evaluation matrix	Learning manual	Group discussion room, Media room
5	Group discussion	Solution finding	In what specific ways could the goal be established?	Exchanging the ideas with brainstorming	Brain-storming	Learning manual	Group discussion room

Step	Core Learning Task	Learner's Core Activity	Facilitator		Supporting		Learning Environment
			Triggering Question	Facilitating Activity	Tool	Info	
5	Drawing out the solution	Priority action planning	What is the priority to make the action plan?	Selecting the priority through voting	Idea grid	Learning manual	Group discussion room
	Stating the action plan	Action planning with 6WH	Making the action plan in specific ways	Presenting how to make the action planning form	Action plan	Learning manual	Group discussion room
6	Making the presentation product	Making presentation product that includes all the learning contents	Let's make the product with a media	Explaining how to make the product with powerpoint	Powerpoint		Group discussion room
	Presentation	Presenting the learning product to share with the members in the other groups	In what ways and procedures might the presentation content establish the goal of the learning?	Time keeping, Media usage		Learning manual	Group discussion room

Step	Core Learning Task	Learner's Core Activity	Facilitator		Supporting		Learning Environment
			Triggering Question	Facilitating Activity	Tool	Info	
6	Debriefing	The presentation contents give the feedback to establish the learning goal	Do the presentation contents bring the result of creative problem solving result?	Supporting the brief feedback to each group presentation	P2CA	Learning manual	Group discussion room, Media room
7	Reflection meeting	Reflective thinking activity on the learning activity	How do you evaluate this learning activity as a whole? What are the advantage, limit, and the unique point?	Explaining how to use the six thinking hats and reflection note tool	Six thinking hats, Reflection note	Learning manual	Group discussion room
	Reflection presentation	Correct the wrong learning way, Communication with the other teams	What are the problems or good points of the other team's learning activity	Synthesize and analyze all presentation content	Round robin	Website	Group discussion room

STEP I KNOW	Write what you know
STEP II WANT	Write what you want to know
STEP III LEARNED	Write what you learned

Figure 1. K-W-L
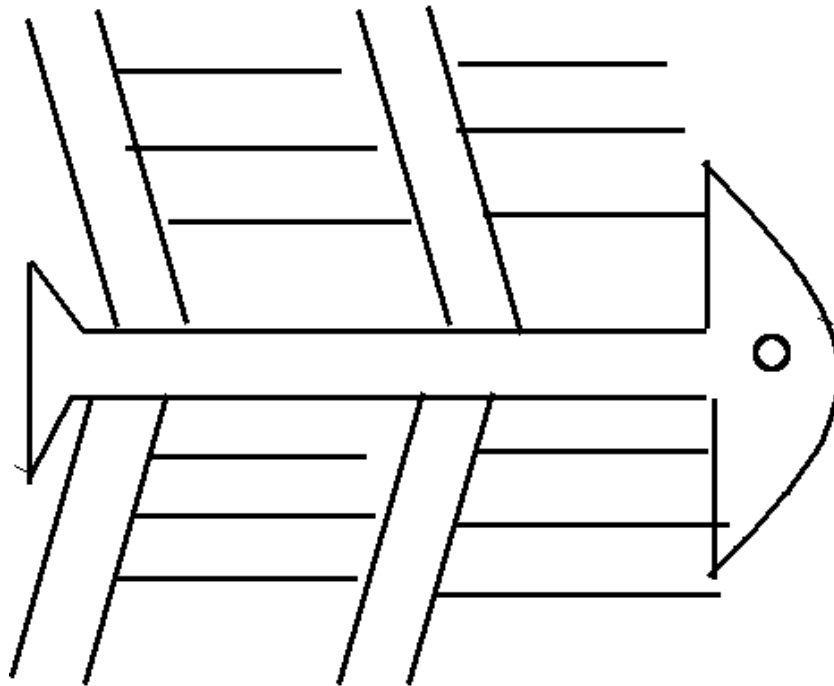
Figure 2. Fish Bone Diagram
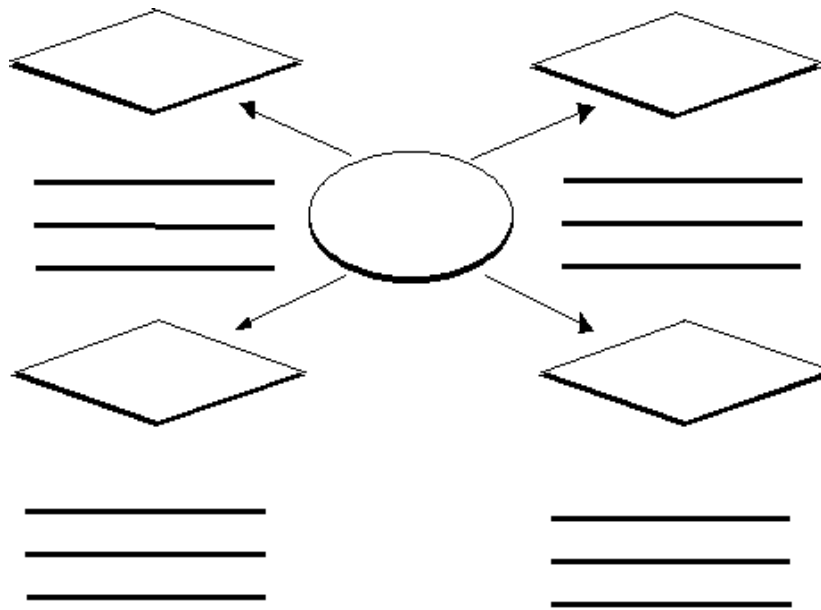
Figure 3. Mind Mapping

ITEM	IDEAS	CR1	CR2	CR3	CR4	CR5	합
		평가기준					
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Figure 4. Evaluation Matrix

ACTION	
REFLECTION OR FEELING	
FUTURE PLAN	

Figure 5. Reflection Note

Research Question and Method

Research Question

This research sets for the following research question to analyze the effectiveness of this learning model for improving creativity.

'Is there any improvement of creativity in the post group where the learning model for improving collaborative creativity is applied?'

Research Method

Measurement tool

This research practiced a quantitative research to find out the statistical effectiveness. It took place in the 2nd grade of K middle school(30 students) in Busan. For this, TTCT(Torrance Tests of Creative Thinking: language) was applied to the middle school students.

This research used the test manual to guide the test process carefully and used two different types of the pre test and the post test in order to reduce the similarity of the contents so that this research may have the least problem that could happen in this

research method. Therefore the pre test used Torrance Tests of Creative Thinking: language A and the post test used Torrance Tests of Creativity Thinking: language B.

TTCT takes 45 minutes and it's performed by the researcher twice, on March 7th for the pre test and on July 4th for the post test according to the direction of the test manual. And the evaluation was also performed by the manual written by Torrance (1990).

Data Treatment

In order to verify the effectiveness between two groups where the learning model is applied in two groups, the researcher used the SPSS/PC for paired t-test.

Table 2. Research design

group	Pre test	treatment	Post test
K middle school(30)	TTCT : language A	Apply 'the learning model for improving collaborative creativity'	TTCT: language B

Research Result

As the result of the verification between the post test and the pre test, the post group has the higher average score than the pre test. This shows that applying the design for the collaborative creativity meaningfully increases the average of the creativity ($p < 0.001$).

Table 3. Research result

		mean	N	Standard deviation	Coefficient of correlation	t
confrontation	before	82.76	30	15.28	.775	9.699***
	after	103.08	30	14.63		

***: $p < 0.001$

Results and Discussion

As stated above, the result of applying the learning model for improving collaborative creativity showed that the creativity of the post group was improved. This result proves the effectiveness of the learning model for improving collaborative creativity. This means that if the class applies the learning model for improving collaborative creativity to a specific subject, the possibility of improving the learner's creativity as well as expanding the information and knowledge of the subject would be enhanced.

This design, the Learning Model for Developing Collaborative Creativity based on CPS, made and suggested by this study has the following main strategies:

1) Improving the ability of the problem solving, this design develops the creative problem solving to explore and solve the problems by students, themselves.

2) Integrating the curriculum and developing the strong points and weak points of the students.

3) Carrying out the individual instruction. The students have all different backgrounds and each one has a different preference of learning method, learning style, various ability and characteristics. Therefore, the learners should have the chance to use the method they prefer and in the unique way to develop their characteristics and abilities.

4) Carrying out the experience-centered learning. The learners should have a chance to have the information and the experience for enhancing the problem solving and the creative thinking to change the action and tendency of the learners.

5) Supplying the learning activity fitting for the various learning styles. Also, the flexible learning activity should be supplied to extend and generalize the learning style preferred.

6) Utilizing the thinking tool of 'brainstorming'. The most merit of the 'brainstorming' is drawing out the more ideas with the group members together so that they can gain much more effectiveness than that of the individual's effort.

7) Having the learners take responsibility in the learning community and use their ability in the community.

8) Forming the multi-functional heterogeneity groups so that the various learners in the group may collaborate and share information one another.

This research has verified the effectiveness of creativity improvement by comparing the results between the pre group and the post group. If the research tries out to verify the effectiveness and improvement of collaborative creativity according to the teaching type between the matured instructors and the immature instructors, or to the achievement degree of the students, it would help to understand and analyze the various elements which affect the effectiveness of the development of creativity.

Above all, in order to improve the creativity of the students, the learning environment that supports psychological stability that brings creative ideas should be equipped. Especially the words and deeds of instructor need to be improved by training programs. Also, the method of the evaluation should concern the instructional design which develops creativity and make a new evaluation system such as portfolio. There are lots of difficulties and problems to evaluate the development of creativity with the portfolio, but if we solve this problem and develop a new evaluation system, we can make more effective instructional design for developing collaborative creativity.

Conclusion and Future Direction

Since the knowledge-based society has come and the paradigm of education has been changed in the 21st century, the various students centered instruction method became emphasized and the research for the practical teaching strategies and method is required. Therefore, the purpose of the research is creating the communication and collaboration centered learning environment to improve the ability of creativity and problem solving, the learning model for improving collaborative creativity.

This research analyzed the characteristics of CPS, and on the base of these characteristics, it supplied the specific teaching strategy and the manual for designing the learning environment, the interaction between the learners and the instructor continues for the collaborative creativity in the learning community, in order to have the successful learning result, the various methods and tools for improving group building and activities are designed in the learning model.

While the other researches concerned the collaborative creativity couldn't present the detailed manual for improving collaborative creativity so far, this research proposed the blue print of the entire agenda, the instructional design for the learning environment and the supporting system.

Also, while the other researches have focused on the individual learning mainly, this research extended the boundary of the offline learning community, and build up the virtual learning community on the internet, so that it can suggest the specific manual that helps the learners in the collaborative learning be able to act online and offline simultaneously to improve not only the individual learning but also the group collaboration learning.

This research suggests that the model for developing collaborative creativity can be applied in the various subjects and learning or training program, and it can be used not only at schools but also at home, community and a company covering the wide range from the elementary students to the adults.

Above all, this research has the important meaning that it could make the learning community the training field where the members of the learning community can use their gifts and share the knowledge and technique together.

This research has explored the effectiveness of the collaborative creativity for middle school students, but in the future if we try it to college students, it may be helpful for the students to enhance more sophisticated thinking, problem solving and critical thinking. Furthermore, the college students need creative thinking desperately for being adaptive in the informational communication based society.

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