A Developmental Study of an Instructional Systems Design Model for Elementary School Teachers

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Introduction

Instructional design or instructional systems design conceptualizing the preparatory process of instruction is the most representative field in educational technology (Gustafson, 1981, 1991). Instructional design is defined as a systematic approach of analyzing, designing, developing, implementing, and evaluating instruction (Gustafson & Branch, 2002). Although a variety of Instructional design models have been emerged, the Dick & Carey model (Dick, Carey & Carey, 2005) is one of the most frequently referred conceptual models.

However, even the Dick & Carey model is confronted with the various critiques both theoretically and practically. The Dick & Carey model is appeared to have a limitation of premising linear process (Jones & Richey, 2000). The outputs from one component of the model become the inputs for the next component and the final outcome can be revised by conducting formative evaluation. Thus, opinions of stakeholders cannot be adequately reflected until the last component. To overcome this limitation, the Rapid Prototype model is being explored as an alternative. This approach emphasizes the importance of opinions of stakeholders by developing the prototype in early phase.

In addition, the Dick & Carey model has a problem of not being well applicable in schools. Selected studies reported that school teachers apply the instructional design models rarely and irregularly although they recognize the importance of prescriptive activities of the model. According to Park (2007), though school teachers are aware of developing instructional skills and needs analysis as the most important things, defining instructional object based on needs analysis and developing materials are not fulfilled well. It is because they don’t have enough time and knowledge. Also, they think those processes are unnecessary because teachers’ guide is enough to prepare the instruction. Jeong (2009a) also supported these results. He reported that elementary school teachers did not practice instructional design well, and they thought the instructional design as a formal, meaningless, and difficult activity. That is, Dick & Carey model as one of representative Instructional systems design models is not well utilized in schools.

Instructional design is on the top of the practical areas of teachers and functions as a significant factor to become a professional teacher. In spite of its importance, teachers do not apply the Instructional systems design models because they did not adequately reflect the conditions and situations of the school.

The purpose of this study is to develop an optimal Instructional systems design model for elementary school teachers considering the progress of recent theoretical development and reflecting the situation and conditions of school realities. In order to achieve this goal, an initial model was developed by suggested principles by reviewing relevant literatures and then revised it to the optimal condition by design-based research methodology.

Theoretical Background

The Theoretical Problems of Instructional Systems Design Models

Instructional systems design is suggested to apply scientific principles of various learning and education to activities teachers should consider when they plan instructions (Gagne, Briggs, & Wager, 1992). This approach, stressing systemic of problem solving, is called as systematic instructional design (Dick, Carey, & Carey, 2005), instructional systems design or instructional development. Though instructional systems design model have worked satisfactory in guiding instructional design process systematically, there are some theoretical limitations.

Dick & Carey’s model (Dick, Carey, & Carey, 2005) representing the instructional systems design model has linear process. In traditional instructional design or instructional systems development, instructional designers can get information provided learners’ situational contexts at the end of a long development process (Naumann & Jenkins, 1982). As a result, learners’ needs are not applied exactly and the outcomes become unsatisfactory despite of spending lots of time and costs (Lim & Yeon, 2006). To overcome this problem, Tripp and Bichelmeyer (1990)
suggested rapid prototyping which emphasize the rapid development of final form in the early part. This model was based on previous instructional systems design models and each design activity is reiterate and simultaneous. It emphasizes the continuous interaction between designers and a client and this makes the designers possible to reflect the client’s demands fully.

In addition, as traditional instructional systems design models has been influenced by theories from behaviorism and cognitivism, they are not reflected recent research of constructivists. To improve this problem, we can consider scaffolding, portfolio, and rubric based on scientific research results stressing learner centered learning activity or constructivism. Portfolio is not just learning outcomes, but useful to reflect learning processes. Rubric is helpful to improve an achievement as the guidance suggesting learning goal or expectation level of task (Noh, 2008).

Last but not least, instructional systems design models so far are too generous to use in specific design situations. Since initial model of Dick and Carey (Dick & Carey, 1978) was proposed, lots of models have been developed. However, there are not clear differences except using just a little bit different terms. It is necessary to define instructional systems design components applicable to specific contexts. Not only that, it is also asked to use refine process and gather data systematically to improve model’s efficiency. Consequently, more realistic and specific instructional systems design model considering teaching context and condition is required.

Instructional Design Conditions of Elementary School Teachers

Instructional design is the core of all professional activities of the teacher (Young, Reiser, & Dick, 1998). Recently, the needs of teachers’ competency of instructional design grow bigger with emphasizing their instructional expertise. Though they also recognize the importance of instructional design activity, they don’t practice it properly (Park, 2007).

The researches about instructional planning show that teachers don’t follow rational objectives-first model (Driscoll, Klein, & Sherman, 1994; Reiser, 1994). They plan instruction focusing teaching contents (Bullough, 1987; Clark & Peterson., 1986; McCurcheon, 1980; Shavelson, 1983), and establishing learning goal is not importantly considered in their design (Clark & Peterson, 1986; Shavelson, 1983; Yinger, 1980). Clemente and Martin (1990) identified the primary gap between teachers’ instructional planning and instructional design model. It is because teachers used mental plan not written plan when they planned instruction. Moallem (1998) found that in teachers’ thinking and their instructional model, planning, practicing, and evaluating steps were interlocked. He also said that teachers do not follow instructional systems design model when they plan instructions but used well developed mental structure with several years’ teaching and learning experiences. The Young et al. (1998) also reported that teachers did not emphasize the defining learning goals and do any test based on the goals.

In Korea, although most of the teachers recognized the importance of prescriptive instructional systems design activity, they did not practice it fully (Park, 2007). The reasons were as follows: lack of time and cost, lack of expert knowledge, dependence on teachers’ guidance, lack of school supports, and regarding it unnecessary. Meanwhile, more reasons were pointed as follows: national curriculum (Karaca, Yildirim, & Kiraz, 2008), lack of teachers’ recognition, several socio environmental factors (Clemente & Martin, 1990; Park, 2007), and cultural differences in design (Kircshner & Van Merrienboer, 2002).

As discussed above, in spite of the importance of the prescriptive instructional systems design activities, model has not been well practiced in real-world settings. This is correspondent to the result of several studies that model is not reflect the reality. Therefore, we would like to develop the instructional systems design model considered existing state of elementary school teachers’ instructional design. Meanwhile, we also identify four primary conditions of elementary school affecting teachers’ instructional design activities.

First, in elementary school curriculum, there exist basic contents of textbook to teach. Since contents are already provided, teachers do not carry out needs analysis, task analysis, learner analysis, and environment analysis (Park, 2007). Dick and Carey’s model (Dick, Carey, & Carey, 2005) is asked to do those analyses in the beginning and then develop instructional strategy, and those processes are distinct to the model.

In addition, the primary outcome of the instructional design activity is units design. Teachers’ guides suggest lesson activities and materials by units. The units are usually composed of similar contents and goals to teach and central to design instruction.

Third, there are lots of resources and data to refer for designing instruction. Digitalized data and materials not only by national organizations but also by private firm are provided. These resources are positively or negatively influenced elementary school teachers’ process of instructional design (Han, 2009).

Last, school and classrooms are equipped with information communication technology. Computers connecting internet and projection TV electronic boards and others are ready to use in the classroom.
As discussed, previous instructional systems design models have several theoretical problems and are not used well in a real setting because they do not reflect elementary school teachers’ situations and conditions. Therefore, this study seeks to develop an optimal instructional systems design model for elementary school teachers by considering the progress of recent theoretical development and reflecting the situation and conditions of the school realities.

Methods

Design-Based Research

This study is conducted as a design-based research process. Design-based research method, being developed by Collins (1992) and Brown (1992), is focused on real educational environment where participants interact with one another, and on design settings rather than in laboratory settings. Within design-based research, iterative cycles of design and implementation are used, and each implementation is used as an opportunity to collect data for the subsequent design. By doing so, it can be illustrated and predicted when and how the learning occurs in real educational setting (Kim, 2008).

The purpose of design-based research is to generate competency for knowledge product or perfect understanding of certain area. The research is divided into two types such as product and tool research and model research (Richey & Klein, 2007). Since this study has focused on developing instructional systems design model for elementary school teachers, this study should be considered as a type of model research. The opinions of the elementary school teachers’ about model based on theories are collected and analyzed in depth. After that, those results are applied to revise the previous developed model repeatedly.

Research Process

According to the design-based research, the model is developed and revised based on expertise’s review and elementary school teachers’ opinions.

The development of the initial model

The initial model was developed including steps and specific principles based on the literature review. The reviewing the literatures were conducted in two areas; one was about the limitations of current instructional systems design model and the other was related to the reality of using instructional design model in elementary school. Through literature review, ‘development of user-centered rapid prototype’, ‘conducting realistic and iterative formative evaluation’, and ‘applying principles of constructivism’ are identified. In addition, following issues are suggested; ‘conducting analyzing learning objective as the first step’, ‘developing the model based on unit design’, ‘benchmarking proficient teachers’ instructional design process’, ‘using the resources efficiently’, and ‘emphasizing evaluation plan’. These principles were applied to develop the initial model. The guidebook with specific examples was also developed to increase the possibility of applying the model to instructional design in schools.

The development of the second model based on the experts’ review of the initial model

The professors concerned with elementary education and experienced elementary school teachers reviewed the first model. Through semi-structured interview, we gathered the data and analyzed it. A packet of the information including guide, abstract of the model, and questions those we would ask before the meeting was emailed to each of the reviewers. The interviews were conducted to investigate the improvements of the model and the participants’ responses were analyzed. The responses were categorized according to model in general and steps and then coding them based on improvements. The results were reviewed and applied to refine the initial model, and the second model was developed.

The development of the final model based on the review of the second model

To increase the possibility of utilizing the model in elementary school, the model was tested for use by elementary school teachers and the opinions were suggested. A total of 6 teachers, 3 novices under 2 year’s experiences and 3 experts with over 6 year’s experiences, participated. The expert teachers were selected to collect opinions about the instructional design process and the novice teachers were selected to investigate the difficulties
when they design the instruction according to the model. Another packet including guide, abstract, and review points was electronically sent to the reviewers. The interviews were conducted on August 16, 2010. First, description of the purpose of the study and a brief review of the model were conducted. After that, 6 elementary school teachers were divided into two groups, novice and expert, and then asked to design instruction according to the processes of the model. They followed the steps from 1 to 7 except the last step of summative evaluation with using worksheets developed to aid teachers’ design of instruction. To identify the improvements, interviews were conducted with them after completed the steps of the model. The participants’ responses were organized according to model in general and steps. The second model was refined based on the participants’ feedback and the final model was developed.

Results

The Development of the Initial Model

The initial model was designed by considering these two criteria: the direction of the theoretical development of the instructional design model and the possibility of applying the model in the elementary school. <Table 1> shows the design principles identified by reviewing the relevant literature.

<table>
<thead>
<tr>
<th>Implications of researches about instructional design model</th>
<th>Design principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limitation of linear processes (Naumann &amp; Jenkins, 1982)</td>
<td>Rapid prototyping method, formative evaluation</td>
</tr>
<tr>
<td>Effect of learner-centered learning activity (Park &amp; Min, 2008)</td>
<td>Instructional strategy design to maximize the learners’ participation</td>
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<tr>
<td>Deficiency of model applying in school (Park, 2007)</td>
<td>Specialized model(for novice elementary school teachers)</td>
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<td></td>
<td>Considering school context</td>
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</table>

Above all, existing instructional design model couldn’t reflect learners’ need exactly because evaluation is conducted at the end of the process (Naumann & Jenkins, 1982). Therefore, based on the rapid prototyping method, ‘formative evaluation’ steps are applied after unit and lesson design. Second, in constructivism, the core of the instructional strategies is learner-centered learning activity. It means that learner leads learning activity according to development level and trait of the learner (Duffy, Lowyck, Jonassen, & Welsh, 1993). Since elementary school students are in the concrete operational period, effective learning occurs when a variety of cognitive activities are suggested (Piaget, 1972). That is, the focus is designing learning activities to learn through cognitive participation. In this regard, instructional strategies based on constructivism, learners’ self-evaluation and teachers’ reflection, are suggested.

Third, the elementary school teachers use the instructional design model rarely because the user of the model is not defined and the previous instructional models are not reflected the conditions and situation of the school (Park, 2007). The initial model was developed based on the understanding of school context and elementary school teachers’ reality. <Table 2> shows the design principles from the literature review about teachers’ instructional design activities.

<table>
<thead>
<tr>
<th>Implications from ‘real condition of teachers’ instructional design’</th>
<th>Design principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Already existing of learning objective and contents to teach in national curriculum (ministry of education, science and technology, 2008)</td>
<td>Beginning from analyzing learning object</td>
</tr>
<tr>
<td>Emphasis on design for unit (Song, 2001)</td>
<td>Lesson design after unit design</td>
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</table>
Experienced teachers’ instructional design method
(Cho & Yun, 2009) → Experienced teachers’ formative evaluation on novice teachers’ instructional design

Abundant instruction-learning materials
(Jeong, 2009a, 2009b) → Emphasizing on analyzing instruction-learning resources

Insufficient plan of evaluation
(Park, 2007) → Emphasizing evaluation planning

First, teachers usually focus on instructional strategy because learning objective and contents to teach already exist (Bullough, 1987; Clark & Peterson, 1986; McCurcheon, 1980; Shavelson, 1983). Also, elementary school teachers don’t have to analyze learners and learning environment since they can identify learners’ learning level by observing everyday in the classroom. Considering the context of the elementary school, analyzing learning objective and contents is the first step based on teachers’ implicit analyzing learners and learning. Second, unit is composed of similar contents (Byun et al, 2007). Designing a lesson after designing a unit first, is helpful for an effective learning because the relation among learning contents can be identified.

Third, if novice teachers can learn how experienced teachers design an instruction, they may reduce their trial and error (Chung, 2001). Experienced teachers’ instructional design methods including instructional strategy, instructional materials, and lesson plan can be shared via the internet (Kim, 2008). The analyzing of instruction and learning material including these data can have a role to point the right direction of instructional design for novice teachers. Experienced teachers’ know-how can be applied to formal evaluation of novice teachers’ instructional design. Though the subject of formative evaluation should be students, it is not effective to collect elementary school students’ opinions because of elementary school students’ cognitive development. In this circumstance, most effective and realistic way of evaluation is from experienced and competent coworkers. In addition, using instruction and learning materials which are uploaded in the internet affect teachers’ instructional strategies. Since elementary school teachers must teach minimum 4 hours every day, the existing resources are helpful to teach. Therefore, analyzing of teaching resources is stressed and the materials should be revised based on the specific needs for students.

Fourth, in the process of teachers’ instructional design, planning the evaluation is not conducted well (Park, 2007). It is important to check of students’ learning outcomes, so planning evaluation is highlighted.

Based on the design principles, the initial model was developed (Figure 1).

![Figure 1. The first instructional systems design model for elementary school teachers](image)

The characteristics of the initial model are as followings. First, design a lesson after design a unit first. By identifying a unit objective first and then design a lesson, the lessons can be more organized. Second, analyzing learning objectives and contents is the first step of designing instruction processes. This is because educational objectives are given to teachers in the elementary school context. Third, formative evaluation is rapidly conducted after designing of a unit and a lesson. This leads to revise the prototype of the instructional design through experienced teachers’ evaluation not waiting the end of the process. Fourth, analyzing instructional resources is conducted prior to design instructional strategies. The analyzing instructional resources and designing instructional strategies are not separate process but incorporated process. Analyzing instructional resources places above designing instructional strategies is because there are plenty of resources and they can influence to design instructional strategies.
The activities in each step are as follows. The first step, ‘analyze learning objectives and instructional contents of units’, is about analyzing unit objectives and contents based on the learners and learning environments. Teachers investigate the unit contents by reviewing ‘teachers’ guide’ and ‘textbook’. Then, they revise the learning objectives and contents according to learners and learning environments. They can plan to integrate lessons or subjects and change the orders of the lesson. The outcome from analyzing is shown to be ‘unit structure map’, relationship of learning topics in unit.

Second step is ‘design instructional strategy for units’. After making a ‘unit structure map’, teachers plan the teaching method roughly. Considering students’ characteristics and level, learning places and learning materials are selected. The ideas are written on the ‘unit structure map’.

The ‘plan evaluation’, the third step, is the process of deciding evaluation method based on the instructional strategies and media. Assessment criteria for performance evaluation should be checked and conduct evaluation right time.

Forth step, ‘conduct primary formative evaluation’, is for evaluation of unit design. The evaluation is conducted by experienced teachers in the same grade. The comment of experienced teachers about unit design can be applied to revise the instructional design of the unit.

‘Analyze instructional resources’ is the fifth step. After finishing unit design rapidly, teachers confirm the learning objective again and write learning objective using behavioral verb. And then, they search for the instructional resources to teach effectively and select among them. When they select the material, they must consider learning objective, students’ learning level, and possibility of using it.

The sixth step is ‘design instructional strategies for lessons’. In this phase, teachers plan the detailed instructional strategies and write the lesson plan. They plan learning activities, learning order, and organizing environments on the basis of analyzing learning task. When they design the learning activities, learners’ participation, feedback, and opportunity of reflections should be considered. The form of lesson plan is based on the Gagne’s nine events.

The next step is ‘conduct secondary formative evaluation’. It is consisted of experienced teachers’ evaluation, rehearsal of teaching, conduct implementing a lesson, students’ evaluation, and teachers’ self-evaluation. Before beginning the class design for lesson is evaluated by experienced teacher and then revised based on their feedback. Teacher rehearses the lesson process mentally and plans how to react to the expected learner’ responses. During the class, teacher can identify the learners’ learning status and organize the learning outcomes. After the class, teacher can ask the students who had a problem in learning about their difficulties. By writing the comments of experienced teachers and learners and learning outcomes, teacher reflects their teaching based on the expectation when he or she designs the instruction.

The last step, ‘conduct summative evaluation’, is for confirming learners’ learning outcomes after finishing the unit. The test results are recorded and used to help students’ learning.

The Review of the Initial Model by Experts and Results

The initial model was reviewed by 6 experts and then revised based on their responds. Their opinions reflected on the second model are as followings. First, develop worksheets including various examples. Though specific guide and examples are suggested to increase the possibilities of applying the model to school, the need for worksheets are still asked to use model more easily. The comments of experts are mainly about activities of steps and examples in explanation report of the model. They suggest more activities and the need of developing various worksheets forms in order to choose the form according to teachers’ conditions.

Second, revise the term. The most suggested opinion is the need for changing the terms. The terms used in the model are different to the teachers’, so it is difficult for teachers to understand the activity of the steps. Therefore, it is necessary to revise the term.

Last, revise the linear process. The model suggested activities to follow in every step helping novice teachers use the model easily. At the same time, formative evaluation is applied to overcome the linear trait. However, each step is conducted simultaneously. Considering it, the model is revised to show the steps are overlapped.

Though most of the participants respond positively to the model, they responded differently each other for the opinions that ‘analyze instruction resources’ is prior to ‘design instructional strategies’. However, considering the influence of abundant resources and positive aspects of the resources for novice teachers, the order is not revised.
The Development of the Second Model

[Figure 2] visualized the second model. Activities of the step are same with the initial model but components of a unit and a lesson design are placed parallel to stress activities are conducted simultaneously. In this model, each step is not separate but incorporated and overlapped.

Also, the term is changed to help to understand the activities clearly. To show the purpose of the step definitely, ‘unit’, and ‘lesson’ is used repeatedly. In addition, ‘formative evaluation’ is altered to ‘evaluate the design’, since term of formative evaluation is used differently to elementary school teachers.

The worksheets with specific guide and various forms are developed for teachers to use model (Figure 3).

Figure 3. The example of worksheet
The experienced teachers’ designing methods are added to specific activities. In analyzing learning objectives and learning contents, reorganizing processes such as incorporation of lessons and changing the order of the lesson are highlighted. Also, the various evaluation methods including students’ self-evaluation and peer-evaluation are introduced.

The Review of the Second Model

The elementary school teachers, 3 novice and 3 expert, suggested the opinions about the second model after they designed the instruction by using the model. The expert teachers designed without any difficulty. They also said that the model is useful to plan the lesson effectively. Through observing their design process, it is identified that the components of the unit design are conducted at the same time and analyzing the resources is prior to designing instructional strategies.

The novice teachers have some difficulties in designing instruction using the model. Especially, it is hard to control the scope of the unit design for them. They have a tendency to focus on the individual lesson rather than understanding the unit, so they design the unit including lesson design activities. They insist to provide more specific guide and examples and need various forms of worksheets to select according to their conditions.

Commonly, they ask to simplify the things that they should write because they feel burden to use the model if there are a lot of things to do. Elementary school teachers must teach minimum 4 hours a day. Therefore, if there are many things they have to do when they design an instruction it is hard to use it.

The results of the review revealed that the second model is effective to design instruction. However, more worksheets were developed and specific guides were added in the explanatory guidance.

Conclusion and Discussion

This research intends to guide an effective instructional design for novice elementary school teachers. The first model was developed based on the theories of instructional systems design model and principles of effective learning. The model was revised based on the resulting feedback of experts and elementary school teachers.

Through this study, four characteristics of theoretical model to guide instructional design for teachers are suggested as follows. First, the first step of ‘analyze instructional resources’ are emphasized. ‘Design instructional strategies’ influences to develop instructional materials in previous instructional design models (Dick & Carey, 1978; Dick, Carey, & Carey, 2005). The step of ‘analyze instructional resources’ is conducted before the step of ‘develop instructional materials’ in elementary school conditions. It is possible because there are plenty of instructional materials in a various forms available. The activity of ‘analyze resources’ for effective learning positively influences on the instructional design. Especially it is useful for novice elementary school teachers who teach all subjects and have difficulties in designing instructional strategies for effective and efficient instruction.

Second, it proposes a specific practice of formative evaluation for instructional design. The evaluation after finishing a class doesn’t help to improve the actual lesson (Lim & Yeon, 2006; Naumann & Jenkins, 1982). In this respect, formative evaluation steps are conducted after unit and lesson design. The comments of experienced teachers are helpful to reduce expected trial and error and effective instruction.

Third, design lessons after design unit. The unit is composed of lessons. By designing lessons based on the design of a unit, former learning is systematically combined with the next. Experts and elementary school teachers in this study identified the effectiveness of this process.

Forth, ‘analyze learning objectives’ is the first step of the model. The teachers usually focus on learning contents rather than learning objective when they plan the lesson (Clark & Peterson, 1986; Shavelson, 1983; Yinger, 1980). It is because learning objective and contents are already fixed in national curriculum. Though a decision relating to analyze learners and learning environments effects another in the process of instructional design, the information about learners’ learning levels and learning environments are in teachers’ mental structures because elementary school teachers can observed students everyday in the classroom. Considering this condition, the first activity should be ‘analyze learning objective and instructional contents’ based on teachers’ existing information about learners and environments.

Meanwhile, in this study, some implications of developing instructional systemic design model are identified by design-based research. First, in the process of designing instruction, teachers take steps concurrently. In the first model, steps are definitely distinguished to increase the understanding and possibility of using the model. However, reviewers in this study indicated that it may be impossible to divide activities of instructional design distinctly. In elementary school, it may be hard for teachers to spend much time planning the instruction, so steps of instructional design may have to be overlapped.
Second, it is necessary to use the terms to communicate with teachers. Every organization has its specialized terms. To develop the model for elementary school teachers, it needs to apply the term that elementary school teachers can understand and use. The ‘formative evaluation’ used in the initial model is transformed to ‘evaluate the design’ since teachers use the ‘formative evaluation’ as the evaluation of students to check their learning. To communicate with the user of the model, it is important to select the terms used in the real contexts.

Third, the job aids are necessary to support teachers’ instructional design. One of the reasons why teachers don’t design an instruction is that they have little time (Park, 2007). If it takes time to follow the steps of model for designing instruction, teachers will not try to apply it. Experts advised the needs of worksheets and the elementary school teachers also responded the importance of the worksheets in the interviews. Through the interviews with the teachers, the importance of providing worksheet with the model is identified to increase the possibility of using the model.

In conclusion, through this study, the characteristics and design principles that can be applied to develop an effective instructional design model are identified. Although a variety of instructional design models have been developed by many researchers, teachers use the model rarely because of the theoretical limitation of the model and realistic problems (Park, 2007). In this situation, it is expected to use the model developed in this study widely since it is based on the understanding of real conditions. Also, for novice teachers, it is useful to plan the instruction effectively and efficiently. Furthermore, if it applies to pre-service teachers’ curriculum, it will help students design an instruction systematically.

The further studies to investigate the improvements of the model by applying the model to a large number of teachers and schools and examine the effectiveness of the model are expected.

Reference


