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An Approach for Redesigning Learning Environments with Flow Theory

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This paper proposes a framework that provides hints and suggestions for teachers and course designers with utilizing flow theory to redesign their own teaching and educational settings, even if they have little knowledge on flow theory. A prototype system, including a checklist for compatibility with flow theory, was developed in an online environment under the open source learning management system, Moodle. An initial formative evaluation was conducted with 16 participants. From the questionnaire survey, it was found that this check list could cover a wider variety of teaching/learning environments and it had some potential for users to acquire new perspectives for their redesign activities. Further study, including usability issues, were also discussed.

Keywords: flow theory, learning environment, redesign approach, e-learning

Introduction

Public education tends to depend on the performance of the teachers involved. Teachers are expected to educate students in developing the ability to learn, think, judge, and act by themselves as a complete individual. Recently, there have been many changes in the Japanese educational system and its surroundings. The teacher training and qualification system has changed, and the system now requires that teachers update their certification every 10 years. According to the governmental policy, many ICT (Information and Communication Technology) facilities, such as e-blackboards and PCs, are being introduced into school classes each year. As for junior high school students in Japan, the ratio of students who have affection for mathematics and science is lower than the global average, according to the Trends in International Mathematics and Science Study [TIMSS] (Olson, Martin, & Mullis, 2008). In terms of science, 57% of 4th graders chose "I strongly enjoy learning science"; in 8th grade, however, this number dropped to a mere 18%. The same tendency is observed in mathematics. Additionally, in higher education, the dropout rate in e-learning courses is higher than that in on-campus courses (Xenos, Pierrakeas & Pintelas, 2002). The main factors that contribute to this dropout rate are academic locus of control and student satisfaction, according to Levy (2007). The ARCS model of motivational design is one of the systematic model approaches for

designing motivational instruction (Keller, 1983). Such an approach of refining motivational aspects can be one way to improve current issues. Therefore, motivational design would play an important role in educational research and practice. We propose that a major goal in the field of education should be developed to raise life-long learners who are intrinsically motivated and who find learning enjoyable.

When people concentrate on a task, forgetting time and other concerns, simply enjoying the task itself, they often find themselves in an optimal experience that is known as a "flow experience" (Csikszentmihalyi, 1975). Recently, detailed research on flow theory has been accomplished in various fields such as psychology, business administration, education, and so on. According to the reviewed literature, flow theory has potential for improving and enhancing motivational design in educational applications and e-learning environments (Chen, Wigand, & Nilan, 1999; Keller, 2009). Much research has been conducted on flow theory, which has recently been applied to educational areas. For example, in foreign language learning, "flow" does exist in the classroom, and flow theory offers an interesting and useful framework for conceptualizing and evaluating language learning activities (Egbert, 2003). Another study focuses on EFL teachers reporting their flow experience during teaching (Tardy & Snyder, 2004). In the area of mathematics, some computer-based math applications can control some of the flow components and help students increase flow experiences (Sedig, 2007). In an online course about management, the relationship between students' flow experiences and their learning outcomes was studied (Rossin, Ro, Klein & Guo, 2009). Csikszentmihalyi (1997) has described flow experience as a magnet for learning because sustainable flow experience requires new levels of challenges and skills. Therefore, flow theory can be an effective approach for constantly motivating both teachers and learners.

A preliminary investigation was also conducted on the relationship between teacher and student motivation. The number of samples was very small, but there seems to be a link between teacher and student motivation (Atkinson, 2000). Other research showed that there is a relationship between student engagement and motivation and their flow experience in e-learning settings (Rha, Williams, & Heo, 2005; Pearce, 2005). Sutton and Wheatley (2003) found that teachers' emotions, especially positive emotions, may influence teachers' and students' cognition, motivation, and behavior. They implicate that a teacher's positive emotions may thus cause flow experiences for both parties. Fave and Massimini (2003) investigated teachers' flow experiences in daily life by conducting questionnaire surveys. They reported that teachers have experienced more flow when reading books as well as by teaching classes and pursuing their own hobbies (Fave & Massimini, 2003). Many teachers might also experience flow without being aware of it. Like an experiential learning cycle (Kolb, 1984), a reflective stage is very important for teachers to bring flow up in their consciousness; then the flow-based approach can begin to be employed to improve their teaching/learning environment.

Increasing the level of motivation of both teachers and students can be one way to improve complex situations in various educational areas. In addition, flow theory can provide one perspective among many psychological/instructional design theories and practices. Flow theory has been studied extensively in the field of positive psychology; however, educational application and applicable areas of flow theory have not yet been studied thoroughly. It is, therefore, the intention of this paper to propose a redesigning framework based on flow theory

to improve the existing learning environments and courses in order to provide some ideas and suggestions to teachers and course designers. Because flow theory is not very popular for teachers and course designers, we propose a formative approach. This includes an introductory course to educate teachers or designers on topics such as an outline of flow theory, checklists of flow theory compatibility, and other activities. Much theoretical research and practice exist for the purpose of designing a whole learning/teaching environment; hence, we focus on redesign aspects such as improvement and refinement in our first stage of flow theory application.

Flow-based Redesign

Framework

As shown in Figure 1, we propose a flow-theory-based redesigning process and an online portal site as its implementation. This framework is targeted for teachers and course designers and aims to provide them hints and suggestions, which are derived from flow-theory-based checklist, to improve their teaching/learning environment, and to increase and enhance their motivation.

This framework is addressed to users who have little knowledge as well as to those who have a vast understanding of flow theory. The framework also covers teachers/designers with beginner to expert experience. We attempt to clarify that this particular framework shows the feasibility of applications of flow theory in educational settings, applicable areas of topics, and keys to improving teaching and learning. Using this framework, the suggested practices, learned knowledge of flow theory, and suggestions involving the redesign of learning environments can be collected and shared among many teachers and designers.

This framework includes four major processes and three major contents. Those will be explained in detailed as follows. The outer circle in Figure 1 is a cycle for teachers/designers who are trying to improve their environments. A thick line in Figure 1 means a path for them and a dotted square does a portal site.

(1) Check with Checklist (at the top)
We have developed a checklist for compatibility with flow theory, which can be applied in educational areas, such as classroom teaching, e-learning, etc. According to the checklist, teachers or course designers check their teaching or learning environments. They rate each item from “Strongly agree” to “Strongly disagree” on the five-point Likert scale.

(2) Propose Improvement (at the right)
After checking each item, if there are some items which they have rated as “disagree,” they are asked to think about and write down their improvement activity in their environment in terms of the checklist item.

(3) Perform Active Experimentation and Get Concrete Experience (at the bottom)
Away from checking activities in the portal site, they do improve their teaching or designing environments according to what they write in the above in their real environments. Then, they would obtain practical concrete experiences.

(4) Write Feedbacks (at the left)
After the execution of their redesign practices, they are asked to write down the results of their practices and feedbacks.

The inner loop in Figure 1 includes supporting contents for the main processes. There are three types of content and a thin line in Figure 1 means an information path in the portal site.

(1) Database on Redesign Practices (at the top)
When teachers/designers write their practices and feedbacks after the execution of their proposed improvement, that information is stored in the database on redesign practices. When users visit this portal site, they can refer the database while thinking the improvement of their environments.
(2) Introductory Course on Flow Theory (at the right)
Teachers/designers learn not only definitions and flow experience cases, but they also write about their own flow-like experiences and rate them on their own in order to deepen their understanding of flow theory and to increase their involvement of this new flow-based redesign approach.
(3) Database on Flow Experiences (at the left)
Teachers/designers can share their own flow experience examples among other users in the portal site. It will be helpful for them to understand flow theory deeper and this is an advantage for an online system.

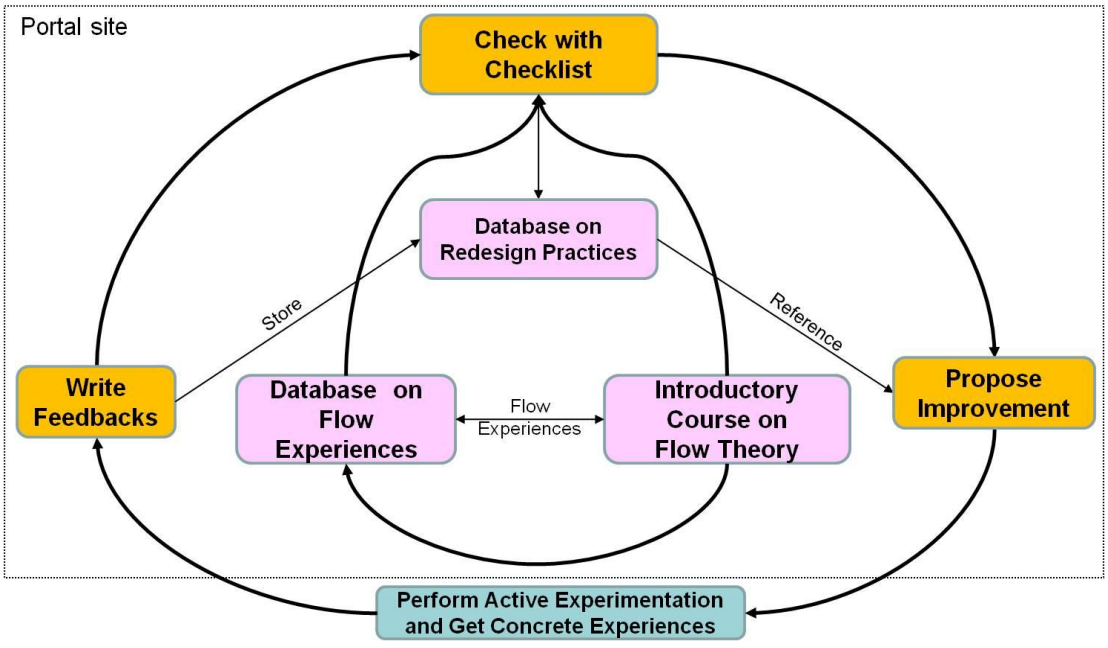

Figure 1. *Redesign Process with Flow-based Checklist*

The framework, including the introductory course, checklists, databases, and a portal site, is designed to be very flexible and self-regulated so that users have control over as many of the

decisions as possible. Figure 2 shows the current menu of this flow-based redesign site. Details in each activity may change according to ongoing formative evaluations and accumulative feedback from the real-time usage of this system.

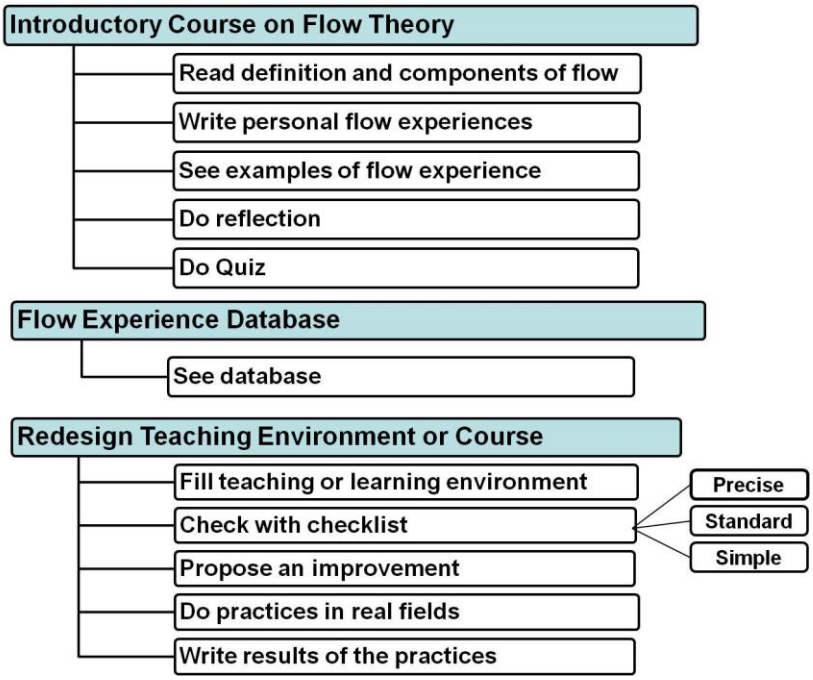

Figure 2. *A Menu of Flow-based Redesign Site*

Introductory Course of Flow Theory

This introductory course of flow theory is for teachers/designers to know basics of flow theory and prepare for using the checklist for compatibility with flow theory. There are five activities in this introductory course shown in Figure 2: defining "flow," collecting examples of users' real flow experiences, revealing other examples of flow experience from professionals, a reflective activity about users' own flow experience, and finally several quizzes to check their level of understanding.

Definition and components of flow

The first section in this course defines what flow is. Csikszentmihalyi (1975) proposed this concept, and a wide variety of research related to flow theory has been conducted so far, including its measurement, called a Flow State Scale (Jackson & Marsh, 1996). Ten components of flow are listed in this introductory material (Csikszentmihalyi & Rathunde, 1993). The goal of this activity is to help users to acquire a "declarative knowledge" on flow theory.

Personal flow experience

After understanding the definition of flow, users are requested to think about and describe their previous personal flow experiences. This is limited not only to their teaching, learning, and designing but also to their daily lives. They write about their personal experiences, the surrounding situations, and their emotions and thoughts during those times. Then, to rate the depth of the personal flow experience, users self-evaluate those flow states. In addition, these experiences are stored in the database in the portal site and would be shared. The goal of this activity is to allow users more involvement with flow theory and to increase relevance to the flow experience.

Examples of flow experience

There are many flow experiences described in various research studies. Csikszentmihalyi (1975) conducted many interviews with professionals such as rock climbers, rock dancers, chess players, physicians, etc. Those professionals explained their flow experiences with varying language. The goal of this activity is to show users the variety of flow experiences they may have, from deep to shallow, and to provide some suggestions for self-reflection on their own flow experiences in the following activity.

Reflection on personal flow experience

After browsing and understanding some examples of flow experiences, users are given reflective work on the previous personal experience, which had just been completed. They can then change their description and rating if necessary. Also, if other personal flow experiences come to mind, they can add them to the database as well. This is the most important part of the introductory course. The goal of this activity is to combine users' personal experiences and flow experiences in order to show them that a flow experience is not special or limited to the most professional athletes, and to increase more relevance to the flow experience.

Quiz of flow theory introduction

This activity is a set of quizzes about flow theory and experience. Some may confuse the flow state with addiction, which is a psychological symptom. Others may misunderstand the flow state as a simple state of concentration. It is an example: "A man is watching T.V., and he is not aware of a telephone call. Is his condition a flow state?" Users will check their understandings of flow theory by replying to these quizzes and checking their answers. This activity is self-paced and up to users' selective behaviors because we would like to give users more chances to feel a sense of control. The goal of this activity is to give users more confidence and some satisfaction about their knowledge on flow theory, as well as to check the accuracy of their declarative knowledge on flow theory.

Checklist for Compatibility with Flow Theory

This checklist, shown in Table 1, is designed for teachers and course designers to check the compatibility of their teaching/learning environments with flow theory. Following the Checklist Development Checklist (CDC) (Stufflebeam, 2001), we have developed this checklist as its initial stage. The checklist continues to be under development through a process of evaluation and operation. The items in the checklist are mainly derived from the Flow State Scale, which was developed to be applied in athletic and physical activity settings (Jackson & Marsh, 1996; Csikszentmihalyi, 1990; Csikszentmihalyi & Csikszentmihalyi, 1992). Some of them are from other research studies on flow theory, its applications, and theoretical considerations. Rezabek (1994) proposed a synthetic approach to integrate flow theory with the motivational design theory of instruction. A learning process with educational games was analyzed and it was discovered that reflection can play an important role in fostering motivation (Paras & Bizzocchi, 2005). Components and antecedents of flow experiences were examined in the context of navigation behavior in online Web usage (Novak & Hoffman, 1997). Some tips of Web site design that promote users' flow experience were presented as an emotional Web design, including usability (van Gorp, 2008). A framework of flow in computer-mediated environments, such as online games, was also proposed. It is based on an experiential learning theory (Kolb, 1984) and called an experiential gaming model (Kiili, 2005). Flow is shown as one of the factors of "Relevance" in ARCS motivational design model (Keller, 2009). We have integrated our checklist with this related research.

There are three types of checklists: precise, standard and simple. The precise checklist is very informative. The standard one omits detailed descriptions so that users can get directly to each checklist item. The simple one is a very simple, directly for users who have a lot of experience in teaching/designing and are knowledgeable about flow theory. It contains only the minimum words. Table 1 shows the simple checklist, which consists of 15 check items. There are no extra descriptions or explanations of each checklist item.

Table 1. *Simple Checklist*

Flow Antecedent	
1	Intrinsically rewarded activity
2	Clear goals
3	A sense of control
4	Direct and immediate feedback
5	Attention
6	Balance between ability/skill and challenge
7	Usability
During Flow Experience	
8	Distorted sense of time
9	A loss of the feeling of self-consciousness
10	Concentration
11	Tele-presence
After Flow Experience	
12	Increase of learning
13	Attitude change
14	Exploration behavior
15	Recognition of control

Prototype System

As an implementation of the redesign framework, we developed an online environment, including a community portal, to allow a wide variety of users to know how to utilize and embed flow theory in their teaching/designing environments.

A prototype system was developed under the Moodle system (Dougiamas & Taylor, 2003) because it is an open-source-based system and widely used Learning Management System (LMS) not only in Japan but also in many universities and institutions across the world. The multilingual function embedded in Moodle can be applied to this system in order to build a global community.

Experience levels in teaching or designing materials differ as well as users' knowledge on flow theory. Ideally, many steps or individually-adaptive environments might be the best from flow theory (Chen, 2007). So, we proposed a practical three-by-three matrix type front page on the portal site as an initial start (Figure 3). However, this approach does not limit each level to three. After some formative evaluation, a matrix can be bigger or smaller according to the usage and effectiveness of the number of levels. Because the balance between challenge and skill is one of the most important components in the flow experience, a three-by-three matrix is provided, and users have to choose which level to start at with this material by themselves. This top page had totally nine entrances and assigned three different types of activities: introductory course, flow experience examples, and three types of checklists. All activities to start and to do would depend on the user's decision, since a sense of control is another important component of the flow experience. This classification levels were not strictly defined, because we provided more flexibility with users. They can easily move to another level by their decision. The following subsection shows how to use this matrix-type interface.

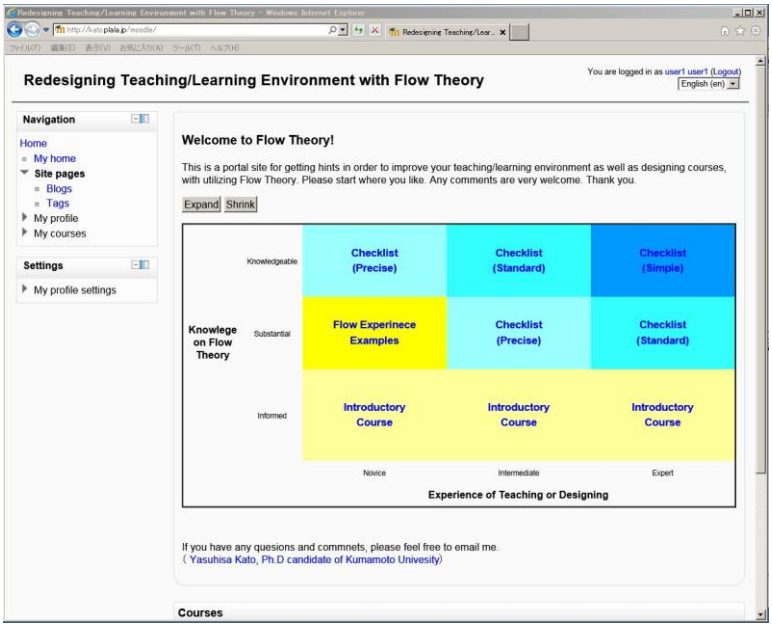

Figure 3. *Top Screen Image of Flow-based Redesign Site*

As shown in Figure 3, if users are novice in teaching or course designing, they will select the left-side column. Then, if they have little knowledge on flow theory, the first activity would be to take the introductory course on flow theory at the bottom row of the matrix. Then, they would go up to the middle row to see flow experience examples. After having substantial knowledge on flow, they will go up to the top row, which has an activity of the precise checklist. If users are intermediate, they will start the same introductory course on the middle column if they don't know flow. Then, they will go up to the activity of the precise checklist or the standard checklist according to their level of knowledge on flow. If they are experts by their experience, they will go to the same introductory course on the right-side column by their little knowledge on flow. Then, the second one is the standard checklist. If users are knowledgeable on flow, they go directly to the simple checklist.

Figure 4, 5, 6, and 7 show sample screen images of the prototype system. Figure 7 shows a checklist item of "Balance between ability/skill and challenge". There are functional buttons written "on" and "off" in Figure 7. Users can control the visibility of the usual description and the precise description. If both descriptions are invisible, a checklist will become the simple checklist. If both are visible, it will become the precise one. The standard checklist has only the visible usual description part.

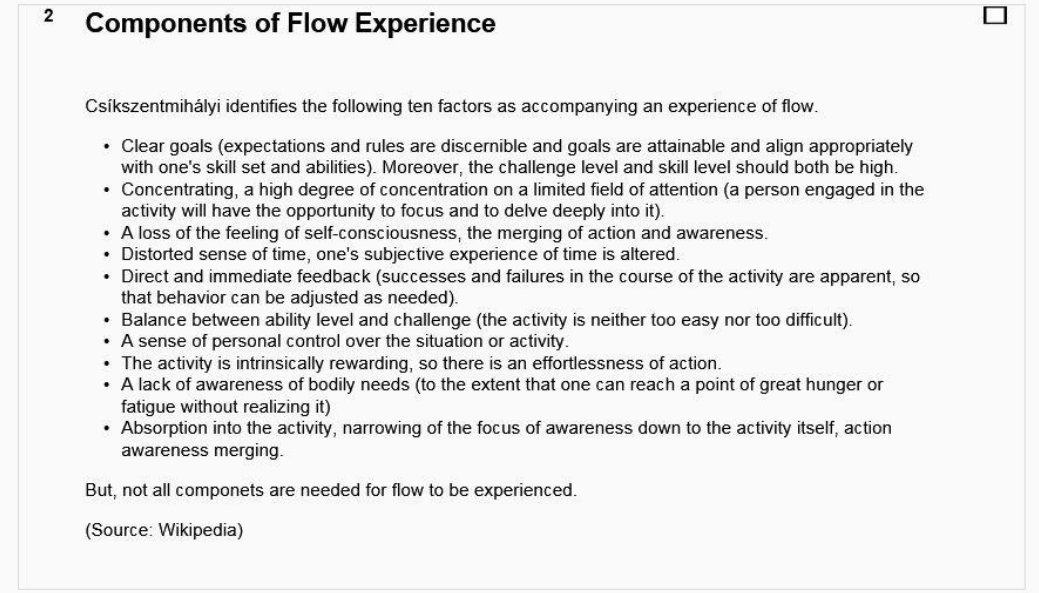

Figure 4. *Screen Image of Introductory Course: Component of Flow Experience*

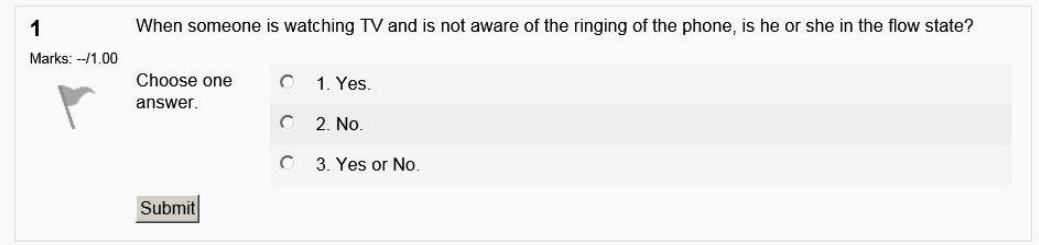

Figure 5. *Screen Image of Introductory Course: Quiz*

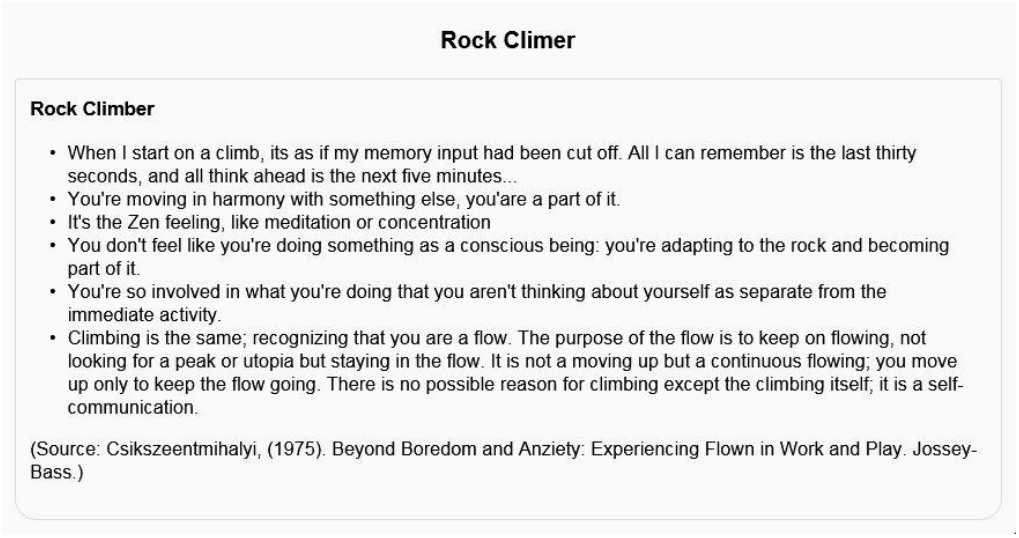

Figure 6. *Screen Image of Flow Experience Example: Rock Climber*

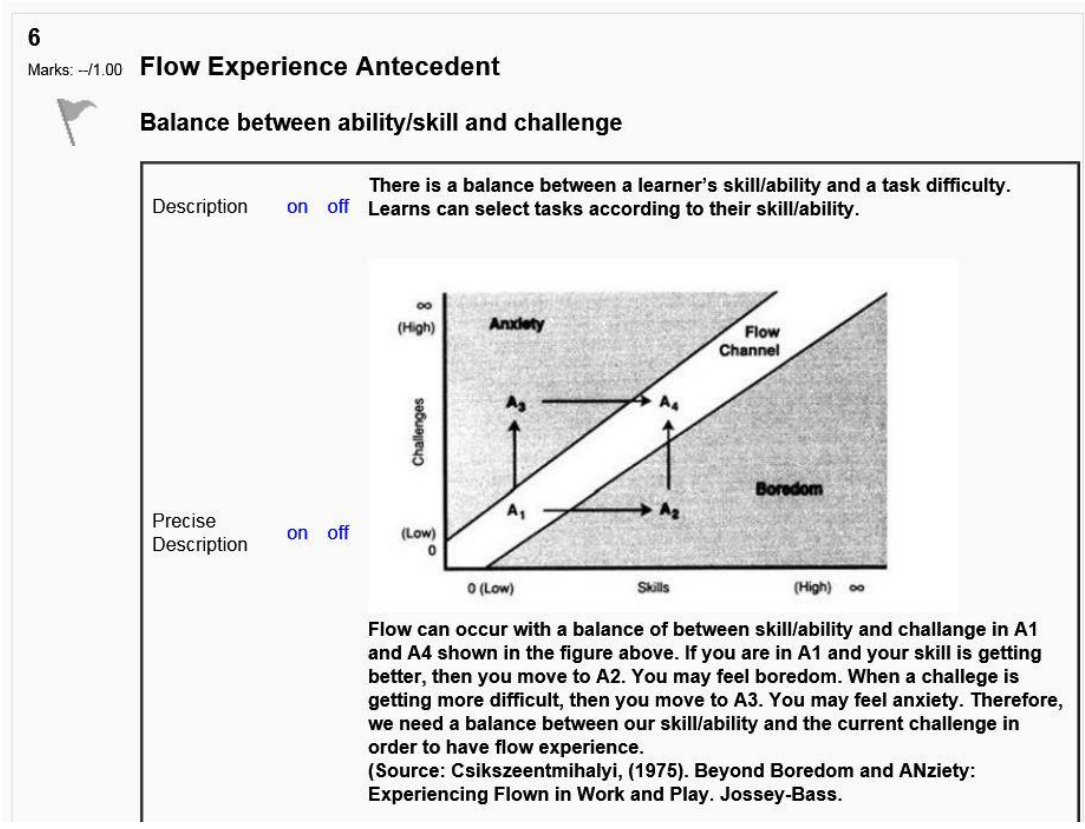

Figure 7. *Screen Image of Checklist Item #6*

Formative Evaluation

After having several expert interviews, we added two new descriptions on each checklist item as reference data. To reduce users' effort and to help to think up improving ideas, an improvement perspective and an improvement example added to each checklist item. The improvement perspective is expressed by a simple sentence, and an improvement example shows a revised example as well as issues in the original content. Figure 8 shows an example of some e-learning course from the perspective of "Increase feedbacks. Provide immediate feedbacks." Before the improvement, tests are designed to be done after completion of all lessons, so learners cannot have any feedback during doing lessons. The improvement example shows that tests are allocated after relevant lessons, so learners have more feedbacks than before. Another example shows in Figure 9. The improvement perspective is "Provide choices with different difficulty." The improvement example shows that an additional indicator with task difficulty is attached to each lesson in the table of content, so learners can understand which lesson is easy or difficult at one view.

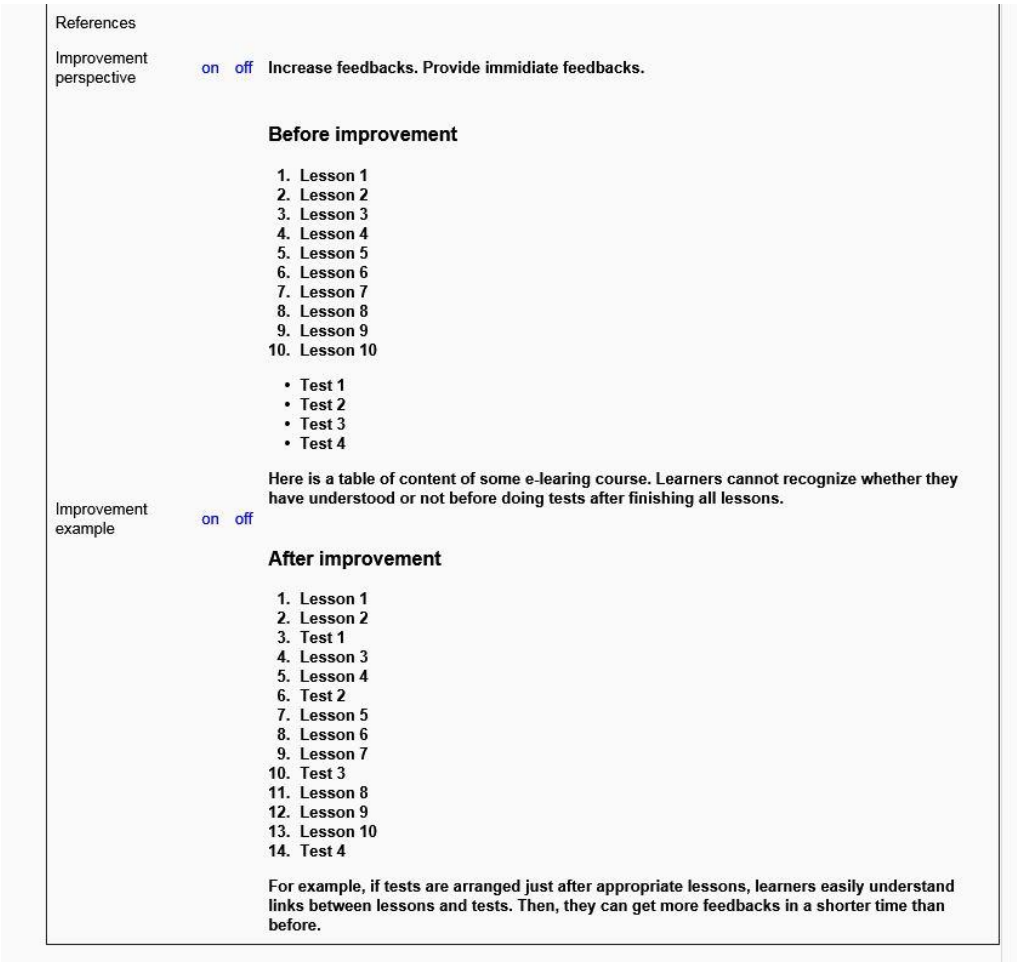

Figure 8. *Screen Image of Hints of Improvements: Checklist Item #4*

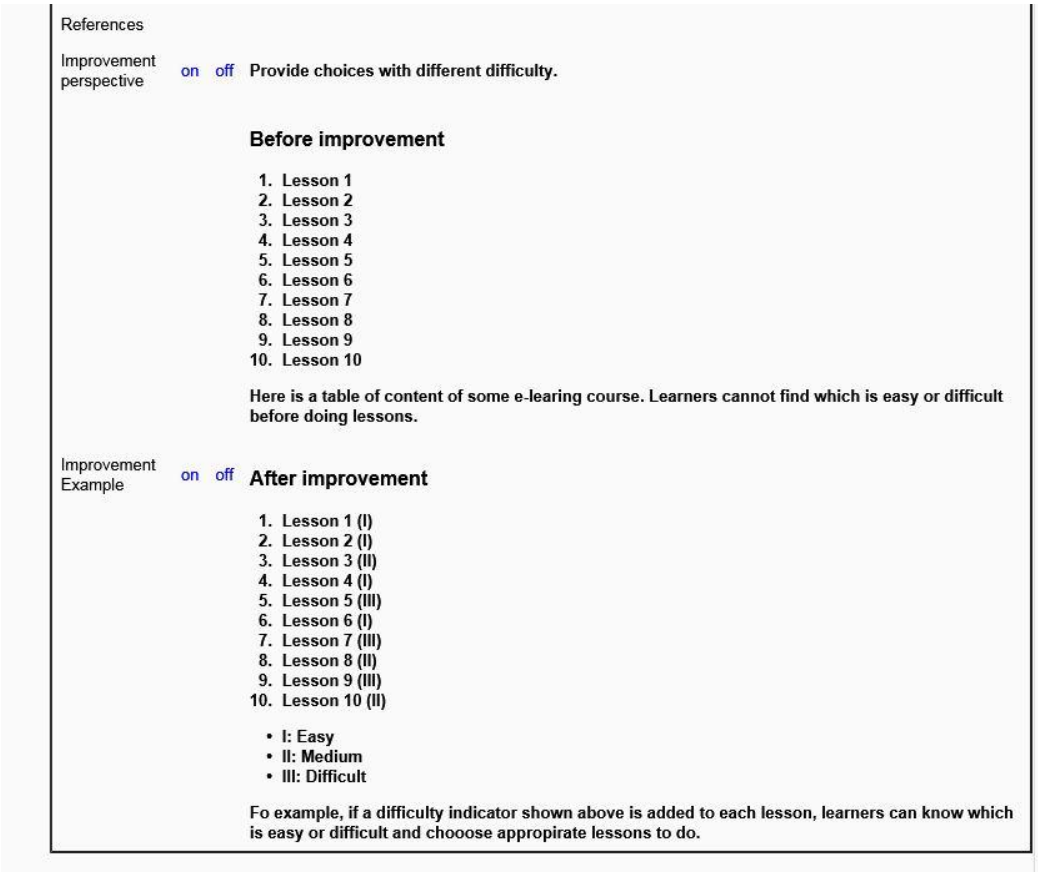

Figure 9. *Screen Image of Hints of Improvements: Checklists #6*

Questionnaire survey

The initial formative evaluation was performed to test the checklist validity for wide variety of environments and some user interface approaches. The participants were 16 people, who had at least one-year experience of teaching or designing course. With using the developed prototype system, each subject filled out a profile sheet, which includes an experience, ones' teaching/learning environment, etc. Then, he/she used the checklist for compatibility with flow theory, and finally answered the questionnaire. All activities were done by online under the prototype system. 15 checklist items and other evaluative questions required five point Likert-scale statements. Participant checked their environments of their choice. The topics of participants' targets had a wide variety: business manner, mental health, logical thinking, nursing practice, psychology, computer networks, etc. Besides, some courses were provided as a usual classroom style and others are online or hybrid environment.

Results and Discussion

Results of evaluating the checklist are shown in Table 2. The average of the usefulness in all check items was 3.91. It had a range from 3.44 to 4.20. The highest point was the item of "A

balance between skill and challenge". The lowest was the item of "Distorted sense of time". The highest score of compatibility is 4.06 of "Clear goals", and the lowest is 3.06 of "Attention." After seeing histograms of Figure10 and Figure 11, it is found that participants who selected "Disagree" or "Strongly Disagree" as checklist compatibility test (Figure 10), tended to choose "Strongly agree", "Agree", or "Average" on their usefulness question (Figure 11). When participants checked their teaching/designing environments with some checklist item and those environments were not compatible with flow theory, they would think the check list item was useful. It is also supported by the words from participants as free answers. Useful check items are different for the participants because their environments are different. As for the validity of the checklist, there were only five answers in both compatibility test and usefulness survey, which were "Not applicable", out of 240 (Table 2). So, almost 98 % were applicable, and then the checklist can be applied to most participants, which had a wide variety of topics and environments.

Table 2. *Results of Evaluating the Checklist*

Check Item	Compatibility			Usefulness		
	Mean	**SD**	**N/A**	**Mean**	**SD**	**N/A**
#1	3.20	1.15	1	3.87	0.92	1
#2	4.06	0.77	0	4.19	0.91	0
#3	3.56	1.21	0	3.73	0.96	1
#4	3.19	1.22	0	4.19	0.91	0
#5	3.06	1.18	0	3.75	0.58	0
#6	3.25	1.06	0	4.20	0.86	1
#7	3.50	0.89	0	4.19	0.75	0
#8	3.31	1.08	0	3.44	0.89	0
#9	3.13	1.09	0	3.69	0.70	0
#10	3.19	1.33	0	3.67	1.05	1
#11	3.93	0.46	1	4.00	0.65	1
#12	3.33	0.82	1	3.56	0.63	0
#13	3.60	0.63	1	3.94	0.85	0
#14	3.53	0.74	1	4.19	0.91	0
#15	3.44	0.73	0	4.00	0.73	0
Total	**3.42**	**0.26**	**5**	**3.91**	**0.26**	**5**

Other results are shown in Table 3. The usefulness of the introductory course was relatively high, and a function of changing visibility of the descriptions was relatively low. We need to improve the visibility function after having some usability survey. Additional descriptions of an improvement perspective and examples had higher scores.

As shown in Figure 3, three-by-three matrix type interface was provided on the prototype system. Figure 12 shows a distribution map of user profiles of knowledge on flow theory and experience of teaching/designing. A size of a circle area represented a number of participants. Before using the checklist, those profiles were answered by participants with 5-point Likert-type scale. '1' means less and '5' does much in experience or knowledge in Figure 12. It shows that

participants relatively had much experience in teaching and less knowledge on flow. Figure 13 shows frequencies in use of the three-by-three entrance of the top page during the survey. In Figure 13, usage of left and middle columns was dominated. The average score of the usefulness of this interface was 4.06, which was not so low score (Table 3), but it means that our initial design, that we allocated the activity of examples of flow experience at the location, where experience was novice and knowledge was substantial, might be mismatched among user needs. Participants needed to see more examples of flow experiences than we expected.

Table 3. *Results from Questionnaire*

Usefulness survey	**Mean**	**SD**
Introductory Course	4.50	0.50
Flow experience examples	4.25	0.72
Three-by-three entrance	4.06	1.03
On/off function	3.69	1.04
Improvement perspective	4.31	0.58
Improvement examples	4.44	0.70

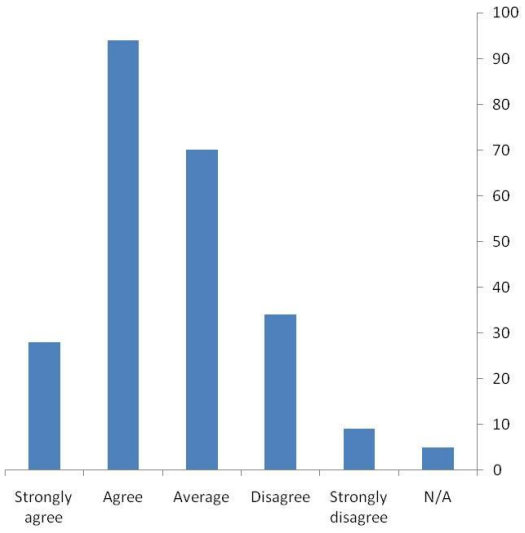

Figure 10. *Histogram of Checklist Compatibility*

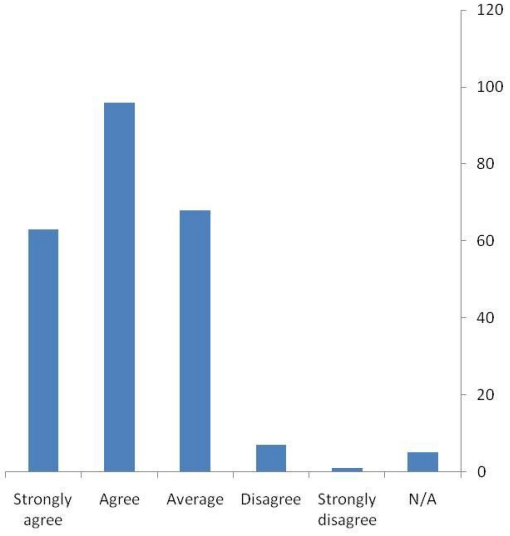

Figure 11. *Histogram of Checklist Usefulness*

Concluding Remarks

The purpose of this study was to propose a redesigning framework for teachers and course designers to help redesigning their environment by using the flow-theory-based checklist, to develop a prototype system, and to assess the validity of this system through the formative evaluation process.

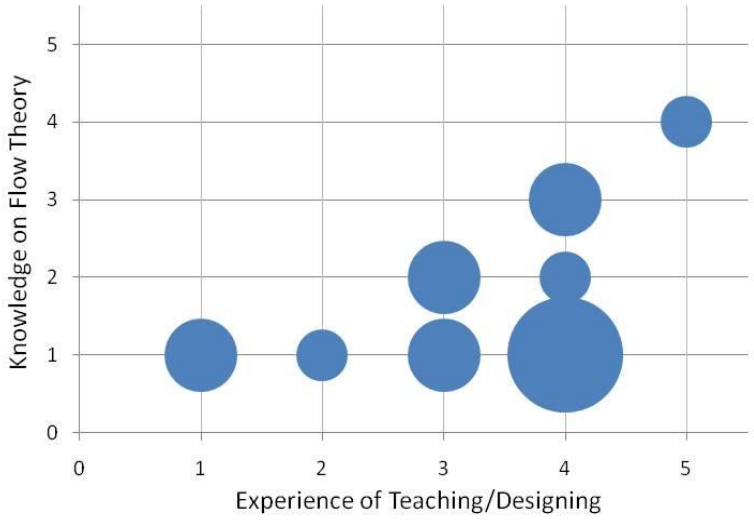

Figure 12. *Distribution of User Profile*

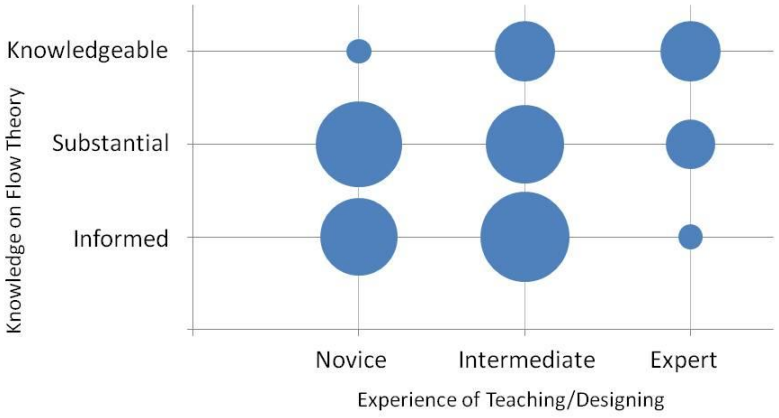

Figure 13. *Frequency in Use of the Top Page Entrance*

The research findings are as followings. Firstly, the developed checklist for compatibility with flow theory has a high potential to adapt to educational applications because it has very small number of answers of "Not applicable," as well as getting high evaluation scores.

Secondly, when participants thought a checklist item was not compatible with their environment, they thought that the checklist item was useful. They could get some unexpected hints/suggestions from that checklist item.

Finally, the three-by-three interface is relatively effective, but the allocation of flow experience examples should be improved.

Our conclusion is that the flow-based redesigning framework has the potential for teachers/designers to help redesigning their teaching/learning environments. We conducted the

initial formative evaluation and achieved several findings for further formative evaluation.

In order to improve this flow-based approach, future research should include the following pursuits:

1) Assessing the validity of the introductory course and database on flow experiences as well as the whole system
2) Providing a function of personal adaptive checklist and assessing all over usability including activity allocation.
3) Providing collaborative activities or functions
4) Providing multilingualism and finding global differences and commonalities
5) Solving issues on individual differences
6) Using a multi-device environment and increasing mobility with smart phones or tablet devices
7) Finding security from unavoidable disadvantages
8) Increasing popularity in educational areas/applications

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