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Research Trends in Game-based Learning

Tae Young Baek

Sunchon National University, South Korea

Heeok Heo

Sunchon National University, South Korea

The purpose of this study is to analyze research trends in game-based learning. To achieve this purpose, related studies at national and interactional levels conducted during the past 10 years were selected and analyzed. The articles selected for this analysis were 89 papers in total including 44 Korean and 45 international studies. The major analysis categories include research contexts, methods and themes. As a result, several points of difference were found between Korean and international studies. While many international studies used simulations as a type of game for education, many Korean studies focused on role-playing games for providing educational input. The theoretical approaches to games-based learning are also different in Korean and international studies. Based on the results, some suggestions were provided for future studies on game-based learning.

Keywords: game-based learning, edutainment, educational games, research trends, content analysis.

INTRODUCTION

In the early days of computer games, they were used mostly for entertainment and considered to be a negative influence because games caused players to lose control of their own work and life (Chappell, Eatough, Davis, & Griffith, 2006; Kwon, 2001). However, through the rapid advancement of gaming technologies and design experiments, these concerns have changed, as computer games can shift the way people learn and experience things. Recently, many educators have been paying more attention to the usage of newly-emerged forms of games in the learning process and their impact on an individual's learning experience. The emergence of such forms of learning represents the potential of combining entertainment games and education in the development of learning environments which are friendly within the digital culture in a knowledge-based society. There are many studies that have investigated the possibilities of game-based learning as an alternative way to improve a learner's problem-solving abilities and motivation for learning. Despite the recent efforts in these studies, this area is still relatively new in comparison to other educational fields of study (Ke & Hoadley, 2008; Mayo, 2009).

In order to further the development of educational game research, this study analyzed research trends in game-based learning focused on research articles published in major Korean and international journals. The findings of this study reveal the current trends in game-based learning research and suggest further studies.

GAME-BASED LEARNING

In this study, game-based learning is a learning environment in which learners follow prescribed rules and regulations for achieving certain educational goals (Alessi, & Trollip, 2001; Smaldino, Lowther, & Russell, 2008). It can be a way of experiencing and making meaning in competitive and immersive

contexts. There is much debate about the positive and the negative impact of games in human experience and learning. Some may be concerned that games could negatively influence an individual's genuine experience. Some others insist that games can motivate individuals to participate and develop thinking skills. It has been demonstrated that the inconsistent results of previous studies on educational games (Garris, Ahlers, & Driskell, 2002). Bramucci (2002) divided the trends in game-based learning research into two areas: one is about using games as a learning medium, and the other is to treat games as a learning environment or a learning system. In a former case, games may be employed as a supplementary way to motivate learners and to provide rewards for learning performance. However, when games are considered as a learning system, it is essential to incorporate certain pedagogical paradigms and theories.

As games meet digital technologies, their types and usages become more varied, and the opportunities for them to enhance learning performance are increased. A major type of game is more like simulations, such as the *SimCity* series. In simulation games, the scenario is the main vehicle for motivation, and educational objectives are embedded throughout the playing. By playing games learners can recognize patterns, memorize facts and principles, discover creative behavior, and finally achieve learning goals.

Prensky (2001) insists for the following reasons that game-based learning is necessary in education: Firstly, the games allow players to engage in the game contexts as well as the learning contents of the game. This is especially helpful for people who have lost their motivation to learn in conventional ways. Secondly, players can learn interactively depending on the learning goals, and games allow for a variety of learning methods. Lastly, they provide two or more solutions in an entire situation. This allows for players to choose the best solution among many possibilities in order to solve a given problem. Game-based learning may not only be effective for enhancing basic skills but also for developing higher-order thinking skills. Games can play an extremely important role in motivating learners to tackle difficult learning topics (Wideman, Owston, Brown, Kushniruk, Ho, & Pitts, 2007).

There are some studies that trace the research trends of games and education for their own purposes. For example, Kim and Jung (2005) provide some conclusions about educational games by analyzing the trends of educational games in international studies. They would like to see the extension of the research perspectives beyond educational fields. Kim, Kim, Sohn and Jung (2008) tried to conceptualize the meaning of edutainment by analyzing previous studies. Based on their findings, current studies on games and education have focused on using computer technologies and blending the technologies in physical learning settings. Even though some studies report the tendencies of research on games and education, they are not enough to explain comprehensive trends in games-based learning.

In this respectIn order to do this, this study investigated the research trends in game-based learning and suggested further implications. For analyzing the trends, research contexts, methods and themes were employed as analysis schemes.

RESEARCH METHOD

Content analysis was conducted to analyze research trends through research papers that have been published in peer-reviewed journals since 2000 based upon Cooper's (1998) content analysis. The review and analysis involved the following phases: (1) identification of research questions, (2) creation of inclusion criteria and identification of relevant evaluation research, (3) critical appraisal and extraction of key measures, and (4) synthesis of the findings.

Research Questions

The following research questions were established:

(1) What is the overall pattern of research trends in game-based learning in Korea and internationally?
(2) What is the implication for further studies on game-based learning?

Selection and Identification of Studies

The selection process for our literature review was guided by the following criteria:

First, studies had to examine game-based learning (GBL) according to the definition of this study.
Second, studies had to be original and empirical.

Studies reviewed in this study were drawn from Korean-language or English-language publications identified through a literature search on (1) computerized bibliographic databases (i.e., ERIC, Educational Technology Abstracts, and ProQuest Educational Journals), (2) major journals on education and games[1] and (3) conference proceedings. During the literature search process, the main keywords used included "games and learning," and "edutainment and educational games." The publications were filtered using the above inclusion criteria. Three components were addressed for each study that met the inclusion criteria: the purpose of the study, educational approaches and data collection methods.

Initially over 100 papers were found, but some studies on digital games only and on game addiction were excluded. Finally, 89 papers were selected in total. Among them 44 papers were selected from Korean publications and 45 papers from international publications. Table 1 shows the numbers of papers in each journal by research years.

Table 1. *Numbers of Papers by Research Years*

Journal names		Research years										Total (%)
		00	01	02	03	04	05	06	07	08	09	
Korean level	Journal of Korea Contents Association			1				4	4	4		**13 (29.5%)**
	Journal of Educational Information and Media	1				1	1			3		6 (13.5%)
	Journal of Korea Game Society						1	1	1			3 (7%)
	Journal of Korean Association of Computer Education		1				1		1			3 (7%)
	Journal of Korean Institute of Information Scientists and Engineers	1	1			1		2				5 (11.5%)
	Other Journals	1		1	2	2	2	2	2	2		14 (31.5%)
	Total	3	2	2	2	4	5	9	8	9		44 (100%)
International level	Simulation & Gaming	2	2	3	2	1		3	1	4	3	**21 (47%)**
	Educational Technology Research and Development			1			2	2	3	4		12 (26.5%)
	British Journal of Educational Technology				1				9	2		12 (26.5%)
	Total	2	2	4	3	1	2	5	13	10	3	45 (100%)

* ( ) indicates the ratio of papers to total papers in each level

Journal of Education Information and Media, Journal of Korean Association of Computer Education, Journal of Korea Contents Association, and Journal of KIISE in Korean journals, and Simulation & Gaming, Educational Technology Research and Development and British Journal of Educational Technology in the English journals

Data Analysis

When conducting the literature search, we developed an initial coding matrix to categorize each study's research contexts, research methods and research themes. This coding matrix was refined as the analysis process proceeded. It was an overlapping process of coding the studies and placing them into categories. Using the constant comparative method (Strauss and Corbin, 1990), the authors constantly compared the data collected/ coded to revise the coding categories, reanalyzed studies, and gain new insights. The consistency and rigor of analyses and results were achieved by using multiple coders (the first and the second authors) for peer examination and inter-rater checking during the coding process (Creswell, 1998). The average code-recode intra-rater reliability was 90% agreement and the inter-coder reliability (Cohen's Kappa) was 85% agreement. In case of disagreements, a single code was determined after discussion among the coders.

RESULTS

The taxonomy for synthesizing and classifying important features of game-based learning studies was developed through the initial analysis and findings. Figure 1 shows the taxonomy for further analysis in this study.

Research Contexts

Research contexts include research targets and the type of games used in research. Research targets are divided into school levels, such as elementary, middle and high schools, colleges, and others. Game types are divided into five categories including simulations, role-playing games (RPG), quizzes, puzzles and others, which are the main modes for educational purposes (Dondi & Moretti, 2007).

Table 2. *Number of Papers in Terms of Research Targets*

Target audience		Research years										Total (%)
		00	01	02	03	04	05	06	07	08	09	
Korean level	Elementary school students	1	1			2	2		1	2		**9 (20%)**
	Middle school students				1		1		2			4 (9%)
	High school students									1		1 (2%)
	College students							3				3 (7%)
	Others	2	1	2	1	2	2	6	5	6		27 (62%)
	Total	3	2	2	2	4	5	9	8	9		44 (100%)
International level	Elementary school students						1		2	1		4 (8%)
	Middle school students							1		1		2 (5%)
	High school students		1							1		2 (5%)
	College students	1	1	1	2			2	3			**10 (22%)**
	Others	1		3	1	1	1	2	8	7	3	27 (60%)
	Total	2	2	4	3	1	2	5	13	10	3	45 (100%)

Table 3. *Number of Papers in Terms of Game Types*

Game types		Research years										Total (%)
		00	01	02	03	04	05	06	07	08	09	
Korean level	Simulations	2	1		2							5 (11%)
	RPG		1			1	1	5		1		**9 (20%)**
	Quiz	1							1	1		3 (7%)
	Puzzle						1	1		2		4 (9%)
	Others			2		3	3	3	7	5		23 (53%)
	Total	3	2	2	2	4	5	9	8	9		44 (100%)
International level	Simulation	2	2	3	2	1		2	1	2	1	**16 (35%)**
	RPG						1		3	2		6 (14%)
	Quiz											0 (0%)
	Puzzle								1			1 (2%)
	Others			1	1		1	3	8	6	2	22 (49%)
	Total	2	2	4	3	1	2	5	13	10	3	45 (100%)

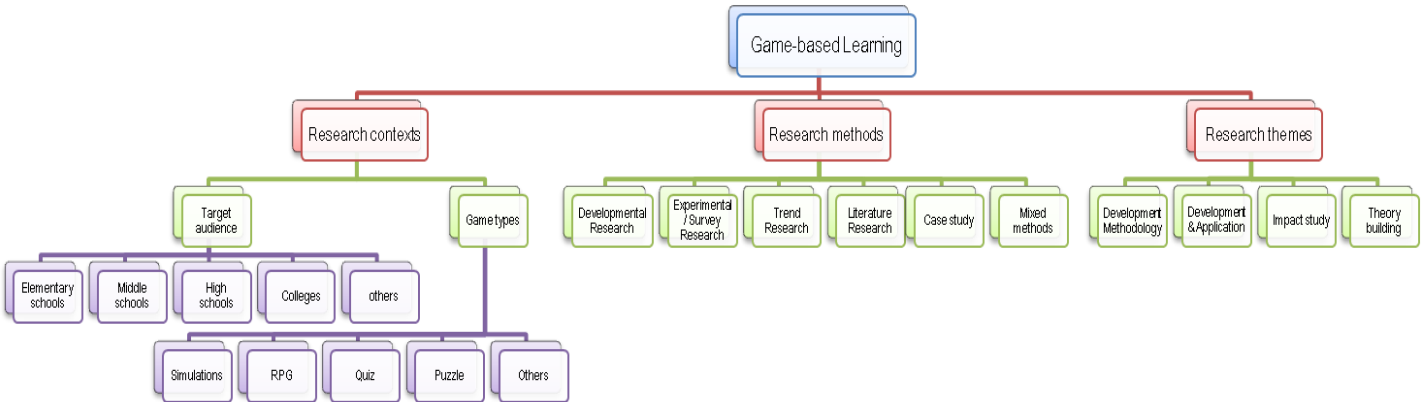

Figure 1. *Taxonomy for trend analysis of game-based learning research*

Research trends in terms of research contexts are summarized in Table 2 and Table 3. While most studies targeted elementary schools (20%) in the Korean publications, international studies on game-based learning mainly focused on college levels (22%). The category "others" included teachers, parents and the contents themselves, and studies with no mention of targets. As shown in Table 3, the major types of games employed in the studies are RPGs (20%) in the Korean publications and simulations (35%) in the international publications. The other types consisted of shooting games and action games. Most international studies emphasized the educational value of simulations as a type of game. However, in the Korean studies, RPGs are a more popular type than simulations in game-based learning research.

Research Methods

Research methods are classified into 6 categories such as developmental research, experimental/survey research, trend research, literature research, case study and mixed methods. Table 4 shows the numbers of papers in research methods by research years.

Table 4. *Number of Papers with Research Methods by Research Years*

Research methods		Research years										Total (%)
		00	01	02	03	04	05	06	07	08	09	
Korean level	Developmental Research	2	2	1	1	1	1	5	4	4		**21 (47.5%)**
	Experimental / Survey Research	1			1	3	2	2	1	2		12 (27%)
	Trend Research						1					1 (2.5%)
	Literature Research			1			1	1	1	2		6 (13.5%)
	Case Study							1	2	1		4 (9.5%)
	Mixed methods											0 (0%)
	Total	3	2	2	2	4	5	9	8	9		44 (100%)
International level	Developmental Research	2			2		1		2	4		11 (24.5%)
	Experimental / Survey Research		2	2					2	2		8 (17.5%)
	Trend Research											0 (0%)
	Literature Research			2	1		1	2	6	3	3	**18 (40%)**
	Case Study					1		2	1			4 (9%)
	Mixed methods							1	2	1		4 (9%)
	Total	2	2	4	3	1	2	5	13	10	3	45 (100%)

There are 34 studies using quantitative approaches and 10 studies using qualitative approaches as research methods in the Korean studies. As shown in Table 4, the most popular research method is developmental research in the Korean studies. They developed an educational game for achieving a specific learning goal and described the development process.

In the international studies, 19 studies employed a quantitative approach, 22 studies a qualitative approach, and 4 studies mixed methods, totaling 45 studies. Relatively, more studies focused on literature review (40%) than on other approaches (Table 4). These studies discussed theoretical grounds to improve the use of games for educational purposes.

In the case of experimental/survey research, there were 12 Korean studies and 8 international studies. Experimental research has been receiving steady interest in Korea. The T-test is the major method of data analysis, followed by the multiple regression analysis, ANOVA and ANCOVA in the Korean studies. It is similar in the international studies as well. Referring to the study conducted by Kim and Jung (2005), there were hardly any empirical studies in both Korean and international publications in the early 2000s. However, interest in empirical findings of educational value has increased since 2004.

Research Themes

Research themes are classified into 4 areas according to the purpose of study, such as development methodology, development and application, impact study and theory building, which are similar to those in a recent study on educational games (Kim, & Jung, 2005). Table 5 indicates the frequency of studies in terms of the research themes by research years.

Table 5. *Number of Papers with Research Themes by Research Years*

Research themes		Research years										Total (%)
		00	01	02	03	04	05	06	07	08	09	
Korean level	Development Methodology	2	2		1	1		3	2	2		**13 (29.5%)**
	Development & Application			1			1	2	2	2		8 (18.5%)
	Impact Study	1			1	3	2	2	1	2		12 (27%)
	Theory Building			1			2	2	3	3		11 (25%)
	Total	3	2	2	2	4	5	9	8	9		44 (100%)
International level	Development Methodology	1			1		1		1			4 (9%)
	Development & Application	1			1				1	4		7 (15.5%)
	Impact Study		2	2				3	5	3		15 (33%)
	Theory Building			2	1	1	1	2	6	3	3	**19 (42.5%)**
	Total	2	2	4	3	1	2	5	13	10	3	45 (100%)

In terms of research themes, game development is the most popular topic in the Korean studies. Among them, 13 studies mainly reported how to develop a game for educational purposes and 8 studies investigated the verification results of the games including the development processes. Respectively, in the same context, 4 and 7 studies were reported in the international studies. In the former case, 3 studies designed an instructional model for the effective use of games.

There are 12 Korean studies and 15 international studies in the area of impact study that investigated the effects on learning achievement. Interestingly, many studies have investigated learners' characteristics as an important factor to prove the effect of educational games. For example, Baek and Jung (2004) conducted an experiment to examine the effect of a learner's game proficiency level and game based learning on their logical thinking skills and reported a positive influence on logical thinking skills. Also, learners' motivation and engagement are other major factors in some impact studies (e.g., Baek, & Kim, 2005; Kim, & Kim, 2005). Eck and Dempsey (2008) investigated the effect of competition and contextualized advisement as key features of computer-based instructional simulation games on the transfer of mathematical skills. Snow, Gehlen and Green (2002) reported the effect of simulation games on student performance including attitude toward the simulation, and the amount of effort and group cohesion. Inal and Cagiltay (2007) examined children's flow experiences in an interactive social game context through observations and interviews. They found out that flow experiences occurred more among boys than girls during game play, and that the challenge and complexity elements of games had more effect on the flow experiences of the children than clear feedback while playing games.

Theory building or theoretical discussion in games-based learning research has been steadily growing in both Korean and international studies during last 10 years: 11 Korean studies and 19 international studies. Among them, 5 Korean studies and 11 international studies explored the conceptual and theoretical foundations of game-based learning. For example, Kim and his colleagues (2008) discussed the basic concept of game-based learning and extended the concept to edutainment theory. Among the international studies, Dickey (2005) investigated game design strategies and their implications for instructional design. In particular, he reviewed the main components of games, such as the trajectory of player positioning or point of view, the role of narrative and the methods of interactive design, and then incorporated them with the main features of engaged learning. Also, Amory (2007) explored a theoretical model for designing educational games and for evaluating games use in classrooms. Each component in the model is classified into four spaces: game, visualization, problem and actors' spaces.

The other 5 Korean studies and 3 international studies conducted case studies on games. For example, Ahn and Song (2008) analyzed representative cases by the types of edutainment, classified into learning games, animation books, cyber museums and digital experience spaces. Kim and Jun (2008) developed a mobile game by applying Keller's ARCS model at elementary levels. Leigh and Spindler (2004) explored

chaos theory as a framework of open simulations and conducted a case study in higher education. They found that chaos theory, a reference point, can help educators to position themselves as more effective improvisers of learning and participants to discover their own learning preferences. Lainema (2009) reconceptualized the constructivist learning paradigm for the development of simulation games. He insisted that constructivist approaches on knowledge building, meaning making and thinking are very relevant to simulation game design. Using a different perspective from the previous studies, Klopfer and Squire (2008) attempted to incorporate the features of handheld devices and augmented reality with educational gaming. They also reported on the development of augmented reality educational gaming and some positive evidence from field trials.

In sumFinally, while Korean studies employed theoretical grounds from various fields and domain-general subjects, international studies focused on socio-cultural learning theories and domain-specific subjects, such as linguistics, business, history, culture, sociology and computer science.

CONCLUSION

This study investigated the research trends in game-based learning based on research articles that have been published in peer-reviewed journals since 2000. The trends were analyzed in terms of research contexts, research themes and research methods.

In the research contexts, the primary research targets are elementary students in Korea and college students in international studies. In fact, some international colleges adapt classes using management simulations and the conferment of the degree as their curriculum (Kim & Jung, 2005; Chun, 2006), but it is not the same in Korean educational settings. Also, simulations and RPGs as game types are mainly used in the studies of each.

While Korean studies have focused more on game development in respect of research themes and research methods, international studies have paid more attention to theory building and impact study. This is probably the result of the time spent studying game use in education for both. Game studies in education are relatively new in Korea (Cho, 2007). Negative perceptions of earlier commercial games might have influenced educational researchers to develop different games for education (Baek & Lee, 1997). However, in Korea recently there has been an increase in theory building and impact study in game-based learning.

Based upon the findings, the following suggestions are made for further studies in Korea.

First, more attention should be paid to simulations as a game type for teaching and learning in Korea. Kim and Jung (2005) insist that simulation games are relatively easy to incorporate with learning contents and instructional strategies. Apparently, there are still some obstacles to developing educational simulation games and to employing them in educational settings. That is why we need to make greater efforts in studying simulation games.

Second, the majority of Korean studies were dedicated to developing educational games, but the studies just focused on developing games for learning. Many of them did not report any application results and verification data in educational settings. The development of new games is a starting point to carry out game-based learning research. However, we need to go beyond the development and to conduct data-driven research for proving its impact on teaching and learning. Developmental research methods will be a good way to do it in the field of educational technology. Development in a research context includes not only planning and production, but also comprehensive evaluation (Richey, Klein, & Nelson, 2004). Conducting design-based research is another approach to gathering comprehensive information from design and development to field trials and evaluation.

Third, Korean studies need to build sound theoretical grounds to develop educational games and to effectively utilize them in educational settings as Kim and Kim (2008) suggested. While Korean studies paid attention to game development, recent international studies have showed more interest in socio-cultural learning theories for the better use of games in educational settings. When educational games are supposed to affect individuals' cognitive, affective and socio-cultural development, various psychological theories should be reviewed in order to build theoretical grounds for game-based learning.

Fourth, both Korean and interactional studies need to have a more systematic way to evaluate the impact of educational games on individuals' learning processes and outcomes. Some studies presented the effects of games on learning in terms of learners' characteristics using different measurement scales. Some studies proved the positive effects, and some others showed little effect or negative effects on learning. It is apparent that there are few consistent results on the impact of educational games. We need to have more comprehensive and systematic approaches to understand the effects of educational games on human learning.

Games are not a new way for individuals to live, play and experience their external worlds. However, as the types of games have changed and become more various, interest has been growing in their educational applications. It has accelerated due to the advent of digital technologies. When games combine with computer and Internet technologies, their valuable contributions to changes in human life will be enhanced. This study is limited to Korean-language and English-language articles only because of its primary purpose, which is to suggest methods for improving Korean studies on game-based learning. However, the findings also indicate some current trends in mainstream game-based learning research.

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APPENDIX

Table 6. *Referenced Papers for Analysis* *

Research Categories			Total (K / I)
Research contexts Target audience	Elementary school students	K (2, 5, 10, 12, 15, 18, 35, 37, 44) / I (14, 23, 35, 42)	9 / 4
	Middle school students	K (8, 16, 32, 34) / I (19, 40)	4 / 2
	High school students	K (36) / I (4, 39)	1 / 2
	College students	K (24, 26, 27) / I (2, 3, 6, 10, 11, 16, 17, 21, 22, 32)	3 / 10
	Others (Etc. or not mentioned)		27 / 27
	Total		44 / 45
Game Type	Simulations	K (1, 2, 4, 8, 9) / I (1, 2, 3, 4, 5, 6, 8, 10, 11, 13, 16, 17, 21, 35, 38, 44)	5 / 16
	RPG	K (5, 10, 18, 20, 23, 24, 26, 27, 37) / I (14, 25, 28, 29, 37, 41)	9 / 6
	Quiz	K (3, 32, 44)	3 / 0
	Puzzle	K (16, 25, 36, 38) / I (30)	4 / 1
	Others (Etc. or not mentioned)		23 / 22
	Total		44 / 45
Research Method	Developmental Research	K (1, 3, 4, 5, 7, 9, 13, 16, 20, 22, 23, 24, 25, 29, 32, 33, 35, 36, 38, 43, 44) / I (1, 2, 10, 11, 14, 25, 32, 35, 36, 37, 39)	21 / 11
	Experimental / Survey Research	K (2, 8, 10, 11, 12, 15, 18, 26, 27, 34, 37, 41) / I (3, 4, 5, 7, 24, 28, 40, 41)	12 / 8
	Trend Research	K (17)	1 / 0
	Literature Research	K (6, 14, 19, 30, 39, 42) / I (6, 8, 9, 13, 15, 18, 20, 26, 27, 29, 30, 31, 33, 34, 38, 43, 44, 45)	6 / 18
	Case Study	K (21, 28, 31, 40) / I (12, 16, 19, 21)	4 / 4
	Mixed methods	I(17, 22, 23, 42)	0 / 4
	Total		44 / 45
Research Themes	Development Methodology	K (1, 3, 4, 5, 9, 13, 22, 23, 25, 29, 33, 38, 43) / I (1, 11, 14, 25)	13 / 4
	Development & Application	K (7, 16, 20, 24, 32, 35, 36, 44) / I (2, 10, 32, 35, 36, 37, 39)	8 / 7
	Impact Study	K (2, 8, 10, 11, 12, 15, 18, 26, 27, 34, 37, 41) / I (3, 4, 6, 8, 16, 17, 19, 21, 22, 23, 24, 28, 40, 41, 42)	12 / 15
	Theory Building	K (6, 14, 17, 19, 21, 28, 30, 31, 39, 40, 42) / I (5, 7, 9, 12, 13, 15, 18, 20, 26, 27, 29, 30, 31, 33, 34, 38, 43, 44, 45)	11 / 19
	Total		44 / 45

* K: Korean level; I: International level
* Detailed information of the 42 studies is available at: http://blog.naver.com/btyzzang/130085573679