

Identification of the Content Validity of the Concept and Constructs of Invention Competency

Kyungpyo Lee, Kyunghwa Lee

Abstract The purpose of this study was to derive and identify the constructs of the invention competency. The basic frameworks of this study were made based on literatures review in order to investigate and elicit the constructs of invention competency through FGI. And content validity was confirmed by experts of invention and creativity. In addition, a preliminary survey and subsequent main survey were done to confirm the constructs and verify its content validity. This research elicited 3 major parts-intellectual property, invention convergent creativity, invention personality and 11 components including 32 sub-factors.

Keywords: Constructs of invention competency, Intellectual property, Invention convergent creativity, Invention personality. Content validity

I. INTRODUCTION

In October 1st, the Nobel Prize in physiology or medicine was announced in 2018. American scientist James Allison and Japanese scientist Tasuku Honjo won the Nobel Prize in Physiology or Medicine in 2018. The effort for invention and discovery will be proven by the Nobel Prize.

The invention implicates both innovation and creation [1]. Therefore, one of the characteristics of creative talents required in future society will be the invention competency [2]. In other words, the invention competency is a capability to create social values by associating knowledge from various fields such as mathematics, science, humanities, and technology to think about creative ideas that can solve practical problems and extend them to intellectual property. Therefore, education for the fostering of creative talents should be based on the invention competency. Nevertheless, the education in the area has not been systematical on the base of the invention competency. One of the reasons for this is because there is a lack of research on constructs of invention competency and there was no foundation to establish the educational goal of fostering the talents.

There has been much research on subjects such as invention education research, inventive textbook development, and invention teacher education, but there have been few for basic research on the invention [3], [4]. The same tendency is found in overseas studies as the concept of the invention, inventor, and inventive education had been unclear and there had been lack of awareness of invention competency [5], [6]. Recently with the start of the gifted education for gifted students in the invention fields, some related researches have been conducting interested in invention competency for the development of measurement tools to identify the gifted students with the invention.

The invention can be done by anybody, not just by certain people. As the importance of intellectual property is increasing steadily, there is a growing demand to develop invention competency to use their ideas in connection with intellectual property. Therefore, it is a time to set an education system to encompass all the people to improve invention competency. In other words, it is necessary to implement a systematic invention education that can realize the invention competency at each level and step for researchers, inventors, and students in companies or universities, and it is necessary to do research on identifying constructs of invention competency. The value of the invention is increasingly expanding, extending to new values through integrated linkage between different types of knowledge [7]. In addition, the maker movement around the globe is creating a new social environment where there is no clear borderline between the consumers and producers. Creating and utilizing new ideas is a driving force of national competitiveness. In order to establish a systematic educational system to foster talents who would be able to cope with the uncertainty in the fast-changing world of information-oriented society and globalization, people's invention capacity must be nurtured. And identifying the concept and components of competence, it will help to establish direction for education [8], [9]. Therefore, this study aimed to clarify the concept and to derive the constructs of the invention competency. And identify the content validity of it.

II. Method

2.1. Participants

In this study, the expert council was formed in order to identify the concept of invention competency and to identify the constructs. In the expert council, the primary focus group interview (FGI) was conducted to derive the concept of invention competency, and in the second interview, content validity of the concept derived was confirmed. Based on the research that 6-10 experts are sufficient to enable the provisional results in a relatively short time [10], 10 experts who have the expertise and experience to be able to discuss the subject of this study (see Table 1).

Participating experts consisted of 5 university professors with plentiful research experiences, 3 primary and secondary school teachers who won the grand prize for invention education, 1 researcher of research institute related to the invention, and 1 patent attorney with abundant experience in invention education.

Revised Manuscript Received on May 06, 2019

Kyungpyo Lee, Doctor of Education, Dept. of Lifelong Education
Soongsil University, Rep. of Korea

Kyunghwa Lee, Professor, Department of Lifelong Education,
Soongsil University, 369 Sangdo-Ro, Dongjak-Gu, 06978, Seoul, Korea.



Identification of the Content Validity of the Concept and Constructs of Invention Competency

Table 1: Expert group composition

	position	gender	academic	career	criteria
1	professor	M	Doctor of Education	more 20years	invention education
2	professor	M	Doctor of Education	15years	invention education
3	professor	F	Doctor of Education	more 20years	invention education
4	professor	M	Doctor of Education	more 20years	invention education
5	professor	M	Doctor of Education	more 20years	invention giftedness education
6	senior Research Fellow	M	Doctor of Law	more 20years	invention education
7	Attorney	M	BA in Chemical Engineering	15years	attorney
8	High school teacher	M	Doctor of Education	15years	invention education
9	Middle school teacher	M	Doctoral course completion	more 20years	invention master teacher certification
10	Elementary school teacher	M	Master of Education	more 20years	invention master teacher certification

2.2 Instrumentation

In order to derive constructs of invention competency, the semi-structured questionnaire consisting of 3 domains, 12 components, and 37 items was developed for the first survey of the expert council. The questionnaire was based on the contents obtained through the analysis of literature review and precedent studies.

Through the first FGI, the items were renamed as sub-factors. The final version was settled with 3 domains, 11 components, and 32 sub-factors. Based on the invention competency concept defined in the first survey, the tool for a second expert council survey was executed.

Table 2: Survey tool for expert group (1st)

Component Factors and Comments on Large Zone Naming

Component	Constituent factor	Large zone
① knowledge about the intellectual property system ② Ability to utilize intellectual property	(1) Intellectual property expertise	Intellectual Property Expertise Capability
① Wide range of knowledge ② Interest and curiosity about science and technology ③ Quick understanding of science, mathematics, and technology ④ Humanities, Society, Art Litigation	(2) seeking knowledge in various fields	Intellectual Property Expertise Capability
① practicality ② operational ability ③ sense of design	(3) Design and manufacturing ability	
① Information collection and analysis ② Ability to utilize Knowledge	(4) Ability to utilize information	

Component Factors and Comments on Large Zone Naming

Component	Constituent factor	Large zone
① Higher-order thinking ② Flexibility of thinking ③ Ability to grasp associativity	(1) Convergent thinking ability	Competency in invention and convergent creativity
Fluency elaboration Imagination ④ Flexibility ⑤ Originality	(2) Creative thinking ability	
Curiosity Sensitivity ③ Task commitment ④ Adventure	(3) Creative personality	
① Logical / analytical thinking ability ② Pursuit of perfection ③ Task management ability	(4) Problem solving ability	
① Value-oriented ② Future insight ③ Challenging spirit	(5) Entrepreneurship	

Component	Constituent factor	Large zone
Voluntary Will ② Goal Orientation ③ Passion	(1) Self-directive ability	Competency in invention and convergent creativity
Self-management ② Communication skills ③ Collaboration skills	(2) Creative Leadership	



① Social responsibility and consideration ② Social awareness and commitment

(3) Social Responsibility

Please provide your feedback, including what to fix, add, or remove.

2.3 Procedure and Analysis

The purpose of this study was to define the concept of the invention competency and to derive the constructs of invention competency and to identify the content validity. In this study, the expert council was formed in order to derive and identify the concept of invention competency and the constructs of the competency. In the expert council, the primary focus group interview (FGI) was conducted to derive the concept of invention competency, and in the second interview, content validity of the concept derived was confirmed. Therefore the following research procedure was performed. First, based on the precedent studies, a basic framework was established for the constructs of the invention capacity. Second, the expert council meeting was held twice. The concepts of invention competency, components, sub-factors, items were derived through FGI in the first and content validity tests in the second.

There is no definite definition in the previous study regarding the inventive capacity to be identified in this study. Therefore, in order to define the concept of inventive capacity and to derive the sub-factors, we organized a specialist council composed of 10 experts and preceded FGI twice. The first FGI was held in the meeting room of the Korean Invention Promotion Association on July 27, 2017. The questionnaire was distributed in advance and collected after the fact so that free opinions could be added. Secondary validity test was conducted by e-mail survey from August 27 to August 31, 2017.

A. Focus Group Interview (FGI)

In this study, Focus Group Interview (FGI) was conducted because it was intended to discuss topics raised by researchers and gain insight into research that is difficult to elucidate through other methods through interaction. Therefore, first, the semi structured questionnaires were distributed in advance based on the definition and contents of the invented competency extracted from the literature review analysis, and then the discussion was conducted together. After the discussion, we collected questionnaires that added free opinions and summarized them.

B. Content validity by Experts

The results of the FGI were evaluated for feasibility. The applicability of the invention competency was investigated by a structured questionnaire based on the Likert 5-point scale and an open questionnaire to suggest revisions and other opinions. Technical statistics for calculating the mean, standard deviation, and CVR values were collected from the collected data.

C. Identification of Invention Competency Constructs

The results of the FGI and the content validity survey through the operation of the expert council changed the domain - constituent factor - the naming of the constituent to

the domain - constituent factor - the sub-factor, and the concept of invention competence, domain and constituent factor, and examined the content validity. Based on this content, measurement items were produced.

In this study, three domains, 11 constituents, 32 sub-factors were provisionally derived. Content Validity Ratio (CVR) was calculated and applied. Lawshe suggested the CVR value can be judged to be the content validity only at the level of significance .05 with items having the CVR value equal to or more than the minimum value according to the expert panel number. In this study, because the number of panellists is 10, the candidate is estimated by taking the items with the minimum CVR of .62 or more and expert opinion.

From the results of this study, the constructs of invention competency were identified, and the sub-factors of the constructs were derived for verification of content validity.

III. Result

3.1 Identifying and Deriving Constructs of Invention Competency

Based on the analysis of the precedent studies, the definition of invention competency, 3 domains, 11 components, and 32 sub-factors was derived from the first meeting of the expert council (FGI). First, the invention competency was defined as 'the ability to contribute to the society by creating economically significant values using expertise in a particular field and problem-solving through intellectual property based on convergent thinking and creativity. Furthermore, the competency was divided into three categories: intellectual property, invention-fused creativity, and invention personality. Through precedent studies and discussions with experts, the inventive competency was named reflecting the viewpoint of knowledge, skill, and attitude, and the definitions of constituents as following.

First, for intellectual property, we extracted and defined 3 components of intellectual property expertise (information on the intellectual property, ability to utilize the intellectual property, expertise in a specific technology area), various knowledge in different areas (general knowledge of various areas, interest in science and technology, quick understanding of science, mathematics and technology, humanities, social and artistic literacy), and information literacy (information gathering and analysis, knowledge information literacy), and their 9 sub-factors. Second, for invention-convergent creativity, 4 components of convergent thinking, creativity, problem-solving ability, and design and production ability and their 11 sub-factors were derived and defined. Third, for creative personality, 4 components of self-directedness, creative leadership, social responsibility, and entrepreneurship and their 12 sub-factors were extracted and defined. The results are shown in Table 3.

Identification of the Content Validity of the Concept and Constructs of Invention Competency

Table 3: Results of FGI (1st)

Classification		Contents
domain	1. Intellectual Property domain	Ability to understand and apply knowledge of intellectual property as a whole based on expertise in a specific area and to apply knowledge and skills in various fields
Component	Sub- factor	Specific- contents
knowledge about the intellectual property	Information about intellectual property	Possesses overall knowledge and information on creation, utilization and protection of intellectual property
	Ability to utilize intellectual property	Ability to judge whether the right of ideas can be secured through analysis of patent trends in specific technology fields and to set appropriate patent claim scope
	Expertise in a specific technology area	Specialized skills through steady and systematic knowledge acquisition and experience in specific fields
Knowledge of various areas	General knowledge of various areas	Rich knowledge of various fields (science, humanities, arts, etc.)
	Interest in science and technology	Great interest in science and technology and strong desire for intellectual inquiry
	Quick understanding of science, mathematics and technology	Ability to understand and accept the concept and meaning of science and knowledge
	Humanities, Society, quality	Recognition of humanity and society as a whole and interest and knowledge about art
Ability to utilize information	Information gathering analysis	Ability to gather necessary and useful information from various sources and analyze it according to their purpose

	Knowledge information utilization ability	Ability to process, deliver, evaluate, and manage the acquired information
domain	2. Invention and convergent creativity domain	Competence related to the ability to produce products with convergent thinking, creativity and problem solving ability
Component	Sub- factor	Specific- contents
Convergent thinking	Higher-order thinking	Ability to use all his knowledge to select problem solving options and to present appropriate alternatives through review and evaluation
	Flexibility of thinking	Ability to flexibly change and devise solutions to problems with changes in the surrounding environment
	Ability to identify associations	Ability to quickly identify the challenges to be solved and their relevance to various knowledge and principles
Creativity	Creative thinking ability	The ability to produce many answers with a rich imagination and a wide variety of unique, sophisticated and diverse categories (imagination, creativity, elaboration, flexibility, fluency)
	Creative personality	Attitudes to be immersed and resolved, even if there is a difficulty, while trying to be new by responding sensitively to the environment with curiosity
Problem solving ability	Logical / analytical thinking power	Ability to think and judge analytically based on rational grounds
	Understanding and awareness of the Problem	Ability to identify problems and identify their nature to shape the goals of problem solving
	Problem management ability	Ability to identify problem solving strategies, apply appropriate solutions, and present optimal solutions through assessment

Design and production ability	Planning and Design Ability	An efficient and feasible plan for producing and solving problems. Ability to design.
	Operational ability	Ability to handle tools and materials appropriately and efficiently for problem solving and production
	Sense of design	Aesthetics that can pursue aesthetic values in the production and problem solving
domain	3. Inventive personality domain	Ability to pursue social values with self-assurance and social responsibility and to fulfill goals
Component	Sub- factor	Specific- contents
Self-directive characteristics	① Voluntary will	Put the focus of one's life on oneself and try to achieve a positive outcome with pure will
	② Goal Orientation	Attitudes to achieve the goal and achieve satisfaction
	② Meta-motivation	A willingness to engage in enthusiasm and enthusiasm with genuine affection for self-determined goals
Creative Leadership	① Personal leadership	Ability to achieve goals through self-practice and control with confidence and motivation.
	② Social leadership	Ability to respect members and support growth and to share their sense of belonging as a community
	③ Problem-solving leadership	Ability to accurately understand the problem, to utilize information and resources to explore and implement solutions, and to lead members to common goals
Social responsibility	① Recognition of social problems	Open mind to find out what problems to solve in order to create a better society
	② Social Responsibility and	Public attitude as a member of society to seek for alternatives to

Entrepreneurs hip	Commitment	social problems
	③ Consideration	Attitude to understand the situation and feelings of others and acknowledging the value of others and respecting opinions and choices
	① Value orientation	Attitude to pursue personal values while pursuing social value with acting with goals
	② Future Insight	Attitude to distinguish between the technology to be developed and the technology to be used in view of the future, and to prepare for the expertise to be developed in order to utilize the technology
	③ Challenge spirit	Attitude to have attempts to try new things even if you fail and risk

3.2 Verifying the validity of the constructs of invention competency

The constructs derived from the first expert group meeting (FGI) was verified by collecting opinions. Some factors were revised and complemented, and the final version had 3 domains, 11 components, and 32 sub-factors. In the second expert council, the opinions of the experts on the definition of the invention competency and its constructs, the revision of sub-factors, and the opinions on the parts to be revised or added, and the validity of the content were evaluated. Based on the results, the average, standard deviation, and CVR values were calculated and examined for each factor. The average for each factor was 4.0 or more and the CVR value was in the range of .60 to 1.00. The opinions of the experts on the revisions and changes were reflected and the results are as follows.

First, the meanings of the invention competency were clarified through some revision. The results of content validity and revision in the second expert group meeting based on the results of the first FGI are shown in Table 4.

Table 4: Conformity of Invention Capability Definitions

Domain division	1st Expert Council (FGI results)	2nd Expert Council (terms revision)	CVR check		
			M	SD	CVR



Identification of the Content Validity of the Concept and Constructs of Invention Competency

Inventive Competency Definition	Ability to create economic value and contribute socially through problem solving based on expertise and knowledge of intellectual property based on fused thinking and creativity	The ability to solve problems by using expertise and knowledge of intellectual property based on convergent expertise and creativity, and the ability to make social contribution by creating meaningful economic value	4.60	.52	1.0
---------------------------------	---	---	------	-----	-----

The following are the results of revision and content validity survey of each construct of the invention competency according to experts.

First, the content was revised and supplemented to clarify its meaning for intellectual property. In addition, the opinions that there is redundancy between factors were reflected in the result. As the constructs of intellectual property expertise are misunderstood as the expertise of knowledge in the field of intellectual property, it is revised to 'general knowledge and utilization related to intellectual property' and the sub-factors were modified to strengthen the connection with the component. Especially, 'expertise in a specific technology field' among the sub-factors was modified to be 'ability to link intellectual property' so as not to damage its meaning while strengthening linkages among factors. In addition, pursuant to the opinion that it is necessary to clarify the meaning of the components of 'various knowledge in different areas', it was revised to 'knowledge and literacy in various areas (science, technology, humanities and arts and respective sub-factors were modified. In addition, the sub-factors of 'general knowledge in various areas' were .60 which was less than .62, but the difference was not large, and the average was 4.3. Taking that the factor has its importance, the definition of the factor was clarified. The sub-factors of 'information literacy' were divided two from three to clarify the meaning (see Table 5).

Table 5: Conformity of Intellectual property domain

domain 1	1st Expert Council (FGI results)	2nd Expert Council (terms revision)	CVR check		
			M	SD	CV R

Intellectual property domain	Ability to understand and apply knowledge of intellectual property as a whole based on expertise in a specific area and to apply knowledge and skills in various fields	Ability to realize economic value through the understanding and utilization of the overall knowledge about intellectual property about the creative result based on the expertise of specific area and the fusion of knowledge and technology in various areas	4.70	.49	1.0
division1	1st Expert Council (FGI results)	2nd Expert Council (terms revision)	CVR check		
			M	SD	CVR
Constituent factor	Intellectual Property Expertise	Intellectual Property related general knowledge and utilization	4.75	.50	1.0
Sub-factor	① Information on Intellectual Property Possesses overall knowledge and information on creation, utilization and protection of intellectual property	① General knowledge about intellectual property Possesses basic knowledge on creation, utilization and protection of intellectual property	4.80	.43	1.0
	② Ability to utilize intellectual property Ability to analyze patentability trends in specific technology areas to determine if they can secure ideas and to set appropriate patent claims	② Ability to utilize intellectual property information Ability to identify the existence of similar technologies through patent search and analysis, to obtain necessary technical information and to derive appropriate invention technology	4.50	.98	.8
	③ Specialization in specific technology fields	③ Ability to link intellectual property	.71		.8

	Specialized skills through steady and systematic knowledge acquisition and experience in specific fields	Ability to promote appropriation as appropriate intellectual property for the invented invention			
division 2	1st Expert Council (FGI results)	2nd Expert Council (terms revision)	CVR check		
			M	SD	CVR
Constituent factor	Knowledge of various areas	Knowledge and literacy of various areas (science, technology, humanities, arts, etc.)	4.75	.50	1.0
Sub-factor	① General knowledge of various areas Rich knowledge of various fields (science, humanities, arts, etc.)	① General knowledge about various areas Have a basic knowledge of various areas that apply in real life	4.30	.83	.6
	② Interest in science and technology Great interest in science and technology and strong desire for intellectual inquiry	(integrated)	4.60	.70	.8
	③ Quick understanding of science, mathematics and technology Ability to understand and accept the concept and meaning of science and knowledge	② Understanding of various areas Ability to understand and accept concepts and meanings through a great deal of interest and interest in various areas of knowledge	4.90	.32	1.0

	④ Humanities, Society, quality Recognition of humanity and society as a whole and interest and knowledge about art	③ Ability to apply and apply knowledge on various areas Ability to apply and apply knowledge and information from various areas to actual problem situations	4.50	.53	1.0
division 3	1st Expert Council (FGI results)	2nd Expert Council (terms revision)	CVR check		
			M	SD	CVR
Constituent factor	Information utilization ability	Information utilization ability	4.50	0.58	1.0
Sub-factor	① Information gathering and analysis Ability to collect necessary and useful information from various sources and analyze it according to their purpose	① Information gathering ability Ability to collect necessary and useful information from various sources	4.80	.43	1.0
	② Knowledge information literacy Ability to process, deliver, evaluate, and manage acquired information	② Information analysis ability Ability to analyze the collected information according to its purpose	4.70	.49	1.0

Second, in order to clarify its meaning for invention-fused creativity, some parts of the contents were modified. Some of the factors were revised by reflecting the opinions of experts. 'Design and production ability' was deleted according to the opinion that it could be misunderstood as 'manipulation ability' for devices and that it overlaps with 'design ability'. Therefore, it was revised as 'planning and design ability'. The results are shown in Table 6.

Identification of the Content Validity of the Concept and Constructs of Invention Competency

Table 6: Conformity of Invention and convergent creativity domain

Domain division	1st Expert Council (FGI results)	2nd Expert Council (terms revision)	CVR check		
			<i>M</i>	<i>SD</i>	<i>CV R</i>
Invention and convergent creativity domain	Competence related to the ability to produce products with convergent thinking, creativity and problem solving ability	Ability to materialize output based on convergent thinking, creativity, and problem solving ability	9.48	10.43	11.10

Third, according to the opinions that differentiation among sub-factors is needed for 'social responsibility' in the inventive personality domain, 'social problem recognition' was revised to 'community problem recognition'. Also, as the meaning of 'future insight' among the 'entrepreneurship' was too broad in meaning so it was revised to 'future readiness' for clarification. The results are shown in Table 7.

Table 7: Conformity of Inventive personality domain

Domain division	1st Expert Council (FGI results)	2nd Expert Council (terms revision)	CVR check		
			<i>M</i>	<i>SD</i>	<i>CVR</i>
Inventive personality domain	Ability to pursue social values with self-assurance and social responsibility and to fulfill goals	(maintain)	4.80	.43	1.0

3.3 Results of the identification of concept and constructs of the invention competency

Based on the analysis of the previous research, the results of the content validity test at the FGI and the second expert council were derived from three domains, 11 components and 32 sub-factors. First, the concept of inventive capacity is defined as follows. Inventive capacity is the ability to solve problems by using expertise and knowledge of intellectual property in a specific field based on fused thinking and creativity. It is also defined as the ability to create meaningful economic value through social contribution.

In this study, we searched for the inventive capacity as the intellectual property domain, the invention fusion domain, and the invention domain. Definitions, constituent factors and sub-factors of each area are as follows.

First, the 'intellectual property' domain is defined as the ability to solve problems by using expertise and knowledge of intellectual property based on convergent expertise and creativity, and the ability to make social contribution by creating meaningful economic value'. And three components and nine sub-factors were derived. The three components are knowledge and information management of intellectual property general knowledge, intellectual property information utilization and connection ability, various fields (science, technology, humanities, arts), Knowledge intellectual property utilization ability, ability to link intellectual property, general knowledge on various areas, understanding of various areas, ability to apply and utilize knowledge on various areas, ability to collect information on various areas, ability to analyze information on various areas, And information management ability factors in various areas.

Second, we define three components and eight sub-factors as 'ability to materialize output based on convergent thinking, creativity, and problem solving ability' in the Invention and convergent creativity domain. And the three components are convergent thinking, creativity, and design competence. The eight sub-factors are high-order thinking, ability to identify associations, logical/analytical thinking, recognition and management of problems, planning and design ability, creativity (fluency, , imagination, flexibility, creativity), creative personality (curiosity, sensitivity, task attachment, adventure) and design sense factor.

Third, we define 'inventive personality' as ability to pursue social values with self-assurance and social responsibility and to fulfill goals, and consist of four components' and nine sub-factors. The four components are self-initiative, leadership, community consciousness and social responsibility, entrepreneurship, and nine sub-factors are voluntary commitment, goal orientation, meta-motivation, creative leadership, community problem recognition, Problem solving, and challenging mental factors.

IV. CONCLUSION

The purpose of this study was to establish an educational foundation for fostering inventive talents through the investigation of invention competency and its constructs. Therefore in this study, the invention competency was defined as 'ability to solve problems by using expertise in specific fields and knowledge of intellectual property based on invention-fused creativity and to create economically significant value through social contribution'.

This indicates that what is needed to achieve an accomplishment as an inventor is to have the ability to draw creative and valuable outcome and the ability to link them to intellectual property rights such as patents. Therefore, it is necessary to have the ability to link the outcome to intellectual property through the related knowledge based on the invention fused-creativity and convergent thinking.

In addition, the constructs of invention competency were identified as the following three: the acquisition of the related knowledge,



invention-fused creativity which is the ability to link the creative outcome to intellectual property, and creative personality which is the attitude to persist for the invention as social responsibility. Considering the three aspects of the invention competency, a customized educational program should be provided on the basis of the components of the necessary areas. In conclusion, an educational program should be provided with a curriculum for the intellectual property field that can create superior patent rights based on a clear understanding of intellectual property and prevent conflicts of rights in advance. Also, for those who have the potentials, a curriculum should be provided to complement the needed ability by stages of development and to maintain the inventive attitude in the inventive personality domain. In addition, training opportunities should be provided to educators who teach inventive education systematically. The conclusion of this research can be utilized as the foundational data to establish lifelong invention educational system for people and students by stages and levels and provide the inventor with an opportunity to self-check on the invention competency and discover his/her needed capability.

Based on the results of this study, if the validity and standardization of the test can be developed, it will be useful for schools and lifelong education institutions in the whole country. The inventor can diagnose his or her inventive ability at the invention site and understand the capacity to be supplemented. Also, it is possible for the adolescents and ordinary people who have the potential of invention to diversify their efforts to identify and enhance the lack of competence through self-diagnosis will be.

In this study, the constructs of invention capacity in terms of bringing out the intellectual property domain and original artifacts in terms of linking intellectual property rights acquisition with knowledge acquisition of inventive competence, attitude to carry out invention continuously and to have social calling and the invention of humanity on the side. Considering the three aspects of the inventive capacity, a customized educational program should be provided on the basis of the constituent elements of the necessary areas that should be focused on the invention education. In other words, a person who achieves the invention should provide a curriculum for the intellectual property field that can create superior patent rights based on a clear understanding of intellectual property and prevent conflicts of rights in advance. Also, for those who have the potential of the invention, a curriculum should be implemented to complement the deficient capacity by stages of development and to maintain the inventive attitude of the inventive personality domain. In addition, educational opportunities should be provided to educators who teach inventive education systematically. Therefore, the results of this research will provide the inventor with an opportunity to self-check on the inventive capacity and discover the lack of inventive capability, and a lifelong life that can constitute the inventive curriculum for each stage of development. It can be used as basic data of invention education system.

References

1. Choi, Y. H. (2014). Research on Invention Education. Seoul: Hyungseol Publishing Company.
2. Lee, K. P., & Lee, K. H. (2016). Needs and Expected Effects for Establishment of an Invention Education Institution. *Global Creative Leader*, 6(2), 49-67.
3. Kim, D. H., Choi, Y. H., Kang, K. G. (2014). Research Trends of Invention Education Based on Journals. *Korean Journal of Technical Education*, 14(2), 216-233.
4. Moon, G. J., Hwang, Y. H. (2017). What distinguishes an inventive gifted from a scientific gifted. *Journal of Learner-Centered Curriculum and Instruction*, 17(11), 357-378.
5. Lee, J., Park, K., Jin, S., An, Ryu J., Lee S., Ahn, S., & Jin, B. (2012). Understanding the characteristics of the invention gifted in order to establish the invention giftedness. *Journal of Gifted/Talented Education*, 22(3), 551-573.
6. Lee, J., Park, K., Jin, S., An, Ryu J., Lee S., Ahn, S., & Jin, B. (2013). Modeling the Conception of Giftedness in Invention Based on Inventor's Three Main Aptitudes. *Journal of Gifted/Talented Education*, 23(3), 435-452.
7. Son, S. J. (2016). The Fourth Industrial Revolution, Changes in Intellectual Property Policy, *STEPI Insight*, 197, 1-19.
8. Jung, Y. (2016). Exploration of Career Education Competency of Elementary School Teachers. *Global Creative Leader*, 6(2), 49-67. Lee, J., et al., 2012, 2013).
9. Lee, K., Shin, O., Kim, D., & Tae, J. (2015). The comparison of university students' core competency and creative personality to promote the confluence education base on the core competency. *The Journal of Educational Research*, 13(2), 1-24.
10. Rabiee, F. (2004). Focus - group interview and data analysis. *Proceedings of the Nutrition Society*, 63, 655-660.

Authors Profile

Kyungpyo Lee, Doctor of Education, Dept. of Lifelong Education
Soongsil University, Rep. of Korea

Kyunghwa Lee, Professor, Department of Lifelong Education, Soongsil
University, 369 Sangdo-Ro, Dongjak-Gu, 06978, Seoul, Korea.

-