Multi-Converging Educational Program for Design with the usage of 3D Printer: Targeted for Middle School Students

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Abstract

Background Demand for utilization of 3D printers which affects today's clothing, food and shelter as well as our overall industries is increasing in educational field today. In this study, we have developed a converging educational program for design with the usage of 3D printing to verify educational effectiveness. We will find out how to use 3D printer as a multi-converging education program for design targeted for middle school students, will establish the concept of creative thinking ability which is being emphasized recently, and present the direction in which the school education needs to go about in education program for design using 3D printing technology.

Methods To develop a multi-converging educational program for design targeting middle school students, this research has analyzed the characteristics of design education for middle school students and has developed 16 design educational sessions using 3D printing. In order to verify the effectiveness of the developed program, indexes which were formed by 'common competence' and 'design competence'. were constructed and mock classes were given to the actual middle students with a total of 16 session plans developed. After examining the effectiveness through pre and post evaluation, it is the scope of the study to find out how to utilize 3D printer as a program in multi-converging education for middle school students.

Results To investigate the effectiveness of design education program using 3D printing through examining the changes of creativity, problem solving ability, self - initiative, goal orientation and design competence before and after implementation of multi-converging design education program using 3D printing, countermeasure example t-test was carried out. As a result of the test, it is found that there is a very positive change in all areas as shown.

Conclusions It is meaningful that it was designed to create a multi - disciplinary and interdisciplinary effect. In order to maximize the impact and development of sustainable competencies of middle school students using 3D printing, multi-converging design education should be implemented to converge more diverse contents than present.

Keywords 3D Printing, Design Education, Creativity, Multi-Converging, Middle School Student

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1. Introduction

1. 1. Research Background and Objective

Demand for utilization of 3D printers which affects today's clothing, food and shelter as well as our overall industries is increasing in educational field today. 3D Printing technology can be utilized as a tool for creating innovative business models, educational methods, and also can be utilized as a groundbreaking tool to materialize an idea into a product. As a result, schools and companies are conducting 3D printing education on their own, and 3D printing related departments and courses are being established in domestic schools today for integrated creative education for the highly gifted. However, the sad truth today is that our domestic 3D printing education still only focuses on the assembling of 3D printers and 3D modeling tools.

Kainat (Kainat, 2017) mentioned that application of 3D printing technology is necessary for a better understanding of elementary and basic education (Lee, Y. C, 2015). Through the verified result of testing for creativity of the inventive educational program with the usage of 3D drawing and 3D printer, he has concluded that 3D printers increase creativity in elementary students. The result especially showed the effect of enhancing openness, fluency, and flexibility among the sub-factors of creativity. Also, the result from verified results of the creativity test, of comparative group showed a significant difference in the level of creativity improvement compared to the comparative group of general inventive education which was tested simultaneously. The factor which showed the most significant difference among the sub - factors in creativity was fluency.

In the case of the UK, 3D printing is adopted and applied in UK's formal education to help the students age 10 and over to grasp the method of actualizing their creative ideas and imagination through 3D printing (ZD Net Korea, 2014). Currently, many research centers and groups in UK are studying active utilization of 3D printing technology in design and art contexts in higher education (Walter & Devies, 2010).

However, Korea's educational program implemented today is still insufficient in developing a multi-converging program which is designed organically for the theory, principle and practice of 3D printing. Therefore, in this study, we have developed a converging educational program for design with the usage of 3D printing to verify educational effectiveness. We will find out how to use 3D printer as a multi-converging education program for design targeted for middle school students, will establish the concept of creative thinking ability which is being emphasized recently, and present the direction in which the school education needs to go about in education program for design using 3D printing technology.

1. 2. Research Scope and Method

To develop a multi-converging educational program for design targeting middle school students, this research has analyzed the characteristics of design education for middle school students and has developed 16 design educational sessions using 3D printing. In order to verify the effectiveness of the developed program, indexes were constructed and mock classes were given to the actual middle students with a total of 16 session plans developed. After examining the effectiveness through pre and post evaluation, it is the scope of the study to find out how to utilize 3D printer as a program in multi-converging education for middle school students.

Table 1 Research Flow Chart

Analysis of prior research related to 3D printer education	→	Analyze programs using 3D printers and set up design education direction for middle school students	
		▼	
Prior meeting with the experts	→	Development of 3D printing application program. Expert consultation ar verification of measurement tools and programs	
		▼	
Program development and application	→	Development of multi-design education program utilizing 3D printing: Developing a program that can be applied to the free- period system under the theme of 'future design related profession'	
		▼	
		Development and verification of 16 session plans	
		▼	
		Applying a session (16 times in total) that links 3D printing with the theme of "Profession related to future design"	
		Applying a session (16 times in total) that links 3D printing with the theme of "Profession related to future design"	
		▼	
Program evaluation and analysis	→	Perform pre and post evaluation for evaluation of program utilizing 3D printing.Evaluate and analyze capability of program utilizing 3D Printing. Analyze student's 3D printing program work	
		▼	
Draw conclusion	→	Draw conclusion	

2. 3D Printing as a Multi-Converging Education

2. 1. Multi-Converging Education for Design

As the 21st century digital society arrived in course of time, patterns of education are transforming accordingly. Ever since STEM education of the US has been introduced to Korea in 2012, many educational institutions have been carrying out multi-converging education in accordance with the characteristics and educational ideology of each institution. In addition, because the study of multidisciplinary approaches in the field of education has become a hot topic, the curriculum for a multi-converging education for design is emphasized in the quest for knowledge based problem solving. For this reason, it can be seen as the means to learn the expertise of individual studies through the research in which the students actually participate in and to solve the limitations of inter-disciplinary areas. Therefore, through the experience of multi-converging education for design, it is possible to obtain a unidirectional problem solving ability as well as a more integrated problem solving ability and also be able to combine collaborative thinking ability (Seo, I, S, 2017).

In this research paper, I have developed a 3D printing usage as a design educational program as a part of the multi-converging education system to enhance middle school students' creativity. A 3D printer refers to a machine that produces 3D objects based on drawings that a 2D printer prints. The principle of a 3D printer is to divide a three-dimensional shape into small planes and analyze it, then build a three-dimensional model by stacking layers one by one with a thin film. There are four stages of modeling using a 3D printer. The first step is a design process for designing an idea and form. The second step is a 3D modeling process for creating the thought image as a 3D drawing. The third step is a 3D printer output process using a 3D modeling drawing. Finally, the post-processing process that polishes and colorizes the surface of the produced molding.

This 3D printing has potential as a means of multi-converging education. The educational significance and potential of utilizing 3D printing are as follows. (Choi, H. S & Yoo, M. R, 2015) First, it provides an opportunity to express abstract knowledge physically, thereby enhancing the knowledge understanding. The abstract concept of the student can be described by the modeling software and by actualizing the concept physically through the new media, the possibility of utilizing the concept can be enhanced. Second, it provides design based experience in designing algorithms and adjusting parameter values in 3D modeling process. This has the potential to improve information science thinking while expressing creative ideas as a modeling software. Third, it is not limited to use the existing materials in the physical computing education that integrates software and hardware, but it is possible to utilize hardware produced by the student with 3D printing. In other words, by sensing external information with a microcontroller such as Arduino and making a model through 3D printing, the student himself can create an object that responds to external information.

2. 2. Characteristics of Design Education for Middle School Students

The school is where potential future professional designers and potential consumers coexist. If you take a look into the 2009 revised curriculum of 11 kinds of middle school art textbooks by the 2009 they are divided into the areas of experience, expression, and appreciation. The field of appreciation does not include design, and even in the field of experience and expression, the textbooks that throw philosophical and ethical questions about 'for whom design is for, where it is used and how it is made' can only be found in a few cases. Also in the expression area, it is only organized into designing conditions such as purposefulness, economics, practicality, aesthetics, originality, and division of visual, product, and environmental design, contents for each division, and production training. It is difficult to deny the fact that the practice of design education in the art education field was an education concentrated for designers and designers who are focused in the producer position. (Park, M. R & Ahn, J. H, 2003)

Classification	Field
Basic design	basics and principles of color, history of design, type of design, terms of design
Product design	industry (chair, lighting, car etc.), fashion design
Environmental design	interior design (interior design, display) Exterior design (public design, super graphic, street furniture, architecture
Visual design	Letter design, illustration, manga, pictogram, symbol mark, poster design, advertisement design, book art, character, caricature, packaging design, CIP, portfolio
Media design	Photography, UCC, animation, web design, computer graphic
Social work design	Universal design, green design

Table 2 Classification of Desig	1 field in Middle School Art Textbooks
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The purpose of carrying out the free period school plan for the middle school students announced by The Ministry of Education (2013) aims to: First, provide opportunities where the students will self-evaluate and develop through the experiences of searching for their own dreams and talents in which they will be exploring, aiding and designing their aptitudes and future. Second, it transforms knowledge and competitive education into a self - directed learning and future - oriented competence (creativity, personality, sociality, etc.). Third, through changes in public education and restoration of trust, provide the students a happy school life. Basic direction of the policy is to promote career based education through the concentrated career lessons and experiences provided by the free period **plan**. elementary school (recognizing a career) - middle school (searching for career) - high school (building a career). The development of multi-converging education programs using 3D printing can be applied to the free period of middle school, which can improve creativity, problem solving ability and design ability. It is possible to expand thinking ability by searching design related occupation by investigating changes in future life in free period system, and to be able to design 3D product related to future job as a result. By searching for future living conditions and investigating design related careers during free school period, one can not only expand cognitive thinking but also design a molding relating to possible future career as an outcome which will be a good model for a multi-converging education.

2. 3. Introduction and Application of 3D Printing Education

Newly emerging system and paradigm spread out faster through internet and social network due to the converging of technology in diverse fields. The openness and the sharing brought by these not only break the barriers between studies but also the barriers between industries. The openness and sharing of the Internet and social networks also lowered the barriers to entry in the field of design. The popularity of design tools opened up opportunities for non-design majors to design their own business. (Kim Y. E, 2017) As the paradigm of design education is changing, 3D printing can be a good tool for middle school students to promote awareness of technology convergence, openness and sharing.

3. Development of Design Education with 3D Printing Application for Middle School Students

fable 3 Development Result							
Production making for multi– converging education using 3D printing	16 teaching sessions	4 out of 16 sessions consist of understanding and application of 3D printing,After that, theme of clothing food and shelter is applied to each 4 sessions					
	Program activity	The activity consists of 3 activities, It is composed of cards for searching and writing future career and activity for sample production		e en el			

3. 1. Future Occupational Program Through Future Forecast

To foster creative and converging competent to prepare for the changes of the Fourth Industrial Revolution, which dismisses physical, biological, and decadal boundaries, education programs that converge design thinking processes to cope with various changes are very much needed rather than programs which just focus on the technical ability of 3D printing. We intend to explore various future occupations through research on future life condition by strengthening the executable features of educational programs in free school period. We developed and distributed activities to organize the contents of the students to enable them to understand at a glance. In this study, we developed an educational program based on Kim, Jin - Soo's PDIE model and developed an educational model by understanding the educational approach through consultation with three experts. After that, we conducted the convergent education using 3D printer and verified the change of creativity through pre and post creativity test of the participants of single group education.

3. 2. Present Development of The Program

Experts predict that 3D printers will bring revolution to traditional manufacturing methods through systems, and will also make many changes in how people consume and how they learn. The purpose of the design education as general education was to develop the concept of job searching for middle school students and to explore various future occupations. For this purpose, it aims to explain how various occupations of modern society are related to science, aiding students to consider the changes of occupation in future society and to produce related contents using 3D printing. As shown in Table 4, in the demonstrated mocking class, students were able to develop future-oriented thinking ability by pre-studying the occupational change in future society and conducting workshops to investigate future life and to draw a mind map through group discussions. After that, practical classes were organized to search for core contents related to occupations by division and linked them with 3D printing by dividing into clothing, food, and shelter group.

Table 4 Demonstrated Mock Class Photos

Formation	The process of finding ideas theory and group workshop	s through s sessions 1–4	Practical course Session5-16		
Activities by group	1) Designing my future job by investigating and predicting the life of the future society; Designing a job to be predicted through group discussions on future society	2) Selection of moldings that can represent future job and sketch idea sketches: Sketch ideas individually and link them to 3D printing pens or 3D modeling classes	3) Using the 3D printing pen to produce relevant moldings (using the activity) or 3D modeling classes	4) 3D Modeling Production of 3D modeling program and completion after post- processing using 3D printer output	
Image					

As a result of exploring the core contents of occupations by dividing into clothing, food, and shelter groups, an interrelated 3D printing artwork idea was derived from individual students' imaginations combined with the content of investigation of actual future living conditions.

Table 5 Demonstrated Mock Class Student Result

Main Result of Future Occupation Program With the Usage of 3D Printing

Main Kesu	Main Result of Future Occupation Frogram with the Osage of 5D Frinting							
NO	1	2	3					
Торіс	3D printing applied program for future clothing lifestyle conditions	3D printing applied program for future food lifestyle conditions	Program using 3–D printing for future residential environment					
Contents	Developed potential future fashion item based on possible changes in environment and technology	Development and application of possible food related products with future changes of food & lifestyle conditions that can be with usage	Develop a architectural design according to the change in future society living conditions					
Name of the Idea	Disposable clothes for cleanliness	Rapid freezing ice cream generator using 3D printer	For space camping Personal space ship					
Image								
Concept Summary	3D printer disposable cooking clothes design for cleanliness in food manufacturing	Device that can be made by putting ingredients in the desired shape of ice cream	Personal spaceship design for camping for free space travel					

Education plan was divided and programs were planned into 16 classes in order to integrate diverse topics and subjects such as technical engineering, mathematics, humanities, and arts with 3D printing. The 16 class programs developed as a middle school education instruction using 3D printer is as follows.

Table 6 Teaching and Learning Process

	0	0					
Program Name	Design world with 3D print	l made ting	School level	Middle School	Number of Sessions	16	
Learning objective	Explain how various occupations in modern society are related to science, and exploit their future profession by taking into account changes in profession in the future society and product them by 3D printing						
Related subject		science : (7) Science and My Future Art : (1) Experience Process of Technology : (3)Resource management and independence, (5) Using technology					
2015 revised	Science	Content Eleme Occupation re	ent: lated to science, c	hange of occupat	ion in future soc	iety	
curriculum links		Achievement Criteria : 9 Science 07–01 You will be able to investigate the types of science-related jobs and their work, and discuss the competencies needed for that job. 9Science 07–02 Explain how various occupations in contemporary society are related to science and discuss changes in occupations in future societies. changes in the future society.					
	Technology home	Content criter Explore Influe social and env	ia : ence of future tec vironmental aspec	hnology, society ts	, and future tec	hnology on individual,	
		Achievement 9 Tech Home and search for values. 9 Tech Home technology de	Criteria : 03–09 Recognize or and design a c e 05–01 Unders evelops, predict fu	the necessity of course that meet tand changes in ture technology u	career design fro s his aptitude b n society, fami se and change i	om a lifelong viewpoint, based on sound career ly and occupation as n society	
	Art	Content Eleme Converging of	ent : art and other fiel	ds, types of occup	oationrelated to	art	
		Achievement 9 Art 01–04 V 9 Art 01–05 L related to art.	Criteria : Ve can find ways t Inderstand the typ	o converge art an bes and character	d diverse fields. istics of various	occupations	

Teahing and learning content categorized by the session numbers				
Understanding and Utilization of 3D printing	1-2/16 session	 Development of 3D printing and understanding future society Future society and exploration of the related jobs due to the development of 3D printing Thinking in terms with my possible future career 	Science	
	3-4/16 session	 Utilization and practice of 3D printing Utilization and practice of 3D modeling Understanding 3D printing though modeling practice 	Technology/ Home	
Theme of future clothing		Understanding the future change of clothing and food (change in clothing and lifestyle)	Technology/ Home	
lifestyle 3D application program	5-6/16 session	 3D printing and future career "World of Fashion Design" Designing fashion product items according to future environmental changes Sketching of fashion product items 		
	7-8/16 session	 3D modeling through practices related to fashion design (Possible producing of various wearable products) 3D printing as modeling data Possible utilization of 3D printing pen type Post finishing of 3D printed products (finishing and coloring) Mini fashion show (video recordings are permitted) 	Art	
Theme of future food lifestyle		Understanding the future change in clothing, food, and shelter (change in diet)	Technology/ Home	
3D application program	9/10-16 session	 3D printing and future career "World of Food Design" Designing food related product items according to future dietary changes Food related product sketches (Tableware Design) 		
	11-12/16 session	 3D modeling through the practice related to food design (various tableware products can be produced) 3D printing as modeling data Utilization of 3D printing pen type possible post finishing of 3D printed products (finishing and coloring) Food decoration (video recordings of exhibition are available) 	Art	
Theme of future residential		Understanding the future changes of clothing, food, and shelter (change of residential life)	Technology/ Home	
application program	13-14/16 session	 3D printing and future career "World of Architectural Design" Designing architecture according to future change in living and natural environment Architectural design sketches (available in various house forms) 		
	15-16/16 session	 3D modelling through learning related to architectural design (various architectural design production available) 3D printing as modeling data Utilization of 3D printing pen type available Post-finishing of 3D printed products (finishing and coloring) Construction completion ceremony held 	Art	

3. 3. Assessment Index of Multi-Converging Educational Program for

In order to evaluate the program development and educational capacity, indicators were formed by 'common competence' and 'design competence'. Creativity indicators was formed based on the creative expressiveness of Torens ttct and Lowen Felt and these were the top specification of problem solving ability and self - independent goal orientation. Torp & Sage (2002) presented three simple features of problem-based learning. First, students are positioned as stakeholders in problem situations. Second, organize curriculum as a comprehensive problem-solving so that students can learn in a contextual way. Third, the teacher advises students' thoughts, guides student exploration, and creates a learning environment that promotes deep understanding. As the Torp & Sage (2002) theory above shows, when students solve problems in a contextual way, students become self-directed and will gain a goal-oriented approach to solving problems. The design competency was based on the US NEAP Arts Education Assessment Framework (2008), revised 2015 curriculum arts and achievement standards

Competence Evaluation Items For Creative Converging Education		For	Activities by group		
Field	Advanced Ability	Lower Ability	Questionnaire for Middle School Students (5 points scale)		
Common	Creativity	Fluency	I can talk about the role or principle of various tools.		
Competence		Flexibility	I can explain situations in our everyday life with an example.		
		Originality	I can plan and make it in my own way.		
		Accuracy	I can set the topic, investigate it using various methods, organize it and present it.		
		Sensitivity	I can explain what I have learned in school in detail.		
		Openness	I am able to solve given problems quite easily.		
		Imagination	I am more imaginative and expressive than my friends.		
		Task commitment	I can make or design new things with the knowledge I have learned at school.		
	Problem Solvin	ig Ability	I think a lot about ideas and solutions to problems.		
	Self Initiation		I plan and execute my plans to achieve my goals.		
	Goal Orientate	d	I act actively to achieve my goals successfully.		
Design Competence	Imagination	Image Formation	I can freely imagine and express using my five senses.		
	Design that Idea and meets the Concept theme and purpose		I can design specific things for different purposes.		
	Creativity	Originality	I can design ideas in my own way.		
	Design related thinking	Creative problem solving	Design ideas help to solve real life problems.		
	Sensibility	Sensitivity	I like to appreciate work piece.		
	Expression	Accuracy	I can express my thoughts and feelings using appropriate materials.		
	Formability	Visual harmony and balance	I can express my thoughts and feelings in a stable and harmonious way.		
	Accuracy	Visual materialization	I can express my thoughts and ideas accurately by design.		
	Design management	Commercializing design	Commercializing design		
	Aesthetic	Capacity	I can easily learn new design techniques.		
	reflection	Interpreting ability	I like creating, understanding, and explaining work pieces.		
		Constructive criticism ability	I can objectively evaluate the work of other friends.		

Table 7 Assessment Index

4. Application of Developed Program: Verification of Multi-Converging Education for Design's Effectiveness

4. 1. Result of Experiment Through Applied Program in Actual Sessions

This study with experimental classes was taken place with 47 selected students who wished to participate in the program from G - junior high school students in Goyang - si, Gyeonggi - province for two months from August 2016 to September 2016. Pre - evaluation was carried out at the end of August and post - evaluation was carried out at the end of September immediately after the end of the program. The participants were applied to middle school students composed of 26 students in the first grade and 21 students in the third grade respectively. Among these, the correspondent results that matched pre and post evaluation of 47 students were used for the final analysis. To investigate the effectiveness of design education program using 3D printing through examining the changes of creativity, problem solving ability, self - initiative, goal orientation and design competence before and after implementation of multi-converging design education program using 3D printing, countermeasure example t-black was carried out. As a result of the test, it is found that there is a very positive change in all areas as shown in Table o. As a result of the analysis, the overall competency increased by 0.62 points from the pre-test (M = 3.60) to the post-test (M = 4.22), showing a statistically significant difference (t = -7.515, p <.001) These results show that the capacity after the development program has increased significantly in all areas. In particular, 'idea' competency in the design competence field showed the highest increase in post evaluation compared to the pre evaluation. Therefore, it is proved by the result that the design education program using 3D printing had a positive effect in enhancing students' creativity, problem solving ability, self - Orientation, and design competence (Shim, H.Y, 2018).

Evaluated Area		Pre (N=47)		Post (N=47)		t	р	
				SD	М	SD		
Common	Creativity		3.54	.61	4.02	.73	-3.966***	.000
	Problem Solv	em Solving Ability		.67	4.15	.57	-3.862***	.000
	Self Initiation	Self Initiation		.85	4.12	.76	-3.822***	.000
	Goal Orienta	tion	3.75	.71	4.21	.64	-3.810***	.000
	Common Con	npetence (Total)	3.64	.55	4.13	.47	-5.438***	.000
Design	imagination	Image Formation	3.40	.80	4.06	.78	-5.339***	.000
	Idea	Idea and Concept	3.37	.74	4.13	.69	-6.169***	.000
	Creativity	Originality	3.62	.77	4.19	.72	-4.444***	.000
	Sensibility	Sensitivity	3.38	.99	4.00	.71	-4.444***	.000
	Expression	Accuracy	3.38	.84	4.02	.73	-4.445***	.000
	Formability	Visual harmony and balance	3.50	.73	4.15	.78	-4.872***	.000
	Accuracy	Visual Materialization	3.60	.69	4.31	.70	-5.148***	.000
	Aesthetic Reflection	Capacity	3.02	.83	3.92	.84	-5.466***	.000
		interpretive ability	3.54	.85	4.12	.70	-4.017***	.000
		Constructive Criticism Ability	3.63	.79	4.38	.69	-5.476***	.000
		Total	3.40	.65	4.14	.57	-6.274***	.000
	Design Comp	oetency (Total)	3.44	.57	4.13	.51	-6.964***	.000
	Total Compet	tency	3.60	.49	4.22	.42	-7.515***	.000
	Total Competency		3.60	.49	4.22	.42	-7.515***	.000

Table 8 Difference in Pre and Post Evaluation for Design Education for Middle School Students

p<.01, *p<.001

4. 2. Utilized Measures of 3D Printer as a Multi-Converging Educational

Today's education involves not only the recognition of the existing intelligence (IQ) that emphasizes the cognitive aspect of the student but also the multifaceted and defining aspects of emotional intelligence (EQ), moral intelligence (MQ), and social intelligence (SQ). The program using 3D printing resulted in having a positive effect on improving overall creativity, problem solving ability, self - initiative, goal orientation and design competence of junior high school students. In contrast to the way in which current educational institutions have been focusing 3D printing on the technical ability of 3D printing, this research has focused on the topic setting of future career search for middle school students. It is meaningful that it was designed to create a multi - disciplinary and interdisciplinary effect. For the future, various programs that combine various subjects such as technical engineering, mathematics, humanities, and arts, including 3D printing, in a comprehensive manner should be organized and developed by combining various learning styles of multi-converging design education using 3D printing. In addition, the gradual development of the design education program for junior high school students which leads to high school and university education, will able one to recognize the social role and value of design. It will help one to continually develop teaching method in multi-converging design education as a process to discover and participate in solving social problems.

5. Conclusion

5.1. Discussion

The purpose of this study is to investigate the effect of design education program based on 3D printing on the creativity, problem solving ability, self - initiative, goal orientation and design competence of middle school students and to utilize development program in the actual free period school term. Through the theoretical review and analysis of the previous research, the theoretical and technical process of 3D printing and the point of design education program applicable to junior high school were derived. In order to verify the effectiveness of the developed design education program, we applied the 16 experimental sessions of 'Future Designer' program applied with 3D printing to 47 students attending 'G' middle school in Gyeonggi - province. In order to verify the effectiveness of the program, pre and post evaluations were conducted and results were analyzed. Through the verification of the results, the significance of 3D printing multi-converging education for creativity was confirmed.

In order to maximize the impact and development of sustainable competencies of middle school students using 3D printing, multi-converging design education should be implemented to converge more diverse contents than present.

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