Journal of Occupational Therapy Education

Volume 6 | Issue 3 Article 8

2022

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Recommended Citation

Harada, Y., Sawada, Y., Suzurikawa, J., Takeshima, R., & Kondo, T. (2022). Short-Term Program on Three-Dimensional Printed Self-Help Devices for Occupational Therapy Students: A Pre-Post Intervention Study. *Journal of Occupational Therapy Education, 6* (3). Retrieved from https://encompass.eku.edu/jote/vol6/iss3/8

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Abstract

Despite the increasing importance of digital fabrication, of which three-dimensional printing is an important aspect, educational programs in this area have not been fully developed. To utilize three-dimensional printing optimally, occupational therapists need to be familiar with this new technology, understand its scope of application, and possess certain levels of skills for producing. The purpose of this study was to examine the effectiveness of a short-term program for occupational therapy students to increase the acceptance of three-dimensional printed devices by acquiring the basic knowledge and skills of making three-dimensional printed self-help devices. The research involved an intervention study with a pre-post design. Participants comprised 112 entry-level occupational therapy students. The program consisted of two 90-minute sessions during 2019 and 2020. It included a three-part lecture series and two types of practice. The conducted pre-post questionnaires were structured into four categories: I. student profile; II. knowledge about digital fabrication technology; III. ideas and attitudes toward three-dimensional printed self-help devices; and IV. impressions and thoughts. After the program, the number of students who acquired basic knowledge of digital fabrication and who felt confident about making three-dimensional printed self-help devices significantly increased ($p < 0.05$). The study suggested that the program was effective and assisted occupational therapy students to understand the usefulness of this new technology and be comfortable using it.

Keywords

3D printing, education, assistive device

Acknowledgements

This work was supported by JSPS KAKENHI Grant Number JP19K12893.

Volume 6, Issue 3

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ABSTRACT
Despite the increasing importance of digital fabrication, of which three-dimensional printing is an important aspect, educational programs in this area have not been fully developed. To utilize three-dimensional printing optimally, occupational therapists need to be familiar with this new technology, understand its scope of application, and possess certain levels of skills for producing. The purpose of this study was to examine the effectiveness of a short-term program for occupational therapy students to increase the acceptance of three-dimensional printed devices by acquiring the basic knowledge and skills of making three-dimensional printed self-help devices. The research involved an intervention study with a pre-post design. Participants comprised 112 entry-level occupational therapy students. The program consisted of two 90-minute sessions during 2019 and 2020. It included a three-part lecture series and two types of practice. The conducted pre-post questionnaires were structured into four categories: I. student profile; II. knowledge about digital fabrication technology; III. ideas and attitudes toward three-dimensional printed self-help devices; and IV. impressions and thoughts. After the program, the number of students who acquired basic knowledge of digital fabrication and who felt confident about making three-dimensional printed self-help devices significantly increased ($p < 0.05$). The study suggested that the program was effective and assisted occupational therapy students to understand the usefulness of this new technology and be comfortable using it.

Introduction

In recent years, digital fabrication, a design and/or manufacturing method using three-dimensional (3D) data, has become widespread. One of the promising applications of digital fabrication is small-lot manufacturing with 3D printers (Takagi, 2014; Zuniga et al., 2018), which has been used in various medical fields such as orthopedics, spine surgery, maxillofacial surgery, neurosurgery, and cardiac surgery (Tack et al., 2016). In medical and healthcare education, considerable effort has been devoted to developing programs that introduce and/or incorporate novel emerging technologies (Han et al., 2019). These include virtual reality/augmented reality (Dyer et al., 2018; Pantelidis et al., 2018), robotics (Naik & Mandal, 2020; Tanzawa et al., 2013), telemedicine (Walker et al., 2019; Waseh & Dicker, 2019), and 3D printers (Chen et al., 2020; Nicot et al., 2019).

In occupational therapy, reports confirming the advantages of the use of 3D printers for assistive technology devices have been introduced in the area of prosthetics, orthotics, and self-help devices (Schwartz, 2018; Togami et al., 2019). Self-help devices are relatively small assistive devices that are used for activities with the upper limbs, such as the adaptation of spoons for an easier grip. Occupational therapists have an important role in the area of self-help devices, such as finding commercially available devices that meet clients' needs, altering existing devices, and designing and manually creating original self-help devices. To select optimal self-help devices, 3D printers have many advantages. For example, a 3D printer can be used for customized fabrication (Nakagawa et al., 2018), and, if the original is lost or broken, it is duplicable with high-shape accuracy. Design data of self-help devices used for 3D printing are also editable and reusable for other clients after modification, in accordance with body functions. The weight and aesthetic aspect are two further advantages of 3D printed products (Portnoy et al., 2020). Given these benefits, 3D printed self-help devices are soon likely to play an important role in the daily lives of persons with disabilities. In spite of these advantages, knowledge of 3D printing and 3D printed self-help devices have not fully permeated the discipline of occupational therapy.

The Technology Acceptance Model (TAM) has been widely used to explain how users accept new technology (Ma & Liu, 2005). The model suggests that people have to believe that technology will help them to perform their jobs better (perceived usefulness), and not be too hard to use (perceived ease of use; Davis, 1989). The model also suggests that the perceived usefulness might be followed by a perceived ease of use. According to this model, occupational therapists have to perceive that 3D printed self-help devices are useful for clients and easy to provide. Based on this model, Benham and San (2020) developed an introductory program of 3D printing for occupational therapy students and indicated that this 12-week program would improve the acceptance of 3D printing technology.

We also incorporated the ideas of TAM and developed a two-day (180-minute) educational program, aiming to facilitate the students' acceptance of 3D printed self-help devices as one of the important areas for the practice of occupational therapy. The program consisted of a three-part lecture series and two practices, including assignments. The purpose of this study is to examine the effectiveness of the program that we developed by comparing the students' knowledge of and their impressions and thoughts about 3D printed self-help devices through questionaries that we conducted before and after the program.

Method

Design

This study employed a pre-post intervention design using a four-part survey, which included demographics, Likert-type scale questions, knowledge-based "yes/no" questions, or responses based on participants' preferred ways of description.

Participants

The sample comprised third-year undergraduate occupational therapy students from two universities in Japan. All students were taking a course on assistive devices, which included self-help devices.

Program and Procedure

The educational program was 180-minutes in duration. It consisted of a series of three lectures, including the introduction, the usefulness of 3D printed self-help devices and process of making them, and tips for making them and figuring out possibilities. It also contained the two types of practice: one was to experience customizing the devices, and another was to investigate the shared data of 3D printed devices online and download them. Three 3D printers were used for the program to explain the parts, demonstrate the process, and allow practice for the students. One or two faculty members with an occupational therapy background instructed the program. The following paragraphs and Figure 1 provide the details of the program that was conducted.

In the first 90-minute session, Lecture 1 and 2 were conducted. Lecture 1 covered an overview of 3D printers and the advantages and disadvantages of using them. In Lecture 2, the usefulness of 3D printed self-help devices in comparison to existing self-help devices, and the basic steps involved in creating a 3D printed self-help device (preparation, setting, and printing) were explained. After the lectures, the students practiced the partial process of making a 3D printed pointing device with a universal cuff. The intention of this first practice was for the students to understand the process of downloading the data and modifying them. For this practice, the students first measured the hands of other students. Subsequently, they proceeded to download a JSCAD-based parametric design tool, a specifically developed software using the script-type 3D modeler that enables novices of 3D design to adjust the shape of a self-help device simply by inputting some parameters and then generate Standard Triangle Language (STL) data (Nilsiam & Pearce, 2017). At the end of the first session, the second practice was assigned. The students were introduced to Thingiverse (https://thingiverse.com), one of the largest databases of 3D data for 3D printing, from which data on self-help devices can be downloaded. Using this community and design-sharing platform, the students selected their favorite self-help devices while investigating the purpose, target population, and ways to use it, then downloaded its data and picture for the second class. Through this practice, we expected the students to be aware of extensive possibilities of 3D printed self-help devices, explore the usefulness of them, and recognize the easiness of access.

In the second 90-minute session, the students presented their assignment to other students, after they received the devices that they modified after the first session. As a part of second practice, the lecturer chose the data that the students downloaded as the assignment and demonstrated how to print using the 3D printers. While printing, Lecture 3 was conducted. This lecture covered the last step in making a 3D print (continued from the lecture in the first session), the different types of filaments and their application, as well as creating Creative Commons licenses. Finally, the program concluded with a reflection on the usefulness of 3D printing in occupational therapy along with future possibilities.

The program was conducted between 2019–2020 at two universities in Japan by the first author and the second author, respectively. They have occupational therapy backgrounds and work at the different universities. Each program was held at the university for which they worked. To avoid differences in educational content in delivering the program across the two universities, the same slides and materials were used. Several meetings were held to ensure consistency of delivery of the program.

Questionnaire

To evaluate the effectiveness of the program, pre-post questionnaires were administered. They consisted of four categories: I. student profile to understand the demographic information of the students and their characteristics; II. knowledge about digital fabrication technology; III. ideas and attitudes toward 3D printed self-help devices; and IV. impressions and thoughts about the 3D printed devices and the program. The pre-post questionnaires are detailed in Table 1.

As shown in Table 1, Category I included five questions: age, experience of creating assistive devices, preference for and competence in manual creation, and preference for computer work. Category II consisted of 11 questions regarding basic knowledge of digital fabrication technologies. The students selected indicated their knowledge of as many technologies as relevant. Category III consisted of six questions on the ideas and attitudes toward 3D printed self-help devices. In Category IV, the impressions and thoughts regarding the program and the sense of competence in making 3D printed self-help devices were investigated. The students responded to Categories I, II, and III before the program, and II, III, and IV after the program. The answering methods included descriptive, Likert scale, and multiple selections based on “yes” or “no” answers (see Table 1).

Figure 1
Structure of the Two-Day Educational Program

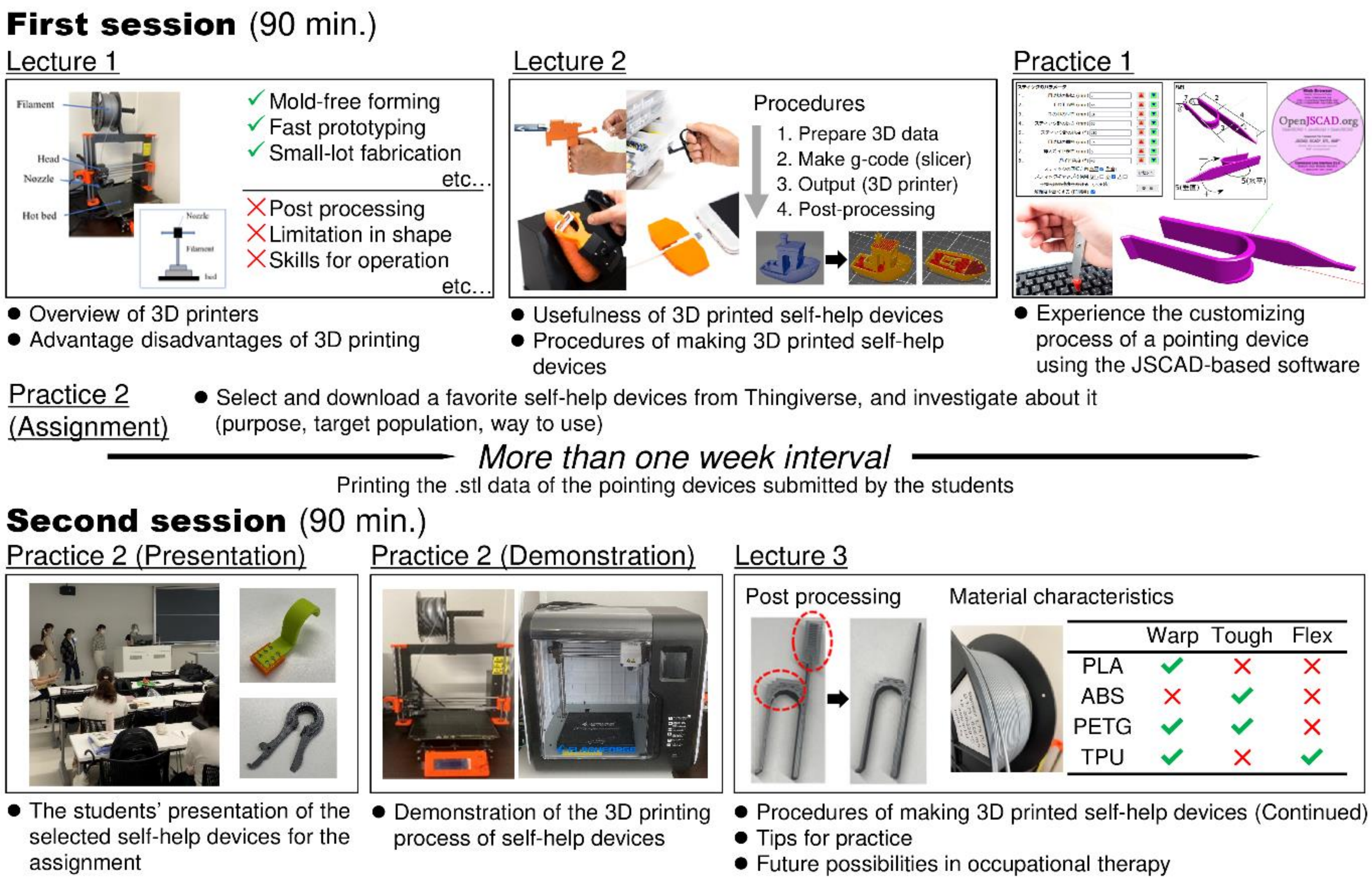

Table 1

Questionnaire

Category	Items	Answering Method	Data Analysis
Ⅰ. Profile	Q1. Please state your age	Q1 [Descriptive]	Descriptive analysis
	Q2. Have you ever made self-help devices?	Q2 [Three-level Likert scales] 1 = multiple times, 2 = once, 3 = no	
	Q3. Do you like to make things, such as crafting?	Q3-5 [Five-level Likert scales] 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree	
	Q4. Do you think you are good at making things?		
	Q5. Do you think you are good at working with computers?		
Ⅱ. Knowledge of digital fabrication technology	Q. Please check the sentences below and answer by indicating "Yes" or "No" Based on 3D data, a machine can create an object. With 3D data, you can duplicate the same object repeatedly. 3D data can be designed using CAD software. 3D data can be used by downloading data created by others from database sites. 3D data can be created by scanning existing solids. Some 3D printers are not expensive and are affordable. 3D printers are used in various ways, such as parts of the products and implants in the medical field. Some devices can be made with a 3D printer and some cannot. Soft materials can be used for 3D printers. 3D data needs to be converted to modeling data with dedicated software dedicated for a 3D printer. By fine-tuning the 3D data, you can easily modify the shape of the object.	[check the sentences in agreement by Yes/No（no limit on the number of checks]	McNemar test

Ⅲ. Ideas and attitudes toward 3D printed self-help devices	Q1. Do you think that 3D printed self-help devices can improve the quality of life for people with disabilities and the elderly? Q2. Do you think 3D printers can be used in occupational therapy? Q3. Do you want to make 3D printed self-help devices? Q4. Do you think occupational therapists need to have the knowledge and skills to create 3D printed self-help devices? Q5. Do you think occupational therapy students need to learn the knowledge and skills to create 3D printing self-help devices? Q6. Do you think you can make 3D printed self-help devices by yourself?	[Five-level Likert scales] 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree	Wilcoxon's signed rank test
Ⅳ. Impression and feedback regarding the program	Q1. How satisfied were you with the self-help devices that you made in the program? Q2. How much do you think you understand the 3D printed self-help devices? Q3. How difficult was the program? Q4. Do you want to learn more about making 3D self-help devices?	[Five-level Likert scales] 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree	Spearman's rank correlation coefficient (correlation with category I)

Data Analysis
A descriptive analysis was conducted for Categories I and IV. Acquisition of digital fabrication knowledge under Category II was examined through the McNemar test, comparing the number of students who marked the items before and after the program. Wilcoxon's signed rank test was conducted for the Likert-rated items in Category III, to examine the changes in ideas and attitudes regarding 3D printed self-help devices. The influence of student profiles on ideas and attitudes after the program was analyzed by Spearman's rank correlation coefficient. SPSS Statistics version 24 (IBM Corp., Armonk, NY, USA) was used for analysis. The significance level was set at .05.

Ethical Considerations
This study was conducted after obtaining approval from the ethical review committees of both universities (Nos. 29-91 and 19A049). It was verbally explained to the students that participation was voluntary, that they would not be at any disadvantage for non-participation, and that their data would be anonymized. All participants signed an informed consent before participating in the study.

Results

Profiles
Of the 112 students, 90 submitted the pre-post questionnaires. Of these, 79 (aged 20.7 ± 0.6 years), excluding 11 participants who did not complete the forms, were included in the analysis. Among these 79 students, 57 (72.3%) had made self-help devices more than once (I-Q2). In terms of preference for making things, such as crafting, 62 students (79.1%) responded "strongly agree" or "agree," and only four (4.9%) responded "strongly disagree" or "disagree" (I-Q3). Twenty-three students (29.1%) thought they were good at making things while 28 (35.4%) thought they were not (Q4). Sixteen students (20.3%) thought they were good at working with computers while 34 (43.1%) thought they were not (Q5).

Digital Fabrication Knowledge
The number of students with basic digital fabrication knowledge after the program was significantly higher, as demonstrated by the increase in the percentage of those who checked the "agree" option as displayed in Table 2 that follows.

Table 2

Pre-post Changes in Digital Fabrication Knowledge

Question Item	Number of Checks		Amount of Change (%)
	Pretest	Posttest	
It is a machine that creates a solid object based on 3D data.	74	76	2 (2.7)
With 3D data, you can duplicate the same thing repeatedly.	55	73	18* (32.7)
3D objects can be designed using CAD software.	6	64	60* (966.7)
3D data can be used by downloading data created by others from database sites.	15	66	51* (340.0)
3D data can be created by scanning existing solids.	45	49	4 (8.9)
Some 3D printers are not expensive and are affordable for individuals.	19	48	29* (152.6)
3D printers are used in various ways, such as creating parts for different machines and implants in the medical field.	24	60	36* (150.0)
Some devices can be made with a 3D printer and some cannot.	21	41	20* (95.2)
3D printers can also make soft materials.	12	44	32* (266.7)
3D data needs to be converted to modeling data with dedicated software to be used with a 3D printer.	6	47	41* (683.3)
By fine-tuning the 3D data, you can easily change the shape of the modeled object.	16	54	38* (237.5)

Note. (n = 79) The amount of change and its percentage are post-pre and (post-pre)/pre×100, respectively.
*McNemar test, $p < .05$

Ideas and Attitudes toward 3D Printed Self-Help Devices

The changes in ideas and attitudes toward 3D printed self-help devices are demonstrated in Table 3 that follows.

Table 3

Changes in Ideas and Attitudes Toward 3D-Printed Self-Help Devices

Question Item	Pretest						Posttest						*p**
	1	2	3	4	5	Mean ± SD	1	2	3	4	5	Mean ± SD	
Q1. Do you think 3D printed self-help devices can help improve the quality of life for people with disabilities and the elderly?	28 (35.4)	44 (55.7)	7 (8.9)	0 (0)	0 (0)	1.73 ± 0.61	35 (44.3)	40 (50.6)	4 (5.1)	0 (0)	0 (0)	1.61 ± 0.59	.18
Q2. Do you think 3D printers can be used in occupational therapy?	29 (36.7)	40 (50.6)	10 (12.7)	0 (0)	0 (0)	1.76 ± 0.66	27 (34.2)	47 (59.5)	4 (5.1)	1 (1.3)	0 (0)	1.73 ± 0.61	.76
Q3. Would you like to create 3D printed self-help devices?	19 (24.1)	46 (58.2)	11 (13.9)	3 (3.8)	0 (0)	1.97 ± 0.73	19 (24.1)	43 (54.4)	14 (17.7)	2 (2.5)	1 (1.3)	2.03 ± 0.80	.61
Q4. Do you think occupational therapists need the knowledge and skills to create 3D printed self-help devices?	18 (22.8)	50 (63.3)	10 (12.7)	1 (1.3)	0 (0)	1.92 ± 0.64	21 (26.6)	48 (60.8)	7 (8.9)	3 (3.8)	0 (0)	1.90 ± 0.71	.84
Q5. Do you think students need to learn the knowledge and skills to create 3D printing self-help devices?	11 (13.9)	37 (46.8)	23 (29.1)	8 (10.1)	0 (0)	2.35 ± 0.89	7 (8.9)	40 (50.6)	23 (29.1)	8 (10.1)	1 (1.3)	2.44 ± 0.84	.38
Q6. Do you think you can make a 3D printing self-help device on your own?	2 (2.5)	13 (16.5)	32 (40.5)	26 (32.9)	6 (7.6)	3.27 ± 0.92	2 (4.7)	23 (29.1)	36 (45.6)	14 (17.7)	4 (5.1)	2.94 ± 0.88	**.01***

Note. (*n* = 79); The numbers in the table indicate: Number of respondents（percentage）. Scale: 1 = *strongly agree*, 2 = *agree*, 3 = *neutral*, 4 = *disagree*, 5 = *strongly disagree*. *: Wilcoxon's signed rank test (Value < .05 is shown in bold)

A significant change was observed for the question “Do you think you can make a 3D printed self-help device on your own?” (Q6; $p < 0.05$). For Q1 to Q4, approximately 90% of the students responded, “strongly agree” or “agree,” which demonstrated positive ideas and attitudes toward 3D printed self-help devices even before the program. This positive attitude continued after the program. For Q5, 30% of the students were neutral both before and after the program.

Relationship between Student Profiles and Ideas and Attitudes Toward 3D Printed Self-Help Devices

There was a weak positive relationship between the response to the Category I question before the program, “Do you like making things, such as crafting?” (Q3), and the response to the Category III question after the program, “Do you think it is necessary to learn the knowledge and skills to make 3D printed self-help devices as a student?” (Q6; $r = .230$, $p < .05$).

Impressions and Thoughts after the Program

Only 58 students responded to the question about satisfaction related to making 3D printed self-help devices (IV-Q1), because some students had not received the self-help devices they had made by the time the post-questionnaire was administered. Among these 58 students, nine (11.4%) indicated that they were satisfied (one for “strongly agree” and eight for “agree”), three indicated they were not satisfied (two for “strongly disagree” and one for “disagree”), and 46 (58.2%) indicated they were neither satisfied nor dissatisfied. Regarding understanding the content of the program (IV-Q2), 78 students (98.8%) responded that they had a good understanding (seven for “strongly agree” and 71 for “agree”), and there were no responses indicating a complete lack of understanding. Forty students (50.6%) perceived the program as difficult because of the use of unfamiliar words (two for “strongly agree” and 38 for “agree”; IV-Q3). Six students did not perceive the program as difficult, while 33 responded that the program was neither easy nor difficult. Twenty-five students (50.6%) agreed to pursue further studies on 3D printed self-help devices (two for “strongly agree” and 22 for “agree”), six students refused, and 33 students neither agreed nor disagreed.

Discussion

In this study, we implemented an educational program on 3D printed self-help devices and evaluated the induced changes through pre-post questionnaires. Based on the results, the students improved their knowledge about 3D printers as well as their self-efficacy regarding making 3D printed self-help devices. According to TAM, acceptance of new technology is largely based on two factors: perceived ease of use and perceived usefulness (Benham & San, 2020). To accept the unfamiliar, it is important to know what it is, as well as when, where, and how it can be useful. In our program, through the lectures, the students were informed about all of these aspects. Additionally, the students had the opportunities to investigate a range of 3D printed self-help devices through the assignment in which students explored the existing 3D printed devices, and investigated their aims, target populations and disabilities, and appropriate use. Further, listening to the presentations from other students in the second session provided further exposure to different types of 3D printed self-help devices. These opportunities could have helped change students' perceptions regarding the usefulness of 3D printed self-help devices, which is one aspect of the cognitive responses.

The students also had the opportunity to not only acquire knowledge of usefulness but to also experience of the easiness to use. Self-efficacy is the perception or belief to have the ability to achieve personal goals through one's own efforts (Yokoyama, 2019), and is thus one of the factors that facilitates learning through experience. To increase self-efficacy in learning, it is imperative to gain successful experiences. Reviewing studies related to education in 3D printing, Ford and Minshall (2019) described that creating artifacts under guidance, commonly used in STEM subjects, is beneficial for students because it brings a sense of realism and excitement to the classroom. Our program included the creation of two 3D printed self-help devices: one session involved the process of making a pointing device with a universal cuff, while the other involved utilizing Thingiverse and observing the process of making the selected devices. Although the processes were partial, these experiences could have provided the students with a better picture of the steps involved in 3D printing and improved their perceptions regarding the ease of use, another cognitive response that affects the acceptance of new technology.

The major finding of our study was that the 180-minute program had the effect of inducing positive changes among students in their knowledge of 3D printing. At the university level, various educational programs have been developed and adopted, particularly in the fields of science and engineering (Ford & Minshall, 2016), along with the introduction of a handful of educational frameworks for 3D printing (Go & Hart, 2016; Radharamanan, 2017). However, 3D printing educational programs within occupational therapy are scarce. The challenges in developing programs for occupational therapy students concern ways to provide the basic knowledge and skills of 3D printing in a manner that facilitates their use in clinical settings, as well as ways to incorporate such programs into existing occupational therapy curricula. The present program was conducted by lecturers with a background in occupational therapy, not experts in 3D printing technology. However, they combined their knowledge of making assistive devices with the expertise of a team of engineers with a strong background in 3D printing technology and assistive devices. Subsequently, the developed program was scrutinized closely to ensure that it provided only the minimum knowledge of 3D printing required by occupational therapy students. The necessary parts of the program can be also delivered on demand. Considering the minimal labor, time, and equipment requirements, this educational program can easily be introduced in various educational institutions, and it could broaden the range of students' choices pertaining to assistive devices. Therefore, the program is expected to play an introductory role in providing students with a uniform opportunity to experience 3D printers.

After the program, the majority of the students recognized that occupational therapists need the knowledge and skills to make 3D printed self-help devices (87.3%), but only 59% agreed that these need to be learned while still at university (see Table 3). There was a low positive correlation between the preference for making things and the necessity of acquiring 3D printing knowledge and skills as students. In other words, participants who enjoyed crafting tended to consider it necessary to learn the skills required to make 3D printed self-help devices as students. A previous study reported that the preference for crafting is related to the experience of creative activities and the degree of such influence (Miyake et al., 2017). For students who prefer crafting, making 3D printed self-help devices may be an outlet to express their creativity, further increasing their motivation to learn about 3D printed self-help devices. For these students, advanced programs, such as those involving modifying existing data or creating original 3D printed self-help devices, may be prepared and introduced to facilitate further learning. Despite the consistency with the previous study, however, this weak correlation requires great caution in interpretation. Because the rating of the Likert-scale is subject to large variability, it is necessary to make considerable endeavors to accumulate more data to further confirm the result in the future.

Although half of the participants perceived the program as difficult, most students (98%) responded that they understood the contents. This result suggests the program was effective in introducing the new technology and setting the foundation for its expansion, as necessary.

Limitations and Future Research

Despite its strengths, this study has several limitations. First, selection bias cannot be ruled out. As filling out and submitting the questionnaire was optional, the opinions of those who did not submit the questionnaire or did not attend the class are not reflected. Particularly, it was considered that only students who were more ambitious and positive toward the subject answered.

Second, the program was offered at two universities. Although the same materials were used at both universities, the content could not be completely consistent because of the different instructors. Further, in one of the classes, nozzle clogging of a 3D printer interrupted the demonstration of fabrication. In another class, some of the students did not receive the fabricated samples of their design trials owing to time constraints. Since these factors could make the process of 3D printing look more complicated than it is, it is necessary to modify the program to minimize differences in the content depending on the setting.

Third, evaluation of the program depended on the subjective answers by the students and lacked objective outcome measures. Especially, all the items in Category II contained correct descriptions because this section was intended to measure the amount of knowledge on digital fabrication by the numbers of the checked items. This answering method possibly caused the participants to blindly check any items regardless of whether they knew or not. However, the actual results suggest rational attitudes in answering since the checked numbers varied among the items and increased after the lecture. Consequently, we do not believe that this limitation largely affects the interpretation of the result.

Finally, the knowledge that students acquired was investigated immediately after the program. In the future, it is necessary to check how much knowledge has been retained by this program. Specifically, we think it is important to conduct a survey over a period of time to see how long the knowledge can be retained. It is also important to know whether the 3D printing technology can be used in clinical practice by taking this program. We would like to check the difference in the opportunities to create 3D printed self-help devices between those who have taken the course and those who have not.

Implications for Occupational Therapy Education

1. Through a 180-minute program combined with lectures and practices, the students may increase the knowledge and the self-efficacy, regarding 3D printed self-help devices.
2. The basic structure of a three-part lecture series, demonstrated by this study, may be useful to develop the 3D self-help device educational program that fits in each educational setting.
3. Whereas the practices were partial, self-efficacy of making 3D printed self-help devices increased. It suggested that the program may be effective even with the limited number of instructors and equipment.
4. Notably, instructors may not be experts in 3D printing technology. Rather they need to have appropriate knowledge of how to apply the technology to the occupational therapy setting, including the advantages and disadvantages of the technology and its usefulness in occupational therapy. However, instructors have to know how to run the printers that they use in the program.
5. The educational program of 3D printed self-help devices may elicit the acceptance of 3D print technology for students of occupational therapy and help them to select optimal assistive devices for the clients who need them when they become occupational therapists. The educational program of occupational therapy should consider incorporating the program of 3D printed self-help devices as a class material.

Conclusion

In summary, we developed an educational program to fabricate 3D printed self-help devices, verifying its efficacy through pre-post questionnaires. The program influenced students' knowledge of 3D printers and their sense that they could create 3D printed self-help devices. Educational interventions related to new technologies, such as 3D printing, constitute an emerging area, and current practices may not be available to the public. For future development, more reports by practitioners are needed.

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