Designing an Experience Process for Digital Fabrication to Motivate Newcomers

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***Abstract*—The purpose of this study is to design the stages where newcomers in digital fabrication can learn. Although many newcomers are interested in digital fabrication, few of them can learn continuously. To overcome the problem, this study assumes that maintaining motivation will contribute to the solution and proposes a step-by-step experiential process that will enable the acquisition of basic skills without losing their motivation.**

***Index Terms*—3D Printer, Conceptual Support, 3D Modeling**

I. Introduction

Digital fabrication is a technology for creating objects based on digital data using digital machine tools such as 3D printers and laser cutters. Recently, the reduction in the size and price of digital machine tools has made them available for home use. However, it is difficult for newcomers to enter the creative field using digital machine tools because of preconceived notions regarding the difficulty of creating data and coming up with ideas. This preconception affects the motivation to create, and a lack of motivation makes it difficult for newcomers to enter the field. To overcome the preconceptions, we design a digital fabrication process for newcomers who want to acquire skills on digital machine tools and propose content that experiences digital fabrication with the process.

II. Designing the digital fabrication process

The proposed digital fabrication process was designed based on the barriers faced by newcomers. Hudson et al. investigated the differences between professionals and newcomers in 3D printing [1]. The results revealed that novices face two barriers: the first barrier is *the perception of three-dimensional space.* The newcomers could recognize flat surfaces but not depth and had difficulty placing objects. The second barrier is *the need for creative activities*. Users of 3D printers do not create data for printing, but obtain data from the Internet and print it. However, newcomers who obtain data from the Internet do not continue to use 3D printers. This implies that newcomers must engage in creative activities. To eliminate these barriers, we designed a digital fabrication process using a 3D printer for newcomers. This process aims to reach the stage where newcomers start learning by maintaining their basic skills and motivation.

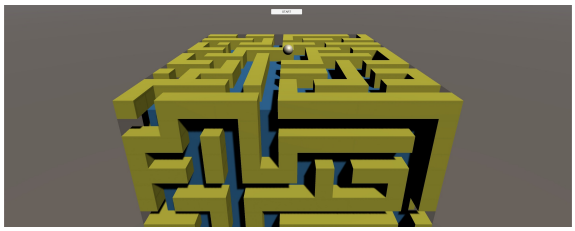

Fig. 1. 3D maze developed in this study

III. Proposed contents

Based on the discussion in the previous section, we propose the content needed for experience with the designed process. The process consists of four steps. Step 1 involves acquiring spatial awareness skills. We adopt a 3D maze as the content. In 3D modeling, the perception of space is determined by manipulating the camera and rotating the object. Because creating the 3D maze requires consideration to achieve a logically correct maze, it is suitable for this purpose. The newcomer then gains spatial awareness skills by manipulating a 3D maze that performs similar operations. In step 2, the newcomer experiences 3D modeling. Newcomers must have creative experience. However, it is difficult for newcomers to perform 3D modeling. We develop a 3D modeling tool that can only combine parts. In Step 3, newcomers think about the ideas they want to create. However, it is difficult for a newcomer to think of ideas. Therefore, this study provides support for conceptualizing ideas based on the creative rubric designed by Dousay et al. [2]: design the idea while filling in the parts that the newcomer wants to focus on, such as appearance. In Step 4, the newcomer uses the content introduced in Steps 2 and 3 to perform creative activities. In this study, we designed a digital fabrication process and associated content for newcomers. By taking newcomers a step-by-step experience of the proposed processes will help them stay motivated and learn the basics of digital fabrication.

References

[1] Hudson, N., Alcock, C., and Chilana, P. K. :Understanding Newcomers to 3D Printing: Motivations, Workflows, and Barriers of Casual Makers, *Proc. CHI'16*, pp. 384–396 (2016).

[2] Dousay, T. A. and Weible, J. L. :Build-A-Bug Workshop: Designing a Learning Experience with Emerging Technology to Foster Creativity, *TechTrends*, Vol. 63, No.1, pp.41–52 (2019).

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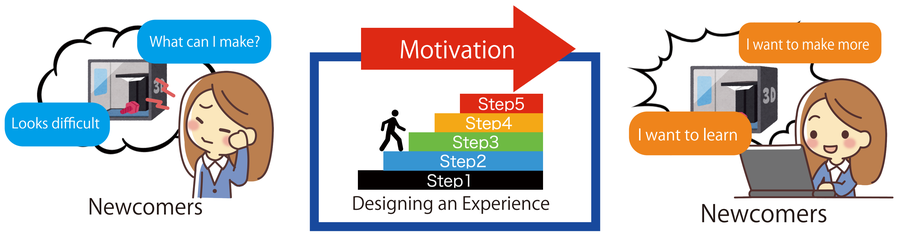
1.Introduction



• Purpose・・・

Aim of this study is to design an experience for newcomers in digital fabrication to reach a stage where they can learn

• Problem・・・

It is difficult to continue to learn digital fabrication

• Proposal・・・

Designing a step-by-step experience to gain basic skills and motivation

2.Designing the Digital Fabrication Process

Newcomers face two barriers:

1.**Perception of three-dimensional space**

2.**Keeping motivated to learn digital fabrication**

To eliminate these barriers, we designed a digital fabrication process learning a 3D printer for newcomers. This process is intended to help beginners reach the beginning stages of learning while keeping their basic skills and motivation alive.

Step.1

Spatial awareness skills

Playing **game content** to gain ---

- Camera operation
- Rotating an object

Step.2

3D modeling Skills

Trying **3D modeling tools** obtain you ---

- Basic skills
- Objects Placing skills

Step.3

Idea generation skills

Brainstorming, according to the answering sheet which we provide, obtain you ---

- Skills to Organize ideas

Step.4

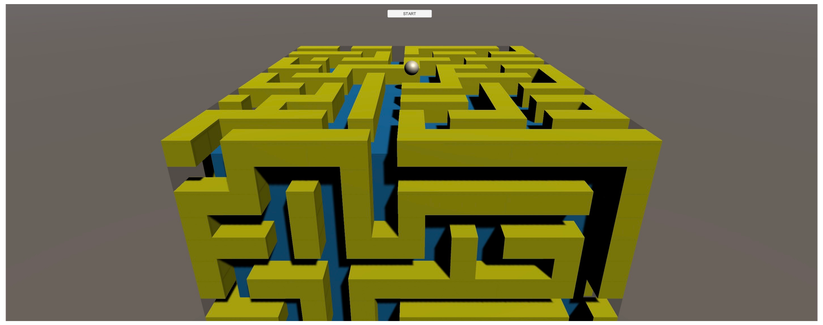
Fullfilment

Experiences these steps of **achievement** make you ---

- Motivated for Digital-Fabrication

3.Proposed contents

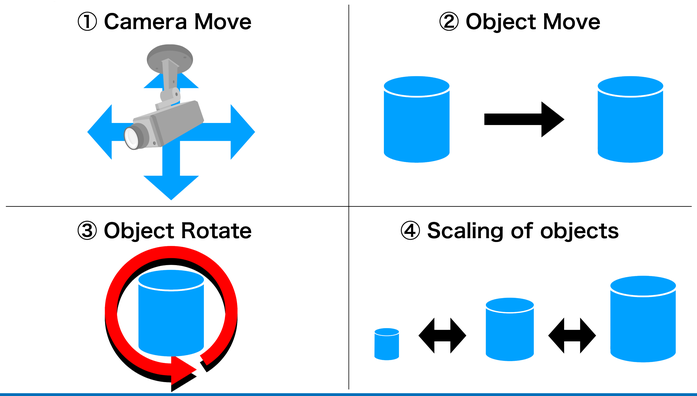
Game contents for getting spatial awareness skills



- The perception of space is determined by operating camera and rotating the object.
- Learners will get used to this control method by playing the 3D maze

3D Modeling Tools

- In this study, 3D data is created by composing parts
- Use modeling tools that allow only basic operations to be used



Brainstorming Support

- We provide answering sheet based on the creative rubric which support Brainstorming
- By answering the questions, you could organize your ideas.

Example