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# Grasping the Actual Situation of Student's Viewpoints on the Improvement of Manufactured Products and User Perspective in Material Processing Learning

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# 1. INTRODUCTION

## Purpose of the Research

This study aims to comprehend the actual situation in materials and processing technology learning in junior high school regarding viewpoints on improving what has been produced and user perception that students have after learning.

# 1. INTRODUCTION

## Research Background

Japan National Curriculum guidelines (2017)

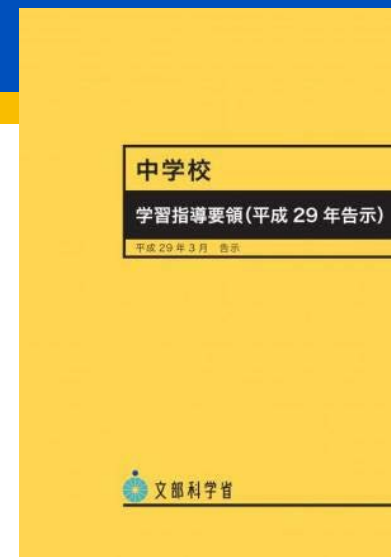
In Japanese junior high school technology classes,

‘To understand the phenomena in daily life and society from the viewpoint of their relation to technology and to optimize technology by focusing on social demands, safety, environmental load, economic efficiency, etc.’

‘To find problems related to technology in daily life and society and to set issues.’

‘To attempt to devise and create technology appropriately and with integrity.’

From the above, it is essential to cultivate an attitude of ingenuity and creativity with **a view to the demands of society** through the production, utilization, and evaluation of subject matter in learning activities such as the production and cultivation of manufacturing, etc.



# 1. INTRODUCTION

## Research Background

**The New Framework of Technology and Engineering Education for Creating a Next Generation Learning ,  
The Japan Society of Technology Education(2022)**

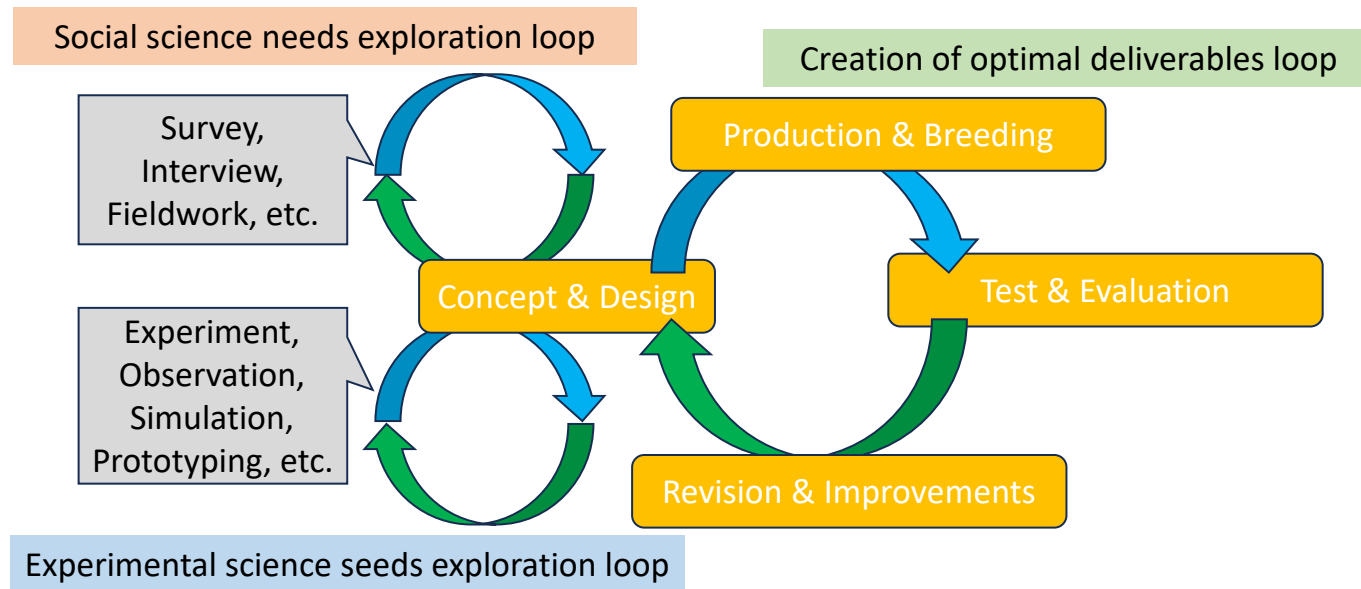


Fig.1 The triple-loop model of the technical problem-finding and solving process,  
The Japan Society of Technology Education(2022)

# 1. INTRODUCTION

## Research Background

It is essential to cultivate the ability to identify and solve technical problems in line with the triple-loop model with elements such as user assumptions, needs identification, and seed exploration.

However, in technology education in Japan, research on these has not progressed.

# 1. INTRODUCTION

## Research Background

Therefore, in this study, we attempted to understand in an exploratory method what kind of viewpoints of improvement students may have after the fabrication of the manufactured product, and what kind of user perception they specifically have in that case.

Specifically, we shall focus on material processing learning positioned first in junior high school, conduct a survey of students after the study.

# 2. SURVEY METHOD

## Subject of survey

833 junior high school students (8th-9th grade)

They have already studied materials processing learning.

Number of valid responses: 721, Valid response rate: 86.6%.

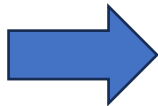
The subjects of the survey were of three types:

1. Free design and production subject : 4 schools, 366 students
2. kit subjects who could choose from several productions: 2 schools, 253 students
3. kit subjects whose productions were unified : 1 school, 102 students

# 2. SURVEY METHOD

## Subject of survey

1. Free design and production subject (free production)  
4 schools, 366 students





# 2. SURVEY METHOD

## Subject of survey

2. kit subjects who could choose from several productions (choice kit), 2 schools, 253 students

木 材

木 材

★の作品には縦びき加工があります。

COMPACT SIZE

— 従来製品よりコンパクトになって登場!! —  
従来のパイン13との比較をしてみました。

**600mm** パイン13

釘は木材をキズつけないように小箱に入っています。

各1種各1箱 基本材10箱 部材50箱 ※保鮮に便利なエコ手袋が同梱。

品名	材質	仕上り寸法(厚×幅×高さ)	数量
板 材	パイン集成材	115 × 150 × 600mm	2
角 材	-	115 × 60 × 600mm	1
その他	鉄丸釘(字頭黒) 30mm×36本 エコ手袋1袋		

サイズ比較

コンパクトになりました

340mm (従来) vs 290mm (600mm)

370mm (従来) vs 320mm (600mm)

従来 パイン13 vs 600mm パイン13

— 仮組み・試作製作をして設計しよう!! —

N9454 15mmトライアルパーツ付/オプションN4162設計・製作シミュレーション模型材料

新発売 トライアルパーツ (仮組み治具) 板厚15mm用

N9454 15mmトライアルパーツ 10×幅 460mm (約100mm)

Option (別売) ※詳細はP15参照  
設計・製作シミュレーション模型材料

片面は方眼印刷、他面は木目印刷されているので縦横方向や材料取手の字面が最適です。

製品に必要な機能や構造を検討し、構造の問題点・整理や修正が的確に行えます。

校対→修正

本題材を製作する前に寸法や作りやすさ、改良点の確認ができます。構造の問題点の整理や修正が的確に行えます。

Option (別売)

N6748 紙ヤスリ・ボンドセット 190mm (約100mm)

紙ヤスリ #180・#240 (140×115mm) 60枚と 木工ボンド10g

創(つくる) by Shade 3D

コンピュータを活用して設計しよう!!

創(つくる) by Shade 3D ※詳細は P14 参照

創(つくる) by Shade 3D

※この製品が入手できることで、コンピュータで設計が簡単...

# 2. SURVEY METHOD

## Subject of survey

### 3. kit subjects whose productions were unified (unified kit)

1 school, 102 students

**推奨品**

品番	品名	規格	10%税込価格(本体価格)
N8970	12mm スピルスプルス3	作品例3点 ※販売数量材料付	2,630円(2,391円)

6~10

削(つくる) by Shade 3D  
ヤマザキホームページより  
テンプレートがダウンロード可能!

ヤマザキ  
ホームページより  
図面がダウンロード可能!

A: 材料と加工の技術  
(2) (3)

**スピルスプルス  
集成材**  
スピルス集成材は  
加工性に優れています。

210mm 12mm

シンプルな  
設計なので  
使いやすい!

Aタイプ

**Step 1** 材料の厚みを考慮し **体験** できる **実験材料** !!

MDF材(4mm厚)・両面テープ ▶ 2種類の組立方法

材料の寸法によって、組み合わせ方が変わるのを理解しよう。

2種類とも製作できます。

**タイプ1**

底板	①	①
両面テープ	②	②

外寸は同じです! MDF厚4mm

**タイプ2**

底板	③	③
両面テープ	③	③

材料の厚みを  
考えなくて  
切断したことは  
ありませんか?

切断

切り損じた...

品名	材質	仕上り寸法(厚さ×幅×長さ)	数量
板材	スピルス集成材	t12 × 210 × 210mm	3
角材	~	t12 × 60 × 234mm	3
その他	実験材料 MDF 材…1式 鉄丸釘平頭真鍮メッキ 25mm…30本 エコ手揚げ袋		

釘は木材をキズつけないように  
小箱に入っています。

各1梱包入数: 12組  
※保管に便利なエコ手揚げ袋付。

# 2. SURVEY METHOD

## Survey method

The survey was conducted in April 2022 in technology classes by technology teachers using the web (Google Form) .

## Questionnaire

(1) Items for assessing consciousness and learning experiences in 'material-processing learning'

:choosing one of the following four responses: 4, I strongly agree; 3, I agree; 2, I somewhat disagree; and 1, I strongly disagree.

(2) Items for assessing viewpoints and user perceptions of manufactured product improvement

Respondents were asked to respond in the form of open-ended questions.

# 2. SURVEY METHOD

## Questionnaire

(1) Items for assessing consciousness and learning experiences in 'material-processing learning'

- I like making things ('like making things').
- I like the technology classes ('like technology classes').
- I like to think about concepts and design ('like concept and design').
- I am satisfied with my production in technology classes ('satisfied with my production').
- I would like to have a career in the future related to what I learned in my technology classes ('career in the future').

(2) Items for assessing viewpoints and user perceptions of manufactured product improvement

- 'If you were a developer of a material processing product and wanted to improve the product you have made, for whom and in what areas would you improve it? Please describe freely without considering your skill level.'



# 3. RESULTS AND DISCUSSION

## Results of a survey

Frequency and rate of items for assessing consciousness and learning experiences toward 'material-processing learning'.

		frequency	rate
like making things	Positive	661	91.7%
	Negative	60	8.3%
like technology classes	Positive	661	92.6%
	Negative	60	7.4%
like concept and design	Positive	549	76.1%
	Negative	172	23.9%
satisfied with my production	Positive	600	83.2%
	Negative	121	16.8%
career in the future	Positive	299	41.5%
	Negative	422	58.5%

# 3. RESULTS AND DISCUSSION

Items for assessing viewpoints and user perceptions of manufactured product improvement

example of description

Student who made a toilet paper holder as a free production

'To make the corners a little more shaved and rounded so that children can use it safely and not get hurt when touching it.'

Student who made a spice rack as a choice kit

'Make it waterproof so that it will not break or get dirty when used in the kitchen for my parents who cook.'

Student who made a bookstand as a unified kit

'I put various patterns and colors on it so that people of different generations can use it.'

# 3. RESULTS AND DISCUSSION

(1) For whom → user perspective

(2) What parts to improve → Viewpoints on the Improvement of Manufactured Products

example of description

Student who made a toilet paper holder as a free production

'To make the corners a little more shaved and rounded so that children can use it safely and not get hurt when touching it'

→ (1) specific users, (2) safety

Student who made a spice rack as a choice kit

'Make it waterproof so that it will not break or get dirty when used in the kitchen for my parents who cook'

→ (1) self/family, (2) functionality

student who made a bookshelf as a unified kit

'I put various patterns and colors on it so that people of different generations can use it'

→ (1) all users, (2) aesthetics

# 3. RESULTS AND DISCUSSION

## Summary results of user perspective

364 descriptions (multiple responses: 326 respondents, 45.2% response rate) were received regarding user perspective.

After categorizing the free-response statements obtained, three categories were established.

**self/family** : descriptions that focused on the lifestyle of family members, including oneself, and attempted to respond to the living environment and individual characteristics. (Examples : myself, family, parents, brothers, sisters)

**specific users** : descriptions that focused on needs arising from psychological and physical characteristics derived from age groups, personality and physical characteristics derived from individuals, lifestyles, preferences, occupations, social roles, etc. (Examples : children, senior people, persons with disabilities, people with specific jobs)

**all users** : descriptions considered users in an all-encompassing manner, such as universal design. (Examples : anyone, everyone, user, purchaser, etc.)



# 3. RESULTS AND DISCUSSION

## Summary results of user perspective

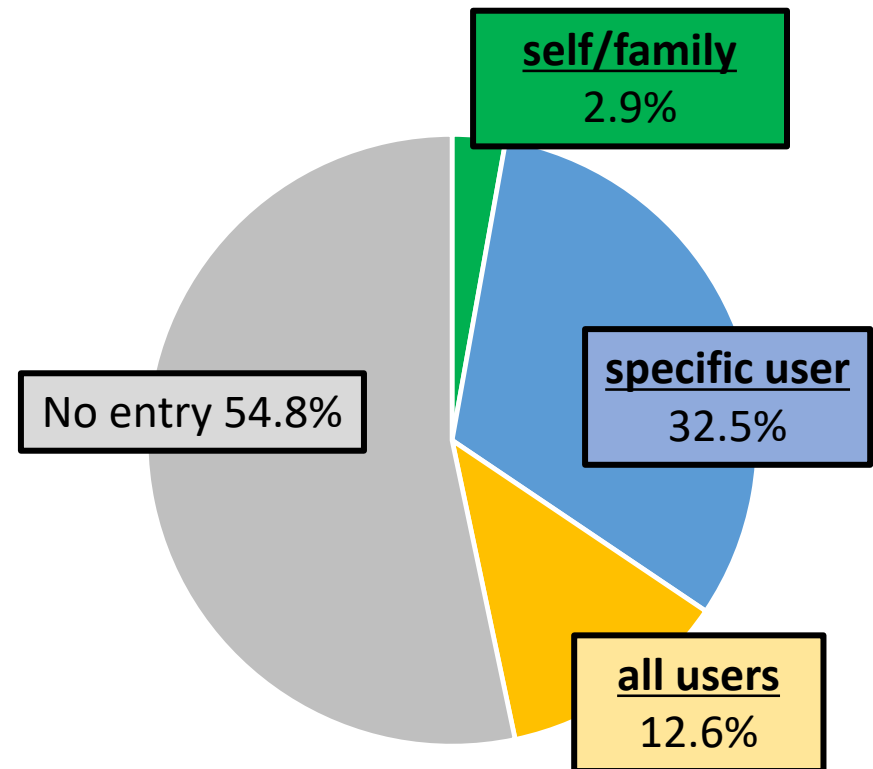
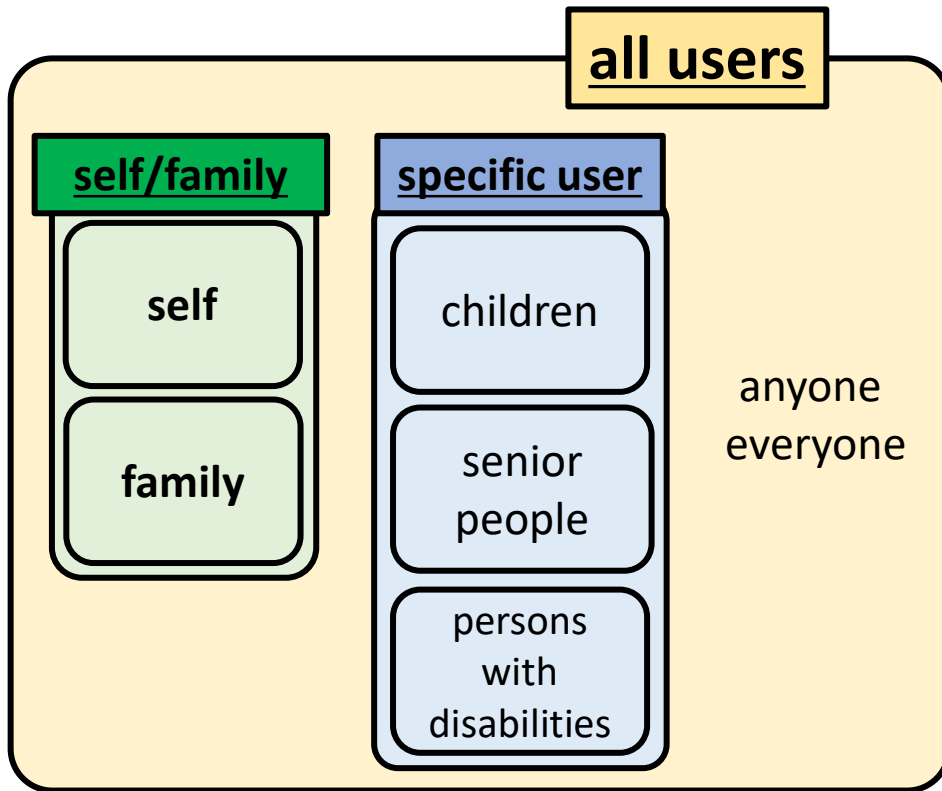
Table 4. Frequency of responses and chi-square results of user perception

	All (N=721)		free production (n=366)		choice kit (n=253)		unified kit (n=102)		Comparison between groups
	frequency	rate	frequency	rate	frequency	rate	frequency	rate	
self/family	21	2.9%	14	3.8%	7	2.8%	0	0.0%	<i>n.s.</i>
specific users	234	32.5%	127	34.7%	73	28.9%	34	33.3%	$\chi^2_{(2)}= 2.37$ <i>n.s.</i>
all users	91	12.6%	48	13.1%	34	13.4%	9	8.8%	$\chi^2_{(2)}= 1.57$ <i>n.s.</i>
Total number of statements	346	48.0%	189	51.6%	114	45.1%	43	42.2%	
Total Number of Writers	326	45.2%	179	48.9%	109	43.1%	38	37.3%	$\chi^2_{(2)}= 5.09$ <i>n.s.</i>

Fisher exact test was used for those with 0 in the observed frequencies

# 3. RESULTS AND DISCUSSION

Summary results of user perspective



# 3. RESULTS AND DISCUSSION

## Summary results of Viewpoints on the Improvement

There were 956 statements (multiple responses; all valid responses, 721/721) regarding fabrication product improvement.

category	Example of description
Safety	Rounded edges with no sharp to prevent children from hurting themselves.
Functionality	More compartments to hold different things.
Durability	Make it sturdy so that it will not break even if it falls.
Convenience	Make it light so that it can be carried and moved easily, even by those who are not strong.
Quality	Varnish the surface to improve the feel, as a rough surface is not good.
Aesthetics	Create a variety of colors to improve the appearance of the product.
Environmental	Use environmentally friendly materials.
Economy	Consider the materials to be used to reduce the cost.

# 3. RESULTS AND DISCUSSION

## Summary results of Viewpoints on the Improvement

Table 6.  
Frequency of responses and chi-square results of analysis of categories related to viewpoint regarding improvement of manufactured products (comparison between the groups of production subjects)

	All (N=721)		free production (n=366)		choice kit (n=253)		unified kit (n=102)		Comparison between groups	
	frequency	rate	frequency	rate	frequency	rate	frequency	rate		
Safety	326	45.2%	168	45.9%	105	41.5%	53	52.0%	$\chi^2_{(2)}= 3.35$	<i>n.s.</i>
Functionality	248	34.4%	148	40.4%	81	32.0%	19	18.6%	$\chi^2_{(2)}= 17.79$	**
Durability	164	22.7%	83	22.7%	56	22.1%	25	24.5%	$\chi^2_{(2)}= 0.24$	<i>n.s.</i>
Convenience	112	15.5%	52	14.2%	40	15.8%	20	19.6%	$\chi^2_{(2)}= 1.80$	<i>n.s.</i>
Quality	53	7.4%	39	10.7%	14	5.5%	0	0.0%		**
Aesthetics	49	6.8%	29	7.9%	17	6.7%	3	2.9%	$\chi^2_{(2)}= 3.13$	<i>n.s.</i>
Environmental	3	0.4%	1	0.3%	0	0.0%	2	2.0%		<i>n.s.</i>
Economy	2	0.3%	2	0.5%	0	0.0%	0	0.0%		<i>n.s.</i>
	957	132.7%	522	142.6%	313	123.7%	122	119.6%		

\*\* $p < .01$  Fisher exact test was used for those with 0 in the observed frequencies

# 3. RESULTS AND DISCUSSION

## Summary results of Viewpoints on the Improvement

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# 3. RESULTS AND DISCUSSION

## Summary results of Viewpoints on the Improvement

Table 7.  
Frequency of responses and chi-square results of analysis of categories related to viewpoint regarding improvement of manufactured products (Group with description or no)

	All (N=721)		Group with description (n=326)		Group with no description (n=395)		Comparison between groups	
	frequency	rate	frequency	rate	frequency	rate		
Safety	326	45.2%	183	56.1%	144	36.5%	$\chi^2_{(1)} = 27.91$	**
Functionality	248	34.4%	114	35.0%	134	33.9%	$\chi^2_{(1)} = 0.09$	<i>n.s.</i>
Durability	164	22.7%	52	16.0%	112	28.4%	$\chi^2_{(1)} = 15.64$	**
Convenience	112	15.5%	72	22.1%	40	10.1%	$\chi^2_{(1)} = 19.47$	**
Quality	53	7.4%	19	5.8%	34	8.6%	$\chi^2_{(1)} = 2.03$	<i>n.s.</i>
Aesthetics	49	6.8%	13	4.0%	36	9.1%	$\chi^2_{(1)} = 7.41$	**
Environmental	3	0.4%	1	0.3%	2	0.5%	$\chi^2_{(1)} = 0.17$	<i>n.s.</i>
Economy	2	0.3%	2	0.6%	0	0.0%		<i>n.s.</i>
	957	132.7%	456	139.9%	502	127.1%		

\*\* $p < .01$  Fisher exact test was used for those with 0 in the observed frequencies

# 3. RESULTS AND DISCUSSION

## Summary results of Viewpoints on the Improvement

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	957	132.7%	456	139.9%	502	127.1%	

\*\* $p < .01$  Fisher exact test was used for those with 0 in the observed frequencies

Easy to focus on **safety** and **functionality** with or without Viewpoints on the Improvement

## 4. CONCLUSIONS AND FUTURE ISSUES

In this study, the following findings were obtained from an open-ended survey of students' viewpoints on improving manufactured products and their perceptions of users after learning materials processing in the technology education.

About half of the students needed a user-oriented viewpoint of improvement after learning material processing. On the other hand, most of the students who had a user perspective focused on 'specific users,' or in other words, on usability.

Moreover, no differences were found when the production subjects compared the user perceptions. From these facts, it can be pointed out that, the importance of appropriately positioning learning about the demands of society and learning to identify problems by envisioning users and understanding their needs.



## 4. CONCLUSIONS AND FUTURE ISSUES

The viewpoints to improve the products, such as 'safety', 'functionality' and 'durability' were formed regarding the improvement of the products.

In addition, the number of statements regarding the improvement of products was higher among the students who made the products freely. This indicates that students tend to develop their viewpoints of improvement and refinement through producing and using the products they have conceived and designed.

Furthermore, the subjects differed in their viewpoints on product improvement. Specifically, it is considered essential to learn more about 'functionality' and 'quality' in the case of a unified kit and 'safety' in the case of a choice kit.

However, since this survey did not allow for comparisons of the same sample size regarding grades and production contents, more detailed surveys are needed.

Thank you for listening to my presentation.

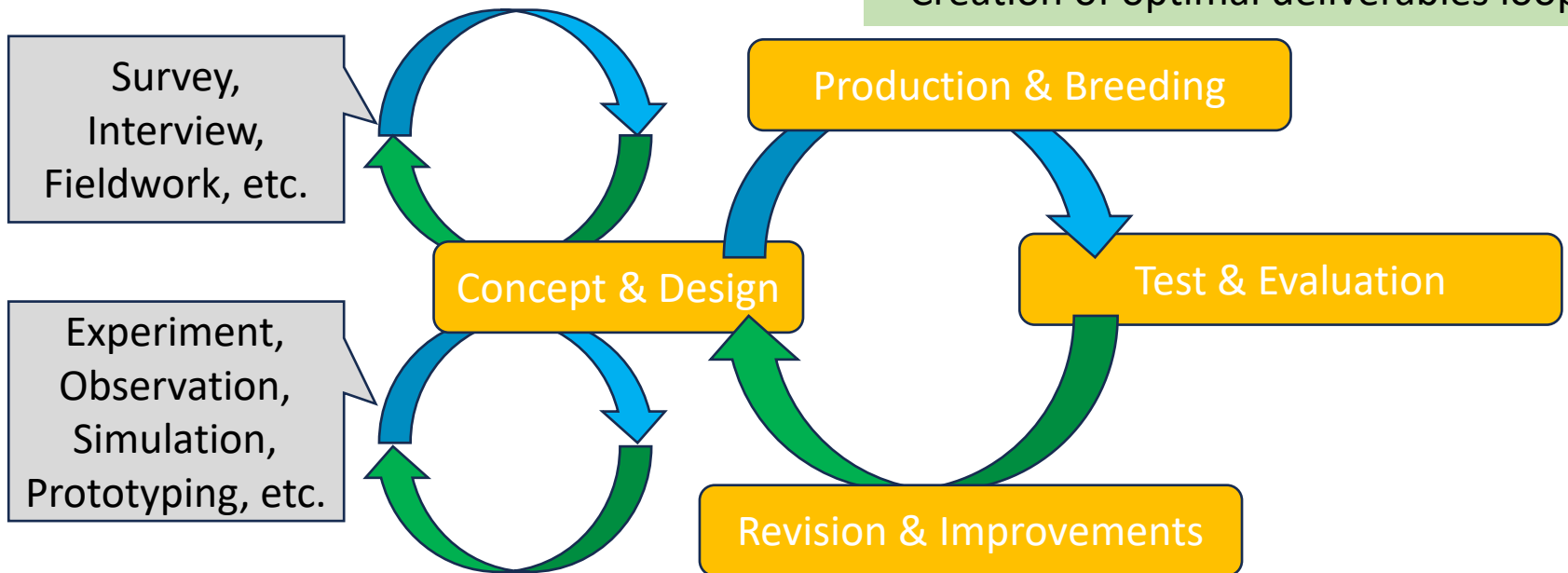


# 1. INTRODUCTION

## Research Background

Social science needs exploration loop

Creation of optimal deliverables loop



Experimental science seeds exploration loop

Fig.1 The triple-loop model of the technical problem-finding and solving process, The Japan Society of Technology Education(2022)

# 3. RESULTS AND DISCUSSION

## Selected Questions : Comparison of Production Subject Groups

		Mean	S.D.	ANOVA	Bonferroni	
like making things	all	3.34	0.64	$F_{(2,718)} = 6.82$ **		
	unified kit	3.56	0.54		unified kit > choice kit	**
	choice kit	3.30	0.61		unified kit > free production	**
	free production	3.31	0.68		choice kit > free production	<i>n.s.</i>
like technology classes	all	3.33	0.64	$F_{(2,718)} = 9.49$ **		
	unified kit	3.54	0.54		unified kit > choice kit	**
	choice kit	3.37	0.57		unified kit > free production	<i>n.s.</i>
	free production	3.24	0.70		choice kit > free production	*
like concept and design	all	2.97	0.77	$F_{(2,718)} = 11.69$ **		
	unified kit	3.24	0.63		unified kit > choice kit	**
	choice kit	3.04	0.74		unified kit > free production	<i>n.s.</i>
	free production	2.85	0.80		choice kit > free production	*
satisfied with my production	all	3.10	0.69	$F_{(2,718)} = 12.4$ **		
	unified kit	3.27	0.63		unified kit > choice kit	<i>n.s.</i>
	choice kit	3.21	0.63		unified kit > free production	**
	free production	2.98	0.73		choice kit > free production	**
career in the future	all	2.39	0.77	$F_{(2,718)} = 2.02$ <i>n.s.</i>		
	unified kit	2.53	0.80			
	choice kit	2.39	0.74			
	free production	2.36	0.79			

\*\* $p < .01$ , \* $p < .05$

# 3. RESULTS AND DISCUSSION

## Selected Questions : Comparison of Production Subject Groups

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like making things	all	3.34	0.64	$F_{(2,718)} = 6.82$ **	unified kit > choice kit ** unified kit > free production ** choice kit free production <i>n.s.</i>
	unified kit	3.56	0.54		
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	free production	3.31	0.68		
like technology classes	all	3.33	0.64	$F_{(2,718)} = 9.49$ **	unified kit > choice kit ** unified kit free production <i>n.s.</i> choice kit > free production *
	unified kit	3.54	0.54		
	choice kit	3.37	0.57		
	free production	3.24	0.70		
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	unified kit	3.24	0.63		
	choice kit	3.04	0.74		
	free production	2.85	0.80		
satisfied with my production	all	3.10	0.69	$F_{(2,718)} = 12.4$ **	unified kit choice kit <i>n.s.</i> unified kit > free production ** choice kit > free production **
	unified kit	3.27	0.63		
	choice kit	3.21	0.63		
	free production	2.98	0.73		
career in the future	all	2.39	0.77	$F_{(2,718)} = 2.02$ <i>n.s.</i>	
	unified kit	2.53	0.80		
	choice kit	2.39	0.74		
	free production	2.36	0.79		

\*\* $p < .01$ , \* $p < .05$

