

## Education of Drawing Courses and Students' Achievements (How to Develop and Make the Best Use of Freehand Sketch Skills)

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### Abstract

The Kanazawa Institute of Technology developed two drawing courses, i.e. "Introductory Engineering Drawing" and "Drawing for Video Content." Their educational objectives are to acquire freehand sketch skills and to make the best use of the skills in various fields. Students, by taking the introductory engineering drawing course, learn freehand sketch skills in order to draw configurations of industrial products/systems and the way they function, carry out graphic communication by sketching their ideas and studying those done by others, and develop new ideas. By taking the drawing for video content course, students learn freehand sketch skills in order to draw artistic works for the video content industry. The authors evaluated the performance and progress in achieving educational objectives. This paper describes the details of instructional materials and class management plans of the two courses. The experience in the courses showed that the instructional materials and class management plans had positive effects on students' achievement of educational goals.

**Keywords:** freehand sketch, graphic communication, students' achievement, education of drawing, illustrated scripts

### 1 Introduction

Engineering drawing is a common communication means employed by engineers worldwide to design, produce, and operate various industrial products and/or systems. Graphic expression through freehand sketches, one of the engineering drawing techniques, is a medium for expressing ideas and saving thoughts. Sketching as a form of drawing has been shown to have properties that make its use important in design [1]. Technical sketches are used for a wide variety of purposes, among which the following are the most important [2].

- To transmit information, obtained in the field or shop, to the engineering office. This occurs when repairs have to be made or when changes in an existing structure are being considered.
- To convey the ideas of the designer to the drafter.
- To make studies of the layout of the views required in an instrumental drawing.
- As a means of making preliminary studies of a design to show how it functions.
- To provide a basis for communicating between

engineers, technicians, and crafts-persons.

- To furnish a three-dimensional picture of an object that will help to interpret the orthographic views.
- To be used as shop drawings for manufacturing.
- To serve as a teaching aid when discussing problems in the classroom.

Kanazawa Institute of Technology (henceforth KIT) started to offer a course "Introductory Engineering Drawing" in 2003, which is mandatory for all freshmen regardless of their majors [3]. The purpose of the course is to help students develop their ideas through a spiral process of engineering design by using freehand sketches as shown in Fig. 1. First, they develop new ideas. This stage is called an idea generation stage. Second, they draw the ideas by freehand sketches. Then, they carry out graphic communication by showing their ideas and studying those done by others. This stage is called a communication/discussion stage. By climbing up the spiral process shown in Fig. 1, they can improve their ideas.

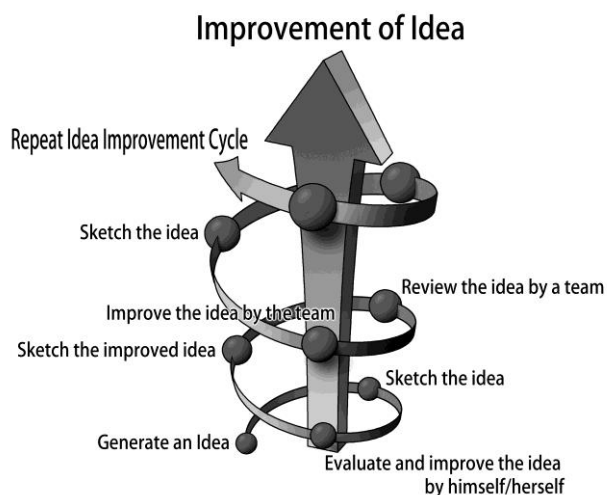


Fig. 1 Spiral process of developing ideas

Recently the information and communication technology (henceforth, ICT) market, and the video content market particular, is expanding rapidly [4]. Educational programs to acquire skills in making sketches and illustrated scripts necessary for the video content industry are needed for the economic success of

ICT engineers and of society as a whole. Illustrated scripts are quite effective to develop and transmit ideas [5].

KIT decided to develop a new drawing course “Drawing for Video Content” in 2011 so that students of Media Informatics will be able to acquire freehand sketch skills and create artistic works for the video content industry, e.g. the animation industry. The course was developed based upon experiences in teaching the Introductory Engineering Drawing. The new course is composed of three steps: the first step is to learn a simplified method to sketch shapes, poses, and facial expressions of people; the second step is to acquire perspective drawing skills and to sketch three dimensional objects; the third step is to draw series of panels of rough sketches outlining a scene sequence of a story which was created by each student. The course is a two-credit, two-hour contact, freshman level class. Students acquire sketch skills necessary for the video content industry.

This paper describes the details of instructional materials and class management plans of the two educational programs, which make the best use of freehand sketch skills.

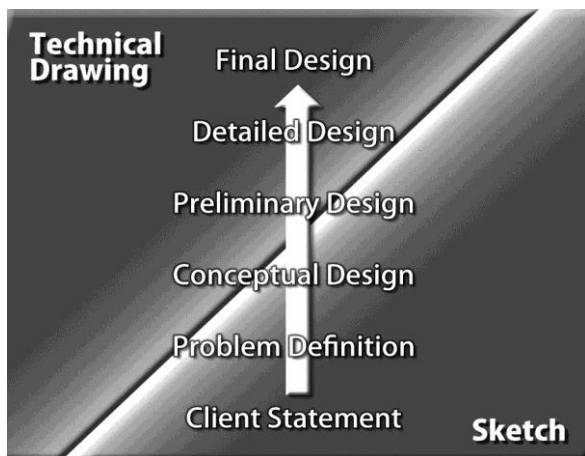
## 2 Introductory Engineering Drawing Course

### 2.1 Course content

The introductory engineering drawing course was developed after noticing that engineers usually draw sketches of their ideas/thoughts and show them to their team members in order to promote their design/production activities. One of the authors wrote two textbooks for freehand drawing skills to be used in the course; one in Japanese and the other in English [6], [7]. **Figure 2** is a schematic diagram that shows how a ratio of sketches and technical drawings changes at various design stages. Generally speaking, sketches are more frequently used at early design stages than technical drawings.

The course is composed of a five-stage program to acquire the following skills:

- Stage 1: Sketch skills to draw basic geometric shapes using ridgelines or outlines



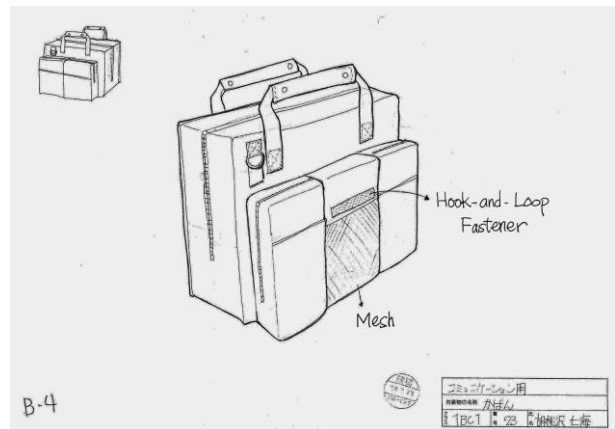
**Fig. 2 Schematic diagram of sketch & technical drawing used at each design stage**

- Stage 2: Sketch skills using shadows and shades
- Stage 3: Sketch skills required to draw intersecting and penetrating parts
- Stage 4: Sketch skills to draw both the configuration of an industrial object and the way it is held, carried and/or operated
- Stage 5: Graphic communication skills in a team

In order to maximize students’ learning, in-class learning activities and homework assignments are issued each week. The activities and assignments during Stage 1 through Stage 3 are to sketch three dimensional objects. At Stage 4, each student selects an industrial object and sketches its configuration and the way it is held, carried and/or operated. Learning activities during Stage 1 through Stage 4 are individual ones. At Stage 5, students are assigned to teams. Each team consists of approximately five students. First, each student shows team members his/her sketches drawn at Stage 4 and studies those done by other team members. Second, they give their team members advice to improve its usability and its geometrical shape. Then they make final sketches based on the advice given by team members.

### 2.2 Example of sketches drawn by students

As an example of graphic communication, this paper shows sketches of a bag drawn by a female student. She selected a bag for her assignment at Stage 4 and sketched its configuration as shown in **Fig. 3**.



**Fig. 3 Student’s sketch before receiving advice**

At Stage 5 she showed the sketch to her team members and received advice from them. The advice is shown in **Fig. 4**. **Figure 4** is written in the Japanese language. Translation of Japanese text in **Fig. 4** is as follows:

Drawbacks identified by the female student are: (1) the bag is not suitable to store wet items, (2) it is not easy to dry the bag, and (3) it is not easy to take stored items out of the bag.

Primary advices given to her from her team members are as follows:

- The bag should be waterproofed.
- A pocket for a wet folding umbrella should be attached to the front face of the bag.
- An outer small bag would be useful to store variety

of articles, i.e. a cellular phone and a ballpoint pen set.

She improved the design of the bag and sketched it using the advice from her team members. As shown in Fig. 5, she modified the configuration of the bag, assembled with a waterproof cloth, and attached an outer small bag.

コンセプトシート (以下の2項目に対し、他の人にその内容が伝わるような文章で作者が、書いて下さい。)

問題点と改善内容  
 濡れ物が入りたくない、合羽の使用で濡れる...  
 取り出しにくい、乾きにくい

これより下は14週の授業で助言者が使用します。作者者は記入せず空欄のままシートに貼って下さい。

### 14週

上の文章で説明された「付け加えた発想」が、このドローイングで伝わったかを各自は以下の基準で評価し、記号に○を付けて下さい。

伝達度：A...よくわかった  
 B...わかった  
 C...わかりにくい  
 D...わからなかった

1人目	A	ⓑ	C	D
2人目	A	B	ⓒ	D
3人目	A	ⓑ	C	D
4人目	A	B	C	ⓓ

アドバイス

1人目	入れる物を分けれるポケットを増やしたらいいと思う。
2人目	濡れた物を入れるためには、製品の材質も素材は何にするのかも考えた方がいいと思います。
3人目	濡れ物と工夫をする、いいと思う。
4人目	ポケットのみに、こあげでき、ポケットもつくるといいと思う。

「改善内容」に対して「自分ならこう考える」「こうしたほうが良い」などというようなアドバイスを簡潔に書いて下さい。  
 「いいアイデアだ」「うまい」「へた」などの評価となるコトバは書かない。  
 また、好みによるアドバイスもしない。

Fig. 4 Advice sheet including advices from team members

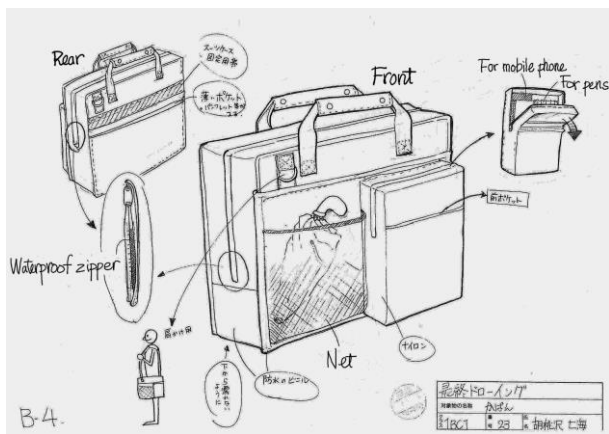


Fig. 5 Student's sketch completed after graphic communication

### 3 Drawing for Video Content Course

The drawing for video content course is designed so that students of Media Informatics Department of KIT will be able to acquire freehand sketch skills and create illustrated scripts for the video content industry, e.g. the animation industry. The course is composed of three steps.

#### 3.1 Step 1

It is necessary to draw people vividly in video contents. This course emphasizes the importance of sketching shapes, poses, and facial expression of people vividly by a simplified method.

The authors developed a simplified method to sketch shapes, poses, and facial expression of people vividly. Teaching materials are shown in Fig. 6. Students are advised to sketch shapes, poses, and facial expressions of people by referring to rules and examples shown in Fig. 6. Figure 7 shows one of the examples of sketches drawn by a student.

#### ■ The head, with a value of 1, sets all of the subsequent ratios

	Adult	Teenager	Child	Baby
Head (H)	1	1	1	1
Body (B)	2.5	2	1.5	1.5
Legs (L)	2.5	2	1.5	1
Feet (F)	1	1	1	0.5

#### ■ By adding a nose, a mouth, and eyes you can indicate direction.

#### Changing the style of the eyes and mouth conveys emotions.

Even if the figures and poses are identical, facial expressions completely change the image. A happy action or a surprised action alone cannot determine the overall appearance of the figure.

Fig. 6 Instructional material for Step 1

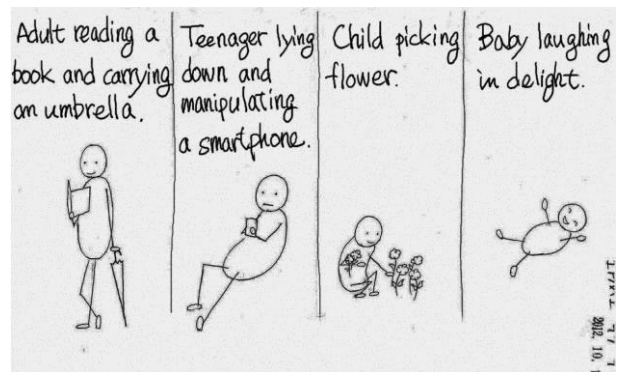
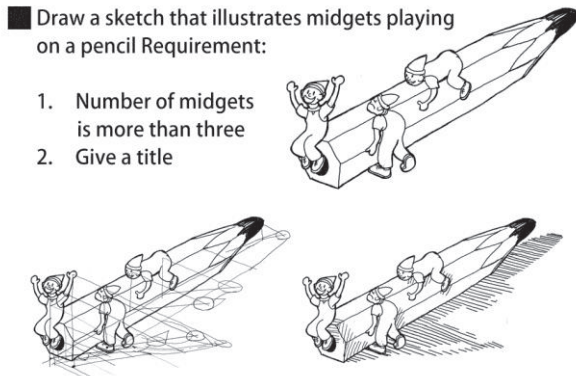


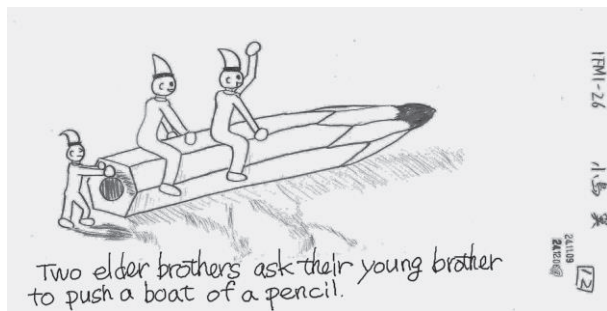
Fig. 7 Student's sketch drawn at Step 1

### 3.2 Step 2

Students, who completed Step 1, learn the basics of the shadow method and the perspective drawing technique at Step 2. Then, they sketch scenes with three dimensional objects and people. Teaching materials of Step 2 is shown in **Fig. 8**. **Figure 9** shows three boys enjoying pushing and riding on a boat as an example of sketches drawn at Step 2.



**Fig. 8** Instructional material for Step 2



**Fig. 9** Student's sketch drawn at Step 2

### 3.3 Step 3

Step 3 is designed to acquire knowledge and skill to draw series of panels of rough sketches outlining sequence of a story. Teaching materials of Step 3 is shown in **Fig. 10**.

Each student creates a story that narrates a chain of events. Assignment at Step 3 is to sketch illustrated scripts including vivid expression of shapes, poses, and facial expressions of people. First, each student drew one scene which illustrates a main scene of his/her story. Instructors advised students to include narrations, sound effects, and music effects in their illustrated scripts. He/she completed the assignment by drawing seven illustrated scripts on the advice from the instructors. **Figure 11** shows one of the examples of illustrated scripts drawn by a student. **Figure 11** is written in the Japanese language. Translation of Japanese text in **Fig. 11** is as follows:

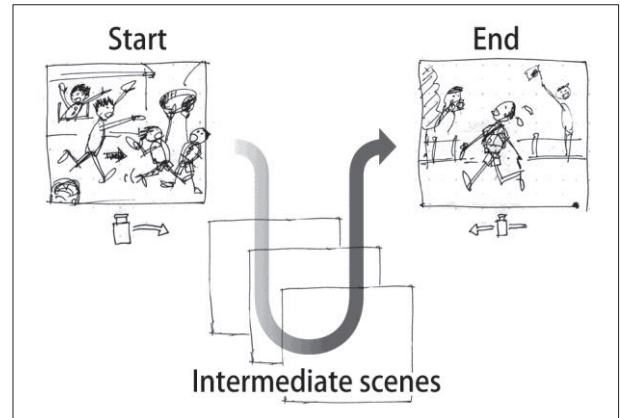
- Title: A snowman melted and disappeared  
 Cut 1: On one winter morning, brothers found it was the snowy world outside.  
 Cut 2: It snowed all day long.  
 Cut 3: The brothers decided to make a snowman.  
 Cut 4: The snowman said "I thank you very much for

making me".

Cut 5: The snowman gave popsicles to them.

Cut 6: The snowman and the brothers played happily together.

Cut 7: The next morning the snowman melted down and disappeared leaving a small puddle.



**Fig. 10** Instructional material for Step 3



**Fig. 11** Student's sketch drawn at Step 3

## 4 Achievements of Educational Goals

One of the requirements for freehand sketches is that they are unambiguous and easy to understand, while artistic drawings are subjectively interpreted; their meanings are multiply determined.

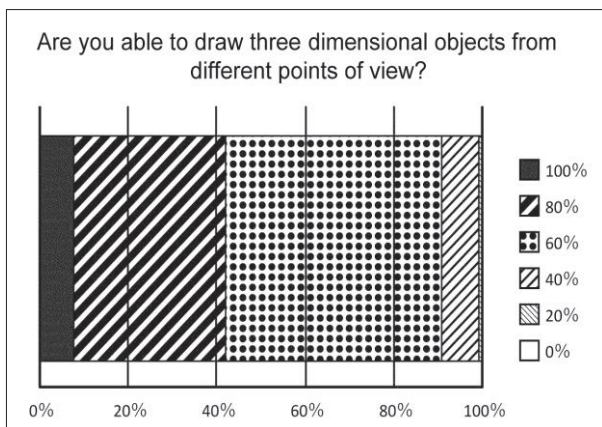
The sketches of the introductory engineering drawing course completed by graphic communication were evaluated from the viewpoint if they were easy to understand or not. The results are shown in **Table 1**. It was found that 93% of sketches were definite and understandable. This indicates that the introductory engineering drawing course is effective to develop freehand sketch skills in order to draw configurations of industrial products/systems and how they function, to carry out graphic communication by sketching their ideas and studying those done by others, and to develop new ideas.

Students of Media Informatics Department evaluated their performance and progress in the learning objectives of the drawing for video content course by answering a post-course questionnaire. Some of the

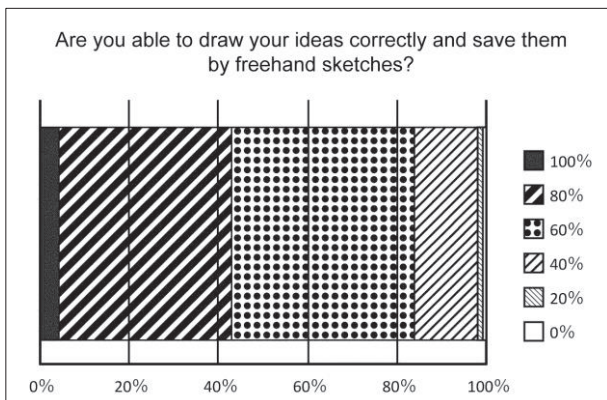
examples of their feedbacks are shown in **Fig. 12** through **Fig. 15**. **Figure 12** shows if they are able to draw three dimensional objects from different angles. **Figure 13** shows if they are able to draw their ideas correctly and save them by freehand sketches. **Figure 14** shows if they are able to understand that a content creator transfers his/her ideas by drawing a scene sequence of a story. **Figure 15** shows if students are satisfied with the course and their level of achievement. It was found that the drawing for video content course is effective to develop freehand sketch skills in order to draw illustrated scripts.

**Table 1 Evaluation of sketches completed by graphic communication at Stage 5**

Level of drawings	Percentage
Comprehended immediately	61 %
Comprehended by careful observation	32 %
Comprehended by reading details of the advice-sheets	4 %
Incomprehensible/ambiguous	3 %



**Fig. 12 Are you able to draw three dimensional objects from different angles?**



**Fig. 13 Are you able to draw your ideas correctly and save them by freehand sketches?**

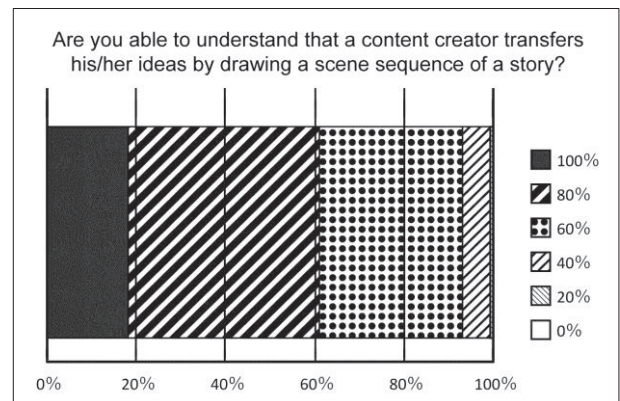
#### 4 Concluding Remarks

The Kanazawa Institute of Technology developed

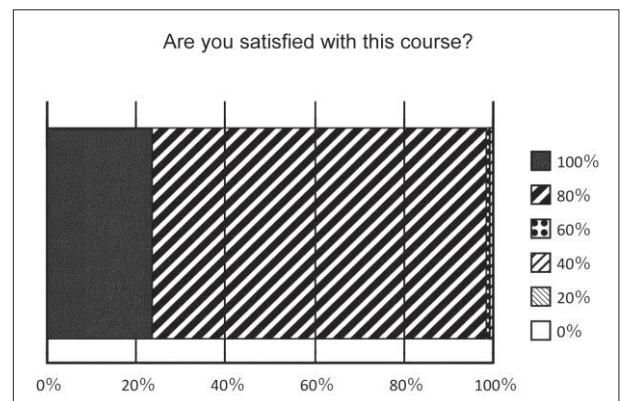
two drawing courses, i.e. “Introductory Engineering Drawing” and “Drawing for Video Content”. Their educational objectives are to acquire freehand sketch skills and to make the best use of the skills in various fields. Important information obtained is as follows:

1. One of the requirements for freehand sketches is that they are unambiguous and easy to understand. It was found that sketches completed by 93% students who took the introductory engineering drawing course were definite and understandable.
2. Most of the students who took the drawing for video content course were able to draw three dimensional objects from different angles.
3. Most of the students were able to draw their ideas correctly and save them by freehand sketches.
4. Most of the students were able to understand that a content creator transfers his/her ideas by drawing a scene sequence of a story.
5. Most of the students were satisfied with the course.

It was found that freehand sketch skills are effective for both engineers and content creators to express ideas, improve them by graphic communication, and save thoughts.



**Fig. 14 Are you able to understand that a content creator transfers his/her ideas by drawing a scene sequence of a story?**



**Fig. 15 Are you satisfied with this course?**

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### **References**

- [1] D. G. Ullman, S. Wood, D. Craig, The Importance of Drawing in the Mechanical Design Process, Computer & Graphics, Vol. 14, No. 2, Pergamon Press Inc., (1990), pp.263-274.
- [2] Dobrovolny, J. S. and O'Bryant, D. C., Graphics For Engineers, Visualization, Communication, and Design, John Wiley & Sons, Inc., (1984), pp. 86-87.
- [3] Nakamura, S. and Matsuishi, M., "Introductory Engineering Drawing Course Aimed at Improving Drawing skills and Graphic Communication", Proceedings of 2006 SEFI Annual Conference, (2006), pp. 1-11.
- [4] The Japanese Ministry of International Affairs and Communications, WHITE PAPER, Information and Communications in Japan 2012, (2012).
- [5] Ohno, H., Learn "Idea generation using illustrated scripts" from Leonard da Vinci, a universal genius-Develop, transmit, and effectively use ideas-, ISBN 978-4-320-07177-3, Nikkan Kogyo Shimbun, Ltd., (2011), (In Japanese).
- [6] Nakamura, S., Idea Drawing as a tool for communication, ISBN 978-4-526-06599-6, Kyoritsu Shuppan Co., Ltd., (2009) . In Japanese
- [7] Nakamura, S., Idea Drawing: How to Draw, ISBN 978-4-924861-35-0, Tanaka & Shobundo Graphic Art Co., Ltd, (2011).

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