

THE DEVELOPMENT AND EVALUATION OF A RELATIONSHIP DIAGRAM TOOL TO AID DESIGN THINKING IN NURSING EDUCATION

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Abstract: The drawing of a relationship diagram like a concept map is one of the design thinking in nursing education. In the context of nursing education, learning effects from having students draw relationship diagram are useful in understanding patients and in the nursing process as a whole. It has also been pointed out, however, that drawing these diagrams is time-consuming, and that the diagram creation process itself places a burden on the students. In this research, we developed a relationship diagram tool with the following 3 features: “Automatic drawing tool”, “Creation process replay function”, and “Evaluation support”. We conducted lectures using the tool at a nursing college and we conducted a questionnaire survey to evaluate the usability and effectiveness of the tool. Based on the results of these evaluations, we confirmed that the opinions obtained were for the most part positive.

Keywords: *design thinking, nursing education, relationship diagram*

1. Introduction

Recently, the importance of design thinking in problem solving has become well accepted. For example, IDEO, an international design and innovation consultancy, defined design thinking as a process to understand, observe, perceive, evaluate, improve and realize (Kelley et al., 2001). The concept has been well regarded and used in product development towards various problem situations in business. These methodologies have been incorporated into university education programs as well, and their effectiveness has been well reported (Dunne & Martin, 2006).

Since many aspects of nursing discussed in this research article, such as understanding patients, recognizing problems, nursing practice and evaluation, overlap with the above methodologies, supporting and training nursing students in design thinking is critical. Therefore, in this study we focused on commonly used relationship diagrams that aim to understand patients in order to support design thinking in nursing education.

In nursing, relationship diagrams are similar to concept maps (Novak, 1990) and mind maps (Buzan & Buzan, 1993) which utilize nodes and linkers to graph the relationship between elements, such as the cause of a patient’s disease, organic and functional changes, symptoms and reduced activity. Students determine the level of care patients require as they understand patients’ conditions using relationship diagrams (Akinsanya & Williams, 2004; Hsu & Hsieh, 2005). The relationship diagrams have the general advantages of 1) promoting patient understanding, 2) making the nursing process

more efficient, and 3) enhancing the critical thinking ability of the medical care professional (Sugisaki & Ogawa, 2006). Nevertheless, most conventional relationship diagrams are hand-drawn and require much time to produce; thus, they are labour intensive for beginners.

Previous research has focused on strategies (All, & Havens, 1997; Schuster, 2002) and evaluation standards (Castellino, & Schuster, 2002; Toyoshima, Itou, Hagi, Nishibori, Kazaoka, Kishita, & Itou, 2005) related to drawing the relationship diagrams in nursing practice. However, because Japanese teachers use different methods to teach students how to draw the diagrams, these earlier R&D results are difficult to incorporate into a Japanese educational environment.”

Previously, we developed a tool to efficiently create relationship diagrams on a computer, which were then implemented in classes (Ishii & Sakuma, 2011). However, even though comments by users who evaluated the tool were generally positive, the time taken to create the diagrams was not sufficiently reduced compared with manual generation of relationship diagrams. Therefore, this study aimed to examine and evaluate the effectiveness and extent of time savings achieved of the newly developed relationship diagram-creation tool for nursing students.

2. Relationship diagram-creation tool

For this study, we developed a relationship diagram tool with the following 3 features: “Automatic drawing tool”, “Creation process replay function”, and “Evaluation support”. The program was made using a Java application and employed the use of three libraries: Processing for specialized graphics, Apache POI for reading and writing Microsoft products such as Excel and Word from Java applications, and JFreeChart for creating graphs from Java applications.

2.1. Automatic drawing tool

A relationship diagram tool known as the automatic drawing tool automatically plots graphs based on the information entered. Figure 1 shows an example of the diagram. The diagram is composed of nodes and linkers. Nodes are positioned from left to right in hierarchical order. Generally, relationship diagrams are created radially, however, after interviewing nursing staff, hierarchical positioning was determined to be easier to visualize and was therefore implemented.

Users enter patient information in the bottom part of the tool and a number of different types of information are selected from the menu. The 6 types of information available are (1) Physical attributes (height, weight, diseases and other features), (2) Social background (family structure, family environment and other histories), (3) Psychological state (mental health and presence of anxieties), (4) Expectations (what is expected in the future), (5) Nursing obstacles (critical problems in caring for patients), and (6) Nursing intervention (nursing activities provided for patients). The linkers between these elements are created automatically as additional information is entered. Normal linkers are indicated with solid arrows and predicted linkers are shown as dotted arrows. The user can add any number of linkers between nodes, which are shown by red arrows.

2.2. Creation process replay function

The relationship diagram tool automatically records the steps in creating the relationship diagram and can replay each step one by one. This is called the “creation process replay function”, and it allows the students or the teachers to review the thinking process behind the diagram.

The student or the teacher is able to browse the process in creating the relationship diagrams step-by-step using the “process replay window”. The tool not only records the addition of nodes and linkers, but also deletion and alteration of information.

2.3. Evaluation support function

The relationship diagram tool is able to display an evaluation sheet after the creation of the relationship diagram (summarized table and graph showing the number of nodes and linkers and ratio of types of nodes and other features) (Figure 2). This is called the “evaluation support function”. The evaluation sheet is compatible with Microsoft Excel and can be browsed in Excel.

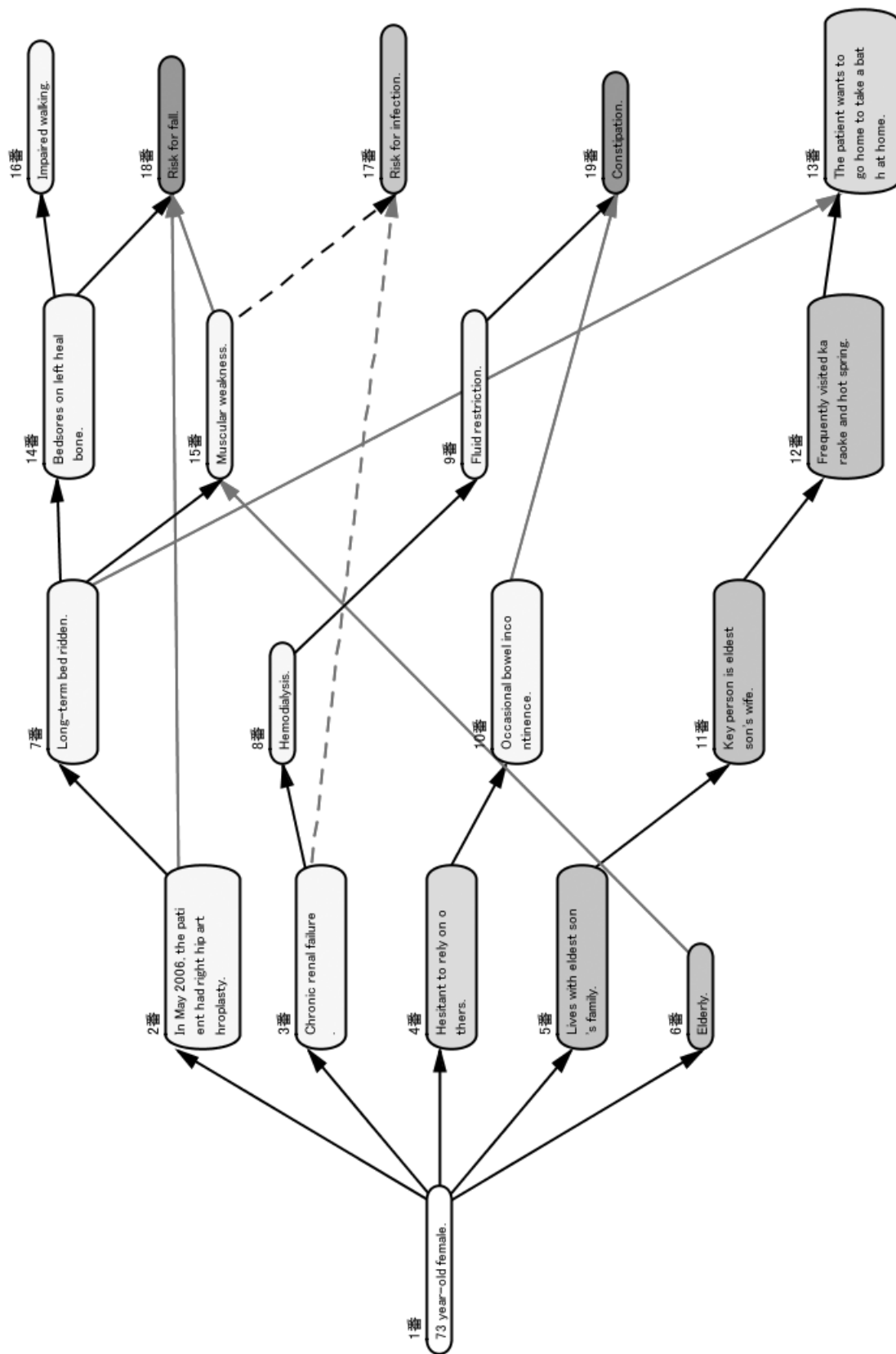


Figure 1. Example of the diagram

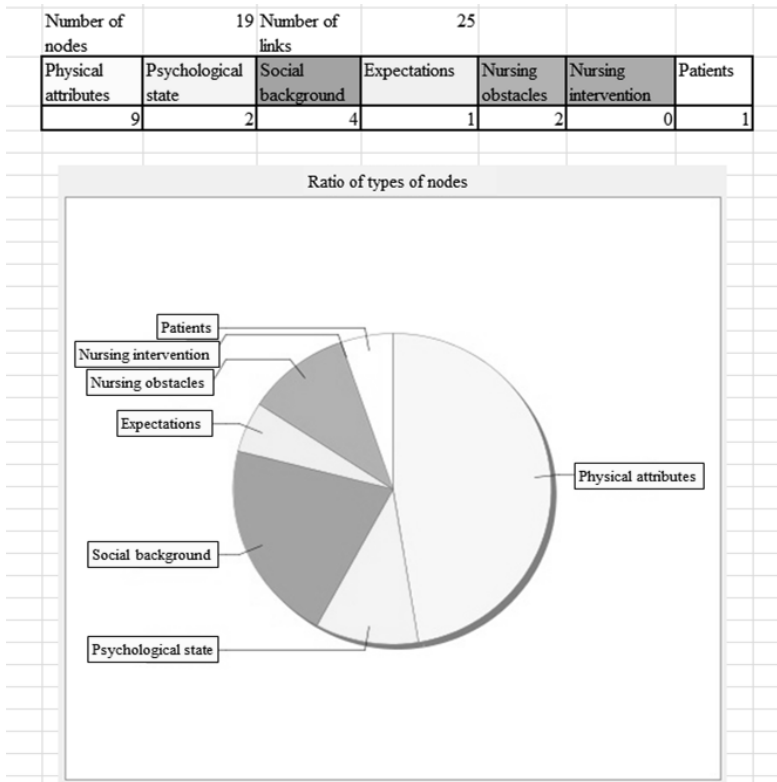


Figure 2. Evaluation sheet

3. Evaluation experiment

The evaluation experiment aimed to assess the effectiveness, usability and operation of the relationship diagram tool. The subjects of the study comprised eight 4th year engineering students. The subjects were given a brief introduction on how to use the tool and were then given sheets containing patient information in list form. The subjects created a relationship diagram using the tool according to the patient information given and afterwards, a survey was conducted to assess the tool. The survey questions consisted of usability of the tools (10 questions, on a scale of 1 to 5) and effectiveness (10 questions, on a scale of 1 to 4) (Table 1).

The survey results are shown in figure 3. A higher score indicates a more desirable result. The average score for usability of the tool exceeded 3.0 for all questions, while the average score for effectiveness was above 3.0 for all statements except question 1 and 7.

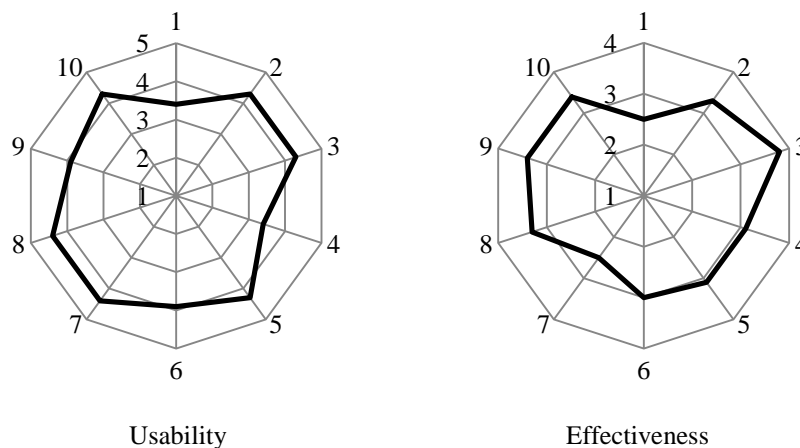


Figure 3. The survey results in evaluation experiment

Table 1. The survey questions

No.	Usability	Effectiveness
1	I think that I would like to use this tool frequently.	It doesn't take time.
2	I found the tool unnecessarily complex.	It is possible to draw diagrams easily.
3	I thought the tool was easy to use.	It is possible to draw diagrams neatly.
4	I think that I would need the support of a technical person to be able to use this tool.	It is possible to draw diagrams in detail.
5	I found the various functions in this tool were well integrated.	It is easy to erase nodes or links.
6	I thought there was too much inconsistency in this tool.	It is easy to revise diagrams.
7	I would imagine that most people would learn to use this tool very quickly.	It is easy to rearrange nodes or links.
8	I found the tool very cumbersome to use.	It is useful to classify information by kinds of color or line.
9	I felt very confident using the tool.	It is easy to organize information.
10	I needed to learn a lot of things before I could get going with this tool.	It is easy to think of associations.

4. Implementation through classes

4.1. Structure of the class

After the evaluation experiment in 3., the usability of the relationship diagram tool were confirmed by its implementation in nursing school class and evaluation in actual practice. Test subjects consisted of eighty 1st year nursing college students who consented to the study. The study was conducted in one 90 minute session as part of the practical component of the subject of basic nursing. A lecture was initially given to students to introduce basic knowledge on relationship diagrams. Then, instructions on using the tool were provided and employed by the students to create a relationship diagram. Following this, the students performed a self-evaluation of the tool using the evaluation sheet, and information was added or altered. The evaluation consisted of the same survey from the evaluation experiment in 3.

4.2. Results

The survey results are shown in figure 4. The average score for the usability of the tool was below 3.0 for all items except question 4, 9, and 10. Scores from other questions averaged higher than 3.0, similar to those of the evaluation experiment.

While the average scores for effectiveness of the tool were all above 3.0, both question 1 and 7, which scored low in the evaluation experiment, scored relatively higher in this survey.

4.3. Comparison to the previous study

The tool used the previous year was compared with the newly developed tool used in the current study described in 4.2 to assess what improvements had been made. The tool used in previous year was developed using Excel VBA. The previous tool differs from the newly developed tool primarily in 3 ways: (1) The nodes are automatically created upon data entry; however, the placements are user-designated, (2) The linkers are also user-defined, and (3) There is no creation process replay function or evaluation support function. Also, previously the class was conducted in two 90 minute periods, while the current study was performed in one 90 minute class (Ishii & Sakuma, 2011).

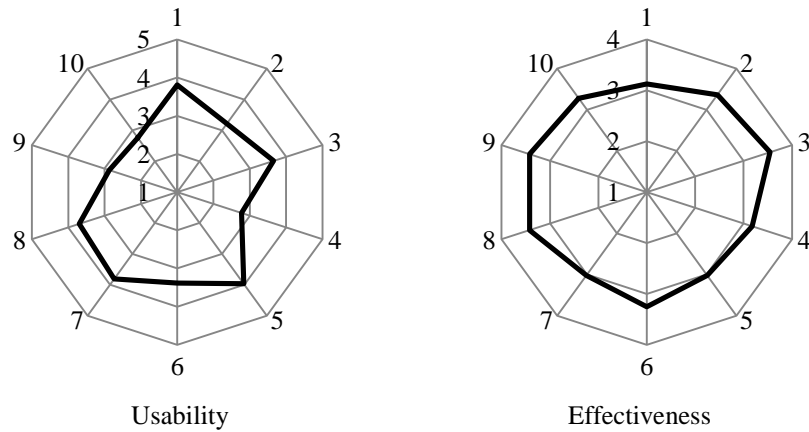


Figure 4. The survey results in the class

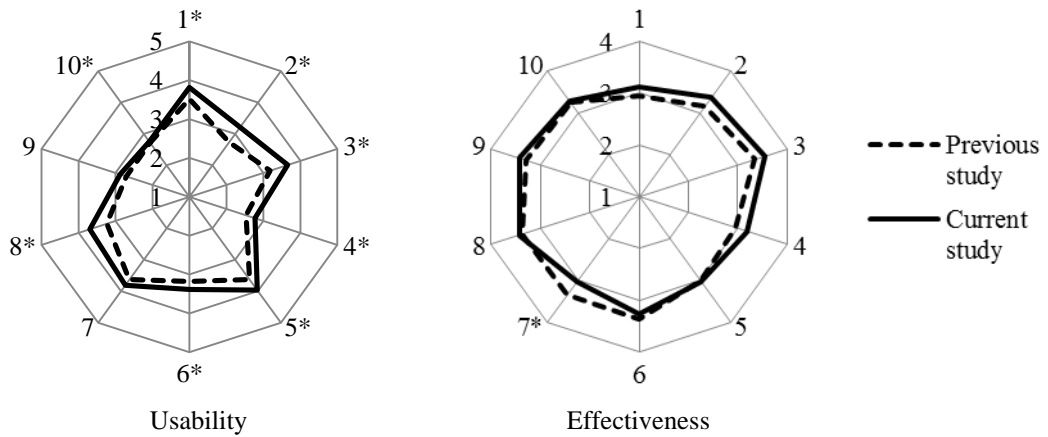


Figure 5. The survey results in the current study and the previous study (*: $p < .05$)

The evaluation results for usability and effectiveness of both tools are shown in figure 5. The average usability scores of the current tool were significantly higher than the previous year’s tool with the exception of question 7 and 9. The average score for question 7 for effectiveness of the current tool was lower with the current tool than the previous year’s tool.

5. Discussion and conclusion

This study presented results of a newly developed tool that aids in the creation of a relationship diagram in less time, which was tested in class. At the beginning, the study was conducted in two 90 minute session. However, students completed their diagrams in half time. This result showed that use of the new tool halved the class time, thereby meeting the main aim of the study. This chapter also discusses evaluation of the newly developed tool in terms of aiding design thinking and future improvements.

First, in creating relationship diagrams, the automatic drawing tool saves users from having to place the nodes. In general relationship diagram creation, the content of the nodes and their locations need to be considered; however, this relationship diagram tool places nodes automatically, thus allowing the users to concentrate more on the content of the nodes. Furthermore, due to the tool’s evaluation support function in the relationship diagram evaluation screen, it is possible to grasp the relationship diagram’s features. With the previous tool, users needed to count the number of nodes and linkers themselves. However, with the current tool, statistical information is represented in graphs and tables, making it easy to identify problems in the diagram.

In addition, the creation process replay function enables not only the learners but also the teachers to review the process of diagram creation step-by-step. The previous evaluation process was based on the final diagram; however, with this new function, educators are able to understand the students' trial and error process as well as characteristics of the students' mistakes, and give appropriate feedback.

Improving usability is an important issue, and results of this study showed improvement in usability of the newly developed tool compared to the previous tool. However, based on results with engineering student test subjects, even further improvement in usability is necessary. This will be the next challenge.

Finally, regarding improving effectiveness, adding further functions to support design thinking in nursing such as aiding the thinking process prior to drawing diagrams, sharing of data with others, and extracting information from the relationship diagram, are in progress. We hope to expand the use of this tool beyond nursing education to many areas where similar diagrams will be useful, such as software development and architectural design.

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