Exploring Visualization Process of Expert Teachers: a Case of the Simple Visual Task

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This paper focuses on finding out visualization process by means of VTA(Visual Task Analysis) of expert teachers' simple task. Findings indicate teachers have coding schema of performing visual task as such; (a) the analyzing by reading and some activities in the task text, (b) conceptualizing or understanding in his/her own way, (c) the explaining of the action or product, (d) the searching by thinking or finding, (e) the decision of visualizing of the task. Expert teachers tried to visualize in the form of abstract graph, and to omit the object which was not directly related to the topic at the pilot study. VAT based on ground theory and protocol analysis was developed and performed. This case study suggests that an additional study for searching a guide and method might be beneficial for conducting a visual task analysis.

Keywords : Visualization Process, Visual Intelligence, Expert Teachers

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Introduction

In the time of modern, advanced society, it is a critical issue how effectively and efficiently to regenerate knowledge as the increasing information to line up with the increase of information. Since the history of pre-literate humans started, human beings have developed brain after standing erect which may give people use hands freely, look and think around the world. Even in pre-literate human history, mankind might try communicate each other like other animals with non-verbal sense, but they could make a new information processing system (language), which could them come to understand each other, because they might have used two hands freely, might have visualized what they were looking, and could put images in the brain to practice. The turning points of technology in the history are (a) the invention of paper which makes it possible to record and accumulate much knowledge and information possible available, (b) the invention of printing technique which enables information and knowledge to share and develop, advancing of human culture by the form of newspapers, books, and so on, (c) developing media and electronic material effect a change to human experience from the quality and quantity point of view.

In the era of technology, what is called, the representation modalities of verbal information have diversified not only character having a systematic symbol but also pictures, drawings, 2/3 dimensional animations, software materials, movies and so on with development of media. In the study field of educational technology, Comenius (1592-1670) emphasized the importance of instruction method with sensory experience in his book titled the 'Orbus Pictus (The World in Pictures)', the first textbook containing pictures. Rousseau (1712-1778) who is a naturalist of education also stressed the importance of sensory education with concrete educational method based on operation. Dale (1945) put emphasis to the form of audio-visual teaching materials for effective learning through 'cone of experience'. The modalities of instructional materials, representational types, and media became various according to the advance of representation technology (Heo, 2006).

What are the problems?

The advent of high speed knowledge information society seem to bring about three types of problems concerning learners and teachers in the highly technology advanced society.

First, learners and teachers are afraid of the explosion of information. We can find easily the amount of information increase explosively not only in printed matter such as books, articles, and so on in but also electronic formant like web data. We should have to go to the library or some place for the purpose of looking for information or knowledge before prevalently using Internet. Now we can access over 2nd or 3rd organized information by the web in any time and any where. Perrolle(1987) make a relation to information delay in this context.

Second, there are difficulties in searching information what we want. Information increase highly in quantity, but it is not easy to find as good quality and suitable data as a searcher want to acquire. There may cause another problem (for example, validity or reliability of the data). Heo et al. (2003) tried to find an easy way for kids using 3D-interface searching design. It can be one trial to solve these problems.

Third, there is much limitation of representation according to the information machine. Even until a few years ago, computer was one of the most popular machine, and there is no problem to consider of machine adapted representation. It is changing now the generation of post PC. Now a day, it is not difficult we can recognize that there are a lot of display forms: for example, PC, lab top, cellular phone, PDA, Smart Phone, Tablet-PC and so on.

What are the solutions?

From these problems, we can recognize that the visualization is one of the keys to solve. Visualization may provide merits to subjects in instruction and learning environment. For learner and teacher, learning contents which have a lot of

information can be more effective and efficiency represented for the purpose not only of teaching but also of learning by adopting visualization.

What is the process of visualization, and how to develop visual skill on the process of visualization for effective and efficient learning and teaching? Assisting people to learn visual elements of an expert's know-how is an important not only in corporation, but also in educational situation. According to Garmston(1998), expert teachers need knowledge in six areas: content, pedagogy, students, cognitive processes of instruction, collegial interaction. Expert teachers organize that knowledge different ways which are easy to learner for retrieving, and apply it in their creative ways. Reigeluth(1999) also represents two types of expert: task expert who have specific task such as managing a project or writing an annual plan and domain expert who is an expert in subject matter of such as economics or physics. We can find that it is not easy to separate visual ability to other expertise, and is all mixed not just the domain area but tasks themselves have visual elements in them. Visual task may be necessary represent in visual expert' thinking.

In this research, visual task expertise is focused on expert teachers who have preceding experience on visualization. Experts are often unaware of the visual elements that guide their performance. Therefore, there are great deals of necessity to find the method to analyze for identifying experts' visual intelligence. This paper briefly conceptualizes expert teachers' visual task and visualization process at the simple task.

Research Questions

- What is visualization pattern of expert teacher at the simple visual task?
- What is the difference between teachers and students?
- How can we analyze visual task?

Visualization Process and Human Visual Intelligence

Visual related researches

In the dictionary, visualization is define (a) formation of mental visual images (b) the act or process of interpreting in visual terms or of putting into visible form and so on (Merriam-Webster OnLine, 2005). But it is not easy to find that there are used a lot of mixed concepts in visual related researches.

Related to the visualization in the field of educational technology, a lot of researchers tried to make a principle or apply at the instruction-learning situation. For example, (a) Visual Literacy is one of hot issues in the field of education focusing on how to teach for student encoding or decoding from visual material (Heinich et al., 1986; Cochran et al., 1980; Dwyer, 1978; Heinich et al., 2002). (b) The effectiveness of visualization (These studies are more related to images, drawings, pictures) has been discussed. Some insist that it is more effective for learning when teachers visualize real world as detailed as they can (Gibson, 1954; Knowlton,1964), but others argue that it is more effective for learning when visualization materials are simple (Alessi, 1988; Canelos, Taylor, & Gates, 1980; Dwyer, 1972; Merrill, & Bunderson, 1994). Some are more interested in the display or structure of text and visual material in the aspect of effectiveness (c) the development and apply of visualization ,which are more related to software design, interface design, web navigation, and so on, has been explored (Schneiderman, 1998; Rosenfeld, & Morville, 1999) (d) the restructuring of data is one of linking to visualization researches. By applying the concept of advanced organizer which is researched by Ausubel(1960), the research of visual and spatial representation (Barron, 1969; Earle, 1969; Estes, Mills, & Barron, 1969), and the study of graphic organizer (Barron & Stone, 1974) were performed (Heo, 2004).

How are 'visualization' and 'visualization process' linked to Visual Intelligence?

Visualization is defined as "visual representation of meaningful object"(Rha, 2005) and adapted in this study. It means the concept of visualization is not only drawing or picture but also include all forms of visual representation of meaningful object text, table, picture, drawing, and so on. This definition is much related to Visual Intelligence which is now developing theory by Rha. Rha (2005) defined a Visual Intelligence as "The ability to utilize the direct or indirect products or byproducts of human vision". He conceptualized the VI to three dimensions and nine properties. Figure 1 shows how to construct and relate each dimensions and properties.

First, the Interpretation-Dimension of VI is the explications of human itself from the response with physical world where is the outside-body. It has three sub-concepts: (a) Physical Vision, (b) Elemental Judgment, (c) Wholistic Interpretation.

Second, the Operation-Dimension of VI is focused on the thought and thinking process within our brain. We can operate all our worlds within our thinking. It means that we can imagine how something to move someplace before doing, that we can communicate and understand the context of the words while hearing 'the third wave', and that we can theorize or make relation from the inside-body (thinking). It has three sub-concepts: (a) Visual Operation of Physical Entity, (b) Visual Operation of Conceptual Entity, and (c) Visual Operation of Wholistic Relationship.

Third, the Creation-Dimension of VI in new creation base on non-reality which means it can be a virtual world, dream, or fantasy. It may give us a lot of possibility of new creative idea: not only our daily life but also applying fields- interface design, instructional design, and so on. It has three sub-concepts: (a) Future Vision, (b) Visual Fantasy, and (c) Dreaming.
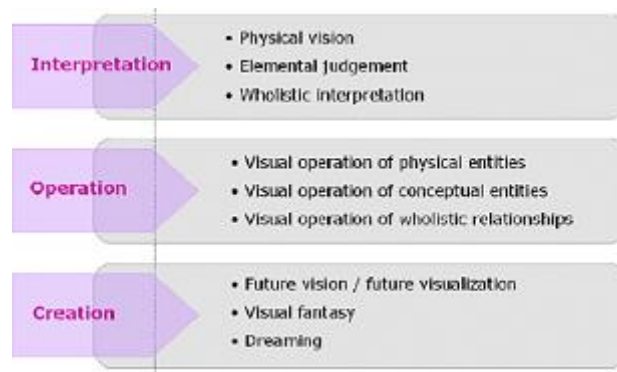
Figure 1. The Framework of Visual Intelligence (Rha, 2005)

Exploring of the Visual Process is critically related to Visual Intelligence, because it can find out the changing mechanism from verbal to visual. It means that a lot of information can be visualized more effective and efficiency way with using the sub-type of dimensions and properties of Visual Intelligence. It is possible that we can not only understand human itself but also extract the guideline what is expert's visual knowledge, skill, and strategy, and how to develop visual material. We can also give basic theoretical ground for designing all kinds of e-Learning or web material.

Expert Teachers' Visual Task & Visual Task Analysis

Expert teacher

According to a lot of researchers, teaching expertise come from complex abilities: the ability of lesson plans and implementation (Allwright & Bailey, 1991; Bailey, 1996), the ability of situated decision making (Leinhardt & Greeno, 1986), ability to shift content on the fly (Freeman, 1989), the number and quality of instructional patterns and routines in their repertoire (Johnson, 1992), and ability of planning as a macro or micro level (Nunan, 1992, 1996) (see Meskill, Mossop, DiAngelo& Pasquale, 2002).

An expert teachers'visual task itself is too ambiguous and complex to separate only two types likes task itself and domain related. Even though consider expert teachers' the necessity of knowledge in six areas, visual task is mixed in all of areas.

Expert Teachers' Visual Task

Visual tasks to expert teachers are visualized working processes in the making and using of visual materials, especially organizing, abstracting, and visualizing for instruction goals. Rha (2005) explained that visual task can be developed more fully by applying HVI. It can help expert teachers' own visual task patterns that novice teachers can easily understand by knowing the visual process of expert. Traditionally, there are a number of researches related to visual elements. A visual task is focused that are related to making visual material from verbal information.

One of the most important roles for expert teachers is organizing and abstracting from a lot of information. Expert teachers' result of visualization is one of forms in organizing and abstracting. It is an important factor for effective and efficient learning in instructional processes. We can also understand the process of expert teachers' visual task and apply it to training novice teachers'.

How to extract and analyze visual process from expert teachers?
: Visual Task Analysis

Task analysis in the field of instructional design is a process of analyzing and articulating the kind of learning that you expect the learner to know how to perform (Jonassen et al., 1999). We can easily identify relevant elements, find concepts and principles, and define relationships with task analysis. Generally, the object of task analysis is for understanding what human do and reducing human (or other) error.

There are traditionally used task analysis methods: (a) job, procedural, and skill analysis method (task description, procedural analysis, job task analysis, and

functional job analysis) (b) learning analysis method (hierarchy analysis, information processing analysis, and learning contingency analysis). Now a day, CTA(Cognitive Task Analysis),   HTA(Heuristic Task Analysis) are introduced for uncover, utilize expertise knowledge elicitation, analysis, and representation(Lee, 2002, Jonassen et al., 1999).

Jonassen et al (1999) categorize CTA from these five methods: GOMS(Goals, Operators, Methods and Selection), PARI(Prediction, Actions, Results, Interpretation), DNA(Decompose, Network, and Assess), Cognitive Simulation, and CBR(Case Based Reasoning). They also explain the methods for knowledge elicitation techniques: Documentation Analysis, Observation, Think-Aloud protocol and so on.

Lee(2002) and Reigeluth (1999) are more interested in extract of heuristic knowledge from expertise. They developed and applied to expertise in designing web-based instruction with formative methods. According to Reigeluth and Frick(1999), they insist that the formative model or method can be developed by the process of like these: a) Select and Design a theory or method b) Collect and Analyze data c) Revise and Repeat.

The emergence of VTA (Visual Task Analysis) concept comes from the same reason. It means that we are very interested in visual knowledge which is sometimes considered the resource of VI and in extracting there visual while working with visual task. But the detail method of VTA is not newly constructed. In Contrast, we gather some methods or theories and apply to analysis visual task for the purpose of finding visual process.

VTA is defined "task analysis for the purpose of extracting visual abilities (knowledge, skill, and so on)". Figure 2 shows that VTA model is adapted and designed for this study: Combined research is based on the ground theory (Strauss & Corbin, 2000) and protocol analysis (Ericsson & Simon, 1992) which are related to complex visual task for analyzing process. We gave a selected task and asked to visualize after explaining the concept of visualization. Task itself is selected by researcher and visualized at the semi-experimental environment. In this context,
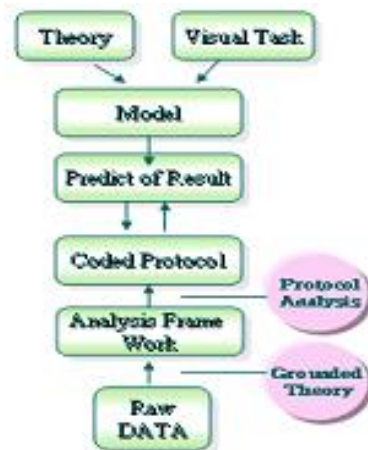
Figure 2. Visual Task Analysis Model

researchers have to follow the method of protocol analysis for finding out thinking process. Even though semi-experimental environment, we have to link to how to conceptualize while we are making coding scheme. It is grounded theory that give us a good example of how to making a code for the understanding of visualization process.

The diverse research methodologies were used to explore how the VTA process can be improved when applied to visualizing from language information. In order to find the VTA process, an ideal sketch (case study) was performed. According to Reigeluth & Frick(1999), case studies can be categorize either a designed or naturalistic case. Developing a new grounded theory or method applying to VTA process developing can be helpful. This study used several part of steps suggested by Reigeluth and Frick(1999) for finding out VTA process: a) Select and Design a theory or method b) Collect and Analyze data c) Revise and Repeat.

Method

Subjects

First, Seven general teachers are selected who have more than 6 years of teaching experience. Their ages are 20's (2), 30's (4) and 40's (1). Second, two expert teachers who have a lot of experience to making instructional web material are more deeply analysis at the same simple task. They are considered as visual experts teacher with peer recognition, recommendation (school and administers of education), prize (software contest), and over 10 years teaching and developing visual instructional material experience.

Task

Ideal sketch was selected as the task to which to apply the VTA process. Respondents (two experts) are expected to show visualizing processes with think aloud from verbal information by making an ideal sketch. Other teachers (7 people) do without think aloud, but interview after finish their idea sketch.

For this ideal sketch task, two paragraphs, which are a part of a newspaper article, selected from a 6th grade textbook. As a visualizing process depends on the nature of context in contents, a visualizing process and visual task analysis are focused.

Ideal sketch before teaching is predominantly a visual task with some procedural elements. It is procedural in that the activities of sketch their ideas are largely determined by the stages that their thinking go through. Expert teachers deciding their visual representation how to intervene is not only a set of steps but also a set of their principle. After finishing the task, the subjects respond the interview questions.

Data Collection Methods

Interviews

Semi-structured interviews were used as the primary data collection method. There were two purposes of interviews: (a) One was how to recognize VTA process for the task of visualization, and (b) the other was to find a way not recognize VTA process. Expert teachers were given the task and interviewed for 30 minutes.

Videotapes and Protocol Analysis

Because direct observation may miss a lot of data which experts think or act, the researcher used recording and videotaping for eliciting experts' thought process. Experts are asked to *Think Aloud* while they are working. After gathering data, scripts are created by protocol analysis. But we did not include the result because of the lack of the time.

Result and Findings

Visual product results were categorized into (a) visual-type and (b) visual-object. Visual-type is the form of visuals which include post-type (symbolic meaning), graph, multiple-time dimension, and so on. They are closely related to the context of texts given to the subjects. Table 1 shows these results.

A visual object is an object which represents features and properties in the visual results. In this study, the task itself includes a lot of text information which are people, apple, arrow, paper, round graph, TV, and so on. We categorized visual objects to main and sub objects. It means that some objects are relatively weighty compared to other objects are not essential but subsidiary. Table 2 shows these results.

Table 1. Analysis type (a) of Respondent

Visual Type	Count	Percent	Etc.
Post-type (symbolic meaning)	2	29	.
Graph-type	4	57	All are Round Graph
Mutiple-time dimension	1	14	Draw a Story based Picture in detail

Table 2. Analysis object (b) of Respondent

Visual Object	Main-Object	Sub-Object	Etc.
Round Graph	4	.	.
TV	.	2	.
Text	.	7	There are a lot of type of texts.(ex: title name, extra information, object label, and so on)
People/A part of body	2	1	.
Arrow	.	2	.
Apple (Metaphor)	.	2	.
News Paper	.	2	.

After analysis the VTA, we can find three major results from simple task analysis.

First, there are three general phases when expert teachers perform the simple visual task:

Phase 1: The understanding of a core problem in the context. At the Figure 3 & Figure 4, we can consider the first boxes at the case #A & #B which are consisted of analysis, conceptualization, and decision of visual cue.

Phase 2: The searching of the problem solving strategy. At the Figure 3 & Figure 4, it is named as a complex searching stage. We can find very interesting of this stage because all activities are mixed. After this stage, subjects decide final visual products, drawing or writing, and explain the result.

Phase 3: The deciding of final visual product. What an interesting result at the Figure 4, we can easily find that it is represented of visualization decision after complex searching stage. All these stages show how we can understand visualization pattern through the Figure 3 and Figure 4.

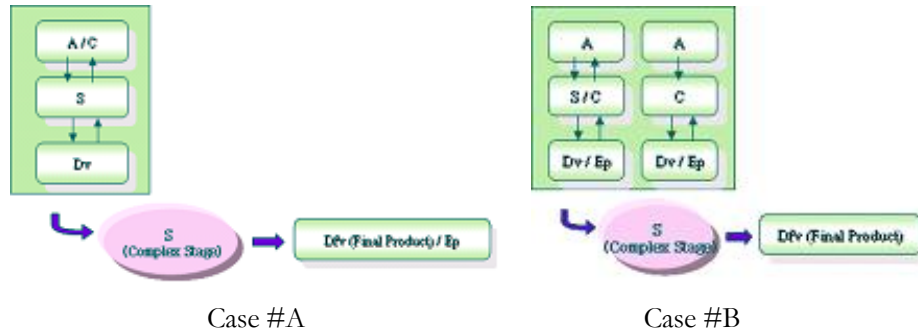Case #A   Case #B

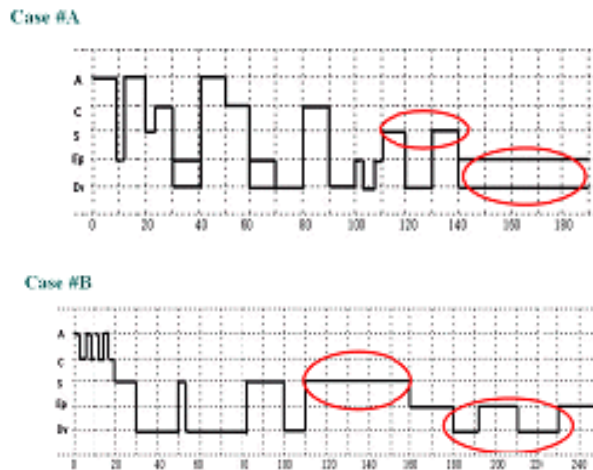Figure 3. Two cases of Visualization Process at the simple task

Figure 4. Space Transition Graph of Visualization Process at the simple task

Second, expert teachers tried to visualize in the form of abstract graph. A visual material itself is the compressed form of a lot of text information. But they also plan about more detailed examples in real teaching situation. It is a great deal of different

result when flowing study of learner, which is not yet reported. Students have a tendency of drawing a sub object in a more detailed manner.

Third, expert teachers tried to omit the object which was not related to the topic. It is an important role to compress the knowledge as visual product.

Conclusion

The initial VTA from the case study worked relatively well in understanding, searching, and visualizing information underlying the expert teachers. And also we can understand expert teachers' visual thinking pattern in this case study. For visual task analysis, semi-interview, protocol analysis and contents analysis were performed. It remains that how to analyze the visual task more effective and efficient. It is important problem that how to verify the validity and reliability in our society.

Finding indicate that teachers have coding schema of performing visual task; (a) the analyzing by reading and some activities in the task text, (b) conceptualizing or understanding in his/her own way, (c) the explaining of the action or product, (d) the searching by thinking or finding, (e) the decision of visualizing of the task. And we can also find pattern of three big stages: understanding, searching, deciding of final visualization.

What an interesting point is there may be exist the complex searching stage, and after this final visualization decision is perform with explain at simple visual task.

This case study suggests that an additional study for searching a guide and method might be beneficial for conducting a visual task analysis. It is my hope that this study will encourage others to conduct additional research to improve the available process, method, and guide for analyzing visual task.

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