International Journal of Arts and Sciences
3(14): 176 - 194 (2010)
CD-ROM. ISSN: 1944-6934
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Is there a Significant Pattern in the way Readers Use Procedural Information? : A Case Study in Technical Communication

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Abstract: A simple classification as visual or verbal learner is an over-simplification of users' learning behavior. Often readers approach the task in terms of their interpretation of the situation. In this experimental study, readers confronted imagery invoking text with graphic details of surgical actions. Readers were asked to mentally animate the impending surgical action based on text and graphic instructions. Results showed that readers are inclined towards approaching a procedural task situationally and there is insignificant correlation between readers' range of preferences for text or graphics in a scale and actual accuracy with imagery invoking text types. Further, there is insignificant correlation between specific situational behaviors and actual accuracy. Results show that for complex dynamic procedures, readers' behavior might not be fully predictable within a specific domain. However, some significant results still indicate that systematic use of imagery-invoking survey text and graphics can help technical writers to a limited extent in understanding if there is any justifiable pattern in the way all individuals process complex procedural information.

Keywords: situational, procedure, imagery

1. Introduction

The literature on technical communication with a focus on situational learning practices indicates research on project team communication practices for cross-functional virtual (organizational) teams suggesting how the virtual network calls for devising new practices for coordinating work (Robey, et al., 2000). There is similar research in technical communication on how readers combine instructional, technological and other resources on the spot to suggest situational learning (Slattary, 2007). Further, professional communication literature has also focused on evolving socio-technical environments for learning (adaptive tutoring, distributed cognition, self-efficacy, learning versus training etc). However, there is almost no research in technical communication to suggest readers' situational approach with procedural instructions for mechanical tasks. Procedural instructions is an important context of application in technical communication research because in order to improve the design of procedural instructions, technical writers need to know how users proceed when they are using them, from their initial reading, and to execute described actions (Ganier, 2004).

A long tradition of research in learning sciences has measured and classified individual differences in spatial ability of the reader [(Carroll, 1993); (Eliot and Smith, 1983); Hegarty and Waller, 2005)]. However, the relationship between individual differences in visual/verbal construct and learning from visual/verbal representations remains understudied (Moreno and Plass, 2006). This paper addresses a significant research question about whether readers are predisposed to interpret a technical document visually or verbally, or whether the task situation

International Journal of Arts and Sciences
3(14): 176 - 194 (2010)
CD-ROM. ISSN: 1944-6934
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in which they do the interpreting trumps any predisposition in learning style. This is an important issue worth exploring for technical communicators because for complex instructions it is often the case that readers approach the task differently and it becomes exceedingly hard to pinpoint why or the extent to which readers deviate from the task approach as suggested by technical communicators. Technical communicators could design instructions in a better way once they know how different cognitive, behavioral and external factors play a role when readers approach a task situation. So, the primary research question for this study is to understand the extent to which readers' situational approaches might play a role in interpreting specific text-graphic situations? In many sources, textbooks and published articles alike, the division between visual and verbal learners is taken as a given. However, recent research showed that verbalizers and visualizers did not differ significantly. There was never a strong support for the hypothesis that verbal learners and visual learners should be given different kinds of multimedia instruction [(Mayer and Massa, 2006), (Roy and Grice, 2004)]. Mayer and Massa's research indirectly indicates that situational factors should be scrutinized more closely within the context of the task situation. So, how do we understand readers' learning resources and approach for completing a complex procedural task? This study used patient education modules (e.g., explaining surgical actions), which might be an effective tool for patients to visualize a complex process and understand readers' learning approach in complex environments [(Farr, 1996); Canada and Schover, 2005)].

2. Significance for Technical Communicators

This study is significant for technical communication practitioners in multiple ways.

1. This study emphasizes the importance of situational learning practices by readers, something that is of paramount importance to technical communicators and how it impacts the instructional resources.
2. This study emphasizes the fact that technical communicators should understand readers' mechanical reasoning process well enough before designing instructions.
3. This study allows technical communicators to understand how readers' perception of task difficulty might not explain how readers access instructional resources.
4. This study emphasizes the fact that designing instructions is not only about making the instructions usable, but also whether, how and to what extent users are willing to use it.

3. Gap in Technical Communication Literature

In order to understand situational responses, it is very important to explore how users perceive physical procedures. Research in technical communication has adequately researched the factors influencing the design of instructions for physical procedures [(Horton, 1991); (Schriver, 1996); Gange and Lipton, 1984)]. However, the problem seems to be that there is too much focus on issues in document design. Foremost, there should be adequate research on how readers respond differently in varying situations depending on factors internal to the task, learner and the document itself.

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Apparently, the technical communication literature does not reflect on any significant pattern or experiments to suggest or even indicate whether there is any tendency from readers involved in procedural action to approach the task in any ways that might be termed as purely situational and independent of any procedural information studied immediately preceding the task. Even when there is no such tendency, it is important to learn such models so that technical communicators are in a better position to design procedural documents. This kind of study will also enable technical designers to understand how readers prefer to access procedural information in terms of the time lag between when the information was studied and the task was approached. Besides, such models will also help in understanding how users use the text-graphics information when they have to.

4. Literature Review

This literature review points out that readers' situational response might be a factor of how readers are able to mentally animate procedures, which in turn depends on how readers process text and graphical information.

4.1 Situational Response

Why is situational learning so important? Recent work by Marton and Booth (1997) and Bowden and Marton (1998) present the theory that it is through the experience of difference, rather than the recognition of similarity, that we learn. A radical situated learning model has been put forward by Lave and Wenger (1991). They concluded that learning is done in social relationships and by co-participation. Cronbach and Snow's (1977) classic definition of aptitude is a characteristic that promotes performance in a certain kind of environment. Snow's vision of aptitude is a property of "person in-situation". Even Mayer and Massa (2003) has focused on the nature and measurement of individual differences, although within specific conditions of computer-based multimedia learning environments. In addition, ability has been identified as a salient dimension along which to examine group differences (Anderman and Midgley, 1997). This indirectly implies that individual differences in how readers prefer to handle text and graphical information might play an important role.

4.2 Individual Difference

Previous research has adequately demonstrated that readers are just not visual or verbal learners and their approach is more complicated. Visual learners depend on graphics and illustrations for understanding procedures whereas verbal learners depend on text analysis for procedural comprehension. Visual learners have two subchannels - linguistic and spatial. Learners who are visual-linguistic like to learn through written language, such as reading and writing tasks. Learners who are visual-spatial usually have difficulty with written language and do better with charts, demonstrations, videos, and other visual materials. They easily visualize faces and places by using their imagination and seldom get lost in new surroundings [(Gardner, 1993), (Saettler, 1990), (Black, 1995)]. However, this classification is often limited. Individual differences in response often results from previous experience with similar instructional resources and that often means that readers might choose to act differently by using instructional resources in different ways, given the specific task situation.

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4.3 Visualizing Dynamic Mechanical Procedures

In order to understand individual's choice of reaction in specific procedural situations, it is important to understand how readers generally approach a text-graphic instructional context for a complicated procedural context.

The process of imagining the behaviors of components of a mechanical system (as for surgical instructions) based on the information about the static configuration of the system has been termed as mental animation (Hegarty, 1992). Research by Hegarty & Sims (1994) has discussed a piecemeal model of mental animation that actually states how readers switch attention between text and graphics for a print manual. Any form of mental animation has to start from the ability of the reader to produce a process of mechanical reasoning [(DeKleer and Brown, 1981); (Gentner and Stevens, 1983)]. Readers might mechanically reason a process in more than one way, depending on experience, skill and the task. Research says that providing subjects with causal modes facilitates learning by increasing the ability to operate and solve problems about machines (Keiras, 1978). Yoon and Narayanan (2004) and Narayanan and Hegarty (1998) have mentioned that during mental animation, people begin their reasoning incrementally, starting with a few components and then reasoning out the interrelationships among components and domain-specific conceptual knowledge.

It is important to understand for readers of this article how individual's choice of context-specific reaction and ability to mentally animate procedures might change based on the way text is written and visuals are shown for instructional contexts. Route perspective shows changing positions of the reader in the work environment with relation to landmarks while survey perspective shows a bird's eye view of relative positions of objects in the work environment (Levinson, 1996). The route perspective took a body-centered approach (for the owner of the body) to describe the positions and landmarks with respect to the replacement parts or the surgical instruments in the environment (Tversky, Lee and Mainwaring, 1999). The route perspective defines terms as left, right etc. to show the specific position with respect to the object under question. The survey text, as used in this study shows the relative positions of the different objects in the environment (Tversky, Lee and Mainwaring, 1999).

4.4 Coordinating Text and Graphics

How readers combine text and graphics should also explain how a complex procedural task might be approached contextually. Research by Ganier (2001) suggested that processing of instructions, whether textual or pictorial relies essentially on verbal recoding of the information, based on separate and specialized cognitive resources for text and graphics. In another study, Glenberg and Langston (1992) concluded that for sequential instructions, when appropriate graphics accompany text, subjects tended to mentally represent the procedure by combining media. There was also substantial research arguing the supporting role that text might play. Booher (1975) concluded that pictures were appealing because of their relative processing ease, the large amount of information that can be presented in a small space and an advantage with long-term memory retention. Gibson (1950) suggested pictures as better than words for showing concrete objects or events. Burns and Warren (1986) and Beiger and Glock (1986) showed that

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an organized display reduces response times and errors significantly for both experts and novice users. Stone and Glock (1981) investigated an assembly task and found that providing graphics during learning decreased errors. Beiger (1982) found that graphics coupled with text instructions facilitated learning of procedural tasks. Research [(Brewer, 1988), (Paivio, 1986), (Sadoski et al., 1993b)] has suggested that concrete, imagery-invoking text is related to comprehensibility, interestingness and memorability in various ways. This review of the literature suggests that situational responses crop up because individuals respond differently to different instructional situations and individuals think differently either because they are specific types of learners or because, based on their experience they adjust their task approach by mechanically reasoning through the process depending on specific types of text-graphic.

5. Problem Statement

Our primary research question for this study is to understand the extent to which readers' situational approaches might play a role in interpreting specific text-graphic situations? But, most importantly, we will need to know how to define situational response. Cronbach and Snow (1977) discussed performance in a certain kind of environment. They suggested that aptitude in the person's head should be replaced by aptitude as a property of person-in-situation". If that is true, does that mean that the aptitude on a purely verbal or visual basis should be replaced by how these resources are used in combination with experience, expertise, task complexity, environment, practice? A major challenge would be to identify situational factors and then fathom how it influences the use of instructional resources.

6. Hypotheses

The following hypotheses are driven by Cronbach and Snow's (1977), Brindley (1987), Marton and Booth (1997), Lave and Wenger (1991) and Bowden and Marton's (1998) discussion of situational performance.

1. Readers prefer to approach the comprehension process and complete a task more in the context of the situation and less on the basis of a pre-defined classification.
2. When readers are more situation-centric, in most cases, only text and graphical factors could not account for the difference in responses.
3. Users' self-reports on task difficulty might not have any bearing on whether they could actually complete the task accurately or not.

7. Methods

The following study is mainly organized to test the impact of situational responses on text-graphic resources.

Sample: 50 participants were tested. The participants were undergraduate students in a technical writing class in a technical institute of higher learning. The institute specializes in engineering studies, architecture, and bio-informatics and computer science. Participants in this study took some introductory coursework in engineering, with supporting knowledge in mathematics,

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physics etc. However, they mentioned that most of the coursework were overly theoretical, foundational and mathematical in nature.

7.1 Test Materials

How readers handled the task: Fifty readers were tested. In total, readers handled six trials. Any particular trial had a test graphic and either route or survey text. Readers saw three trials involving route text and three trials involving survey text, presented alternatingly. This ensured that the readers were exposed to all the graphics and both forms of text with different graphics. Test participants were divided into two groups. The difference between the two groups was that the order of route and survey text presentation was switched between the two groups. Thus only the text order was changed. This ensured not leaving to chance potential problems that a particular reader might have with any particular text or graphic. The difference in performance could also have been due to the readers' spatial ability, reading ability, difficulty of sight, and manipulation of parts and instruments. This test design provided the opportunity to test each reader with all forms of graphic and text. During the testing session the graphics were presented in a sequential order, with readers exposed to the steps in the order that the surgery followed. The readers were asked to choose the correct option (from a set of four alternatives) based on how the surgery actually took place. Readers were not able to go back on the previous page in the questionnaire once a particular trial was completed. This was because graphics were shown in steps in a sequence and a graphic used for a subsequent trial might provide an answer for the preceding trial. Figure 1B shows the schema adopted for group 1. For group 1, route text was presented for odd numbered trial (1, 3, and 5) and for group 2; route text was presented for even numbered trials (2, 4, and 6). Participants were handed out printed materials spread across 6 pages, with one trial per page. Figure 1 explains the experimental model followed.

Graphical Information		**Features of the Associated Text in Each Trial**			
Types of Surgical Action Shown	**Trials**	**Route Perspective in Text**	**Survey Perspective in Text**	**Other Textual Features**	**Other Graphical Features**
Putting artificial parts in the human body	1	Yes	No	**Fixed across trials(F):** 1.Object sentence first 2.Given-new Presentation order 3.Overview / purpose 4.Amount of details - High for route perspective but lesser use of specific adjectives -High for survey perspective but good use of specific adjectives 5.Labeled parts of The graphic were NOT mentioned in the text.	**Fixed across trials(F):** 1.Survey Perspective 2.Same body parts – knee 3.Angles of view from surgeon's perspective 4. Graphical contrast 5. Background color changes
	2	No	Yes		
	3	Yes	No		
	4	No	Yes		
How surgical instruments coordinate during surgery?	5	Yes	No		
	6	No	Yes		

Figure 1. The overall test schema and variables (for Group 1). The arrangement of text is exactly reversed for Group 2 (everything else remaining constant).

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The test session was around 25-30 minutes in duration. I asked readers to read the instructions carefully and gave them a brief overview of what the overall task is and what each trial describes. Although participants were not individually watched during the test session, pilot study, inter-coder reliability analysis, the post-test survey and de-briefing suggested that readers used both text and graphical instructions in most cases.

Participant Selection Questionnaire: The participant selection questionnaire was designed to choose participants for this study whose understanding of medical/surgical issues is not specialized. The purpose was to choose participants who will raise questions (based on their reading of the trials) like any other potential patient.

Pre and Post-Test Questionnaire: The pre-test questionnaire wanted to see if readers prefer to self-report themselves as visual or verbal learners. The post-test questionnaire primarily tried to define situational responses (based on the literature on mechanical reasoning and text-graphics coordination). A Likert scale was chosen for every question in the pre and post-test questionnaire.

Independent Variables: The text and graphical features mentioned in Figure 1B.
Dependent Variables

1. The percentage of accurate responses in comprehending the impending action based on the text-graphic combination provided for replacement parts trials.
2. The percentage of accurate responses in comprehending the impending action based on the text-graphic combination provided for surgical instrument trials.
3. The self-reported difficulty in comprehending the impending action based on the text-graphic combination provided for replacement parts trials.
4. The self-reported difficulty in comprehending the impending action based on the text-graphic combination provided for surgical instrument trials.

7.2 Rationale for the Experimental Design

This experimental design was adopted to study how readers process different kinds of text-graphic combinations. The idea was to understand whether different types of text processing allow for different kinds of individual comfort and ability in processing the information and if that impacts confidence and task accuracy. If results are random and there is no difference in accuracy with different text-graphic types, then it helps to understand and conclude that pre-defined reader preference and cognitive inclination towards text or graphics-oriented information processing might not play any significant role and ultimately, readers process information situationally more often that not.

8. Results

As part of a selection questionnaire, the participants reported having some theoretical knowledge about mechanical procedures related to robotics, artificial intelligence, circuits, and computer chips. However, they self-reported having insignificant or random previous hands-on exposure to mechanical instruments or knowledge of mechanical procedures. Further, there is either little or

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no literature to suggest that there is any transfer effect between engineering expertise and comprehending surgical procedures. It is important to remember that the material being tested is a patient education module and students or any person can be considered as potential patients by every stretch of imagination and the material is designed keeping in mind the common mass having no specific skill set that influence performance in this study. None of the participants reported having any medical or surgical knowledge and that is an advantage because participants do not bring in an understanding of the subject that might load the responses in any particular direction.

Overall findings suggest that there are some statistically significant data, which indicate that some of individual's learning styles are strongly correlated with accuracy. Here the significant factors in learning style include switching attention back and forth between text and graphics (as opposed to using only text or graphics), comprehending actions as a single process or series of smaller actions etc. Readers have combined these factors in their learning strategies. Further, there is some statistically significant data that indicates that readers' perceived difficulty in trials showing manipulation of surgical instruments is strongly correlated with readers' amount of using of text and graphics and how readers defined the task as a single process or series of separate actions. Figure 2 supports the first hypothesis that readers do not possess any strong choice, either with verbal or visual information.

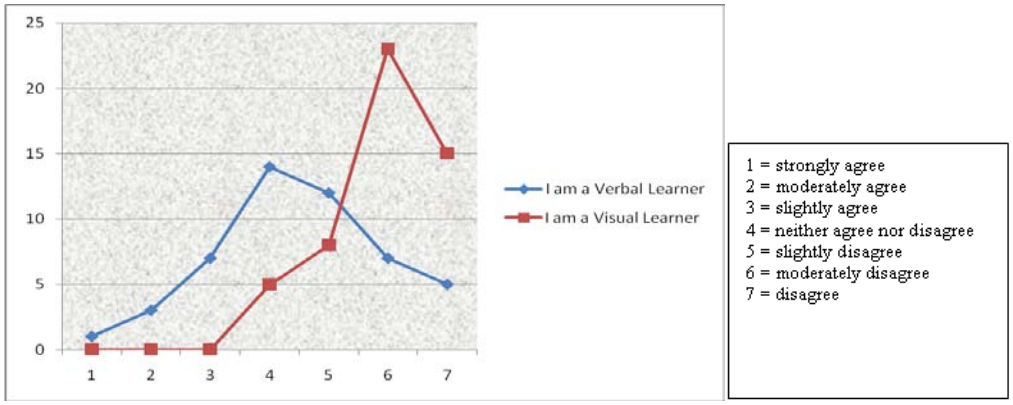

Figure 2. Number of participants with different levels of agreement with verbal and visual learning styles

This indicates towards the possible conclusion that readers do not prefer any single strategy and their approach depends on a combination of factors (task complexity, information overload, experience of reader, mood, and expertise) including text-graphic resources.

Correlation of Learning Styles with Accuracy of Task Completion: Results show that out of the three possible correct responses with each type of text (three trials each with route and survey text), readers were more accurate with survey text (mean value of accuracy = 1.66) than with route text (mean value of accuracy = 1.38). To conclude whether any extent of pre-defined learner classification as a visual or verbal learner actually makes readers perform any better with

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any specific type of imagery-invoking text and graphics, it is imperative to know how readers have actually performed with both route and survey text types when agreeing or disagreeing at different levels with the statement “I am a visual learner” and “I am a text learner”. Results are shown in Table 1. The Pearson correlation values (calculated between numbers of correct responses over all the six trials and the individual reader’s rating on verbal and visual scales) for route text and survey text demonstrates that there is no significant correlation between how readers rate themselves on learning styles and what their actual performance is with specific kinds of text-graphic situations.

Table 1. Correlation between reader's self-reported learning style and # of correct responses with text types:

Measures	Number of Accurate Responses with Route Perspective in Text		Number of Accurate Responses with Survey Perspective in Text	
	Pearson Correlation	Sig. (2-tailed)	Pearson Correlation	Sig. (2-tailed)
“I am a Visual Learner”	-.190	.187	.104	.473
“I am a Verbal Learner”	-.087	.550	.095	.512

This suggests that even when readers think themselves more as a situational learner; the performance is also situational and arbitrary with no pattern. This supports the second hypothesis.

Situational Learning Behaviors: The next hypothesis is tested by defining a few situational learning practices and then testing whether the way readers adopt such strategies influences the outcome with imagery-invoking text and graphics. The post-test questionnaire tried to analyze the way readers approached the learning process situationally in the trials both with route and survey text. Situational responses were divided into 4 major blocks.

- Accessing both text and graphics (literature concerning simultaneous use of text and graphics)
- Sequence in which text and graphics are handled
- Pattern in which attention is switched between text and graphics (literature on mechanical reasoning)
- Way readers consider a task as action, activity or operation (literature on activity theory and constructivism)

To study the self-explanatory nature of text and graphics, I asked readers whether, while completing the task, they looked at the text, graphics or both. Participants reported that most of the time their attention was towards the graphics, or trying to visualize (mentally animate) what the text suggested, rather than looking at the text itself.

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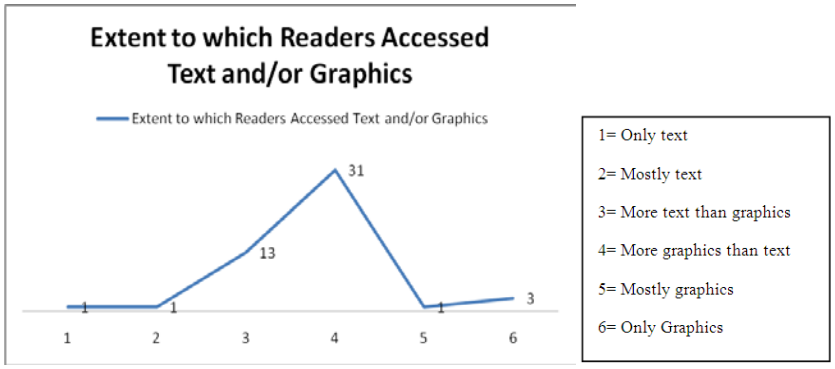

Figure 3. Extent to which readers accessed text and/or graphics

To study readers' order of text-graphics attendance and mental animation, the second question dealt with whether readers started with text or graphics first (Hegarty, 1992). More than half the participants (around 35) reported using "text first", "mostly text first" or "mostly text first than graphics"

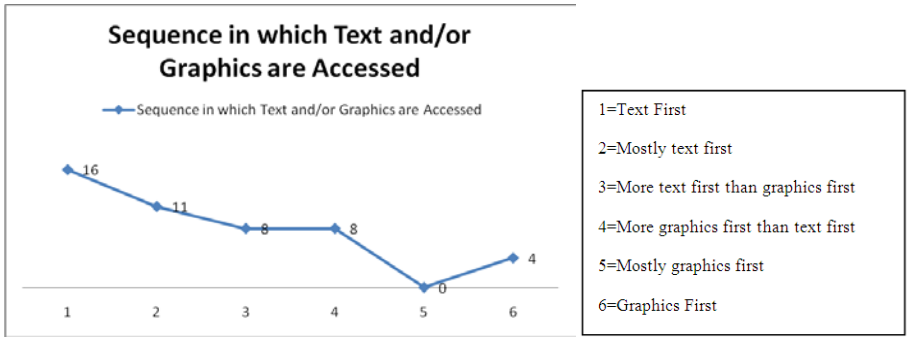

Figure 4. Sequence in which text and/or graphics are accessed

The third questions asked readers how they switched attention between text and graphics.

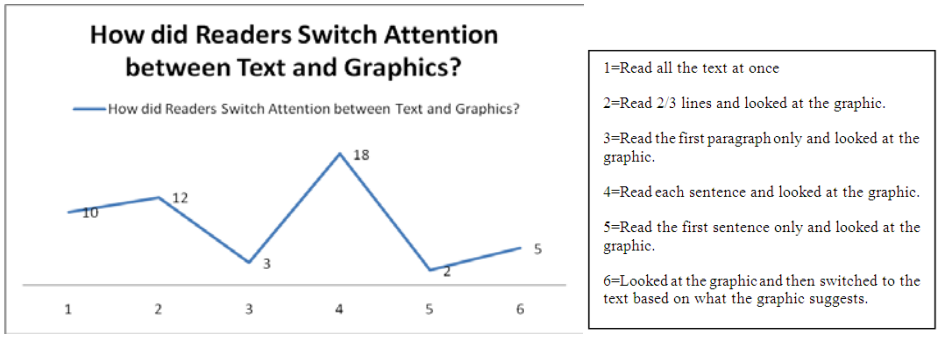

Figure 5. How did readers switch attention between text and graphics?

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The highest frequency is in the category where readers reported that they read one sentence at a time and then switched attention to the graphic. In the next question, majority of the readers reported that they read all the provided text.

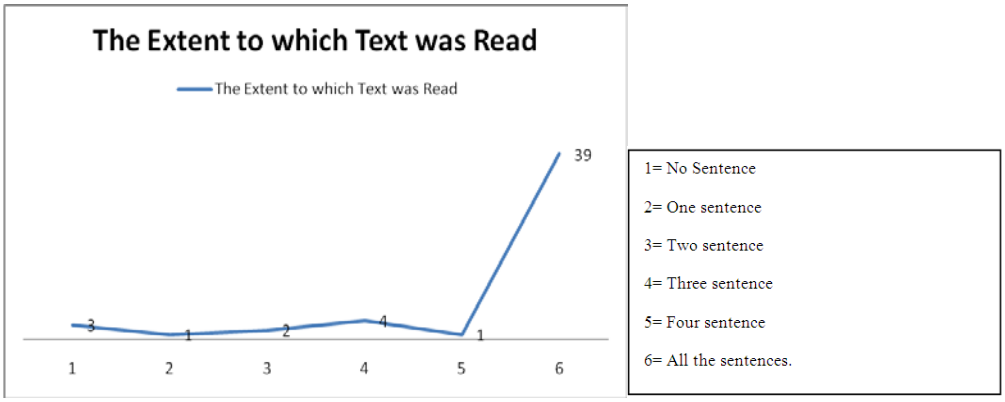

Figure 6. The extent to which text was read

As part of the next question, I asked readers how they perceived individual trials. Did readers view trials as one whole process, or just one action in total, or as a series of separate actions? Results showed that readers most often thought the task was a series of separate actions. However, there were occasions when readers thought the task of comprehending the entire task was one whole process. Data also suggest that while sometimes readers prefer to differentiate between parts identification and manipulation as separate actions (as argued by Heiser and Tversky, 2001) by differentiating between structural and functional identification); sometimes they prefer to handle it as one single action.

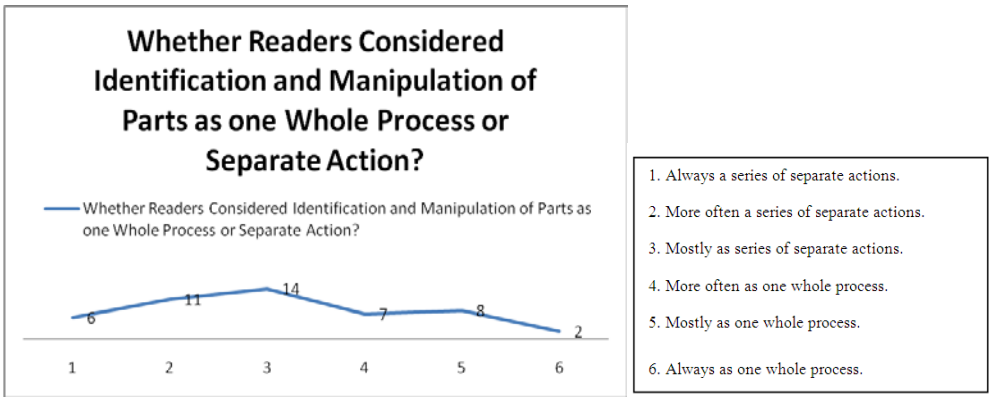

Figure 7. Whether readers considered identification and manipulation of parts as one whole process or separate action?

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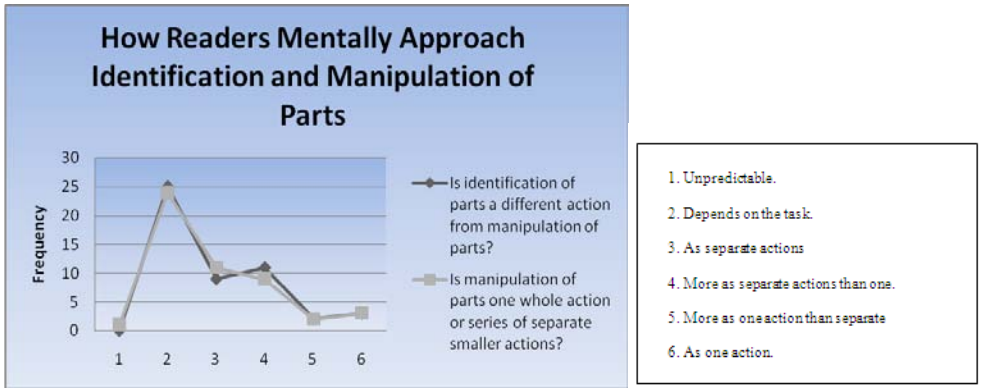

Figure 8. How Readers Mentally Approach Identification and Manipulation of Parts

The current study showed that task approach did not have any consistent effect on terming a specific trial as easy or difficult. It was worth exploring if there is a potential correlation between how the task was approached (switching attention, time spent with text or graphics, text first or graphics first, actions versus activities etc) and accuracy.

Reader's Situational Learning Style and Accuracy: Results showed that there is no pattern to help us make conclusions about any specific mental model. However, there were quite a few positive correlations when readers used survey text. A negative r=-.422 (significant value) suggest that more readers were accurate with survey text; the more they focused on text first and then graphics. A positive r=+. 415 (significant value) suggest that more readers were accurate with survey text; the more they focused on text first but then positively switched their attention to explore the graphics. A positive r=+. 425 suggest that more readers were accurate with survey text; the more they considered the entire task as one whole process. In other words, it might be reasonably safe to conclude that survey text helped readers to see the process as one whole action.

Table 2. Correlation between situational learning styles and accuracy (Group 1 and 2) - Significant Results only

Accuracy with Route and Survey Text	Correlation	Did you access both text and graphics when completing the task	When completing the tasks, did you either start with text or graphics first?	How much of the text did you read approximately?
Number of Correct Responses with Route Text	P Value Sig. (2-tailed)			.440** .03
Number of Correct Responses with Survey Text	P Value Sig. (2-tailed)	-.422* .04	.415* .04	.425* .03

**Correlation is significant at 0.01 levels; *Correlation is significant at 0.05 levels

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Reader's Situational Learning Styles and Task Difficulty: This study reported some strong correlation between reader's self-reported difficulty during task completion and actual accuracy. The significant results can be seen with trials 5 and 6.

Table 3. Correlation between situational learning styles and task difficulty (Group 1 and 2) - Significant Results only

Levels of Difficulty with Trials	Correlation	Would you be able to complete the task only by reading the text or graphics?	How much of the text did you read approximately?
Difficulty with Trial # 5	P Value Sig. (2-tailed)	-.434* .03	
Difficulty with Trial # 6	P Value Sig. (2-tailed)	.409* .04	.461* .02

*Correlation is significant at 0.05 levels

Thus, based on what the data suggest, it can be concluded that in some cases, difficulty is strongly due to the readers' learning ability involving both text and graphics and whether comprehension of body parts, artificial parts, is one whole process or a series of separate actions. "As one whole process" is the high end of the scale. Previous data suggests that for trials 4, 5, 6, readers reported levels to be mostly moderate to very difficult. Further, data also shows that the highest frequency is for readers using more graphics than text.

Linear Practice and Transfer Effect: Another indicator of readers' situational approach is whether readers improved through practice. Readers did not consistently show improvement in accuracy from one trial to another. The pattern of improvement from trial 1 to 4 was somewhat random, suggesting insignificant practice effect. The sudden sharp drop in performance from Trial 4 to Trial 5 might be because of the transfer effect. This transfer effect might result due to various reasons. First, readers faced a route text trial, although not for the first time. Second, readers faced a trial, which, for the first time, introduced them to the surgical instruments in the graphic and required comprehension of how these should be manipulated. Third, it might be the unique combination of text and graphics. Until trials 1 to 4, readers were facing replacement parts in the graphics and their related text explanations. Figure 9 shows the trend.

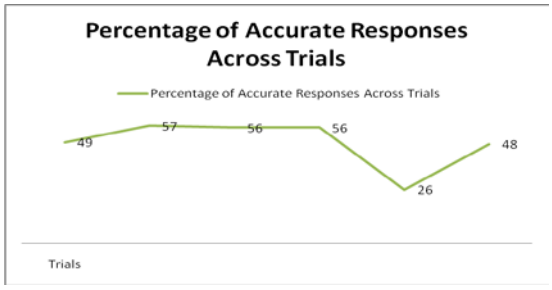

Figure 9. Reader Performance across Trials

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9. Discussion

This study clearly shows that in most cases, it is hard to quantify readers' situational learning approach. However, one thing is established. Readers have numerous learning strategies that are neither part of any predetermined set of actions, nor something that is purely verbal or graphical or any predictable combination of both.

Implications of the Current Findings: There are several implications of the current findings. It is difficult to relate an individual with a single approach like verbal or visual learning. More often it is a combination of several strategies and approaches and yet it is difficult to pinpoint what the exact combination under a specific task situation might be. The situational strategies as discussed in this article provide some insight into how readers might see processes and approaches in a constructivist mode. The more important question is how readers process text and graphics. That processing style might be unique to the task context and the same reader might not repeat the same process for a similar task situation. However, it still provides some insight into the thinking pattern. This study is not designed to identify an individual with visual or verbal learning but to see where they stand on the Likert scale. The idea is to see the extent to which readers agree with specific preferences and then relate it to their actual performance. It is very important to understand that preference for a resource and final outcome does not map into one another automatically. There are other factors like experience, content complexity, expertise, motivation etc that plays important roles in deciding that the final outcome might be.

Do results fill the knowledge gap? Task difficulty and its relation to task approach could not be established as part of the above results. Brindley (1987) suggested that three clusters of factors determine task difficulty: those internal to the learner; those internal to the task; and those internal to the text. An interaction effect of the above-mentioned factors might make it difficult to interpret individual impacts. Further, the importance of the task situation is very important. The way an individual chose to react for trial 1 might not be the same as in trial 2. Similarly, two different people's reaction for a trial might be different due to a different interpretation of the work situation. An identical text-graphic content for different trials might certainly help in thinking similarly, but still a basic difference in problem solving approach or the approach taken to designing text and graphics might make difference in accuracy. Further, people may respond differently, depending on the specific characteristics of the situation. For example, people may respond differently to instructions (that uses similar instructional resources and strategies) about automobile repair than about knee replacement surgery. Data has shown no consistent practice effect in terms of self-reported difficulty. In psychophysical tasks, practice affects the performance (Pellett et al., 1998). For example, reaction time decreases with the simple repetition of the experiment trials (Langston et al., 1994). The findings in this study showing insignificant correlations between combinations of learning styles, text types, accuracy, and task approach with self-reported difficulty are not consistent with what the literature suggests about a steady improvement. What this means is that every task situation is different and unique in its own way.

International Journal of Arts and Sciences
3(14): 176 - 194 (2010)
CD-ROM. ISSN: 1944-6934
© InternationalJournal.org

Do results address the practical problem noted earlier? Results from this study made reasonable indications that survey text, if used properly, in combination with factors internal to the task and learner might result in some significant understanding of how readers might react to specific task situations. From this study, we had some indication of what might be considered as situational response and the extent to which it might or might be influenced by the way text is used in combination with graphics. Further, from this study we also had strong indications that factors internal to the task and learner might overwhelm the text factors to a large extent. So, future studies might work towards exploring Brindley's (1987) study from a new perspective where each of text, context and learner factors can be tested and incorporated in the final instructions to a reasonable extent. It is a reasonably difficult task beyond a certain point, because ultimately factors like user motivation, aptitude etc has to be translated into document design. Frequent usability testing should be done to gauge these factors and instructions should be updated accordingly.

Recommendations for Technical Communicator Practitioners: The above findings indicate towards multiple strategies that technical communicators might adopt before and while designing instructions.

1. Complete the task yourself and see how it is done. Mark down all the activities, actions and operations completed along the way.
2. Differentiate between learning styles between same and similar product and manuals and take note of the specific conditions (resources available, task sequence, motivation etc) in which a task is completed.
3. Maintain outcome logs for each small action and/or operation for sequential tasks and for same or similar tasks undertaken one after another and at different times to record practice effect and how situational approaches/strategies changes with practice.
4. Complete a usability testing and a debriefing session where individual actions and approaches are explained by the reader in details. There should be parallel logs maintained between actions completed and task approach. Concurrent and retrospective think-aloud protocols might be the most effective way to do this. This allows for capturing user thoughts on the approach.
5. Let the user complete the same task twice and with a gap in time and record individual actions. It is important to find out how the task approach or processes are dissimilar so that the gap can be bridged in terms of design.
6. Let readers self-report on their approach but also use observational techniques to find out what they did. Follow it up with a de-briefing to bridge the gap between their self-reports and what has been observed.
7. Situational responses can be systematically broken down into issues like developing a mental model of the program, identifying screen elements and objects, movement between text and graphics, and verifying screen states.
8. During usability testing, try to differentiate situational response (in terms of specific task approach) from practice effect.
9. Future studies can consider a new scale for similar experiments. Research indicates using a new instrument, the Object-Spatial Imagery Questionnaire (OSIQ), was designed to assess individual differences in visual imagery preferences and experiences. The OSIQ consists of two scales: an object imagery scale that assesses preferences for representing and processing

colorful, pictorial, and high-resolution images of individual objects and a spatial imagery scale that assesses preferences for representing and processing schematic images, spatial relations amongst objects, and spatial transformations (Blajenkova et al., 2006).

10. Conclusion

The findings clearly suggest that it is extremely challenging, if not impossible, to quantify situational responses within the scope of a definite range. However, it is still possible to have some basic understanding of situational behaviors for a given context without being very specific about how the resources are handled. One reason for that is because no two individual might access resources in exactly the same way and also because the range of activities for a given task situation might be too robust to calculate. The test materials were designed to explore whether readers can be made to think from specific spatial perspectives and if that can channelize and bring in some pattern in the situational responses. The results suggested that although there are some indications of how some trials work better than others with specific situational responses, there is nothing definite to conclude from these findings. There are too many variables at play and subjectivity in user response.

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