DOCUMENT RESUME

ED 438 789 IR 019 915

AUTHOR	Baylor, Amy L.
TITLE	Novice Instructional Design (NID) of Text.
PUB DATE	1998-04-00
NOTE	31p.; Paper presented at the Annual Meeting of the American Educational Research Association (AERA) (San Diego, California, April 13-17, 1998).
PUB TYPE	Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Higher Education; *Instructional Design; Learning Activities; Learning Strategies; Teaching Methods
IDENTIFIERS	*Novices

ABSTRACT

Novice instructional design (NID) is an instructional strategy where students design instruction in order to better learn information. NID by students is an increasingly common instructional activity, particularly with technology; however, there is little research regarding what the instructional designer learns by engaging in the instructional design process. This paper reports results from an experiment investigating what a person learns from novice instructional design of text-based content. The experimental design encompasses three independent variables: strategy (self-selected learning, novice instructional design); passage structure (well-defined, ill-defined); and achievement (low, high). Dependent variables include concept map comprehensiveness, example generation, and task engagement. Several statistically significant and theoretically intriguing interactions are interpreted in part by Allen and Merrill's (1985) locus of processing theory for instructional strategies. Together with interpreting these interactions, the paper provides both a conceptual background and a research methodology for evaluating NID of text-based content. (Contains 46 references.) (Author/AEF)

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Novice Instructional Design (NID) of Text

Amy L. Baylor

Department of Educational Technology

San Diego State University

Paper presented at the annual meeting of the American Educational Research Association (AERA) on April 14, 1998 in San Diego, California.

ABSTRACT

Novice instructional design (NID) is an instructional strategy where students design instruction in order to better learn information. Novice instructional design (NID) by students is an increasingly common instructional activity, particularly with technology; however, there is little research regarding what the instructional designer *learns* by engaging in the instructional design process. This paper reports results from an experiment investigating what a person learns from novice instructional design of text-based content. The experimental design encompasses three independent variables: strategy (self-selected learning, novice instructional design); passage structure (well-defined, ill-defined); and, achievement (low, high). Dependent variables include concept map comprehensiveness, example generation, and task engagement. Several statistically significant and theoretically intriguing interactions are interpreted in part by Allen & Merrill's (1985) locus of processing theory for instructional strategies. Together with interpreting these interactions, the paper provides both a conceptual background and also a research methodology for evaluating novice instructional design of text-based content.

"The best way to learn something is to teach it"

Introduction

Learning through designing is encouraged by a new classroom philosophy where students act as researchers, teachers, and monitors of progress as opposed to being passive recipients of incoming information (Brown, Ash, Rutherford, Nakagawa, Gordon, & Campione, 1993). Supported by current constructivist views of learning, the prediction is that generative learning strategies, where the student interacts with the material to generate unique learning aids, are more conducive to learning (Wittrock, 1990).

Novice instructional design (NID) as described here is an instructional strategy where students design instruction in order to better learn information. With the increasing presence of technology in the classroom, more students are participating as novice instructional designers. There is much constructivist research that describes technologically based environments for student instructional designers (e.g., Dugdale, 1994; Guzdial, 1995; Harel & Papert, 1991; Kafai & Resnick, 1996; Lehrer, Erickson, & Connell, 1994; Resnick & Ocko, 1993; Sargent, Resnick, Martin, & Silverman, 1996). Such research liberally applies the role of designer to students: for example, including eighth grade students designing hypermedia programs about the Civil War (Lehrer et al, 1994), children developing instructional video games (Kafai, 1995), fourth graders designing Logo programs to teach fractions to third graders (Harel & Papert, 1991), students creating knowledge bases through novice knowledge engineering (Lippert & Finley, 1988) and students designing textile patterns in a Logo microworld (Gargarian, 1996). The question considered in this paper follows: Is novice instructional design

(NID) a valuable learning process? This paper has two purposes: 1) to discuss several statistically significant interactions that result from an experiment investigating effects of novice instructional design (NID) on learner achievement and engagement; and, 2) to present a research methodology for evaluating NID as an instructional strategy.

Novice Instructional Design as a Learning Strategy

When considering NID as a learning strategy, the focus is not on the learner-- the person to whom the instructional design is directed-- rather, the focus is on what the instructional designer learns as a byproduct of designing instruction. As Kafai (1991, p. 18) states "In the research and theory on design this aspect of what is learned through the design process has been neglected"; instead, the research focus has been on what designers do instead of what designers learn. As Rowland (1992) explains, there are recollections and opinions but little systematically-gathered evidence regarding the nature of instructional designing. There have already been numerous studies (e.g., Goel & Pirolli, 1992; Greeno, Korpi, Jackson & Michalchik, 1990; Guindon, 1990; Jeffries, Turner, Polson & Atwood, 1981; Korpi, Greeno & Jackson, 1991; Perez & Emery, 1995; Perez, Johnson & Emery, 1995; Rowland, 1992) implementing verbal protocol analysis to evaluate cognitive processes in design tasks. These studies were generally qualitative, consisting of evaluating and comparing verbal protocols of the instructional design process. Importantly, there has not been an attempt to conduct an experimental study to assess what instructional designers learn and/or what are the positive learning outcomes of instructional design. Consequently, the experiment described in this paper investigates areas that have not been previously investigated.

Another key feature of the experiment is that it focuses on novice instructional design of text-based content in the domain of the social sciences. Most other studies of instructional design use material that is technical in nature: e.g. machines (Rowland, 1992), software design (Jeffries et al, 1981), algorithm design (Kant, 1985), mechanical engineering (Ullman, Dietterich, and Stauffer, 1988), vehicle operation (Korpi, Greeno & Jackson, 1991), and trouble-shooting a diesel engine (Perez & Emery, 1995; Perez et al, 1995). Since most design problems in the real world do not involve manipulations of machines, the implementation of a text-based task is applicable to more domains and has important implications for text processing as will be described in the next section.

Textual Organizational Signals

According to models of textual processing, the cues influencing the reader's planning must be considered. In other words, the structure of text influences a person's ability to organize its content. When processing text, organizational signals, such as headings, overviews, and topical summaries, are used to help the reader discern the topic structure of a text. These signals may be verbal features (i.e., headings, subheadings, pointer words) or visual features (i.e., highlighting, isolated words) that guide the reader through text (Lorch & Lorch, 1986). This implies that the presence of organizational signals in a text should lead to a more complete and coherent representation of the text's topic structure than would occur in the absence of signals. In fact, it has been shown that signals do produce better memory for text topics and their organization (Lorch et al., 1993). As described by Lorch and Lorch (1995), the presence of headings in a text leads to better summaries (Brooks, Dansereau, Spurlin, & Holley, 1983), better outlines (Brooks et al, 1993; Dee-Lucas & DiVesta, 1980), and better memory for the main points of a text (Spyridakis & Standal, 1987).

What if the text is devoid of organizational signals? While the research shows that readers may find signals useful aids, they do not require signals to process information about the topic structure of a text (Lorch et al., 1985). Under many conditions, readers may be able to construct complete and coherent topic structure representations without the aid of organizational signals. For example, if there are few topics and the topics are well developed and easily related to each other, readers may not need the help of signals in constructing a topic structure representation for the text (Spyridakis & Standal, 1987). Yet if the text is complex, signals are more useful.

While there are numerous variables that influence learning from text, two key factors explored in this research are the role of novice instructional design as an instructional strategy, and the role of passage structure. A third factor considered is the achievement level of the student. Taking all three of these factors into account, the next section will develop a conceptual foundation for considering these factors in a more complex relationship.

Level of Achievement

The role of achievement with strategy use has a cogent history. Salomon (1979) suggests that a common pattern in many aptitude-treatment interaction studies can be explained by the difference between cultivation of a skill and activation of a skill. Skill activation is most effective for high-mastery students because they only need to be helped to activate existing skills. Skill activation is ineffective for students with low mastery because they cannot exercise non-existent skills. Furthermore, high-mastery students may suffer decrements in performance when forced to engage in a learning strategy because it interferes with existing and successful skills. Building upon the earlier work by Salomon (1979) and Clark (1982), Allen and Merrill's (1985) locus-of-processing continuum predicts that students with low aptitude for a learning task will profit most by directed strategies, whereas high aptitude students will profit most by self-selected strategies. Recently, Williams (1996) mentioned that such a strategy-selecting system has not been sufficiently tested. This study tests the locus-of-processing continuum through a text-based task.

Predictions

In this experiment, dependent variables reflect differences in three areas: 1) cognitive structure; 2) ability to generate examples; and, 3) task engagement. Consequently, what follows are predictions for each of these areas.

Concept Map Comprehensiveness

Concept maps were chosen to reflect the cognitive structure and knowledge organization of the content by the students. While it is predicted that the novice instructional design strategy will facilitate development of a more comprehensive concept map, it is uncertain as to the interacting roles of strategy, passage structure, and achievement.

In this study, students will brainstorm concepts and then organize them into a concept map. This approach is preferable to providing a list of concepts for mapping because it provides a picture of subjects' individual and idiosyncratic views of a content domain (Winitsky, Kauchak & Kelly, 1994). Following a constructivist conceptual framework, it is also not of interest how the concept maps compare in terms of the similarity of a student's concept map to that of an expert (e.g., Beyerbach, 1988;

Morine-Dershimer, 1991). In contrast, the students' individualized concept maps are of interest.

Example generation

An indicator of learning from instructional design is the learner's ability to generate examples in the content area. It is predicted that the novice instructional design strategy will facilitate example generation.

Synthesizing the research literature, Baylor (1997) derived the following components of instructional design as a cognitive problem-solving process: decomposition, transformation, evaluation, and revision. The first stage of instructional design is decomposition, where a person breaks down the initial problem into primary components and re-creates the structure of the problem. From Baylor's (1997) delineation of design stages, the second stage following decomposition is transformation of the design information into a mental model. Since part of the transformation process is generating information, it follows that one could generate ideas or examples in this stage. As Lehrer (1993) describes, transforming information into knowledge includes such processes as finding information, developing new information, selecting information, organizing information, and representing information. Consequently, example generation could reflect the extent to which the novice instructional designer has transformed the information.

It is also of interest how passage structure may influence example generation given that the information is text-based. As Simon (1973) explained, much problem solving effort of design is directed at structuring problems (i.e., the decomposition stage), and only a fraction of it at solving problems once they are structured (p. 187). If using a well-structured passage eliminates some of the need for the designer to restructure the design problem (the text) in the decomposition stage, the designer could focus on the next-level design stage of transformation which facilitates example generation.

Task engagement

In terms of task engagement, it is predicted that the learner will find instructional design to be more engaging than self-selected learning (where the learner learns the information in any way s/he chooses). The literature suggests that instructional design is supposed to be engaging (e.g., Lawson, 1980; Murphy, 1992) and that by working as instructional designers, students demonstrate more motivation and effort as well as implement higher order thinking skills (Carver, Lehrer, Connell, and Erickson, 1992).

The next section will discuss the experimental methodology developed for evaluating student novice instructional design of text-based content.

Research Design

The research design is a 2 x 2 x 2 factorial, with eight cells and approximately fifteen students in each of the eight conditions. The three factors are strategy (NID, self-selected learning (SSL)), passage structure (well-defined: operationalized as with headings and italicized concepts; ill-defined: without headings and italicized concepts) and level of achievement (high, low).

In the *self-selected learning* (SSL) strategy, students read the passage and learned the content in the passage however they chose. In the *novice instructional design* strategy, students read the passage and designed instruction for content in the passage. In both strategies, students could refer to the passage. Half of the students used a well-defined passage while the other half used an ill-defined passage. The main purpose of the experiment was to compare how designing instruction for text affects the following dependent variables: construction of a concept map; example generation; and, task engagement.

Methods

Participants

The sample includes one hundred and twenty-three general psychology students from a Southeastern community college that were randomly assigned to a treatment. Students represented a variety of fields and background experiences. The mean age was 25 years with a standard deviation of 8.4 years. Sixty-five percent of the students were female and thirty-five percent were male. Ethnicity was fifty-two percent White, forty-two percent African-American, and six percent other ethnic groups. Students from general psychology classes shared a similar syllabus, course objectives, and textbook. The study was implemented after the midterm of the semester so as to exclude those very low-achievers who were likely to drop the class without penalty. Students participated in the treatment activities either during their assigned class period or during one of three voluntary sessions held at other times. Since students were all from general psychology classes, they were prepared to comprehend the content of the passage used in this study given that it described developmental gender differences.

Procedure

After collecting informed consent forms, the researcher presented students with two booklets, a purple booklet containing a passage on gender differences and a yellow booklet containing experimental materials that differed according to treatment group (NID or SSL). The passage is approximately 2000 words in length. The passage is based on modified text regarding gender differences from a general psychology text (Weiten, 1995, pp. 462-467). The passage described actual cognitive and social differences, environmental origins of the differences (e.g., socialization), and the status of gender roles in transition.

After providing personal information including social security number, gender, and age, students were informed that they would be awarded extra credit points based on their overall effort in the study. Following this, students were given ten minutes to read the passage through one time. After ten minutes, students turned to page one in the experimental booklet. Students in the SSL strategy condition were instructed as follows:

> Referring to the passage, learn the content in the passage so that you can do well on an exam. You may write notes below.

Students in the NID strategy condition were instructed as follows:

> Referring to the passage, *plan how you will teach* the content in the passage to a classmate. Your goal is for your friend to learn the material as well as possible so that s/he can do well on an exam. You may write notes below.

All students were given ten minutes to either learn or prepare instruction, depending on their strategy. Both treatments provided incentive for the students to perform well. As listed in the instructions, the student anticipated an exam on the content for him or herself (in the SSL strategy condition) or anticipated an exam on the content for someone s/he would instruct (in the NID strategy condition).

Following this intervention, students were instructed to close the passage booklet and turn the page in the yellow booklet, where they were presented with the following two questions to elicit example generation:

> 1. List ways that you could encourage a male to acquire traditionally feminine characteristics.
>
> 2. List your ideas for characters for a children's television show who will discourage stereotypical gender differences. (For example, an older woman who is a mathematics expert.)

Students were given ten minutes to answer the two questions on this page.

After answering these questions, students listened to a lecture on creating concept maps and also viewed sample concept maps. Following this instruction, practice, and without referring to the passage, students were given ten minutes to draw a concept map representing the material that they read in the passage. The instructions for creating a concept map were adapted from Winitsky & Kauchak (1995):

> Please do not refer to the passage at this time. Create a concept map below to describe your understanding of the content in the passage. There are no 'correct' answers. What is important is that the map you construct reflects your thinking about gender differences. Please try to make your map as complete and as thorough as possible to provide an accurate picture of your thinking regarding the content.

Following ten minutes and the creation of this concept map, students answered questions regarding their curiosity about gender differences and task engagement. Other data that was collected include achievement data, which consisted of exam scores in psychology. This data was collected by social security numbers from psychology instructors of the participating students.

Note that a more detailed description of procedures, scoring, and reliability information is included in Baylor (1997).

Results

The following three sets of results will be discussed: 1) concept map comprehensiveness; 2) example generation of high achievers; and, 3) task engagement. As mentioned previously, each of these dependent variables was examined by a three-factor ANOVA (strategy: SSL or NID; passage structure: well-defined or ill-defined; and, achievement level: high, low).

The Complexity of Concept Map Comprehensiveness

It was predicted that there would be a complex relationship among the three factors (strategy, passage structure, achievement level) in influencing concept map comprehensiveness. Correspondingly, the results present a complex relationship of the factors.

As mentioned previously, concept maps were chosen to reflect the cognitive structure and knowledge organization of the content by the students. The analysis for overall concept map comprehensiveness is comprised of three components: the themes included, organization, and extensiveness of the concept maps.

First, the content of the concept maps was qualitatively assessed by determining whether three themes from the passage were represented. Second, in terms of logical organization, the concept maps were rated on a scale from one to four where four indicates a high level of organization. The scoring criteria are described in Baylor (1997). Third, concept map extensiveness was determined by counting the number of valid concepts on the concept map.

An overall concept map comprehensiveness score was determined by taking themes, organization, and extensiveness into account. The mathematical formula to obtain this score weighs the three factors relatively equally: (concept map overall score) = (extensiveness) + (organization × 10) + (10 points for each of the three themes that is represented). This overall score served as the dependent variable for a three-way (strategy × passage structure × achievement) between-subjects analysis of variance.

Interestingly, there was a 3-way interaction of strategy, passage structure, and achievement [$F(1,103)=4.27$, $p<.05$], as shown in Table 1. There was also a main effect for achievement which would be expected (i.e., that high achievers score higher than low achievers) and is not of interest. The three-way interaction, with the means listed in Table 2 and shown graphically in Figure 1 indicates that low achievers develop better concept maps in the well-defined passage with the SSL strategy, and in the ill-defined passage with the NID strategy. For high achievers, the reverse is true: they developed slightly better concept maps in the ill-defined passage with the SSL strategy and in the well-defined passage with the NID strategy. But what does this *mean*?

Building upon earlier work by Salomon (1979) and Clark (1982), Allen and Merrill's (1985) locus-of-processing continuum would predict that students with low aptitude for a learning task will profit most by directed strategies, whereas high aptitude students will profit most by self-selected strategies. With the addition of passage structure as a third factor, it provides an interesting twist for interpretation in terms of the locus-of-processing continuum.

First recall that the significance of a three-factor interaction indicates that the simple interaction effects of two variables are not the same at different levels of the third variable (Keppel, 1991, p.427). In this case, we will consider the effects of passage structure and achievement at different levels of strategy (NID, SSL).

While studying Figure 1 (and after priming your extra working memory stores), first examine the SSL strategy where students were directed to apply their own strategy to learn the content in well- and ill-defined passages. Interestingly, high achievers have nearly equivalent concept map comprehensiveness score for both the well-defined (X=60.05) and ill-defined (X=61.93) passages. Low achievers, on the other hand, create better concept maps when they were provided with the well-defined passage (X=53.00

vs. 47.33). The better performance for the low achievers in the well-defined passage may be because the textual organizational cues facilitated their usual organization of the text.

The case of the NID strategy is an interesting corollary. Here, the high achievers create better concept maps (*X*=61.71 vs. 50.19) in the well-defined passage. Perhaps with the text figuratively "prepped" for forming an instructional design organization of the material, the high achievers naturally took advantage of the textual cues in implementing instructional design as a learning strategy. The low achievers, on the other hand, developed better concept maps when given the ill-defined passage (*X*=53 vs. 41.07), indicating that they were not savvy enough to recognize the passage structure cues as being relevant to instructional design.

Moving from viewing a glimpse of the cognitive structure of the students, the next section will discuss the performance of the students in terms of example generation.

Example Generation Trend for High Achievers

It was predicted that NID would facilitate example generation. However, the results paint a more complex picture when focusing on the high achievers.

Three two-way ANOVAs with strategy (SSL, NID) and passage structure (well-defined, ill-defined) as the two factors were executed for all three dependent variables involving example generation. While there were no statistically significant results for the total group or for the low achievers as a group, there were interesting findings for the subset of high achievers. For the higher achievers, all three ANOVAs had significant interaction effects of strategy and passage structure: 1) generating socialization strategies [$F(1,65)=5.80$, $p<.05$]; 2) generating gender-sensitive television characters

[$F(1,65)=7.80$, $p<.01$]; and, 3) example generation total, a composite of the prior two scores, [$F(1,65)=4.90$, $p<.05$]. The means are listed in Table 3 and a sample interaction figure is included in **Error! Reference source not found.**.

Recall again that these example generation analyses were performed on high achievers only (N=69) and adjustment to alpha was made (alpha=.017) for the three tests. These results continue to highlight the role of *passage structure* as it relates to the two tasks of SSL and NID. In considering the high achievers, it is assumed that they would be more strategic than the low achievers when given a particular combination of strategy and passage. Notably, in all three cases of example generation, high achievers generated the most examples in the SSL strategy with the ill-defined passage and in the NID task with the well-defined passage. This suggests that the structure of the well-defined passage facilitated example generation for NID but was detrimental for SSL. Perhaps in the self-selected learning strategy, subjects were more likely to generate examples if they had to *impose* a structure on the text (i.e., through evaluating the ill-defined passage). In contrast, for the NID task, example generation was facilitated when the student was provided with more textual structure.

The example generation findings indicate that the well-defined passage was beneficial for NID, but detrimental for SSL. One explanation could be that the designer “borrows” structure provided by the headings and italicized concepts and then examples “fit” this structure which is reinforced through the design process. With respect to the cognitive task of summarization, Kintsch (1990) found that college students did better at the summarization task when the text was poorly structured, implying that students benefit from deeper processing to impose structure on the text. Since instructional design is another cognitive process that requires the student to impose structure on material, possibly this finding on summarizing could be extended to include instructional design as well.

As Simon (1973) explained, much problem solving effort of design is directed at structuring problems (i.e., the decomposition stage), and only a fraction of it at solving problems once they are structured (p. 187). An explanation following this would be that using the well-defined passage eliminated some of the need for the designer to restructure the design problem (the text) in the decomposition stage; consequently, the designer could focus on the design stage of transformation, which is a higher-order task. From the perspective of SSL, it may be better for him/her to create a personalized structure of the textual information. Or, perhaps the self-selected learner finds the well-defined passage structure to be distracting while s/he is trying to learn the textual content, and interfering with his/her ability to generate examples.

The next section will move from evaluating performance to evaluating perceived engagement of NID and SSL by the students.

Low Achievers More Engaged By Instructional Design Task

It was predicted that those using the novice instructional design strategy would report the task as more engaging than those in the self-selected learning strategy. However, the results indicate to the contrary for the high achievers.

A three-way (strategy, passage structure, achievement) between-subjects ANOVA was performed to determine what factors influence task engagement scores for the treatment task. There was a significant interaction of strategy and level of achievement ($F(1, 115)=6.57$, $p=.01$). Interestingly, the two-way interaction indicates that low achievers reported more engagement in the NID task and high achievers reported more engagement in the SSL task.

Perhaps the high achievers saw this role of "instructional designer" as distracting and tedious in comparison to their preferred ways of learning. In contrast, the "role playing" aspect of instructional design may have appealed to the low achievers. In other words, perhaps the low achievers were less accustomed to finding success and positive affect in school tasks (e.g., Kagan, 1990), and were thereby more intrigued by the fantasy, novelty, sociability, and power associated with instructional design. Allen and Merrill's (1985) model would also predict that high achievers would prefer SSL strategies because it would facilitate them in *choosing* their preferred learning strategy.

Even so, designing is supposed to be *overall* more engaging (e.g., Lawson, 1980; Murphy, 1992) and there was no evidence through a main effect that students preferred the design task over the other experimental tasks. There are two reasons why it may not have been engaging in this study. First, the literature indicates that one relevant factor may be situating the designing task in a technological environment (e.g., Harel, 1991; Kafai, 1995). In a technological environment the design task is more complex and with feedback it may be more motivating. Second, students were not focused upon the instructional design product (i.e., artifact) that they created in this study. The literature shows that creating an artifact can be a motivating process for the designer as the designer addresses an unseen audience (e.g., Guzdial, 1995).

Conclusions

The main contribution of this study is in terms of methodological development. Since this was the first experimental study to examine learning from text through instructional design, a methodology for textual processing was developed that can be built upon for future research in this field.

Overall, the findings demonstrate the complexity of the role of passage structure and achievement with novice instructional design in the following three areas: concept map comprehensiveness, example generation, and task engagement. First, concept map comprehensiveness, as it represents cognitive structure, indicates that mental models are influenced by achievement level and passage structure, together with strategy. Second, in terms of example generation, only higher achievers were considered. As predicted by Allen & Merrill's (1985) locus of processing model, the well-defined passage hindered example generation in the SSL strategy condition, while facilitating it in the NID strategy condition. This was found with all three example generation measures. Third, in terms of task engagement, it was found that the low achievers preferred the NID task whereas high achievers preferred the SSL task.

Given that the main task in this study involves instructional design of *text*, it is important to consider the effects of the textual organization, or passage structure. Based on textual organization literature, it would have been expected that the well-defined passage would facilitate performance in *both* strategies (NID, SSL). The lack of a main effect for passage structure together with the series of interactions with passage structure is significant in that it suggests that the role of passage structure is complex.

Several qualifications for the research results should be considered. First, the lack of main effects should be noted. However, it is not surprising that there were no main effects -- they were not really expected given the complexity of the situation. In future research, these questions may be better explored through multivariate analysis.

Second, it is important to note that concept maps may only provide a glimpse of a person's cognitive structure and may not be necessarily representative of a person's mental model. Third, together with limitations in assessing knowledge structures, the text-based instructional design task in this study was most likely not complex enough to elicit extensive problem solving. Future research could include a richer source of material, such as technology or other media, and perhaps creating an artifact. Of course, this study highlights the limitations of an experimental approach; while it allows for more control it sacrifices in terms of ecological validity. While it may be more ecologically valid to use a richer design task, it would be more difficult to study it experimentally. Fourth, these findings warrant replication, even with the large sample size in this study.

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Table 1. ANOVA Summary Table for Overall Concept Map Score

Source	***df***	***SS***	***MS***	***F***
Strategy	1	454.34	454.34	1.19
Passage Structure	1	19.38	19.38	.05
Achievement	1	2648.80	2648.80	6.93**
Strategy × Passage Structure	1	29.94	29.94	.08
Passage Structure × Achievement	1	429.92	429.92	1.12
Strategy × Achievement	1	24.83	24.83	.06
Strategy × Structure × Achievement	1	1633.81	1633.81	4.27*
Error	111	42422.11	382.18	
Total	118			

*p<.05, **p<.01

Table 2. Mean Concept Map Comprehensiveness Scores

Variable	***SSL Strategy*** *N*	*Mean*	*SD*	***NID Strategy*** *N*	*Mean*	*SD*
Ill-defined passage						
Low achievers	15	47.33	16.18	15	53.00	12.56
High achievers	14	61.93	24.32	16	50.19	20.02
Well-defined passage						
Low achievers	7	53.00	25.04	14	41.07	18.28
High achievers	21	60.05	21.33	17	61.71	18.78

Table 3. Mean Example Generation Question 2 Scores for High Achievers

	SSL			NID		
Variable	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*
Generate socialization strategies						
Ill-defined passage	14	5.43	2.59	16	2.69	1.74
Well-defined passage	22	4.09	1.54	17	4.00	3.04
Generate television characters						
Ill-defined passage	14	6.64	4.22	16	4.31	2.75
Well-defined passage	22	4.91	4.32	17	6.59	3.14
Total example generation						
Ill-defined passage	14	12.07	5.69	16	7.00	3.58
Well-defined passage	22	9.00	4.89	17	10.59	5.22

Figure 1. Three-way Interaction of Strategy, Level of Achievement, and Passage Structure for Concept Map Comprehensiveness

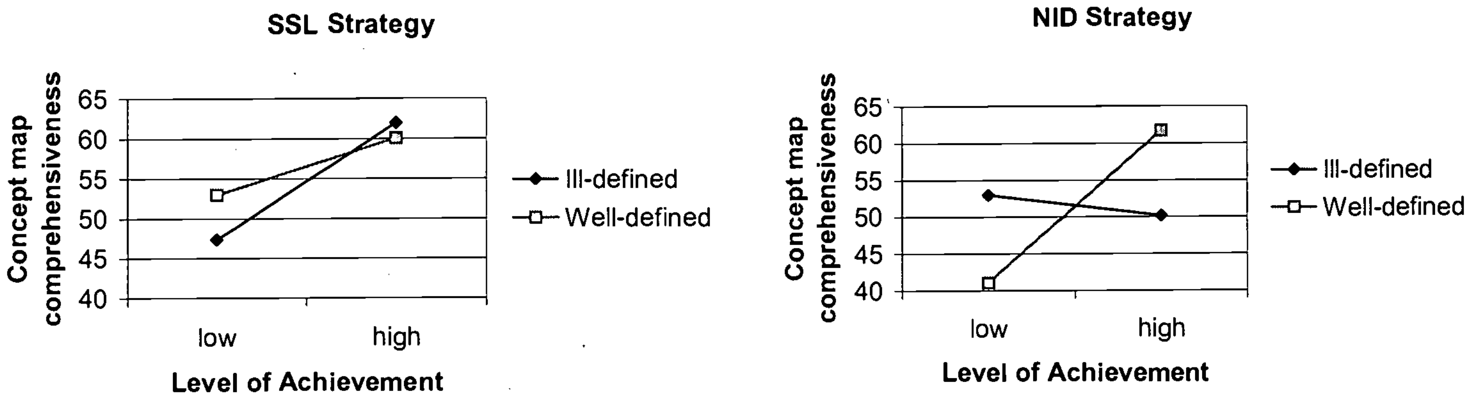
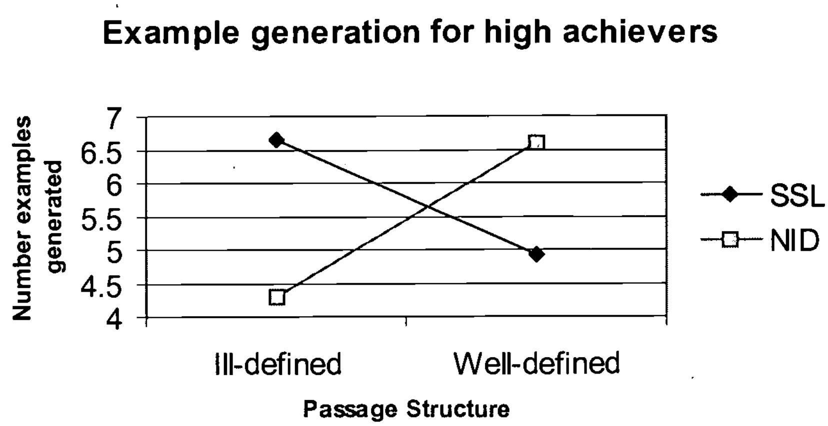


Figure 2. Example of Three-way Interaction of Strategy, Level of Achievement, and Passage Structure for Example Generation Question 2



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Organization/Address: Florida State University, College of Education Stone #307 Tallahassee, FL 32306	Telephone: 850-644-5203	Fax: 850-644-8776
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