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Constructivist or expository instructional approaches: Does instruction have an effect on the accuracy of Judgment of Learning (JOL)?

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Abstract: This study extrapolated from Liberman's (2004) calibration model and Kimball and Metcalfe's (2003) conceptualization in order to evaluate students' judgment of learning (JOL) of material presented in either an expository or a constructivist format. The purpose of this study was to determine if students have differing degrees of JOL based on the format of the instruction, and if JOL is related at all to the level of knowledge obtained. According to the results of this study, there was no significant difference between the test scores for the students in the traditionally taught lesson (expository approach) and the classes which utilized the team taught discovery approach. Additionally, there was no significant difference between the two groups concerning their judgment of learning.

Key Words: Judgment of Learning, Constructivism, Metacognition.

I. Introduction.

The quest to investigate constructivist teaching and learning began as part of a discussion between two professors concerning products developed by students within their classes. Students within the 300 level teaching methods course were asked to produce lesson plans specifically designed to build upon material learned in a prerequisite program course. This material consisted of *conceptual learning* or teaching concepts (such as addition and subtraction). Previously conceptual learning had been incorporated into a 200 level Educational Psychology course and it was expected that students would be able to apply their understanding by constructing conceptual learning lessons in educational methods courses that occur later in the program. But this was not occurring. It was identified that elementary education students enrolled in a teacher education program were unable to successfully develop *conceptual* lessons and consistently produced primarily factual and skill level lessons. Realizing the disconnect within the program, an attempt was made to help bridge the gap by abandoning the lecture or expository teaching approach for the conceptual learning lesson and implementing a discovery or constructivist team-teaching approach (Sigler and Saam, 2006). This previous research demonstrated the constructivist-based lesson was successful in helping students understand how to apply conceptual learning within their lesson plans and curriculum units.

The pursuit to understand the full potential and limitations of constructivist teaching and learning continues in this current line of research. Using this same constructivist-based team-taught lesson and comparing it to the traditional expository lesson, this study investigates how well students understand the given material taught under these two formats. More importantly, we also evaluated how the teaching strategies affect students' ability to monitor their own learning process.

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II. Background.

The constructivist learning approach emphasizes the role of the learner as an active participant in the learning process (Woolfolk, 2005). This is more than simply allowing students to observe or participate in the activity, but forces them to become self-directed learners (Snowman and Biehler, 2000) and discover aspects of research, concepts or ideas on their own (Cruickshank, Bainer, and Metcalf, 1999). In a constructivist-driven classroom, the teacher provides opportunities for students to investigate and debate. On the other hand, the expository approach to learning refers to the transmission of information from expert to novice (Ormrod, 2005). In expository instruction “the teacher is the source and the owner of knowledge” (Martin, 2003, p. 207). Instructors using expository methods dominate the presentation of lessons and use strategies that include lectures, demonstrations, and videos (de Jong, van Jooligen, Swaak, Veermans, Limbach, King, and Gureghian, 1998).

To illustrate this idea, an expository lesson on *commas* may include a Power Point presentation with a slide to include the use of commas, the rules of commas, and the common mistakes using commas. Students would take notes and study these notes for a criterion-referenced test or be expected to use the notes in an applicable writing exercise. A constructivist lesson on *commas* may include students working in groups discussing a paragraph provided by the teacher with no commas, and determining on their own the difficulty interpreting its meaning. Through these investigations, students begin to reveal for themselves the need and usefulness of commas.

Constructivism is not a new concept in education. Its premise stems from the works of Dewey, Piaget, Vygotsky, and Bruner (Driscoll, 1994; Snowman and Biehler, 2000). The value of *constructing* ones’ knowledge has become more evident as instructional strategies move away from rote memorization and toward actively engaging students in the learning process (Ormrod, 1999). Much of the current research dedicated to the development of teaching techniques and learning strategies suggest employment of constructivist or discovery learning approaches to promote meaningful learning and student success (Chambliss and Calfee, 1989; deCapriariis, Barman, and Magee, 2001; Jungst, Licklider, and Wiersema, 2003).

However, research also indicates that although students gain meaningful learning when presented material in a constructivist format, they may encounter difficulty with this method, specifically in regulating their own learning process (Charney, Reder and Kusbit, 1990; de Jong, et al. 1998; Veermans, de Jong, and Joolingen, 2000; Winter, Lemons, Bookman, and Hoese, 2001). That is, the students are required to plan and monitor their activities at a more sophisticated level than required for the more traditional expository approach. In essence, students may need better metacognitive skills in order to gain the desired outcomes from a lesson designed with the constructivist approach.

Flavell (1979) described metacognition as the concept of knowing about knowing. Metacognition is a term that refers to not only one’s knowledge, but also one’s ability to monitor, control and regulate the learning process (Akama and Yamauchi, 2004; Swanson, Hoskyn, and Lee, 1999; Tobias, Everson, and Laitusis, 1999). It is clear that learning about the basic mechanisms of an individuals’ metacognitive behavior will lead to the creation of methods to help improve the learning process (Tobias and Everson, 1997). Furthermore, if students are gathering meaningful information through discovery learning, yet are still encountering problems, it seems important to evaluate the execution of this monitoring process.

Recent studies (Liberman, 2004; Kimball and Metcalfe, 2003; Garavalia and Gredler, 2002; Tobias, et al. 1999, Tobias and Everson, 1997) have attempted to evaluate the process of knowledge monitoring by using a variety of methods that require individuals to estimate their "feeling-of-knowing" (Hart, 1965). Kimball and Metcalfe (2003) use *judgments of learning* or JOL's to estimate an individual's ability to judge the extent to which they have learned particular information. In this instance, individuals were asked to make a JOL, after memorizing a list of target words. Their JOL was an indication of how many words they would remember after a period of time. Liberman (2004) uses the notion of *calibration*, and as with the previous study, participants were asked to make some judgment of the success in the learning endeavor by "indicating their confidence of being correct for each answer" (p.729) after taking a multiple-choice test. Tobias and Everson (1997) used a *knowledge monitoring assessment* or KMA to determine how accurately participants monitor the learning process by recording the discrepancy between their actual knowledge and their knowledge estimate. Although in each one of these studies the ability of the participant to evaluate their own learning was in question, the reasons for obtaining this information varied greatly.

This study extrapolated from Liberman's (2004) calibration model and Kimball and Metcalfe's (2003) conceptualization in order to evaluate students' judgment of learning (JOL) of material presented in either an expository or a constructivist format. The purpose of this study was to determine if students have differing degrees of JOL based on the format of the instruction, and if JOL is related at all to the level of knowledge obtained.

III. Methods.

A. Participants.

All participants in this study were students enrolled in a general educational psychology course, at a small mid-western university across four semesters (2 year time frame). One section of this class was offered each semester. There were 31 students in the fall 04 group, 35 students in the spring 06 group, 36 students in the fall 05 group and 34 students in the spring 06 group. These students were either freshman or sophomores and were taking this class to fulfill the requirement as a component of a teacher education program. Students across all sections were enrolled in the same curriculum and covered the same topics throughout each semester.

B. Intervention.

The educational psychology course utilized in this study was a 200 level class that covered a variety of topics at an introductory level. One topic covered in this course was Knowledge Construction, which described the means by which children develop concepts about the world around them. The material presented in the class was designed for pre-service teachers and required the students to have knowledge, comprehension and application of terms and ideas brought fourth in the curriculum.

For the control group, students were given a lesson in a lecture format (expository approach). They were given terms explaining concepts which included *feature lists, exemplars, prototypes and schemas*. These terms are part of the curriculum for the unit under review. As part of the lecture, students were given definitions and examples of terms. They were given the opportunity to ask questions and discussion was permitted but not part of the format of the lesson.

The intervention consisted of a team taught lesson, utilizing the educational psychology and methods professors and implementing the discovery approach to learning (constructivist approach). For these classes, students were placed in groups and given various household items, such as a hairbrush, a spoon and a ball. Each group was to imagine how they would describe the purpose, function and characteristics of their item to a person who had lived many centuries ago. After a few minutes of group discussion, each group presented their ideas to the class. Afterward, the instructors demonstrated how those ideas constructed by the group could be characterized as *feature lists, exemplars, prototypes and schemas*; allowing for the students to discover how their ideas naturally fell within the categories as defined by the text.

Next, as part of the intervention, students were also shown the demonstration discussed in Sigler and Saam (2006). This was a "mock" elementary school lesson, which demonstrated a skills-approach arithmetic lesson and utilized a symbolic numeration system foreign to the candidates. In order to do this a basic, base-ten numeration system was developed that consisted of unfamiliar symbols instead of the well-known Arabic system. This system used the Wingding font (Microsoft, 2000) and simply replaced each number in the base-ten system with a symbol.

After the presentation, the students were then "debriefed". It was explained that their frustration with the Wingding system is similar to the frustration school children have when teachers teach only the skill of addition and not the concept of addition. This was then connected to the main point of the lesson, which was the discussion of the forms of conceptual learning.

C. Procedure.

This study took place over four semesters. For two semesters the students enrolled in the 200 level course received the traditional course format (control) and for the other two semesters students received the intervention.

During each semester, following the lesson, the students were given a 25-item multiple-choice exam that covered material from the lesson presented. These test items were taken from the test bank that accompanied the text (Ormrod, 2003). Students were asked to answer each multiple-choice question as usual by circling the letter of the chosen response. Following each multiple-choice question, the students were asked to make a JOL based on their confidence of responding to that question correctly. Each student responded to each multiple-choice question by circling *yes* when in their judgment they responded correctly or *no* when in their judgment they may have not responded correctly.

IV. Results.

For each student a test score and a JOL score was calculated. The test and JOL scores were derived from scoring the individual items dichotomously (either right or wrong) and then totally the scores for each student. For the JOL scores, regardless of whether or not a student answered a question correctly, the student received a JOL point based on the correctness of that judgment, not the specific answer. That is, if students answered the question correctly, and indicated that in judgment the answer was indeed correct, then they would receive a positive score. By the same token, if they answered the question incorrectly, and identified that they judged it to be incorrect, that would also receive a positive score. A score of zero was received for incorrect judgments, even if the actual test item was correct. Table 1 demonstrates the means for the test scores and JOL scores for both groups, separated also by semester.

Table 1.Means scores for classes.

Semester	Classification	Mean Test Score	Mean JOL Score
Fall 04	Control	16.00	17.55
Spring 05	Intervention	17.26	17.34
Fall 05	Intervention	15.42	15.89
Spring 06	Control	15.91	16.79

Although there does seem to be a slightly higher mean score overall for the students within the control group, the ANOVA demonstrated no significant difference between the score of students who received the intervention, and those who did not (Table 2).

Table 2. ANOVA of both test scores and judgment scores for all groups.

		Sum of Squares	df	Mean Square	F	Sig.
Test score	Between Groups	4.648	1	4.648	0.366	0.546
	Within Groups	1700.411	134	12.690		
	Total	1705.059	135			
JOL Score	Between Groups	10.198	1	10.198	1.134	0.289
	Within Groups	1205.419	134	8.996		
	Total	1215.618	135			

However, there does appear to be a significant correlation between the test scores and the judgment of learning scores for both groups (Table 3).

Table 3. Correlations between test scores and JOL Scores.

		Test Score	JOL Score
Test Score	Pearson Correlation	1	0.610(**)
	Sig. (2-tailed)		0.000
	N	136	136
JOL Score	Pearson Correlation	0.610(**)	1
	Sig. (2-tailed)	0.000	
	N	136	136

** Correlation is significant at the 0.01 level (2-tailed).

Table 4. Means and Standard Deviations for combined groups.

	N	Minimum	Maximum	Mean	Std. Deviation
Comp	136	3.00	14.00	8.4485	2.55841
Application	136	4.00	11.00	7.6985	1.56971
Comp JOL	136	4.00	13.00	8.8897	2.22335
Application JOL	136	4.00	11.00	7.9779	1.52251

Table 5. Intervention ANOVA for comprehension and application questions.

		Sum of Squares	df	Mean Square	F	Sig.
z –scores comprehension	Between Groups	0.299	1	0.299	0.298	0.586
	Within Groups	134.701	134	1.005		
	Total	135.000	135			
z-scores application	Between Groups	0.232	1	0.232	0.231	0.632
	Within Groups	134.768	134	1.006		
	Total	135.000	135			
z-scores comprehension JOL	Between Groups	2.425	1	2.425	2.451	0.120
	Within Groups	132.575	134	0.989		
	Total	135.000	135			
z-scores application JOL	Between Groups	0.031	1	0.031	0.031	0.861
	Within Groups	134.968	134	1.007		
	Total	135.000	135			

Table 6. Class ANOVA for comprehension and application questions.

		Sum of Squares	df	Mean Square	F	Sig.
z –scores comprehension	Between Groups	6.255	3	2.085	2.138	0.098
	Within Groups	128.745	132	0.975		
	Total	135.000	135			
z-scores application	Between Groups	1.313	3	0.438	0.432	0.730
	Within Groups	133.688	132	1.013		
	Total	135.000	135			
z-scores comprehension JOL	Between Groups	7.778	3	2.593	2.690	0.049
	Within Groups	127.223	132	0.964		
	Total	135.000	135			
z-scores application JOL	Between Groups	1.739	3	0.580	0.574	0.633
	Within Groups	133.260	132	1.010		
	Total	135.000	135			

After some continued analysis, it was proposed that the questions on the 25-item test were indeed broken down into two areas, as identified by the test bank. Some of the questions were knowledge and comprehension questions, inferring lowing level processes, and others were application questions, requiring higher level processes. Therefore, the tests were further broken down into subparts, looking at the relationships between these thinking processes and the intervention. Table 4 shows means and standard deviations for the combined groups looking at the comprehension and application questions. Since there were differing numbers of questions in both of these areas, z-scores were derived to standardize the scores on the individual subparts. This was done using the intervention as the factor. The ANOVA for this assessment can be seen in Table 5. There were no significant differences found.

An ANOVA was also run to determine if there were significant differences looking at the factor of class and not just intervention. There were also no significant differences found (Table 6).

V. Discussion.

The purpose of this study was to determine if students have differing degrees of JOL based on the format of the instruction, and if that JOL is related at all to the level of knowledge obtained. According to the results of this study, there was no significant difference between the test scores for the students in the traditionally taught lesson (expository approach) and the classes which utilized the team taught discovery approach. Additionally, there was no significant difference between the two groups concerning their judgment of learning either. Even when scores were evaluated on a class by class basis, there was still no statistically significant difference.

However, test scores were significantly correlated to the JOL scores. This indicates that those students who demonstrated greater ability on the multiple choice exam also demonstrated greater metacognitive skills in terms of there judgment of learning, despite the intervention.

Ormrod (2006) indicated that expository approach may be the best method for teaching knowledge and comprehension material and discovery or constructivist approach as being a better method for application. With that in mind, utilizing the test bank information which classified questions as knowledge and comprehension or application, further analysis was accomplished, but still showed no significance in terms of the intervention.

It does appear that the method by which this information was taught did not effect the test scores or the students' ability to judge their level of accuracy. This may be due to several things. First it may have more to do with the type of information presented, as opposed to the instructional method.

The course material, by its very nature, in an introductory class requires lower level thinking skills, as it is mostly vocabulary and basic theoretical constructs. The lack of significance may be attributed to the fact that the material itself, regardless of the intervention and the way it was assessed (through a multiple choice test) did not lend itself to a natural differentiation in the test and JOL results between the control and the intervention classes.

Another possible cause of the lack of significance may be attributed to the reliability of the test. The Cronbach alpha shows fairly low reliability for the test scores and even lower reliability for the JOL scores. The Cronbach Alpha was 0.63 for the multiple choice test. The Cronbach alpha for the JOL assessment was only 0.468. Since the item inter-corrections are low, this casts doubt as to whether we are actually measuring a homogeneous construct. It was hoped that utilizing a developed test bank would eliminate this problem, but it does not appear to be the case. This, in it of itself, may be the reason why the results were not significant.

It might also be important to note that the test itself was an extra credit assignment and not part of the course grade. Students received credit for participating in the study, regardless of the scores on the test. Therefore, the possibility exists that the students lacked serious preparation concerning the material.

If indeed the results of are study do accurately portray the realistic outcomes and there is really no difference with the instructional methodology in terms of learning and JOL, it is still important to note, albeit anecdotally, that the students in the discovery intervention were more engaged, active and participatory in the learning process. Additionally, the time it took to construct such a lesson was minimal, therefore not prohibitive in terms of instructor time and commitment.

VI. Conclusion.

Based on the results of this study there does not appear to be a significant difference in the mode of instruction in terms of test performance and JOL for this particular topic. However, there are still many unanswered questions concerning the constructivist approach in terms of the college classroom. The limitations of this study may have prevented an accurate assessment of the differences between the two methods of instruction. First, the reliability of the assessment instrument should be improved, to create a better indicator of student learning. In addition, creating a course assessment that will also serve as a research assessment, one that is a genuine task assessment, may also improve and help clarify results. Lastly, it seems important to match the assessment to the instruction. For example, expository approach traditionally uses assessment techniques such as multiple-choice and true false items, while constructive approach normally uses project based, alternative and embedded assessment strategies. With these changes, the differences between the instructional technique and the students' metacognitive abilities will be more closely linked.

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