

Axtell, K., Maddux, C., & Aberasturi, S. (2008). The effect of presentation software on classroom verbal interaction and on student retention of higher education lecture content. *International Journal of Technology in Teaching and Learning*, 4(1), 21–33.

The Effect of Presentation Software on Classroom Verbal Interaction and on Student Retention of Higher Education Lecture Content

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The purpose of this study was to investigate whether there was a difference in student recall of information or in student verbal interaction after lectures using PowerPoint versus the same lectures featuring two traditional lecture formats (lecture with overhead transparencies and lecture without visual presentation aid). The results showed that the method of material presentation does affect students' retention of the information as measured by a multiple-choice quiz over lecture content. A one-way repeated measures ANOVA was conducted on students' quiz scores. Results of the analysis indicated that lectures presented by PowerPoint slides were more effective in terms of student retention than the other two formats: lecture with overhead transparencies or lecture without visual aids. There was no difference by presentation format in student duration or frequency of interaction.

Keywords: Presentation software, student retention, PowerPoint presentation, the effect of presentation software, higher education, and visual aids presentation

INTRODUCTION

The use of technology is becoming increasingly popular as a teaching and learning tool in education. Presentation software has become an accepted lecture aid in higher education and is frequently used to visually present the main points of classroom lectures.

At present, PowerPoint is the best-known and most popular presentation software. It is included in the Microsoft Office Suite, which makes it widely available and cost effective

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(Newby, Stepich, Lehman, Russell, 2000). As a result of these and other advantages, PowerPoint presentations have become a popular way of presenting information to audiences of all kinds, and are rapidly becoming the standard for academic presentations.

REVIEW OF LITERATURE

Microsoft estimates that there are now over 30 million PowerPoint presentations a day and that the software is installed on 250 million computers worldwide (Amare, 2004). Peluchette and Rust (2005) investigated preferences of faculty members for presentation aids to supplement lectures and found that by far the most popular in higher education was the combined use of PowerPoint along with use of a traditional blackboard or whiteboard. PowerPoint has become so popular and so ubiquitous, that it is rapidly replacing traditional presentation tools such as transparencies projected with an overhead projector (Yaworski, 2001).

The wide acceptance of PowerPoint is due to its many advantages. Screens with great complexity and high visual appeal can be produced quickly and easily. Graphics that have been scanned from traditional media or copied from the Internet can be combined with text or other material. The ability to make use of multimedia materials may make it easier for instructors to address different learning preferences and styles (Daniels, 1999). Further, research suggests that student attention is enhanced if information is presented in more than one modality (Mayer & Anderson, 1992; Mousavi, Low, & Sweller, 1995).

In the classroom setting, PowerPoint is often used as a lecture aid for visual support of oral presentations or lectures, and supporters suggest it can help ensure that the main points of a lecture are clearly made. According to Yaworski (2001), PowerPoint helps speakers organize their thoughts and present them in a clear and concise manner while using multi-sensory tactics to hold audience attention.

Not everyone is positive about the use of PowerPoint in education. Chapman (2003) suggests that PowerPoint is not engaging enough or interactive enough to be useful in education, although he presents no research to support this claim. Another major critic of presentation software is Tufte, a Yale professor and author of the graphic design book *Envisioning Information* (1991). Tufte (2003), in an article entitled "PowerPoint is Evil," says the slides may help speakers outline their speeches, but suggests there are many properties of PowerPoint that may actually reduce the understandability of the content. First, Tufte suggests that low resolution of many computer displays may distort tables and charts or make them illegible. Second, he suggests that the widespread use of bulleted lists in PowerPoint slides may suppress creative and critical thinking about lecture content since students may be led to think in the same order as the order in which major points are listed. Tufte also points out that students may be forced to view bad typography and poor chart layout made by presenters who are poor designers. Further, he maintains that some presenters select poorly-designed templates that distract audiences from the content of lectures. Another problem according to Tufte is that many presenters include too much text on each slide and include distracting animated, point-to-point transitions. Tufte (2003) concludes that PowerPoint is more useful for guiding and supporting a presenter than for helping students to understand and retain lecture material.

Tufte (2003) has strong opinions, but there is little research testing PowerPoint's effect on learning processes such as classroom verbal interaction or on outcomes such as retention. A few studies have compared effects of PowerPoint use to use of other, more traditional presentation aids, typically overhead transparencies shown with an overhead projector. However, these studies used student satisfaction or student attitudes, rather than student outcomes such as verbal interaction or retention as dependent variables.

Results of such studies typically show that students tend to prefer lectures with PowerPoint to lectures with overhead transparencies.

It goes without saying that good teaching is not simply presenting content to students, but must foster students' connections to content and promote student retention of facts and concepts (Mason & Hlynka, 1998). Also critical is the effect of any teaching aid on verbal interaction between students and the instructor, or students with other students. In fact, verbal interaction is considered highly desirable by most instructors, and discussion is generally believed to enhance understanding and retention (Diaz-Rico & Weed, 1995; Kryspin & Feldhusen, 1974; Richards & Rodgers, 1986). Further, Flanders (1970) and (Flanders & Morine, 1973) found that the frequency of student talk is positively related to student achievement. It may be that this is true because students in classrooms where there is much verbal interaction are more involved with all the learning activities than are students where discussion is limited (Flanders, 1970; Flanders & Morine, 1973). Maddux, Johnson, & Willis (2001) agree and argue that students learn best when they are actively constructing new knowledge. Maddux et al., (2001) define Type II technology applications as the applications that place the control with learners and involve them actively and intellectually. Presentation software can be considered a Type II technology application if its instructional use stimulates active intellectual involvement and provides opportunities for spontaneous and open-ended verbal interaction (Maddux et al., 2001). However, there has been no research on the effect of any presentation aid on classroom verbal interaction.

In summary, research has not addressed whether PowerPoint improves student retention of facts and concepts presented in a lecture, or whether PowerPoint stimulates, depresses, or has no effect on classroom verbal interaction. The purpose of the present study was to investigate whether there is a difference in written recall of information (as a measure of retention) and in classroom verbal interaction after a lecture with main points presented visually in PowerPoint versus two, more traditional lecture formats with identical content.

METHOD

PARTICIPANTS

The participants in this study were 71 undergraduate students enrolled in an educational psychology course in a teacher education program in a large, Land Grant institution in the western United States. Sixty-two percent of the participants were female ($n = 44$) and 38% ($n = 27$) were male. The participants' ages ranged from 18 to 57 years. However, more than half of the participants were 20 to 22 years of age. Almost forty-eight percent, (47.9%, $n = 34$) completed some college but did not graduate, and 40.8% ($n = 29$) were high school graduates. Of the 71 participants, 81.7% ($n = 58$) were Caucasian, 9.9% ($n = 7$) were Hispanic, and 8.5% ($n = 6$) selected the "other" category. English was the primary language of the majority of participants. Spanish was the primary language for two participants.

PROCEDURES

Scripts for three different, 40-minute lectures were developed by the researchers and all three lectures were delivered to three different groups of students (Class A, Class B, and Class C). Lecture topics were: (a) B.F. Skinner and Operant Conditioning, (b) Pavlov and Classical Conditioning, and (c) Bandura and Social-Cognitive Theory.

No research was found investigating exactly how PowerPoint is used as a lecture aid. However, from discussions with other educators and from the researchers' own experience, lecturers most commonly use PowerPoint to present a visual outline of major points of a lecture. Therefore, in the PowerPoint group, the lectures were supplemented with PowerPoint slides listing main points using colored texts, non-animated graphics, and animated transitions from point to point.

Each of the three groups received identical lectures, each lecture with a different format: (a) lecture supplemented with PowerPoint slides containing main points brought up one by one as they were introduced; (b) lecture with overhead transparencies containing the same lecture main points uncovered one by one as they were introduced; and (c) lecture without visual presentation aid. All three, 40-minute lectures were delivered to each group during one, 150-minute class, and all students were told they would be tested on all three topics at the end of the class. Both lecture topic and presentation format were counterbalanced to control for order effect. Thus, each group received all three topics and all three presentation formats, and all topics were presented in each of the three presentation formats. Figure 1 details the double counterbalancing of lecture topic and presentation format. The lectures were all delivered from a standardized script by the same instructor who holds a Ph.D. in educational psychology and currently teaches undergraduate and graduate courses.

Figure 1. Double counterbalancing of lecture topic and presentation format

Class	A	B	C
Topic + Medium	Topic 1 + PowerPoint (40 minutes)	Topic 3 + Overhead (40 minutes)	Topic 2 + Traditional (40 minutes)
	Topic 2 + Overhead (40 minutes)	Topic 1 + Traditional (40 minutes)	Topic 3 + PowerPoint (40 minutes)
	Topic 3 + Traditional (40 minutes)	Topic 2 + PowerPoint (40 minutes)	Topic 1 + Overhead (40 minutes)

An overhead transparency presentation format was included to eliminate the mere presence of a computer as a novelty and thus a confounding variable. The lectures with overhead transparencies used the same outlines and identical text, color, and graphics as the lectures with PowerPoint. All three topics were also presented with no visual presentation aid.

Student retention was measured with a ten-point multiple choice quiz in each group for each topic, and verbal interaction was measured in each group with an instrument adapted from the classic interaction studies of Flanders (1970). A video camera was set up at the back of each room during all lectures so that verbal interaction could be independently and objectively scored by three raters.

INSTRUMENTS

The quiz (see Appendix A) to measure retention consisted of thirty, multiple-choice questions (ten questions for each of the three lecture topics delivered to each group). The quiz questions were factual in nature, developed by the researchers, and taken directly from the lecture. Mean scores were calculated by presentation format and could range from 0 to 10. The double counterbalancing meant that the mean for each presentation format included test scores for each of the three topics, and each topic was presented in different order in each class. The same presenter used a script to present all three topic

lectures to each of the three groups and administered the quiz at the end of each of the three class periods.

The instrument used to measure verbal interaction was the *Interaction Data Sheet (IDS)* (see Appendix B). It was developed by the researchers and adapted from the *Flanders' Interaction Analysis* (Flanders, 1970), which Flanders' developed for his classic studies of classroom interaction. The IDS yields both duration and frequency of instructor and student talk. According to Flanders (1970), instructor talk can be either direct or indirect. Indirect talk is when the instructor accepts feelings, praises or encourages, accepts or uses ideas of students, or asks questions. Direct talk is when the instructor lectures, gives directions, criticizes, or justifies authority. Student talk can also be classified into two categories: student talk to respond and student talk to initiate conversation. To respond means to take action after an initiation, to counter, to amplify or react to ideas that have already been expressed. To initiate means to make the first move, to lead, to begin, to introduce an idea or concept for the first time, or to express one's own will.

The instrument was filled out independently by three trained raters who viewed the video recordings of all lectures. When disagreements were found, the raters met, discussed and agreed on how the interaction should be coded.

RESULTS

A one-way, repeated measures ANOVA test was conducted on the students' quiz scores to determine whether there were differences in student retention of material delivered in the three different lecture formats: (a) lectures presented with PowerPoint slides, (b) with overhead transparencies, and (c) with no presentation aids. Scores could vary from zero to ten. The means and standard deviations of students' quiz scores for the three different lecture formats were: lecture presented with PowerPoint slides, $M = 7.61$, $SD = 2.04$, $n = 71$; overhead transparencies, $M = 6.89$, $SD = 1.73$, $n = 71$; and no presentation aids, $M = 6.34$, $SD = 2.24$, $n = 71$. The sphericity assumption was met and results of the repeated measures ANOVA indicated that there were significant differences among the means (SS Between = 57.38, $df = 2$, $MS = 28.69$; SS Error = 299.95, $df = 140$, $MS = 2.14$; $F_{(2, 140)} = 13.39$, $p < .001$). Effect size (ES) was calculated as eta square (η^2) (Seigel & Castellan, 1998; Sprinthall, 2000) and was found to be .94, a large effect.

Paired samples t-tests were conducted to find significantly different pairwise comparisons. Results of these analyses revealed that differences exist in all three pairs (PowerPoint vs. Overhead: $t_{(70)} = 3.44$, $p < .01$; PowerPoint vs. No Presentation Aids: $t_{(70)} = 4.36$, $p < .001$; Overhead vs. No Presentation Aids: $t_{(70)} = 2.39$, $p < .05$). Thus, quiz scores were highest for lectures presented with PowerPoint, next highest for lectures presented with overhead transparencies, and lowest for lectures presented without visual presentation aids.

Data from the *Interaction Data Sheet (IDS)* was examined and both frequency and duration in seconds of student verbal interaction was calculated. Frequency was calculated by recording a count of one verbal interaction when a student started and finished talking or when another student interrupted. Table 1 presents the frequencies for each lecture format across the three groups and overall totals by presentation format. A Friedman Two-Way Analysis of Variance by Ranks test was conducted to determine whether there were significant differences in frequency of student verbal interaction among the three different presentation formats. No significant differences were found ($\chi^2(2, N = 3) = .55$, $p = 0.76$).

Table 1.
Frequency of Student Verbal Interactions for each Medium Across Three Groups

Student Verbal Interaction	Frequency of Interaction for Each Medium		
	PPT	OH	TD
To Respond			
CLASS A	28	27	12
CLASS B	21	25	30
CLASS C	5	4	6
To Initiate			
CLASS A	6	3	7
CLASS B	2	2	2
CLASS C	5	4	6
Total			
CLASS A	34	30	19
CLASS B	23	27	32
CLASS C	7	8	7
Total	64	65	58

PPT - PowerPoint, OH - Overhead Transparencies, TD - Traditional (No presentation aid)

Duration of student interaction was also calculated from the data gathered on the *Interaction Data Sheet (IDS)* and by studying the video recordings. The duration was timed starting when a student started talking and ended when the student finished talking. Table 2 presents this data. Another Friedman Two-Way Analysis of Variance by Ranks test was calculated, this time on total duration data by Class. Again, the analysis was not significant ($X^2(2, N = 3) = .67, p = .72$) and no differences were found in duration of student interactions by presentation format.

Table 2
Duration of Student Verbal Interactions for each Medium Across Three Groups

Student Verbal Interaction	Frequency of Interaction for Each Medium		
	PPT	OH	TD
To Respond			
CLASS A	1.04	1.14	.31
CLASS B	.58	1.09	1.42
CLASS C	.29	.34	.19
To Initiate			
CLASS A	.23	.24	1.11
CLASS B	.31	.21	.12
CLASS C	.40	.27	.01
Total			
CLASS A	1.27	1.38	1.42
CLASS B	1.29	1.30	1.54
CLASS C	1.09	1.01	.20
Total	4.05	4.09	3.56

PPT - PowerPoint, OH - Overhead Transparencies, TD - Traditional (No presentation aid)

IMPLICATIONS

Lectures involving PowerPoint presentations resulted in better student retention of the material than the two other lecture formats: (a) lectures presented with overhead transparencies and (b) traditional lectures with no presentation aids. Mean student test scores were highest for lectures presented with PowerPoint presentations, next highest for lectures with overhead transparencies, and lowest for traditional lectures with no presentation aids. No differences were found across the three presentation modes in terms of frequency or duration of student interaction.

The finding of better quiz scores for lectures with PowerPoint presentations than for lectures with overhead transparencies is interesting, but the reasons for such differences were not investigated in this study. It might be that the way in which PowerPoint slides change as each point is brought up holds students' attention more effectively than simply uncovering points on a transparency. Bringing up major points one by one on PowerPoint slides might have helped students focus better on one concept at a time. This was the only difference between lectures presented with PowerPoint slides and lectures presented with overhead transparencies. In this study, PowerPoint slides and overhead transparencies were identical with respect to color, text, and graphics.

Results of the study showed that lectures presented with either of the two presentation aids were more effective in student retention than lectures presented without presentation aids. Perhaps this is because when visual presentation aids are used in lectures, the content may be more articulated, clarified, and enhanced visually (Harknett & Cobane, 1997; Lever-Duffy, McDonald, & Mizell, 2003; Parkinson & Hollamby, 2003; Shelly, Cashman, Gunter & Gunter 2004). This idea is consistent with the theory that a multisensory approach produces learning that is superior to an approach that makes use of a single sensory modality (Fernald, 1988; Mayer & Anderson, 1992; Mercer & Mercer, 2001; Mousavi, Low, & Sweller, 1995; Murphy, 1997). When information is presented with presentation aids, students hear the words, see the words, and often take notes, making the sensory input visual, auditory, kinesthetic, and tactile. Therefore, for students who are not good auditory learners, the PowerPoint and overhead presentations may increase retention of lecture material.

Future research might explore the effects of adding more features of PowerPoint such as audio and movie files. Such a study might compare lectures with main points presented on PowerPoint slides to lectures with audio and movie files presented through PowerPoint.

The goal of this study was to investigate whether or not the method of material presentation (a) lecture with main points presented through PowerPoint, (b) lecture with main points presented through overhead transparencies or (c) lecture with no presentation aids) affects students' retention of lecture information or frequency or duration of student interaction. The study found that the students did retain more information when material was presented in the PowerPoint format, and they did so with no decrease in frequency or duration of student interaction. Therefore, it appears that the use of visual presentation aids in general, and PowerPoint in particular, is advisable and will be beneficial to student retention of lectures in higher education.

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Appendix A

Quiz

Direction: You will have 30 minutes for taking this quiz. Please circle **only the best answer** from each of the following questions.

-
1. Who coined the term “Operant Conditioning?”
 - a) Albert Bandura
 - b) B. F. Skinner
 - c) Ivan Pavlov
 - d) Skinner and Pavlov

 2. Which of the following **is not** a basic assumption of behaviorism?
 - a) People’s behaviors are simply the result of *their thoughts*.
 - b) Learning can be described in terms of relationships among *observable events*.
 - c) Learning involves *a behavior change*.
 - d) Many species of animals, including humans, *learn in similar ways*.

 3. Which of the following **is not** a reason for behaviorists to use rats and pigeons in their studies?
 - a) They are inexpensive.
 - b) They are convenient.
 - c) Their behavior can sometimes apply to humans.
 - d) Humans are not patient enough.

 4. When does Operant Conditioning occur?
 - a) When a response to a stimulus is reinforced.
 - b) When a response is valuable.
 - c) When a response is desirable.
 - d) When a reinforcer is used only one time.

 5. What is the **BEST** description for how Operant Conditioning *differs* from Classical Conditioning?
 - a) Responses are results from successes and failures of others
 - b) A particular stimulus is used for an expected response.
 - c) A response is involuntary.
 - d) A response is voluntary.

 6. What is a reinforcer?
 - a) An expensive reward (i.e. toys) that increases the frequency of a particular behavior.
 - b) Any enjoyable consequence that increases the frequency of a particular behavior.
 - c) Any consequence that increases the frequency of a particular behavior.
 - d) Any pleasurable feedback that makes learners want to respond.

 7. As teachers, how would you apply Skinner’s learning theory to your students?

- a) Always offer a concrete reinforcer such as money to decrease unsatisfactory behaviors.
 - b) Compliment students when they help their classmates or finish their assignments.
 - c) Report a school psychologist immediately when any unusual behaviors occur.
 - d) Tell the parents when the student behaves badly because it is not your responsibility.
8. Which of the following **is not** an alternative to punishment according to Skinner?
- a) Rearranging the seating of a student may reduce/eliminate the behavior.
 - b) Permit a student to play until he/she is tired of it.
 - c) Keep punishing until the undesirable behavior is extinguished.
 - d) Ignore the undesirable behavior.
9. According to Skinner and Operant Conditioning, what types of responses does Skinner think is not effective?
- a) A negative reinforcement.
 - b) A positive reinforcement.
 - c) A negative stimuli
 - d) Punishment.
10. What is the **BEST** definition of the principle of operant conditioning?
- a) A system of controlling behavior through positive and negative reinforcement.
 - b) A system of controlling behavior through punishment.
 - c) A system of controlling behavior through rewards.
 - d) A system of controlling behavior through social and cognitive process.
11. Who coined the term “Classical Conditioning?”
- a) Albert Bandura
 - b) B. F. Skinner
 - c) Ivan Pavlov
 - d) Skinner and Pavlov
12. When does Classical Conditioning occur?
- a) When a natural reflex responds to the conditioned and unconditioned stimulus.
 - b) When a natural reflex responds to the unconditioned stimulus.
 - c) When the conditioned stimulus is used separately.
 - d) When the unconditioned stimulus is used independently.
13. According to Classical Conditioning theory, when does learning occur?
- a) When a learner responds to the desirable stimuli immediately.
 - b) When a learner responds to the valuable stimuli immediately.
 - c) When a learner responds to the stimulus immediately.
 - d) When a learner responds to the stimulus differently than before.
14. Which kind of conditioning will weaken a response of classical conditioning?
- a) Simultaneous conditioning.
 - b) Delayed conditioning.
 - c) Trace conditioning.
 - d) All of the above.

15. Classical conditioning theory predicts that a response can be learned from:
- Sight preceding pain by a long interval.
 - Sight preceding pain by a medium interval.
 - Sight preceding pain by a short interval.
 - Sight preceding pain by a medium and long interval
16. How could teachers apply classical conditioning *in the classroom*?
- Have the parent help students with their assignments.
 - Create a positive classroom environment to reduce anxiety in learning.
 - Pairing an advanced student with another advanced student.
 - Pay more attention on a student who received straight As than others.
17. Tom falls into a swimming pool and almost drowns. A year later, when his mom takes him to the local recreation center for a swimming lesson, he cries hysterically as she tries to drag him to the side of the pool. How would you explain Tom's problem?
- Conditioned response.
 - Innate response.
 - Generalization.
 - Extinction.
18. What does "involuntary response" mean?
- An automatic response to the valuable stimulus.
 - An automatic response to the unconditioned stimulus.
 - An automatic response to the new environment.
 - An automatic response to the particular reinforcer.
19. How could "involuntary responses" (such as reducing anxiety) be applied in the classrooms?
- Assure that students understand the content before moving to a complicated topic.
 - Students cannot take a break during the lecture.
 - Have students finish assignments before leaving.
 - No late assignments accepted.
20. In the classroom, according to **classical conditioning**, learning is more likely to occur when:
- The conditioned stimulus is reinforced.
 - The conditioned and unconditioned stimuli are provided immediately after one another.
 - The unconditioned stimulus is given thirty minutes immediately after the conditioned stimulus.
 - The conditioned and unconditioned stimuli are given at the same time.
21. Which of the following **is not** a basic assumption of social cognitive theory?
- Behavior innately is self-regulated.
 - People can learn by observing others.
 - Learning is an internal process that may or may not result in a behavior change.
 - Behavior is directed toward particular goals.
22. According to social cognitive theory, which of the following **is how punishment and reinforcement influence learning and behavior**?

- a) Expectations affect how people choose to behave.
 - b) Expectations about probable future consequences affect how people cognitively process new information.
 - c) People's expectations are also influenced by their vicarious experiences.
 - d) All of the above.
23. How does modeling affect human behavior?
- a) Tom goes to school wearing a pair of jeans with holes in the knees because all his classmates are now wearing old, well-worn jeans.
 - b) Jake copies homework from a classmate because late assignments will not get full credits.
 - c) Bill wants to speak Spanish correctly so he reads a Spanish newspaper daily.
 - d) Jan still participates in class even though her classmates laugh at some of her answers.
24. What is a characteristic of *effective models*?
- a) Jake studies French although he thinks French is a "girl" thing.
 - b) Bill tries to speak Spanish with servers when he goes to Mexican restaurants.
 - c) Jan wants to be a teacher so she practices teaching with her younger brother.
 - d) Tom wears the torn jeans that his classmates wear because he thinks he can become popular.
25. According to social-cognitive theory, four conditions are necessary before a student can successfully model someone else's behavior:
- a) Attention, retention, motor reproduction and motivation.
 - b) Attention, retention, motor reproduction and interaction.
 - c) Attention, retention, motor reproduction and stimulation.
 - d) Attention, retention, interaction and motivation.
26. According to social-cognitive theory, how does self-efficacy affect behavior?
- a) Students with low self-efficacy can learn/achieve as much as students with high self-efficacy when actual ability levels are the same.
 - b) Jake dropped out of French class because he thought it was too hard for him.
 - c) Bill dropped out of Japanese class because the teacher was not a native speaker.
 - d) Jan does not cook because her mom always cooks for her.
27. Which of the following **are not** factors in the development of self-efficacy?
- a) One's own previous successes and failures.
 - b) Successes and failures of others.
 - c) Family background and personal goals.
 - d) Messages from others.
28. Maki is a Japanese student attending school in England. Whenever native speakers ask her questions, Maki always thinks first how she will answer correctly in English. According to self-regulated behavior, what is it called?
- a) Self-determined goals and standards.
 - b) Self-instructions.
 - c) Self-evaluation.
 - d) Self-monitoring.

29. According to social cognitive theory, learning is defined as:
- A behavior change.
 - An internal mental phenomenon that may or may not be reflected in behavior.
 - A consequence of positive behaviors influenced by environment.
 - A process of receiving new information.
30. How can social-cognitive theory be applied in the classroom?
- Students must get a chance to observe and model the behavior that leads to positive reinforcement.
 - Teachers must encourage collaborative learning, since much of learning happens within important social and environmental contexts.
 - Teachers must provide the incentive and the supportive environment for the behavior to happen.
 - All of the above.

Appendix B
Interaction Data Sheet (IDS)

Amount of Instructor Talk		Amount of Student Talk			
		To respond		To initiate	
Minutes	Seconds	Minutes	Seconds	Minutes	Seconds
Total =		Total =		Total =	

- Instructor Talk** = (Indirect Talk+ Direct Talk)
- **Indirect Talk:** Accepts feeling, praises or encourages, accepts or uses ideas of students, and ask questions.
 - **Direct Talk:** Lecturing, giving directions, criticizing or justifying authority.
- Student Talk**
- **To respond:** to take action after an initiation, to counter, to amplify or react to ideas which have already been expressed
 - **To initiate:** to make the first move, to lead, to begin, to introduce an idea or concept for the first time, or to express one’s own will