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UNLIMITED LEARNING

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by

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Abstract

This report describes the impact of computer software in a heterogeneous sixth-grade science class at Central Tree Middle School in Rutland, MASS. Heterogeneous classes may inhibit the education of academically gifted students. This project answers the questions: Does the use of computers challenge the academically talented and does it help them acquire higher cognitive levels? Using surveys and pre-/post-evaluations, we found that combination of computers and lectures challenged the academically talented by increasing their performance and enhancing their cognitive levels.

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Introduction

This project revolves around the following focus question:

Does the use of computers in a sixth-grade science class provide adequate individualization for students of high academic levels in a heterogeneous classroom?

To answer our focus question we undertook an experiment in a sixth-grade science class. We observed the style and type of teaching conducted and found that it was mostly taught by the traditional lecture and some group work format. Therefore, we hypothesized that a new format incorporating the use of computer software would compensate for some of the disadvantages caused by these teaching formats.

Hypothesis

Group work is a philosophy of teaching which emphasizes the ideas of cooperation and teamwork rather than individual learning. Traditional lecture is a form of teaching which emphasizes individual learning but at a compromised pace. These concepts of teaching in a heterogeneous classroom with students of all academic abilities are beneficial to the general student body, but they can be a disadvantage to the academically talented students. We hypothesize that the use of educational computer software in the classroom will compensate for this disadvantage by providing a medium that allows students to learn according to their abilities. Furthermore, the use of

computers in a classroom encourages students to perceive computers as a tool for learning.

Goals

The use of computers in the classroom merges society and technology. By interacting with such technology, students are preparing themselves for the future. This IQP aims to find a solution for the disadvantages of group work and traditional lecture in a heterogeneous classroom. If the use of computer software proves to be a viable solution, then it can help school systems to provide the best possible education for every student, regardless of academic ability. It may also encourage the students to use the computer more often for educational purposes.

General Description of Methodology

The experimentation phase of our IQP was performed in a sixth grade science class taught by Fred Ratliff at the Central Tree Middle School in Rutland, MA. Two types of evaluations were used. The first evaluation was a survey, which helped determine if the computer software, traditional lecture or a combination of both was preferred. The second type of evaluation measured the effectiveness of the computer software as an educational tool.

We compared the evaluations to see if the software aided the students in grasping the materials or ideas and if it increased their knowledge and cognitive level. Since the pace and level of learning is compromised in a heterogeneous classroom[1], the evaluations will also indicate if the use of the software challenged the academically talented students by providing more information at a faster pace.

Background

To prepare for the experimental phase of our IQP, we researched some other similar IQP's and relevant articles. We wanted to explore which learning styles the computer software satisfies when used as a teaching tool. Also, in preparation for creating a new teaching format, we wanted to implement the recommendations and conclusions of a previous project that had used computers as a teaching medium. We also researched other types of teaching methods, such as cooperative learning, that have similar advantages and disadvantages as the format of traditional lecture and group work. In preparing to create the evaluations to test the students' knowledge, we researched a theory known as Bloom's Taxonomy, which categorizes different levels of learning. The material we found that addresses these concepts is included below.

Critiques of Previous IQPs

Two Interactive Qualifying Projects completed at WPI within the last four years seemed relevant to our study. The first dealt with learning styles in heterogeneous classrooms, and the second explored computers in education. We used some of the conclusions of these projects as assumptions for our study.

The IQP "Analysis of Learning Style Distribution in High School Science Classes"[2] tried to identify if students with similar learning types were interested in the subject of science. Two learning style methods, GMCS and MBTI, were used. GMCS, Gordon-Mednick Cognitive Style Measure, consists of four learning style types:

1. Implementers are logical in their thought process; therefore they have trouble with conceptualization.
2. Integrators are capable of differentiation and remote association.
3. Problem Finders make sense out of chaos and are comfortable with abstract ideas.
4. Problem Solvers exhibit non-logical way of thinking and are concerned not with the procedure of the solution, but with finding the solution. [3]

MBTI, Myers-Briggs Type Indicator, is another theory; it consists of sixteen types of learning styles. A person has one characteristic from each of the four pairs:

1.
   - perception
   - judgement
2.
   - extraversion
   - introversion
3.
   - sensing
   - intuition
4.
   - thinking
   - feeling [4]

The researchers surveyed the students to see the percentage distributions of the different learning styles in each level of science classes.

Science classes such as Chemistry, Earth Science and Physics were surveyed. Since the MBTI consists of sixteen learning styles, and a one-letter difference in the four-letter naming system is negligible, the MBTI results were inconclusive. The GMCS, on the other hand, showed that particular types prevailed in certain classes. [5]

The IQP "Education and Technology"[6] explores the need for computers in education. Computers are a hands-on learning medium that is perceived to entertain the students while they are learning, especially in areas of math and science. The use of computers in education is believed to "'address different learning styles' (Sillas, 1993)" [7]. To test these theories, a computer program was used in a classroom setting. For a period of two weeks, the material that had been covered with the program was not presented. Then a test was given to the students to see how much of the material they retained. For grades level six to nine, the software "Multimedia Science Classroom" was recommended. It addresses four science subjects and provides on-line experiments and lesson plans. The cost for this software is $900. The researchers concluded that the use of computers in education provides a hands-on method of learning and is necessary to train students for the future. [8]

Since the IQP, "Analysis of Learning Style Distribution in High School Science Classes"[9], could not determine conclusively which learning styles were present in science classes, we assumed that a heterogeneous sixth-grade science class has a diverse set of learning styles. We also assumed that the use of computers satisfies almost all of the different learning styles, as was concluded in the IQP, "Education and Technology"[10]. These assumptions will pertain throughout our IQP.

Cooperative Learning

Cooperative Learning is a philosophy of teaching that has been recently put into practice in school systems. It stresses the idea of students working together in a group as opposed to the prevalent philosophies in the past which stressed individual work. Cooperative Learning encourages student interaction and sharing of ideas and materials. Not every activity can be categorized as cooperative learning. This philosophy consists of specific requirements and goals. First, group members must learn from one another. In theory, an activity should require participation from all the members to complete the task. Secondly, cooperative learning also helps to increase students' self-esteem by having them encourage their peers. Third, every student is responsible for his/her part of the work. [11] Fourth, through the process of cooperative learning, students learn skills such as "leadership, communication, decision-making, trust-building, and conflict resolution skills" [12], which will be helpful to every student in the future. The fifth aspect of cooperative learning is "group processing." This occurs when each group critiques its members on their behavior, accomplishments, and problems. [13] Last, the sixth aspect of cooperative learning is the idea that teaching others in the group will reinforce the concept and aid in the student's learning process. [14]

Cooperative Learning Requirements

1. participation of all members is necessary to finish the task
2. increases self-esteem
3. every student is responsible for the task
4. students learn social skills
5. group processing
6. teaching peers aids in the learning process

The Case for Cooperative Learning

The use of cooperative learning has many benefits. According to Mike Pongracz, cooperative learning "is fundamental to successfully educating a diversity of learners—children with varying cognitive abilities; developmental and learning disabilities; sensory impairment; and different cultural, racial, linguistic, gender and socioeconomic backgrounds." [15] Such interactions within diverse groups of students help each student acquire social and communication skills. Cooperative learning has an overall greater student achievement in academics. Students who do poorly in class, seem to do better when grouped with students who excel academically. [16] Also, since most business settings consist of team-work and cooperation, the cooperative learning concept seems to provide a good experience for the students' future. It also has economic advantages; since activities are planned for a group, the quantity of equipment and supplies is less than if students were working alone. [17]

Advantages of Cooperative Learning

1. grows social acceptance for diversity
2. incorporates all students, regardless of learning disabilities, race or culture
3. academically challenged students learn from academically talented students
4. team-work and cooperation
5. economic advantages

The Case against Cooperative Learning

There are many advantages and benefits from cooperative learning, but there are also drawbacks. Cooperative learning may benefit the students generally, but the academically talented students suffer. First, it seems to encourage "arrogance and lack of trust in classmates." [18] Second, average students seem to depend on higher-level students to complete the work. At the same time, the academically gifted students tend to become bored and take over the group, completing the work themselves instead of sharing the responsibility. Because of this, the academically gifted students appear to be superior, and the other students tend to feel inferior and left behind. Also, the academically talented students feel that they are being deprived of learning at their level and pace. Since they absorb and understand at a higher, faster level, they do not understand why the other students cannot grasp the concept. This attitude can hurt the emotions and performance of other students. [19]

Disadvantages of Cooperative Learning

1. lack of trust among students
2. students depend on academically talented students
3. academically gifted students become bored
4. academically gifted students tend to take all responsibility for the task
5. academically gifted students feel deprived of their education
6. academically gifted student's attitude has harmful effects on others

Possible Solutions

Since cooperative learning is not the solution for every student, Dr. Robinson has four recommendations that may improve on this philosophy. These recommendations may help students overall, but they also satisfy the needs of the academically gifted students. First, any programs for the academically gifted students should not be replaced by cooperative learning in diverse/heterogeneous classrooms. Second, any materials that are beyond the students' general academic ability should be available to the academically gifted students. They may be encouraged to use such materials to satisfy their level of learning. Third, any material that may be advanced according to a student's pace of learning is also recommended for academically gifted students. They may advance to any level they can achieve, eliminating the problem of boredom. Lastly, the difference of student capabilities in a group should be minimal. This is so that a single student is not restricting the group's advancement and ability to understand the material. [20]

There are also recommendations that the use of computers combined with the cooperative learning process will also help satisfy the needs of the academically talented students. [21] The third recommendation of Dr. Robinson seems to encourage the use of computers, since software is available that can provide different levels of achievements. This satisfies the requirement of students advancing according to their pace of learning. Therefore, cooperative learning is generally a good philosophy that teaches the students not only in academics but also the skills for the future. There is only one problem with this philosophy. The academically talented student stills hungers for a faster pace and more in-depth learning. The use of computers and software may bridge the gap that exists

between the cooperative learning philosophy and the idea of homogeneous classrooms where academically talented students are grouped together.

Solutions

1. do not replace special programs for the academically talented students
2. availability of advanced material
3. availability of learning through media that advance at a student's pace
4. students with similar academic capabilities should be put in one class
5. use of computers as a medium of learning

Group Work

Group work is a teaching format which Mr. Ratliff sometimes uses during experiments, in-class homework time or study sessions. Group work is a less complex form of cooperative learning. It does not require a teacher to assign responsibilities within a group. It also does not require every student's participation to finish the task, but it does encourage cooperation and teamwork.

Mr. Ratliff uses group work more in the beginning of the year to observe how the students interact in groups composed of two to four students. Sometimes the students are allowed to choose their partner or group members, and other times Mr. Ratliff assigns the students to a group. Therefore, group work is also a less rigorous teaching format than cooperative learning since it does not require division of responsibility within the group, and the members are not grouped according to personality and ability.[22]

Even though group work and cooperative learning have some differences, the advantages, disadvantages, and possible solutions are very similar. Some of the advantages of group work are:

1. grows social acceptance for diversity
2. team-work and cooperation
3. economic advantages [23]

The other advantages of cooperative learning are not present in group work. Since the group members are not assigned, the students may tend to pick their friends, who usually are at the same academic level or have similar interests and abilities.

Some disadvantages of group work are also similar to those of cooperative learning. In a group containing members at a high academic level, those members tend to help the others, creating the situations that give rise to the disadvantages described below.

1. students depend on academically talented students
2. academically gifted students become bored
3. academically gifted students tend to take all responsibility for the task
4. academically gifted students' attitude has harmful effects on others [24]

Some possible solutions for the disadvantages of group work and traditional lecture are the same as for cooperative learning. Therefore, in our IQP we implemented the proposed solution of using computers as a medium of learning to challenge and educate the academically talented to their highest level and ability.

Similar Projects

"Does it Compute"[25] by Harold Welglinsky of the Educational Policy Information Center describes an experiment performed nationwide at schools to determine whether the use of computers aided the students in learning math and which students benefited. The study was performed at two grade levels, fourth and eighth. A controversy arose pertaining to the use of computers in the classroom.

On the one hand, some saw computers as an instrument to improve "student motivation and teacher morale"[26], "support[ing] ... individual learning, group learning, and instructional management; communication; and administration." [27]

Computer Usage

1. "individual learning"
   --Uses such as practice drills, surfing the web for research, or using simulations to help visualize concepts and theories in math and science

2. "group learning"
   --Uses such as "email... and presentation software to allow group presentations on a project"

3. "instructional management"
   --Uses such as planning lessons, aiding in keeping student assessment folders, and grading

4. "communication"

5. "administration"
   --Uses such as keeping track of attendance, performance and behavior of students

On the other hand, the use of computer software is ineffective if teachers do not incorporate it into their teaching process. It also poses a threat to the teachers since not only do they fear computers replacing them, they also fear that the student-teacher relationship will diminish. [28] Computers also decrease students' interaction with each other. Purchasing and maintaining the computers as a teaching tool is expensive, whereas tutoring is a less expensive, one-to-one alternative learning process which has proven effective in the past. [29]

The findings of the project are interesting. Students, regardless of their financial backgrounds, race, or geography had equal access to the computers in school. [30] There was not much difference in student computer use whether or not the students owned a computer at home. Instead, there were indications that disadvantaged students tended to use computers more than advantaged students. [31] Also the study found that suburban teachers were more comfortable and experienced with computers than urban schools' teachers. [32] Most applications of computer software were aimed at "drill and practice" [33] purposes. Therefore, software which did not address high-order thinking skills in turn proved to be harmful in the teaching process. The students were learning more mechanical skills rather than understanding and developing the application skills.

The effect of the use of computers in the classroom was measured in two ways. Students' achievements on math tests, as well as teacher and student morale, were observed to see if the use of computers had a positive effect on the school. Morale was measured by the degree of "student tardiness, student absenteeism, teacher absenteeism, teacher morale, and student regard for school property." [34]

The study also found that there is a need for teachers to be trained and experienced with computers. [32] The teachers must have a confident attitude towards any

teaching medium, which in turn has a positive feedback on the students. If the teachers are uncomfortable with any medium, their attitude affects their ability to teach with that medium. The study proved that use of computers at school encourages " home computer use and teacher professional development." [36]

The conclusions made by this study address not only the students, but also the teachers. There is a need for teachers to be trained in the area of computers. Using a computer does not necessarily benefit the learning process. If it is only used as a tool for practicing problems, then it may be detrimental since the student does not learn applications and implications of the topic. For computers to aid in the teaching process and in the learning process, they must be used with educational learning games that use high-order thinking skills. [37]

Blooms Taxonomy

Bloom's Taxonomy is a model for classifying kinds and levels of learning devised by Benjamin Bloom in 1956. This theory has three parts: cognitive learning, affective learning, and psychomotor learning. As we will see, cognitive learning pertains more to the sixth grade age group than affective or psychomotor learning.[38]

Affective learning describes student behaviors which indicate "attitudes of awareness, interest, attention, concern, and responsibility, ability to listen and respond in interactions with others..." [39] This part of the theory pertains to the attitude and emotions of the students toward the subject or material presented in the classroom. Students display affective learning by volunteering, questioning or disputing.[40]

Psychomotor learning describes the student's physical skills. This pertains more to a younger age group learning skills such as "coordination, dexterity, manipulation, grace, strength, speed, fine and gross motor skills."[41] Students display psychomotor learning by grasping, writing, and psychical activity such as dance. [42]

The third part of Bloom's taxonomy is cognitive learning. This part pertains to the intellectual ability of the students. There are six levels within this aspect of learning. They are ordered from the lowest level of understanding to the highest level. The first and most basic of the six levels is knowledge. This consists of recognizing, defining and recalling facts or theories. Teachers use diagrams, pictures and books to achieve this basic level of cognitive learning. The second level is comprehension. This consists of describing, restating, and translating the subject matter at hand. Teachers use tables and charts to help students visualize and describe the material more in-depth. The

third level is application, which is usually taught using photographs. At this level, questions are used which require students to illustrate and interpret the facts and theories, in order to test the students' understanding. The fourth level is analysis. This is characterized by analyzing, comparing and contrasting. To achieve this level of learning, teachers use graphs, diagrams and charts to help the students visualize the concepts and draw conclusions. The fifth level is synthesis. This requires that students be able to formulate, design, and develop. For students to acquire this ability, teachers sometimes require students to create a short story, article or video. The last and highest level of intelligence is evaluation. At this level, students predict, evaluate and defend their arguments. For this, teachers have group discussions and debates in the classroom.[43]

These levels of intelligence are acquired at different stages in a student's academic life. This first level is acquired in the early stages of childhood and primary school. The last level is usually achieved at the higher stages in the academic life, such as graduate school or later. Therefore, students in the sixth grade are at some stage in the progression from knowledge to evaluation.

Blooms Taxonomy: Six levels of Cognitive Learning

1. **Knowledge**: (finding out)

remembering previously learned material; recalling facts or whole theories.

--Terms: defines, describes, identifies, lists, matches, and names

--Teachers Use: records, films, videos, models, events, media, diagrams, books

2. **Comprehension**: (understanding)

grasping the meaning of material; interpreting, explaining or summarizing; predicting outcome and effects

--Terms: convert, defend, distinguish, estimate, explain, generalize, rewrite

--Teachers Use: trends, consequences, tables, cartoons

3. **Application**: (making use of the knowledge)

ability to use learned material in a new situation; apply rules, laws, methods, and theories

--Terms: changes, computes, demonstrates, operates, shows, uses, solves

--Teachers Use: collection, diary, photographs, illustration

4. **Analysis**: (taking apart the known)

breaking down into parts; understanding, organizing, clarifying, concluding

--Terms: distinguish, diagrams, outlines, relates, breaks down, discriminates, subdivides

-- Teachers Use: graph, survey, diagram, chart, questionnaire, report

5. **Synthesis**: (putting things together in another way)

ability to put parts together to form a new whole; unique communication; set of abstract relations

--Terms: combines, complies, composes, creates, designs, and rearranges

--Teachers Use: article, radio show, video; inventions, poetry

6. **Evaluation**: (judging outcomes)

ability to judge value for purpose; base on criteria; support judgement with reason (No guessing)

--Terms: appraises, criticizes, compares, supports, concludes, discriminates, contrasts, summarizes, and explains

--Teachers Use: letters, group with discussion panel; survey, self-evaluation[44]

Methodology

Our experiment consisted of several parts. First, we planned our teaching method and timetable. Then we found the equipment needed for our project. After dividing our teaching responsibilities and creating relevant evaluations, we put our new teaching format into effect.

Our hypothesis is that the use of computer software will satisfy the needs of the academically gifted students in a heterogeneous classroom using the group work philosophy. Our goal was to incorporate the expanding technology of educational computer software in a sixth-grade science class taught by Mr. Fred Ratliff at the Central Tree Middle School.

To test our hypothesis, we observed a combination of lectures, surveys, evaluation tests and computer sessions. Mr. Ratliff teaches four sixth-grade science classes in a day. All four classes cover the same material and are taught at the same pace and level, since they are all heterogeneous classes. We taught two topics for our testing phase. For each topic there were two rotations per class, Rotation One (R1) and Rotation Two (R2). For our testing purposes, for Topic One, Rotation Two in all of the classes consisted of Mr. Ratliff lecturing on the topic, introducing the concepts and ideas, and discussing the material in-depth as needed. During this time, Rotation One was split into groups according to their academic ability. For example, students who achieve high grades or seem to grasp concepts quickly were put into one group, and students who have difficulty with science and its concepts were put into another group. When the students were grouped according to their academic ability, they were allowed to use the computer

software and were encouraged to advance to new levels at their own pace. Then an evaluation was given to the students after they were exposed to the software. Then the rotations switched. Rotation Two was introduced to the computer software with only minimal introduction to the topic, if needed, and Rotation One worked with Mr. Ratliff. Then an evaluation was given to the students in Rotation Two.

The purpose of permutating the order of lecture and the use of computer software is so that we can observe whether the software has helped the students learn and understand the material better or helped the students advance to a higher level of learning. The evaluations will be used to understand whether the software aided the students by reinforcing the concepts or by encouraging them to learn more. This will help identify if the computer software is just another medium to reinforce the material or a medium for meeting academically gifted students' need for faster, more in-depth learning. This is the reason for permutating the order of software and lecture.

For the second topic the same procedure was utilized except the permutation of the classes was switched. In other words, for the second topic, Rotation Two was exposed to the software first, followed by the lecture and an evaluation. The other rotation, R1, was exposed to the lecture first, followed by the software, and an evaluation. This process exposes a more diverse set of students with different academic abilities to the two permutations. The reasons for permutations and evaluations are the same as above.

There are approximately twenty to twenty-two students in a classroom, which has only four computers available. This means that for a rotation to work on the computers at the same time, two or three students must work on each computer, which is

an ideal group. Therefore, for two days, half the class (R1) was split into four groups of two or three students, who were allowed to work with the software. Then the other half of the class (R2) worked with the software for the remainder of the week. Again, each group was put together according to academic ability.

Therefore, during our testing phase, we covered two Topics (Topic One and Topic Two), each covering two lessons in the textbook. For each Topic we divided students into two Rotations (R1 and R2) which permutated between the software/lecture and lecture/software patterns. Each Rotation was divided into groups of two or three according to their academic ability. Before each rotation was allowed to work with the software, they were given pre-evaluations. After the computer sessions, the rotations were given surveys and post-evaluations. These will be used in analyzing the affect of the computer software, such as developing students' cognitive abilities to higher levels.

Graphical Representation of the Procedures

Key: L = lecture C = computer software / = "followed by"	Rotation One: (1/2 Class period #1) (1/2 Class period #2) (1/2 Class period #3) (1/2 Class period #4)	Rotation Two: (1/2 Class period #1) (1/2 Class period #2) (1/2 Class period #3) (1/2 Class period #4)

Topic One	Asima	Kirk
Rotation One:	L/C	L/C
Rotation Two:	C/L	C/L
Topic Two		
Rotation One:	C/L	C/L
Rotation Two:	L/C	L/C

Materials and Equipment

Many of the resources necessary for this project were already in place at Central Tree Middle School. For example, Mr. Ratliff's classroom is arranged appropriately either for cooperative learning, group work, or traditional lectures. First, there is enough space for students to work in a group, maintaining eye contact and having easy access to materials for all group members. [45] In addition, the new furniture at the school is comfortable and safe enough to prevent distractions; and the table-and-chairs arrangement lends itself well to group work, unlike a more traditional arrangement of individual desks attached to chairs. [47]

Another resource already present was the four computers in Mr. Ratliff's classroom. These computers can be connected to a large television monitor in a wall cabinet, allowing for easy demonstration of computer techniques to the whole class. To make use of the computers, the final resource we used was the software *Weather Workstation*. [43]

Weather Workstation is an interactive software that deals with the subject of weather. It is recommended for grades six to twelve, and therefore the students were able to increase the pace according to their ability. Since there were four computers available, we ordered four copies of Weather Workstation, which CTMS agreed to purchase for our experiment. Refer to Appendix A for more information on the software.

These resources were present during both lectures and computer learning sessions. The only variable resource was the software, as it clearly was used only during

the computer learning sessions. Therefore, any change in results will be attributable to the use of the software.

Evaluation Tools

In this project, we used three main types of evaluations: surveys, pre-evaluations and post-evaluations of the students' learning from computer software.

Mr. Ratliff regularly (once for each new lesson in the textbook) quizzes his students using his own quiz questions. The curriculum used by the school provides quiz questions in a format characterized by multiple choice and recognition. However, Mr. Ratliff uses his own questions, in a format geared toward short answers and comprehension. After examining the software in detail, we determined the necessary content for such an evaluation; this included evaluation tools that are part of the software, and it also consisted of questions that we created for a written quiz. Therefore, we created our own exams/evaluation for the students after each computer-using cycle. The evaluations consisted of questions that tested the first four Bloom's Taxonomy Cognitive levels. As, Welglinsky concluded in "Does it Compute"[48], computers should be geared toward not only drill questions but also high order thinking skills. We used evaluations to determine how much and how well students learn from their computer exercises.

We use two types of evaluations, a pre-evaluation and a post-evaluation. The pre-evaluation consisted of a set of questions that was given to all of the students (R1 and R2) before the traditional lecture with Mr. Ratliff or the computer session. The pre-evaluation were used determine the status and familiarity of the students before they had any exposure to lecture or software. After a rotation finished working with the software, all the students in that rotation were given a post-evaluation. This consisted of two parts. The first part contained the same questions as the pre-evaluation. This was used to determine how much the students increased in grades by comparing the pre-evaluation

grades given before and after the computer sessions. The second part of the post-evaluation contained a set of new questions. This was to determine if the students increased in their cognitive abilities according to Bloom's Taxonomy levels. All the questions on the pre-evaluation and post-evaluation were based on the first four Bloom's Taxonomy Cognitive Levels (knowledge, comprehension, application, and analysis).

Data Analysis

There were twenty to twenty-two students in each of the four science classes. Since these classes were all heterogeneous, some special education students, who required special evaluations, were present in the computer sessions. Since these students required special attention and had different learning disabilities, to analyze the data with the least possible variables, these students were excluded.

Students who were absent for either the pre-evaluation, survey, or post-evaluation, were also excluded for the same reason as above. Therefore, by excluding the special education students and any absentees, a total of one hundred students in each Topic (twenty-eight in Rotation 1 and thirty-two in Rotation 2) were left. We used these students' pre- and post-evaluation grades and survey to analyze the data.

There are also two possible sources of error. First, due to the lack of time allotted to the students of Topic One Rotation 2, the post-evaluation was given as a take-home evaluation, whereas the other rotation had an in-class evaluation. Since the Topic One Rotation Two students had the post-evaluation under different conditions, some error may be present in the results, since this rotation was included in the data analysis.

The second possible source of error is a self-help worksheet that was provided to all the students in both rotations in Topic Two. This worksheet was aimed to help the students focus on the important theories and ideas, and also was used as a study guide before the post-evaluation. Therefore, not only did we hypothesize that Topic Two will perform better than Topic One, but it also can be a possible source of error in out data analysis.

Results

The results are organized in four different categories. First category is preference. This section answers the question which teaching methods did the students prefer? The second section is improvement. This answers the question: did the software increase students understanding on the subject? If so, who benefited from the software the most? The third category is performance. This pertains to the new questions. It answers the question: did the students learn more than basic knowledge on the subject? How was the academic talented students' performance after using the software? The last category is Bloom's Taxonomy. This answers the question: Did the students acquire any higher cognitive levels? If so, which students acquired these levels? These categories are divided by eight variables: rotation, instructor, group size, group type, software/lecture cycle, science averages, topic and gender. After comparing these variables in all of the categories, we arrived at the results listed below.

Preference

To measure students' preference on the teaching methods, we used a survey after the post-evaluation. The students had three choices of teaching methods: software only, traditional lecture only, or a combination of software and lecture.

Generally, forty to fifty percent of the students preferred a combination of the software and lecture as their choice of teaching methods, but the other fifty to sixty percent of the students' preference differed according to the variables described below.

When we compared the preferences according to gender, the males preferred the software as the choice of a teaching method (refer to Appendix F, page 49). Similarly, when considering group type as a variable, the groups which consisted of all males preferred the software more than groups consisting of all females or mixed (refer to Appendix F, page 53).

Students' preference of teaching methods also differed according to instructor. Kirk's students preferred the software more than Asima's students (refer to Appendix F, page 51). This may be due to different styles of teaching. Kirk was a friend rather than an authoritative figure.

Improvement

To measure the software's affect on students' knowledge, we gave the students two pre-evaluations. The first pre-evaluation was given before the students were exposed to software or lecture. This gave us an idea of their knowledge of the subject before being taught by either of the teaching methods. After finishing with the software, all the students were given a post-evaluation, which consisted of the same questions as the pre-evaluation (pre-evaluation II) and a set of new questions. By subtracting the pre-evaluation II grades from the grades on the first pre-evaluation, we arrived at a pre-evaluation improvement score. This score represented the amount the software helped in increasing the students understanding on the topic.

Most students with a science average of ninety or higher had the greatest improvement on the pre-evaluations (see Appendix H, page 69-70). This may be a result of the academically talented students grasping the basic ideas required to answer the pre-evaluation questions. Therefore, they should also have the highest performance on the new questions, which evolve from the pre-evaluation questions. Since most of the other students struggled on the pre-evaluation II, the academically talented students are required to attain knowledge to this extent in a heterogeneous classroom. Their pace and level of learning is compensated to include and satisfy all students and their academic abilities. The pre-evaluation improvement scores proves that the academically talented were being challenged to their intellectual ability, since not only were they required to know the basics, but also required to apply and theorize in the new questions.

Performance

One other measure we used was a post-evaluation quiz, administered to students after they had worked with the software. Some of the questions on the quiz were identical to the pre-evaluation questions (pre-evaluation II), and we used those questions to calculate an improvement score. The other new questions on the post-evaluation were to compute performance on acquiring higher cognitive levels and understanding of the subject matter.

We discovered that there was no significant difference between the mean scores of Rotation 1 and Rotation 2 and also between the mean scores of males and females. We did, however, discover that the rotation which had Mr. Ratliff's lecture before using the software, software/lecture cycle, performed better on the post-evaluation than the rotation which only worked with the software lecture/software cycle. According to the P-value test, the increase in performance of the lecture/software cycle proved to be a highly significant difference. The P-value for the performances of the two cycles is 0.012 (refer to Appendix I, page 75). There are several reasons why lecture/software cycle received higher grades than software/lecture cycle. One reason may be due to the fact that Mr. Ratliff introduced the students' to the basic ideas in his lecture. Since the subject matter was reinforced rather than introduced to the lecture/software cycle, this caused those students to perform better than the students in software/lecture cycle.

Another noticeable difference in the results is in the students' performance according to topic. Students in Topic Two had higher mean grades that the students in

Topic One. Again the P-value test returned a value of $2.33*10^{-9}$ (refer to Appendix I, page 76), which proved this to be highly significant difference in this comparison. This may be due to several factors. First, there was a self-help worksheet provided with Topic Two, which helped emphasize important ideas and theories and also served as a study guide. For the students in Topic One, the students felt undirected since they were required to take their own notes, individually determining which facts and theories were important. Another apparent reason is that for Topic One students were unfamiliar with the software teaching format, the instructors, and the evaluations. For Topic Two, students had been introduced to the software, the instructors, and the evaluations, therefore may have performed better due to familiar circumstances and our expectations.

The instructor also affected the students' performance. The P-value for this variable was 0.041 (refer to Appendix I, page 77), indicating a significant difference. Kirk was a friend to the students. He gave them freedom to stray from the software lesson plan. Asima, on the other hand, was more of an authoritative figure. She had the students follow the lesson plans strictly, asked questions to check their understanding, and disciplined if necessary. The different styles of our teaching reflected in the student's performance on the evaluations. Asima's students performed better than Kirk's students.

The group's size also affected the students' performance on the new questions. When the groups of two were compared to groups of three, we arrived at a P-value of 0.48 (refer to Appendix I, page 78), which implies that eleven points is significant difference in the means. Groups of two performed better than groups of three. There may be several factors contributing to this outcome. First, smaller groups work better than larger ones. Working with the software required reading/turning the slides and taking notes. The groups of two divided these two responsibilities equally. Groups of

three had trouble dividing their responsibilities, resulting in some students working more than others.

According to the science averages, provided by Mr. Ratliff, the academically talented students (students with science averages higher than 90), were challenged to their abilities. For visual aid, refer to Appendix I pages 79-81. Almost all the students who received ninety or higher on the new questions were the academically talented. Therefore, not only did the software challenge the academically talented students, it also provided the students with a teaching tool which advances at a student's level and pace.

Bloom's Taxonomy

We used Bloom's Taxonomy levels to test cognitive abilities. We included questions that tested the first four cognitive levels. After the students were given the evaluations, we grouped the questions according to the cognitive levels and tabulated the students' performance on each level.

Students who had lecture before the software increased more in their cognitive levels. Again, this trend may have been due to the introduction of the topic, making the software a reinforcement tool rather than a teaching tool.

Similar to the performance results, Topic Two showed increase in the Bloom's Taxonomy levels (refer to Appendix J, page 89). Again, similar to the performance factors, this may have been affected by the self-help worksheet provided in Topic Two, and the familiarity with the teaching medium and the teaching format.

A difference in the improvement in cognitive levels can be seen depending on the instructor. Asima's students excelled in acquiring higher cognitive levels, whereas Kirk's students showed improvement but not as high (refer to Appendix J, page 92 and 95). This may be due the difference in teaching style. Therefore, a more authoritative figure, for this age group, causes the students to be more serious about learning than a companion.

Conclusions

After gathering the data and results, we arrived at several conclusions. First, the software should not be used alone. The best teaching method is a combination of lecture and software, as was the dominant preference in the surveys. As proven by our data, the students should be introduced to a topic by a lecture before they use the software. This allows the students to understand the basic ideas, and then explore with the software at an individualized pace.

We also conclude that the software did increase students' knowledge on the subject matter. For the optimal benefit, the instructor for the software needs to authoritative and groups should have only two members. To increase the students' performance on tests, the instructor should provide a self-help worksheet. In other words, the students should be directed by an instructor, a lesson plan, and a worksheet. The software will not be as beneficial if the students are left to wander to other topics.

Students showed an increase in their Bloom's Taxonomy levels after the use of the software. The academic talented students showed the most increase in performance and cognitive levels. Therefore, the software does aid in students learning and improving their abilities.

To conclude, the software did provide an individualized teaching tool, which helped the academic students learn and develop higher cognitive skills. The use of traditional lecture and computer software may alleviate the problem of compromising the education of the academic talented in a heterogeneous classroom.

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Appendix A

-Introduction
-Web Page

Introduction

Weather Workstation is the software we used to teach at CMTS. This appendix describes the software, its features and other software information. The software's web site can be found at www.eoascientific/products/catalog/weather/sum.htm.

Weather Workstation V. 3.0

Summary

- **Weather Workstation provides an integrated interactive multimedia experience of the sciences of weather and climate:**

- **100,000 words of well-organized and hyperlinked text**
- **500 megabytes of 30 digital movies of:**

  Shuttle launch and land
  Satellite launch from the Shuttle
  Weather satellite sequences
  Storms: tornadoes, hurricanes, floods
  Narrated explanations of storms
  Much more...

- **350 beautiful weather-related pictures of clouds, storms, landscapes, charts, graphs, satellite photos, and more...**
- **Interactive mini-games that teach weather principles**
- **Projects:**

  Building your own weather station from supplies found in your kitchen
  Obtaining and displaying current weather data from the Internet
  Digital image processing
  Digital movie-making
  Weather forecasting
  Ocean climate data visualization movies
  And more...

Courseware Summary

Everyone talks about the weather...Finally there's an explanation! Welcome to **Weather Workstation 3.0**, a comprehensive course in introductory meteorology designed for students in grades 6 through 12.

Four years in development, earlier versions of **Weather Workstation** are being used in homes and science classes throughout the U.S. and Canada. The curriculum has been approved for use in the school systems of four Canadian Provinces. The most recent release (Version 3.0) incorporates many improvements and timely updates.

Weather Workstation is multilevel, addressing the learning needs of students throughout adolescence by offering lessons, appendices and projects at increasing levels of sophistication. Ideal for home schooling, the course provides in-depth understanding of issues current in atmospheric science and will be of interest to parents and teachers as well.

Weather Workstation is multilingual, offering instruction in U.S. English, Canadian English, and Canadian French.

This is serious courseware, not "edu-tainment." But it also is very exciting, fun and fascinating.

Weather Workstation is an organized set of eight main lessons covering fundamentals, with 18 enhancement opportunities for more advanced research. It takes students on an exploration, and yet it is not a loose self-discovery program with no guidance. Students are encouraged to follow the lessons sequentially, steadily gaining a basic understanding of the "hows" and "whys" of local and global meteorology.

Weather Workstation is interactive, with 25 interactive mini-games to entertain students while providing reinforcement of basic concepts.

Weather Workstation outlines many projects for students to begin conducting their own scientific explorations. Included are sophisticated image processing systems, software which provides students with tools to analyze satellite remotely-sensed weather images--a major component of weather forecasting.

Weather Workstation also includes the **EOA Digital Movie-Making Toolkit**, enabling students to combine previously processed images into a movie in order to display the dynamic behavior of global or local weather patterns.

Several independent project software tools are included, including weather data charting software for display of current data that you can obtain from the Internet. Complete instructions are provided for downloading this data.

Engaging, exciting and challenging, **Weather Workstation** brings all the benefits of self-paced interactive learning to your classroom.

Appendix B

-Procedures

Procedures

To put our methodology into effect, we divided each class up into two rotations. For the first two days, the first-rotation students worked with the software, while the second-rotation students attended Mr. Ratliff's lecture. Afterward, we switched groups; now the first-rotation students worked with Mr. Ratliff while the second-rotation students used the software with us.

The topic we chose to present in our classroom was weather. The software Weather Workstation provided us with a comprehensive, in-depth, age- and grade-appropriate software to aid in teaching this subject matter.

In the textbook used by Mr. Ratliff's science classes, there are five lessons in the chapter concerning weather. We allowed the first lesson to be presented to all the classes as the traditional lecture. The first lesson primarily introduced the students to the basic ideas of weather. Therefore, the students had been introduced to this topic before they were exposed to the software. We started our experimental rotations with the second and third lessons of the weather chapter as Topic One, and the fourth and fifth lessons as Topic Two. Since both of our topics pertained to weather, we did not need to purchase another software.

Topic One, the second and third lessons of the chapter, covered the concepts of moving air, technology and weather. We found corresponding concepts covered in the Weather Workstation software in its chapters three, four and ten. Topic Two, the fourth and fifth lessons of the textbook chapter, described changing climates and the greenhouse effect. The corresponding slides of Weather Workstation were in

chapters two and eight. The lists of computer slides that were part of our lesson plans can be seen on the two versions of the "Computer Instruction Sheet" in Appendices D and E.

Mr. Ratliff teaches four sixth-grade science classes. Asima worked with the first two classes of the day, and Kirk worked with the two afternoon classes. For Topic One, we had to make some adjustments due to an unexpected school event which prevented us from working with the students for one day. For this reason, Topic One was allowed only a four-day time period for teaching both rotations of all four classes. Our condensed, four-day Topic One schedule can be seen below:

Lesson Plans for Topic One

	Day1	Day2	Day3	Day4	
½ class 1	Pre-eval introduction start software	Software	Post-eval Lecture 1	Lecture 2	**Period 2 Rotation 1**
½ class 1	Pre-eval Lecture 1	Lecture 2	introduction start software	Software Post-eval	**Period 2 Rotation 2**
½ class 2	Pre-eval introduction start software	Software	Post-eval Lecture 1	Lecture 2	**Period 3 Rotation 1**
½ class 2	Pre-eval Lecture 1	Lecture 2	introduction start software	Software Post-eval	**Period 3 Rotation 2**
½ class 3	Pre-eval introduction start software	Software	Post-eval Lecture 1	Lecture 2	**Period 7 Rotation 1**
½ class 3	Pre-eval Lecture 1	Lecture 2	introduction start software	Software Post-eval	**Period 7 Rotation 2**
½ class 4	Pre-eval introduction start software	Software	Post-eval Lecture 1	Lecture 2	**Period 8 Rotation 1**
½ class 4	Pre-eval Lecture 1	Lecture 2	introduction start software	Software Post-eval	**Period 8 Rotation 2**

On the first day in the four-day condensed cycle, we gave pre-evaluations that consisted of eleven short questions. We gave the pre-evaluations first of all to observe how much

the students had been introduced to weather concepts and how much they retained from Mr. Ratliff's lectures. We also used these pre-evaluations to set our expectations regarding the students' academic capability and knowledge of the subject matter. The same questions from the pre-evaluations were included on the post-evaluations; therefore by comparing the grades on the post- and pre-evaluations, we can see how much the students learned.

We also provided the students with a vocabulary sheet which summarized the important words and some concepts. If the student had come across a word or concept that was a bit complicated, the vocabulary sheet was to help him or her understand.

There was one experimental variable that was not controlled. We did not have enough time to give the post-evaluations during class for the second rotation on Topic One. We had to make it a take-home exam. The first rotation of Topic One was given an in-class post-evaluation. We required all the students in the second rotation to write and sign, "I will not use my notes or any form of help on this", in order to encourage honesty. However, this variable may produce differing results on the improvement of students' grades from pre- to post-evaluations, since the students who had the take-home post-evaluations had more time and may not have been honest in the no-cheating and no-help policy.

We also handed a short survey to the students after they used the software. For the first rotation of Topic One, periods 2 and 3, the students were given the survey after they took the post-evaluations. The first rotation of Topic One, periods 7 and 8, and all of the periods in the second rotation, took the survey before they began their in-class/take-home post-evaluations. This may also produce differing results, since the

students who took the post-evaluations before the survey may have a different opinion of the software.

For Topic Two, we switched the order of the rotations. Rotation 2 worked with the software first, and Rotation 1 attended Mr. Ratliff's lectures, then worked with the software. This was so that all the students had an exposure to different orders of the teaching methods. For consistency, students were kept in the same rotations and the same groups. The schedule for Topic Two was allotted five days, as we had planned before.

Lesson Plans for Topic Two

	Day1	Day2	Day3	Day4	Day5	
½ class 1	Pre-eval introduction start software	Software	Post-eval	Lecture 1	Lecture 2	**Period 2 Rotation 2**
½ class 1	Pre-eval Lecture 1	Lecture 2	Pre-eval introduction start software	Software	Post-eval	**Period 2 Rotation 1**
½ class 2	Pre-eval introduction start software	Software	Post-eval	Lecture 1	Lecture 2	**Period 3 Rotation 2**
½ class 2	Pre-eval Lecture 1	Lecture 2	Pre-eval introduction start software	Software	Post-eval	**Period 3 Rotation 1**
½ class 3	Pre-eval introduction start software	Software	Post-eval	Lecture 1	Lecture 2	**Period 7 Rotation 2**
½ class 3	Pre-eval Lecture 1	Lecture 2	Pre-eval introduction start software	Software	Post-eval	**Period 7 Rotation 1**
½ class 4	Pre-eval introduction start software	Software	Post-eval	Lecture 1	Lecture 2	**Period 8 Rotation 2**
½ class 4	Pre-eval Lecture 1	Lecture 2	Pre-eval introduction start software	Software	Post-eval	**Period 8 Rotation 1**

For the same reasons mentioned before, all students (in all the rotations and the classes) were given pre-evaluations, a vocabulary sheet, surveys before the test, and post-evaluations after the software. There was only one variable that was different

from the Topic One cycle. We provided the students with worksheets that were to be filled while they read the slides from the software. This was to help the students understand and grasp the important concepts and ideas from the software. We based our post-evaluations heavily on the worksheet and the vocabulary list. Therefore we expected better grades on the post-evaluations and a better percentage of improvement on the pre-evaluations from before and after the students were exposed to the software.

Appendix C

Topic One

Chapter 12 Computer Pre-evaluation
Computer Instruction Sheet
Vocabulary List for Weather Workstation
Evaluation for Lessons 12.2 and 12.3
Answer Sheet for 12.2 and 12.3
(Special Ed) Evaluation for Lessons 12.2 and 12.3
(Special Ed) Answer Sheet for 12.2 and 12.3
Survey

CHAPTER 12 COMPUTER PRE-EVALUATION

1. What are clouds made of?

   _____

2. The water cycle consists of three main processes: _____,

   _____, and _____.

3. Most of the earth's weather occurs in which atmospheric layer?

   _____

4. Temperature _____ as you rise through the tropospheric layer.

5. What are jet streams, and where do they occur?

_____

   _____

6. What is a front?

_____

7. Wind is air that moves from a low pressure to high pressure. True or False

   If false, correct the statement.

8. A warm air mass has a lower pressure than a cold air mass. True or False

   If false, correct the statement.

9. What two things determine how much of the sun's heat reaches the earth?

   _____ and _____

10. How are satellites useful in predicting the weather? _____

    _____

11. Satellites cannot take pictures of the earth at night. True or False

    If false, correct the statement.

COMPUTER INSTRUCTION SHEET

As you examine the computer program, study these slides. Follow the links to definitions and interactive exercises.

From computer Chapter Three:

3.4 (includes interactive exercise)
3.5
3.7 (includes interactive exercise)
3.8 (includes interactive exercise)
3.9
3.10
3.18

From computer Chapter Four:
4.2
4.3
4.4
4.8
4.10
4.19

From computer Chapter Ten:
10.1
10.2
10.5

When you've finished these, review by looking at these slides:
3.12
3.14

VOCABULARY LIST
FOR WEATHER WORKSTATION

absolute humidity – the total amount of water in the air

condensation – the process of a gas, such as water vapor, becoming a liquid

conduction – a type of heating by direct contact

convection – a type of heating; the process of warm air currents rising and expanding

dewpoint – the temperature at which the water present in the atmosphere would condense

electromagnetic spectrum – the range of visible light waves and related forms of energy

evaporation – the process of a liquid, such as water, becoming a gas

hydrologic cycle – the water cycle

infrared light – invisible rays of light with lower energy even than red light in the electromagnetic spectrum

precipitation – the process of condensed water vapor falling from the atmosphere to the earth's surface

relative humidity – the percentage of water in the air in terms of the highest amount possible

EVALUATION FOR LESSONS 12.2 AND 12.3

1. What are clouds made of? _____
2. The water cycle consists of three main processes: _____

   , _____, and _____.
3. How do plants contribute to the water cycle by putting water back into the air?

   _____
4. What is conduction? _____
5. What is convection? _____
6. As the air from near the surface rises and cools, what happens to the water vapor it contains? _____
7. What happens as the air becomes even cooler?_____

   _____
8. What is the water table?

   _____
9. How thick is the atmosphere?

   _____
10. Most of the earth's weather occurs in which atmospheric layer?

    _____
11. How is the thickness of the troposphere affected by the warmth of the air?

    _____
12. Temperature _____ as you rise through the troposphere.

13. Why is this? _____

14. What are jet streams, and where do they occur?

_____

_____

15. What is the difference between absolute humidity and relative humidity?

_____

_____

16. What is the dewpoint? _____

17. What is the relationship between dewpoint and relative humidity?

_____

_____

18. As air temperature changes, relative humidity also changes. Why is this?

_____

_____

19. After you've taken a long, hot shower, why is the bathroom mirror covered with condensation? _____

_____

20. What is a front? _____

21. What are easterlies and westerlies?

_____

_____

22. Wind is air that moves from low pressure to high pressure. True or False

If false, correct the statement.

23. A warm air mass has a lower air pressure than a cold air mass. True or False

If false, correct the statement.

24. How does the sun help to create wind?

_____

_____

25. What two things determine how much of the sun's heat reaches the earth?

_____ and _____

26. In which direction do prevailing winds blow across the North Atlantic Ocean?

_____

27. How are satellites useful in predicting the weather?

_____

_____

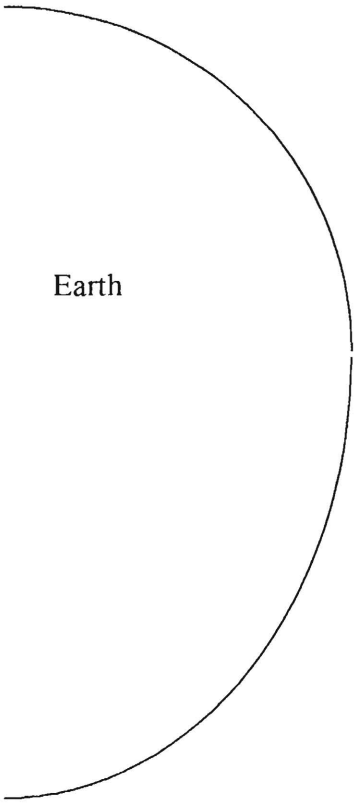
28. What is infrared light?

_____

29. Satellites cannot take pictures of the earth at night. True or False

If false, correct the statement.

30. Draw and label the layers of the atmosphere in order.



Extra-Credit

Describe how a cloud is formed. _____

_____

ANSWER SHEET FOR 12.2 AND 12.3

1. (Slide 3.4) A mixture of air and water droplets or ice.
2. (Slide 3.4) Evaporation, condensation, and precipitation.
3. (Slide 3.4) Transpiration—the process of water evaporating directly from leaves.
4. (Slide 3.4) A type of heating by direct contact
5. (Slide 3.4) A type of heating; the process of warm air currents rising and expanding
6. (Slide 3.5) It condenses to form a cloud.
7. (Slide 3.5) Water droplets or crystals grow heavier until they fall as precipitation.
8. (Slide 3.5) Water which had filtered through soil and rock in the ground to form a source of freshwater.
9. (Slide 3.7) About fifty kilometers.
10. (Slide 3.7) The troposphere.
11. (Slide 3.7) The cooler the air, the thinner the troposphere; and vice versa.
12. (Slide 3.8) Cools (or decreases).
13. (Slide 3.8) The earth's surface is warmed by the sun and then warms the air close to it.
14. (Slide 3.8) High winds flowing in narrow channels; they occur in the tropopause.
15. (Slide 3.9) Absolute humidity is the amount of water in the air; relative humidity is the percentage of the amount of water, relative to the amount the air could hold.
16. (Slide 3.10) The temperature at which the water present in the atmosphere would condense; no more evaporation can occur.
17. (Slide 3.10) The dewpoint is the temperature at which the current amount of water vapor in the air would become 100% relative humidity.
18. (Slide 3.10) Warmer air can hold more water vapor.

19. (Slide 3.14) The warm, steamy air in the bathroom after a shower has a relative humidity of 100%. When it comes into contact with the cooler surface of the mirror, its ability to hold water vapor drops, and some of that vapor condenses onto the mirror.

20. (Slide 3.18) The advancing edge of a moving air mass.

21. (Slide 4.2) Easterlies are winds that blow from the east near the equator; westerlies are winds that blow from the west at high latitudes.

22. (Slide 4.3) False. "high pressure to low pressure".

23. (Slide 4.3) True.

24. (Slide 4.3) The sun heats the earth's surface unevenly, creating warm and cold regions.

25. (Slide 4.4) How much heat the sun is giving off, and the distance between the sun and the earth.

26. (Slide 4.14) West to east.

27. (Slide 10.1) They send pictures of the earth's surface, oceans, and atmosphere.

28. (Slide 10.1) Invisible rays of light with lower energy even than red light in the electromagnetic spectrum; used by satellites to take pictures.

28. (Slide 10.1) False. "can take pictures".

29. (Slide 3.8) The layers of the atmosphere, in order, starting with the layer closest to the earth's surface:

    -troposphere
    -tropopause
    -stratosphere
    -stratopause
    -mesosphere
    -mesopause
    -thermosphere

EXTRA CREDIT ---Warm, moisture-laden air cools; it reaches its dewpoint; and some of the vapor it is holding condenses into a cloud.

EVALUATION FOR LESSONS 12.2 AND 12.3

1. What are clouds made of? _____
2. The water cycle consists of three main processes: _____

   , _____, and _____.
3. What is conduction? _____
4. What is convection? _____
5. What happens to the water vapor as the air becomes cooler? _____

   _____
6. What is the water table?

   _____
7. How thick is the atmosphere?

   _____
8. Most of the earth's weather occurs in which atmospheric layer?

   _____
9. Temperature _____ as you rise through the troposphere.
10. What are jet streams, and where do they occur?

    _____

    _____
11. What is the dewpoint? _____
12. What is a front? _____
13. What are easterlies and westerlies?

    _____

14. Wind is air that moves from low pressure to high pressure. True or False

If false, correct the statement.

15. A warm air mass has a lower air pressure than a cold air mass. True or False

If false, correct the statement.

16. What two things determine how much of the sun's heat reaches the earth?

_____ and _____

17. In which direction do prevailing winds blow across the North Atlantic Ocean?

_____

18. How are satellites useful in predicting the weather?

_____

_____

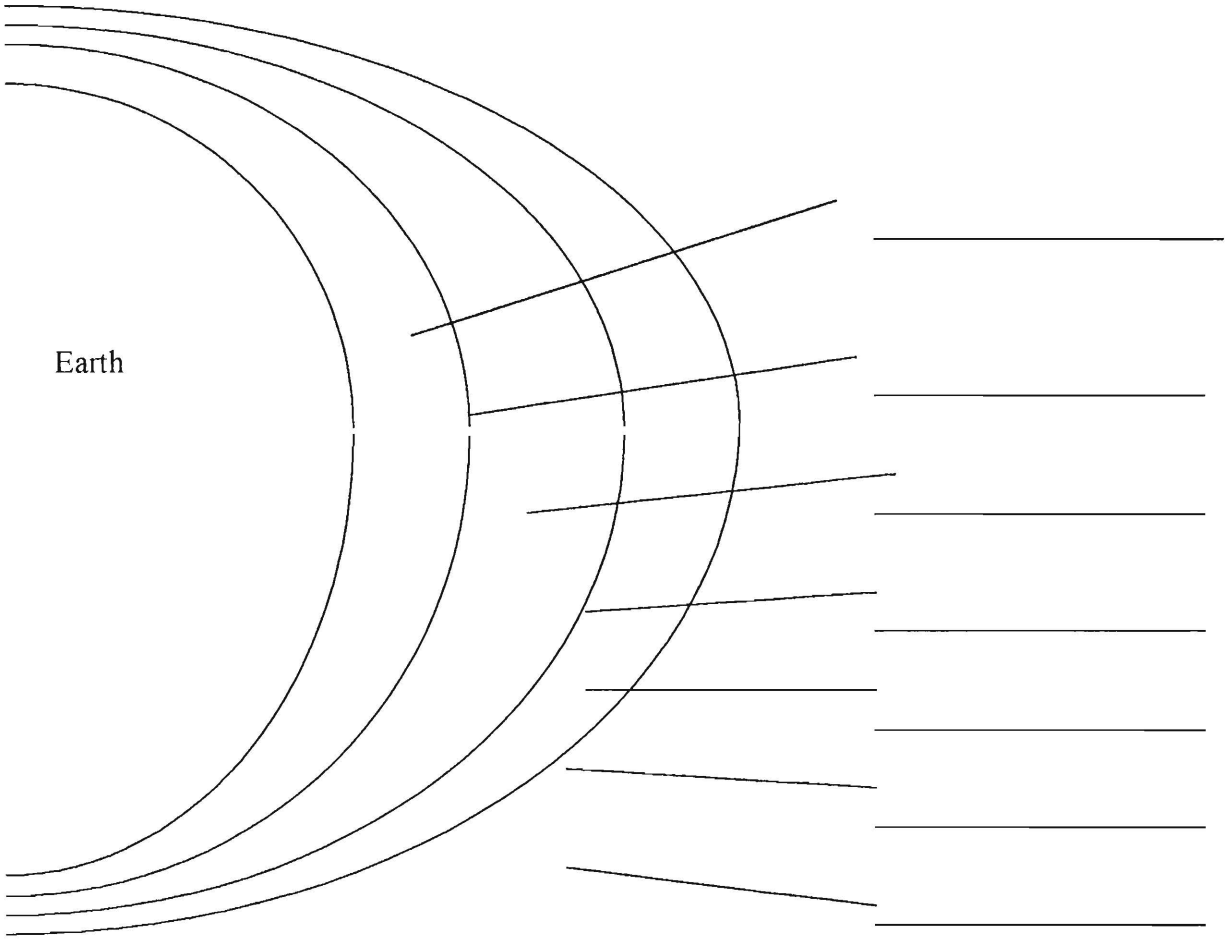
19. What is infrared light?

_____

20. Satellites cannot take pictures of the earth at night. True or False

If false, correct the statement.

21. Draw and label the layers of the atmosphere in order.



ANSWER SHEET FOR 12.2 AND 12.3

1. (Slide 3.4) A mixture of air and water droplets or ice.
2. (Slide 3.4) Evaporation, condensation, and precipitation.
3. (Slide 3.4) A type of heating by direct contact
4. (Slide 3.4) A type of heating; the process of warm air currents rising and expanding
5. (Slide 3.5) It condenses to form a cloud.
6. (Slide 3.5) Water which had filtered through soil and rock in the ground to form a source of freshwater.
7. (Slide 3.7) About fifty kilometers.
8. (Slide 3.7) The troposphere.
9. (Slide 3.8) Cools (or decreases).
10. (Slide 3.8) High winds flowing in narrow channels; they occur in the tropopause.
11. (Slide 3.10) The temperature at which the water present in the atmosphere would condense; no more evaporation can occur.
12. (Slide 3.18) The advancing edge of a moving air mass.
13. (Slide 4.2) Easterlies are winds that blow from the east near the equator; westerlies are winds that blow from the west at high latitudes.
14. (Slide 4.3) False. "high pressure to low pressure".
15. (Slide 4.3) True.
16. (Slide 4.3) The sun heats the earth's surface unevenly, creating warm and cold regions.
17. (Slide 4.14) West to east.
18. (Slide 10.1) They send pictures of the earth's surface, oceans, and atmosphere.
19. (Slide 10.1) Invisible rays of light with lower energy even than red light in the electromagnetic spectrum; used by satellites to take pictures.

20. (Slide 10.1) False. "can take pictures".

21. (Slide 3.8) The layers of the atmosphere, in order, starting with the layer closest to the earth's surface:

    -troposphere
    -tropopause
    -stratosphere
    -stratopause
    -mesosphere
    -mesopause
    -thermosphere

EXTRA CREDIT ---Warm, moisture-laden air cools; it reaches its dewpoint; and some of the vapor it is holding condenses into a cloud.

SURVEY

1. Which learning method do you think you would prefer?

a) computer software b) traditional teaching c) a combination of the two

2. Why? (circle all that apply)

a) The material is not presented too quickly or too slowly.

b) The material is easy to understand.

c) The presentation included the right amount of visual aids.

d) Other: _____

_____

3. Do you think you learn more by working

a) alone

or

b) in a small group ?

Appendix D

Topic Two

Lessons 12.4-12.5 Computer Pre-evaluation
Computer Instruction Sheet
Vocabulary List Two for Weather Workstation
Evaluation for Lessons 12.4 and 12.5
Answer Sheet for 12.4 and 12.5
(Special Ed) Evaluation for Lessons 12.4 and 12.5
(Special Ed) Answer Sheet for 12.4 and 12.5
Survey2

Name: _____
Date: _____
Period: _____
Rotation: _____

LESSONS 12.4-12.5 COMPUTER PRE-EVALUATION

1. What is a geostationary (geosynchronous) satellite?

   _____

   _____

2. What kind of light do satellites use to take pictures at night?

   _____

3. Name three sources that scientists study for evidence of past climate change.

   _____

   _____

4. What makes a cloudless sky blue?

   _____

   _____

   _____

5. Name three sources of atmospheric carbon dioxide?

   _____

   _____

COMPUTER INSTRUCTION SHEET

As you examine the computer program, study these slides. Follow the links to definitions and interactive exercises.

From computer Chapter Two:

2.6
2.7
2.8
2.10
2.11
2.16
2.17
2.18

From computer Chapter Eight:

Slides 8.2 to 8.38

When you've finished these, review by looking at these slides:
2.15
2.19
8.21

VOCABULARY LIST TWO
FOR WEATHER WORKSTATION

albedo – a measure of a surface's reflectiveness

frequency – times per second that the electric and magnetic fields that light is made of are turning on and off

geostationary (geosynchronous) satellite – a satellite that stays above the same spot on the earth as all times

greenhouse gases – gases which trap heat in the troposphere, causing the Greenhouse Effect; these gases include carbon dioxide, methane, and nitrous oxide

infrared light – invisible rays of light with lower energy even that red light in the electromagnetic spectrum

negative feedback – a reaction which tends to diminish its cause; for example, in the Greenhouse Effect, negative feedback might go through the following steps:
-increased greenhouse gases
-increases temperature
-increases humidity and cloud formation
-causes reflection of more solar radiation
-cools the earth
-increases snowfall
-leads to more reflection and cooling

positive feedback – a reaction which tends to increase its cause; for example, in the Greenhouse Effect, positive feedback might go through the following steps:
-increased greenhouse gases
-increases temperature
-increases humidity and cloud formation
-increases heat trapped in troposphere and infrared energy absorbed by water vapor
-raises humidity
-leads to more intense global warming

refraction – the process by which light rays are bent as they pass through a substance

zipper storm – a storm that sets up conditions for a bigger storm to follow

Name: _____
Date: _____

Period: _____
Rotation: _____

EVALUATION FOR 12.4 AND 12.5

1. What is a zipper storm? _____

_____

2. What is a geostationary (geosynchronous) satellite? _____

_____

3. What kind of light do satellites use to take pictures at night? _____

4. Infrared light in satellite pictures represents heat. True or False

   If false, correct the statement.

5. What conditions exist at the eye of a hurricane? _____

_____

6. According to theory, how did a meteor cause the extinction of the dinosaurs?

_____

_____

7. Name three sources that scientists study for evidence of past climate change.

_____

_____

8. When and where did the Little Ice Age occur? _____

_____

9. What are sunspots? _____

_____

10. Sunspots occur in fifteen-year cycles. True or False

If false, correct the statement.

11. When the earth's temperature drops, what happens to the amount of liquid water in the oceans? Why? _____

_____

_____

12. How do snow, ice, and clouds help to cool the earth's surface? _____

_____

13. What is the difference between visible and infrared light? _____

_____

14. What makes a cloudless sky blue? _____

_____

15. What causes rainbows? _____

_____

16. Describe the Greenhouse Effect. _____

_____

_____

17. How much of the atmosphere is composed of greenhouse gases? _____

18. Name three sources of atmospheric carbon dioxide. _____

_____

19. Scientists who study climate change are _____. Circle one.

    a) certain that rising levels of greenhouse gases will cause cooling and another Ice Age

    b) certain that rising levels of greenhouse gases will cause ever-increasing warming and rising sea levels

    c) not 100% certain of the long-term effects of rising levels of greenhouse gases

20. In the Greenhouse Effect, the theory of negative feedback predicts _____. Circle one.

    a) another Ice Age

    b) more global warming

ANSWER SHEET FOR 12.4 AND 12.5

1. (Slide 2.7) A zipper storm sets up conditions for a bigger storm to follow.

2. (Slide 2.10) A geostationary (geosynchronous) satellite stays above the same spot on the earth at all times.

3. (Slide 2.11) Infrared.

4. (Slide 2.11) True.

5. (Slide 2.17) A well structured, low-pressure, calm region bordered by winds.

6. (Slide 8.5) The meteor struck the earth, sending up enough dust to block the sun's rays and causing the earth's temperature to drop.

7. (Slide 8.6) The ground, polar ice, rocks, land formations, fossils such as preserved pollen granules, and air bubbles in polar ice.

8. (Slide 8.10) Three hundred years ago in Europe.

9. (Slide 8.10) Sunspots are dark, cooler areas appearing on the surface of the sun.

10. (Slide 8.10) False. "11-year cycles".

11. (Slide 8.14) The amount of liquid water in the oceans decreases because most of it freezes and becomes ice.

12. (Slide 8.14) White surfaces, such as snow, ice, and clouds, reflect rather than absorb the sun's radiation.

13. (Slide 8.20) Infrared light has lower energy, lower frequency and higher wavelength than visible light.

14. (Slide 8.20) The water droplets and tiny particles in the atmosphere scatter light in all directions, especially blue light, which has the shortest wavelength.

15. (Slide 8.20) The water droplets in the atmosphere refract sunlight like a prism.

16. (Slide 8.23) Heat is trapped in the atmosphere by gases such as carbon dioxide, methane, and nitrous oxide.

17. (Slide 8.25) Less than 1%.

18. (Slide 8.28) People, forests, animals, industry, fire.

19. (Slide 8.32) c)

20. (Slide 8.33) a)

Name: _____
Date: _____

Period: _____
Rotation: _____

EVALUATION FOR 12.4 AND 12.5

1. What is a geostationary (geosynchronous) satellite? _____

_____

2. What kind of light do satellites use to take pictures at night? _____

3. Infrared light in satellite pictures represents heat. True or False

   If false, correct the statement.

4. What conditions exist at the eye of a hurricane? _____

_____

5. Name three sources that scientists study for evidence of past climate change.

_____

_____

6. When and where did the Little Ice Age occur? _____

_____

7. Sunspots occur in fifteen-year cycles. True or False

   If false, correct the statement.

8. Do snow, ice and clouds reflect enough sunlight to make the earth cooler?

_____

9. What is infrared light? _____

_____

10. What makes a cloudless sky blue? _____

_____

11. The Greenhouse Effect is the process by which heat is trapped in the atmosphere by greenhouse gases. True or False

    If false, correct the statement.

12. How much of the atmosphere is composed of greenhouse gases? _____

13. Name three sources of atmospheric carbon dioxide. _____

_____

14. Scientists who study climate change are _____. Circle one.

    a) certain that rising levels of greenhouse gases will cause cooling and another Ice Age

    b) certain that rising levels of greenhouse gases will cause ever-increasing warming and rising sea levels

    c) not 100% certain of the long-term effects of rising levels of greenhouse gases

15. In the Greenhouse Effect, the theory of negative feedback predicts _____. Circle one.

    a) another Ice Age

    b) more global warming

ANSWER SHEET FOR 12.4 AND 12.5

1. (Slide 2.10) A geostationary (geosynchronous) satellite stays above the same spot on the earth at all times.

2. (Slide 2.11) Infrared.

3. (Slide 2.11) True.

4. (Slide 2.17) A well structured, low-pressure, calm region bordered by winds.

5. (Slide 8.6) The ground, polar ice, rocks, land formations, fossils such as preserved pollen granules, and air bubbles in polar ice.

6. (Slide 8.10) Three hundred years ago in Europe.

7. (Slide 8.10) False. "11-year cycles".

8. (Slide 8.14) White surfaces, such as snow, ice, and clouds, reflect rather than absorb the sun's radiation.

9. (Slide 8.20) Infrared light has lower energy, lower frequency and higher wavelength than visible light.

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11. (Slide 8.23) True.

12. (Slide 8.25) Less than 1%.

13. (Slide 8.28) People, forests, animals, industry, fire.

14. (Slide 8.32) c)

15. (Slide 8.33) a)

SURVEY 2

1. Which learning method do you think you would prefer?

a) computer software b) traditional teaching c) a combination of the two

2. Why? (circle all that apply)

a) The material is not presented too quickly or too slowly.

b) The material is easy to understand.

c) The presentation included the right amount of visual aids.

d) Other: _____

_____

3. Do you think you learn more by working a) alone
or b) in a small group ?

4. Did the self-help worksheet help you learn the material in the software? a) Yes.
b) No.

Appendix E

Data Sheets

-Results for Topic One Rotation One
-Results for Topic One Rotation Two
-Results for Topic Two Rotation One
-Results for Topic Two Rotation Two

Key:

avg = science average

prefer = answer to survey question #1

a = software, b = traditional lecture, c = combination

why = answer to survey question #2
reason for preferring a teaching method

a = material not presented too quickly or slowly
b = material is easy to understand
c = presentation included right amount of visual aids
d = other

group = answer to question #3 on survey
prefer working in a ....

a = alone
b = small group

pre-eval = pre-evaluation grades

pre-eval II = pre-evaluation II grades

post-eval = post-evaluation grades
new questions and pre-evaluation II combined

pre-eval imp. = pre-evaluation II grades – pre-evaluation grades

new ? = new questions grades

m/f = identifies gender of the student

Results for Topic One Rotation One

Period 2 Rotation 1

name	avg	prefer	why	group	pre-eval	pre-eval II	post-eval	pre-evl imp.	new ?	m/f
S1	78	b	a,b	b	23	55	40	32	29	f
S2	90	c	a,c	b	55	68	61	13	56	m
S3	62	c	c	a	36	55	35	19	20	f
S4	86	b	a,b	b	59	59	54	0	50	f
S5	79	b	b	a	41	27	30	-14	32	f
S6	88	c	d	b	50	64	47	14	34	f
S7	91	a	a,c	a	45	64	52	19	43	m
S8	82	c	b,c	a	59	41	45	-18	48	m
S9	79	c	a,c	b	36	32	25	-4	20	m
Period 3 Rotation 1										
S10	70	c	b	b	23	9	13	-14	16	f
S11	91	c	b	a	64	68	66	4	64	m
S12	79	a	a	b	50	50	32	0	18	m
S13	71	b	a	a	32	14	11	-18	9	m
S14	96	c	b	b	45	64	71	19	76	f
S15	85	c	b	b	41	41	20	0	4	f
Period 7 Rotation 1										
S16	96	c	d	b	50	68	69	18	70	f
S17	90	c	a,c	b	73	64	50	-9	39	m
S18	66	a	a,b,c	b	55	50	38	-5	29	f
S19	61	a	a,c	b	27	23	22	-4	21	f
S20	80	c	a,c	a	64	66	53	2	43	f
Period 8 Rotation 1										
S21	92	c	b	b	50	68	51	18	38	m
S22	78	a	c,d-fun	a	32	23	12	-9	4	f
S23	61	a	b	b	50	64	36	14	15	f
S24	92	c	c	b	36	50	44	14	39	f
S25	79	c	a,d	b	41	41	36	0	32	f
S26	95	a	a,b,c	b	55	75	55	20	40	f
S27	75	c	b	b	36	55	29	19	9	f
S28	91	c	d	b	27	59	46	32	36	f

Results for Topic One Rotation Two

Period 2 Rotation 2

name	avg	prefer	why	group	pre-eval	pre-eval II	post-eval	pre-evl imp.	new ?	m/f
S29	88	b	d- hard	b	36	66	72	30	77	m
S30	86	b	a.b	a	36	77	69	41	63	m
S31	86	b	d- hard	b	64	86	68	22	54	f
S32	88	b	a.,b	a	55	77	62	22	51	f
S33	93	b	a,b	b	73	82	70	9	61	f
S34	70	c	a,b,c	a	50	68	44	18	26	m
Period 3 Rotation 2										
S35	96	a	a,b,c,d	b	77	86	83	9	81	m
S36	94	a	a,b,c,d	b	91	77	83	-14	88	m
S37	88	c	b,c	a	68	82	71	14	63	f
S38	63	b	b	b	36	41	44	5	46	f
S39	85	c	a,d	b	50	68	59	18	52	f
Period 7 Rotation 2										
S40	86	a	b,c	b	50	82	54	32	33	m
S41	77	c	b,c	a	55	77	52	22	33	f
S42	92	b	a,b,d	a	41	59	68	18	75	f
Period 8 Rotation 2										
S43	74	a	c	b	27	23	15	-4	9	f
S44	76	a	a	b	36	55	35	19	21	m
S45	71	a	a	b	36	45	32	9	22	f
S46	75	a	c,d	a	41	50	48	9	47	m
S47	77	a	a,c	b	36	41	27	5	16	m
S48	77	b	a,b	a	18	77	66	59	57	m
S49	94	c	c	b	50	68	65	18	63	f
S50	93	a	c	b	45	64	55	19	48	f

Results for Topic Two Rotation One

Period 2 Rotation 1

name	avg	perfer	why	group	sheet	pre-eval	pre-eval II	post-eval	pre-evl imp.	new ?	m/f
S1	78	b	a,b	b	b	0	30	47	30	67	f
S2	90	c	a,b,c	b	a	30	95	78	65	98	m
S3	62	c	c	a	a	10	0	41	-10	54	f
S4	86	b	a,b,d	b	a	60	70	71	10	76	f
S5	79	b	d	b	a	0	50	41	50	58	f
S6	88	b	d	b	a	10	70	71	60	96	f
S7	91	a	b	a	a	50	100	79	50	91	m
S8	82	c	a,b	b	a	30	60	75	30	94	m
S9	79	c	a,c	a	a	0	60	44	60	62	m

Period 3 Rotation 1

S10	70	c	b	b	b	0	30	38	30	54	f
S11	91	c	a,b	a	a	20	100	79	80	104	m
S12	79	a	a	b	a	15	65	66	50	87	m
S13	71	c	a	a	a	0	45	37	45	52	m
S14	96	c	c,d	b	a	10	100	81	90	111	f
S15	85	c	b	b	a	30	50	63	20	77	f

Period 7 Rotation 1

S16	96	b	a,b	a	a	40	90	71	50	84	f
S17	90	b	a,b	b	a	20	65	60	45	77	m
S18	66	a	a,b,c	b	a	10	10	44	0	58	f
S19	61	c	a,b	b	a	0	15	40	15	57	f
S20	80	c	a,c	b	a	0	30	54	30	77	f

Period 8 Rotation 1

S21	92	b	a,b	a	a	15	100	90	85	121	m
S22	78	c	c,d	a	a	0	10	53	10	75	f
S23	61	a	a,b	b	a	0	20	41	20	58	f
S24	92	c	c	b	a	10	60	65	50	88	f
S25	79	c	d	b	a	0	70	66	70	94	f
S26	95	a	a,b,c	b	a	30	70	71	40	88	f
S27	75	b	d	b	a	10	40	29	30	37	f
S28	91	c	d	a	a	10	70	60	60	81	f

Results for Topic Two Rotation Two

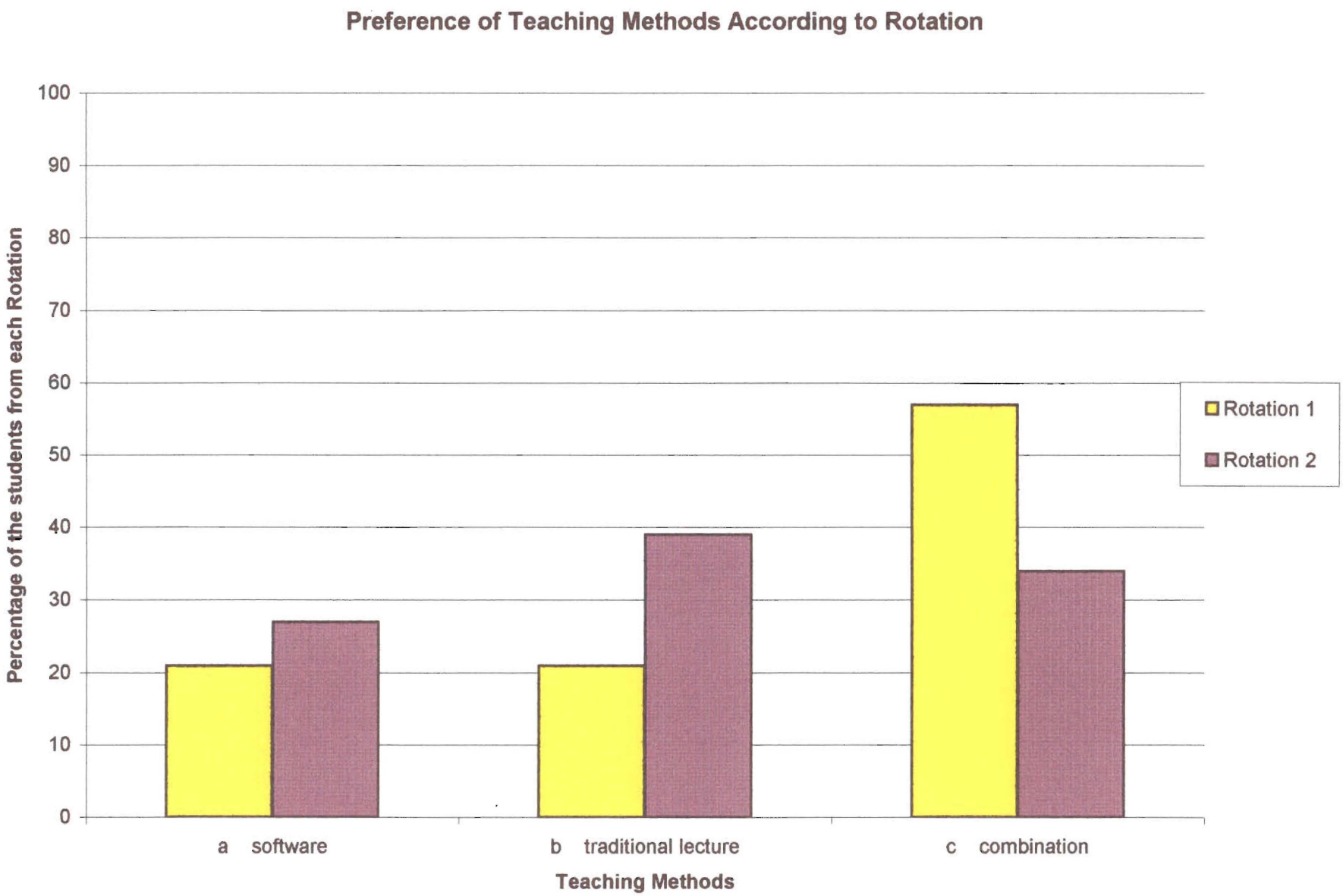
Period 2 Rotation 2

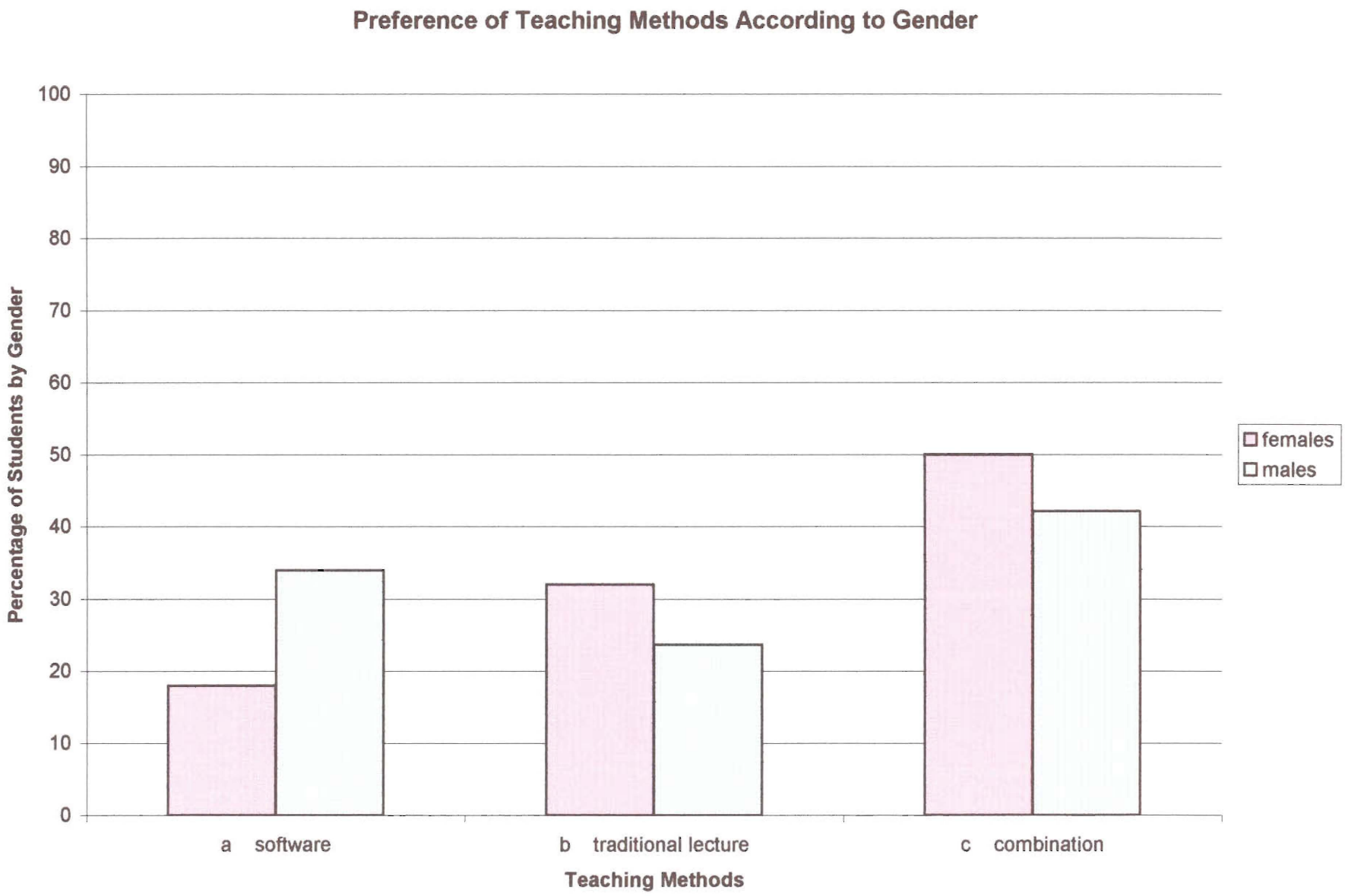
name	avg	prefer	why	group	sheet	pre-eval	pre-eval II	post-eval	pre-evl imp.	new ?		m/f
S29	88	b	a,b	b	a	0	60	69	60		73	m
S30	86	b	b,c	b	c-time	10	25	20	15		18	m
S31	86	b	d-no not	b	a	0	50	71	50		80	f
S32	88	b	a,b,d	a	a	45	55	65	10		69	f
S33	93	b	b	b	a	0	15	65	15		86	f
S34	70	c	a,b	a	a	30	30	44	0		50	m
Period 3 Rotation 2												
S35	96	c	a,c	b	a	50	90	99	40		103	m
S36	94	a	all,fun	b	a	50	90	87	40		86	m
S37	88	c	a,c	a	a	15	70	72	55		73	f
S38	63	b	b	b	a	0	10	29	10		37	f
S39	85	c	b,c	b	a	10	20	35	10		41	f
Period 7 Rotation 2												
S40	86	c	a,b	b	a	40	60	60	20		60	m
S41	77	b	a,b	a	a	10	40	54	30		60	f
S42	92	b	a,b	a	a	10	90	90	80		90	f
Period 8 Rotation 2												
S43	74	c	b	b	b	10	10	34	0		44	f
S44	76	a	b	b	a	15	20	31	5		36	m
S45	71	c	d-info	b	a	10	10	26	0		33	f
S46	75	c	d	a	a	40	60	57	20		56	m
S47	77	a	a,b,c	b	a	20	40	41	20		41	m
S48	77	b	a,b	b	c-maybe	10	20	29	10		33	m
S49	94	c	a	b	a	10	90	69	80		60	f
S50	93	c	c	b	a	60	90	63	30		52	f

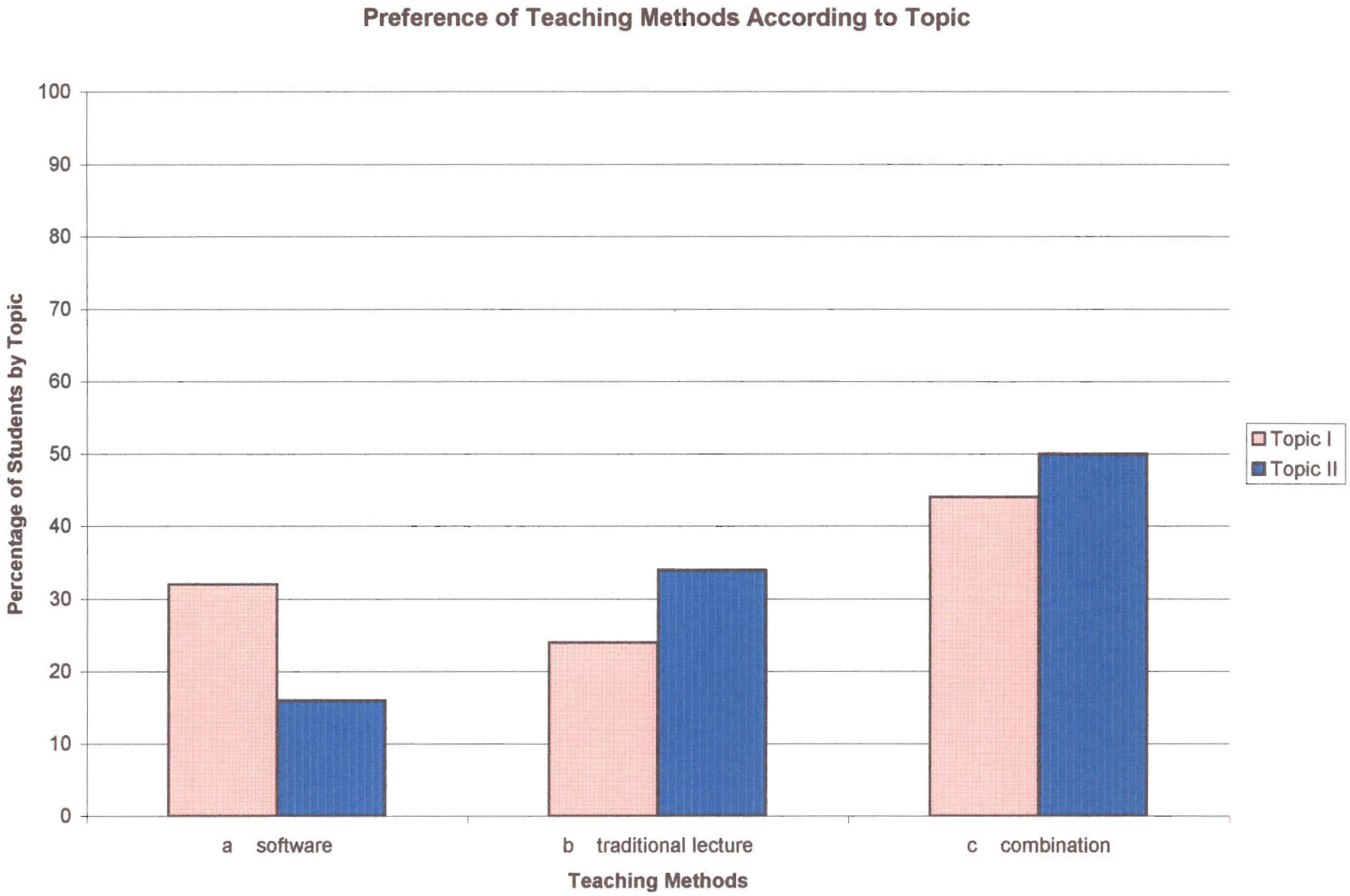
Appendix F

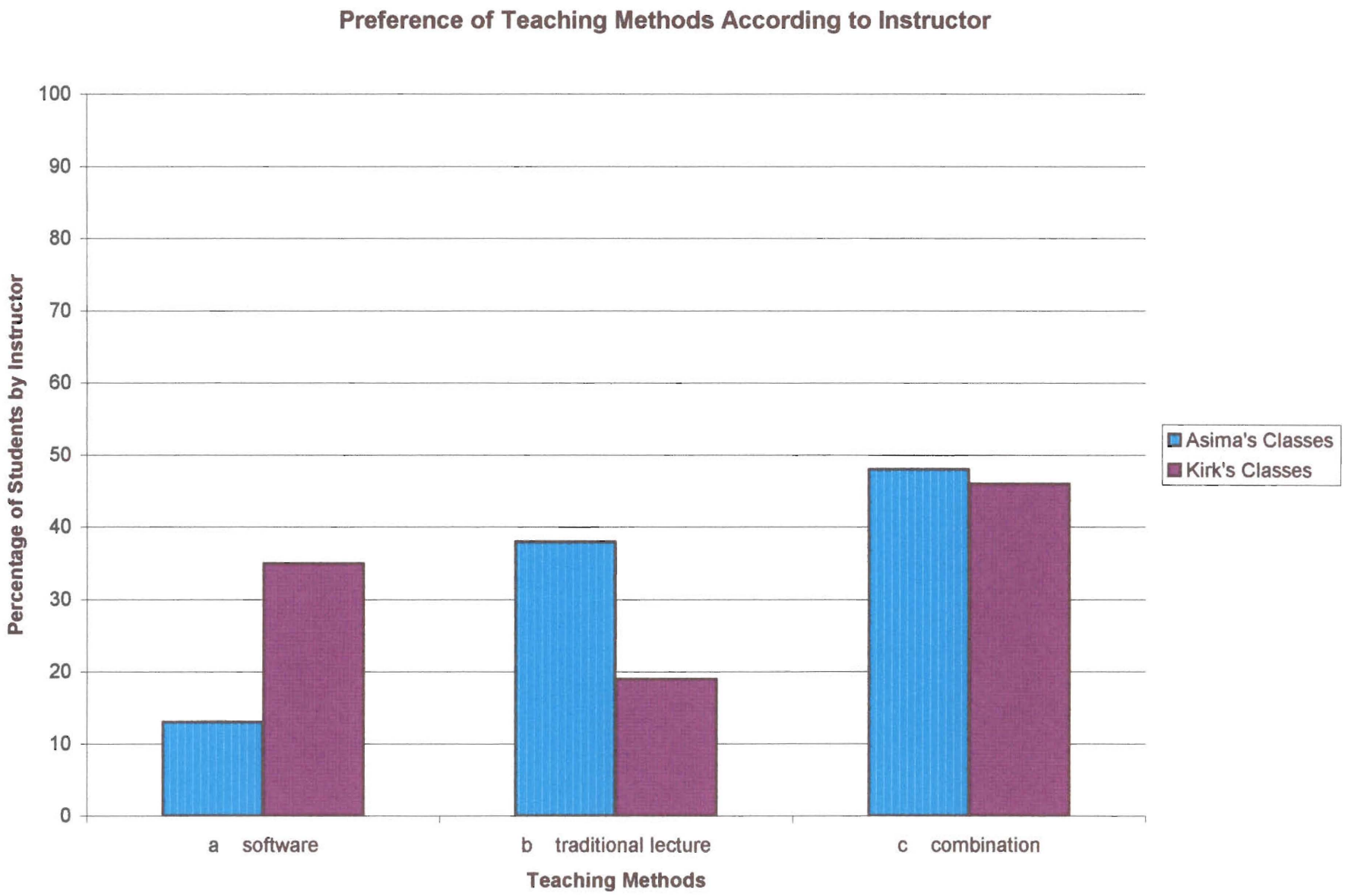
Preference Graphs

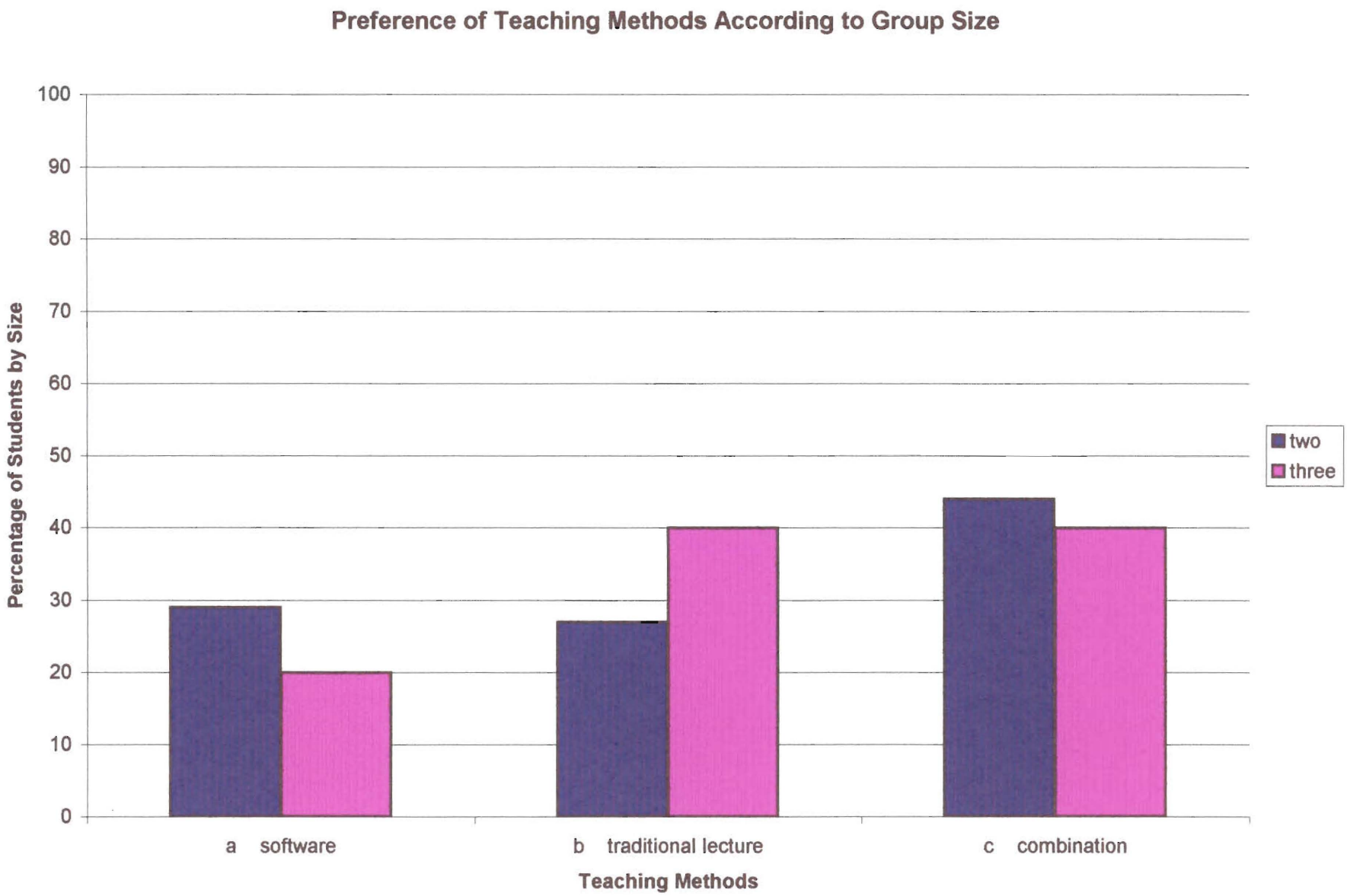
- Preference of Teaching Methods According to Rotation
- Preference of Teaching Methods According to Gender
- Preference of Teaching Methods According to Topic
- Preference of Teaching Methods According to Instructor
- Preference of Teaching Methods According to Group Size
- Preference of Teaching Methods According to Group Type

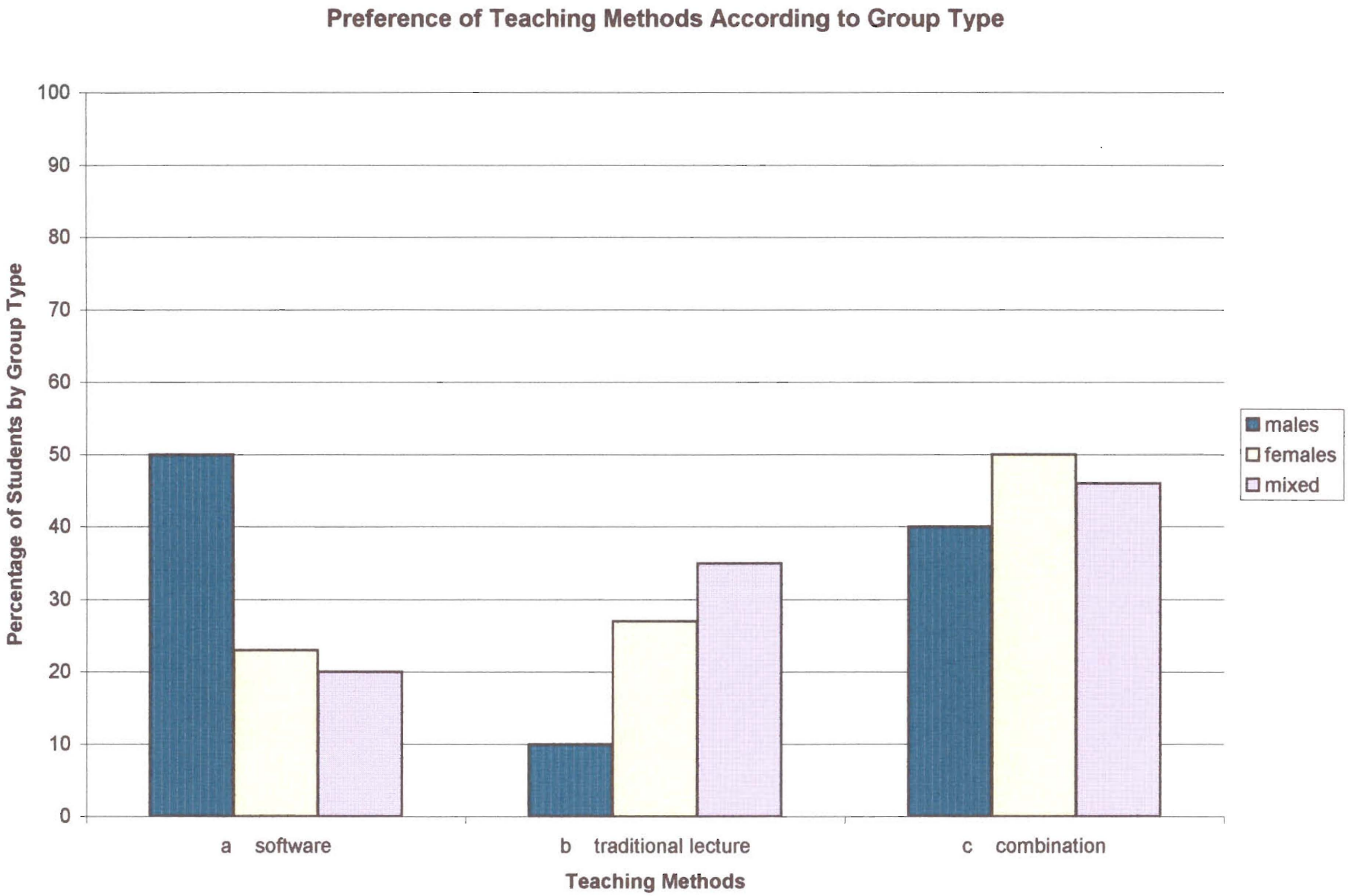

Preference of Teaching Methods According to Rotation
Percentage of the students from each Rotation
100
90
80
70
60
50
40
30
20
10
0
Rotation 1
Rotation 2
a software
b traditional lecture
c combination
Teaching Methods


Preference of Teaching Methods According to Gender
Percentage of Students by Gender
100
90
80
70
60
50
40
30
20
10
0
a software
b traditional lecture
c combination
Teaching Methods
females
males


Preference of Teaching Methods According to Topic
Percentage of Students by Topic
100
90
80
70
60
50
40
30
20
10
0
a software
b traditional lecture
c combination
Teaching Methods
Topic I
Topic II


Preference of Teaching Methods According to Instructor
Percentage of Students by Instructor
100
90
80
70
60
50
40
30
20
10
0
a software
b traditional lecture
c combination
Teaching Methods
Asima's Classes
Kirk's Classes

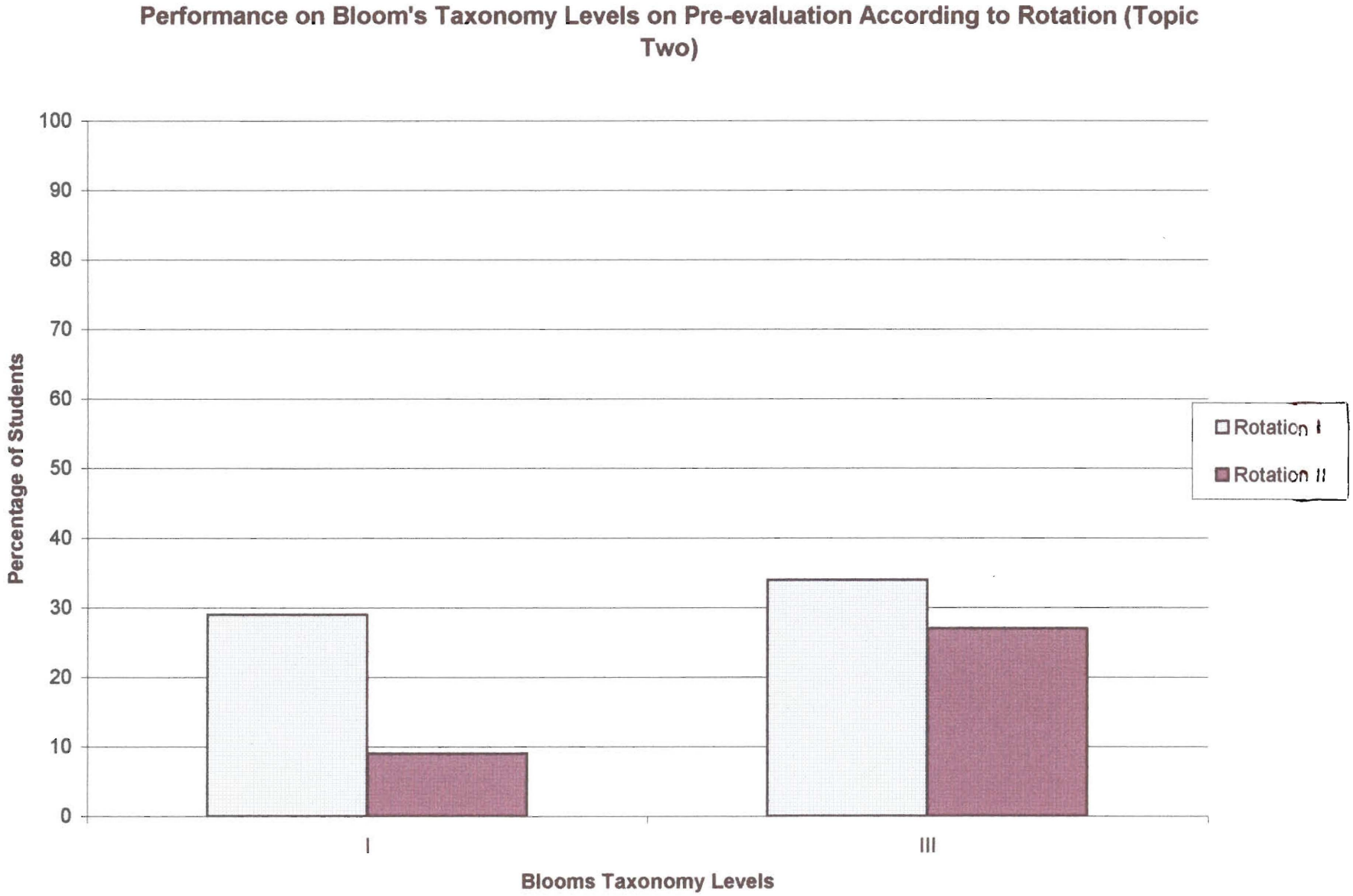

Preference of Teaching Methods According to Group Size
Percentage of Students by Size
100
90
80
70
60
50
40
30
20
10
0
a software
b traditional lecture
c combination
Teaching Methods
two
three

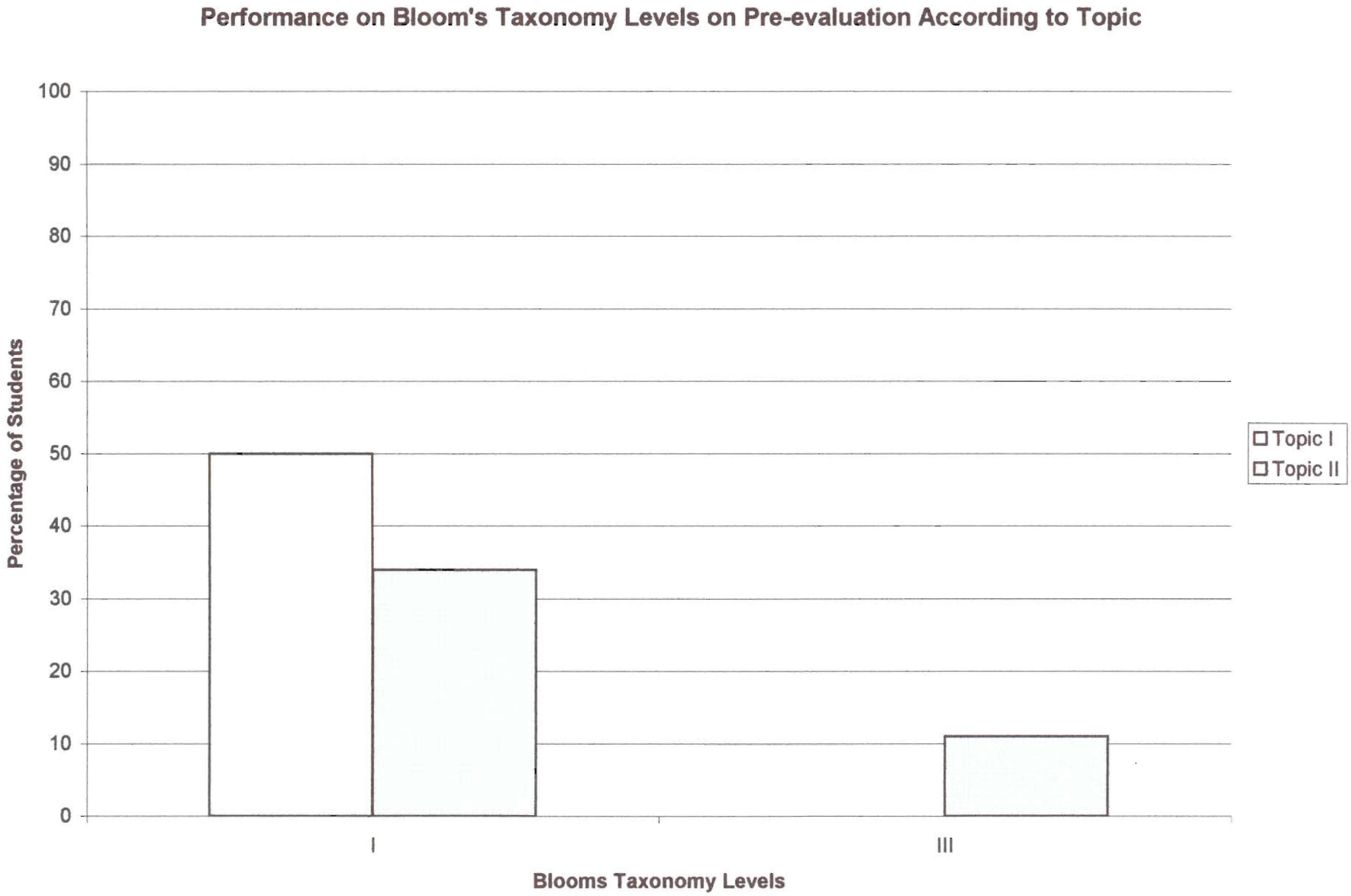

Preference of Teaching Methods According to Group Type
Percentage of Students by Group Type
100
90
80
70
60
50
40
30
20
10
0
a software
b traditional lecture
c combination
Teaching Methods
males
females
mixed

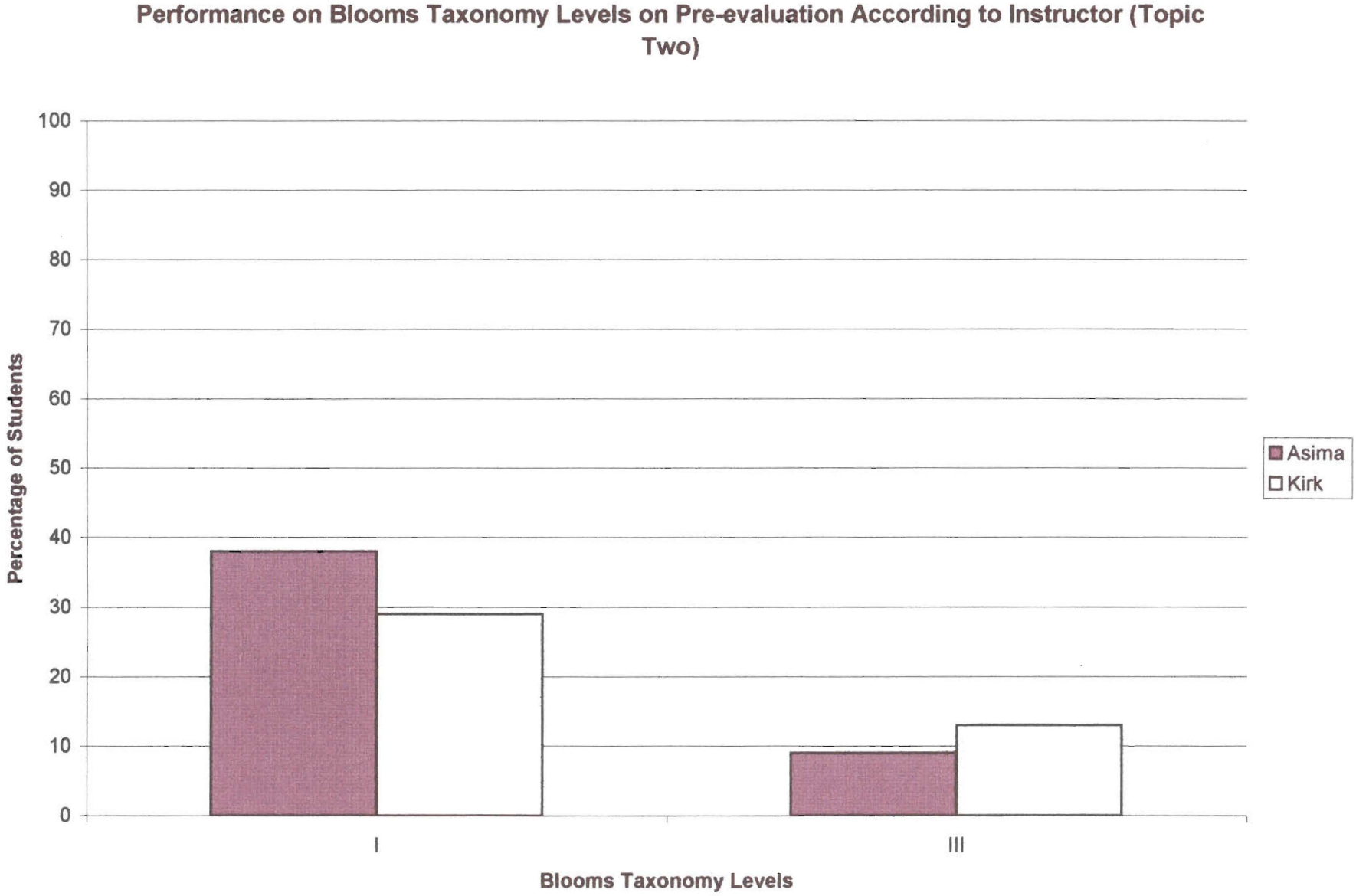
Appendix G

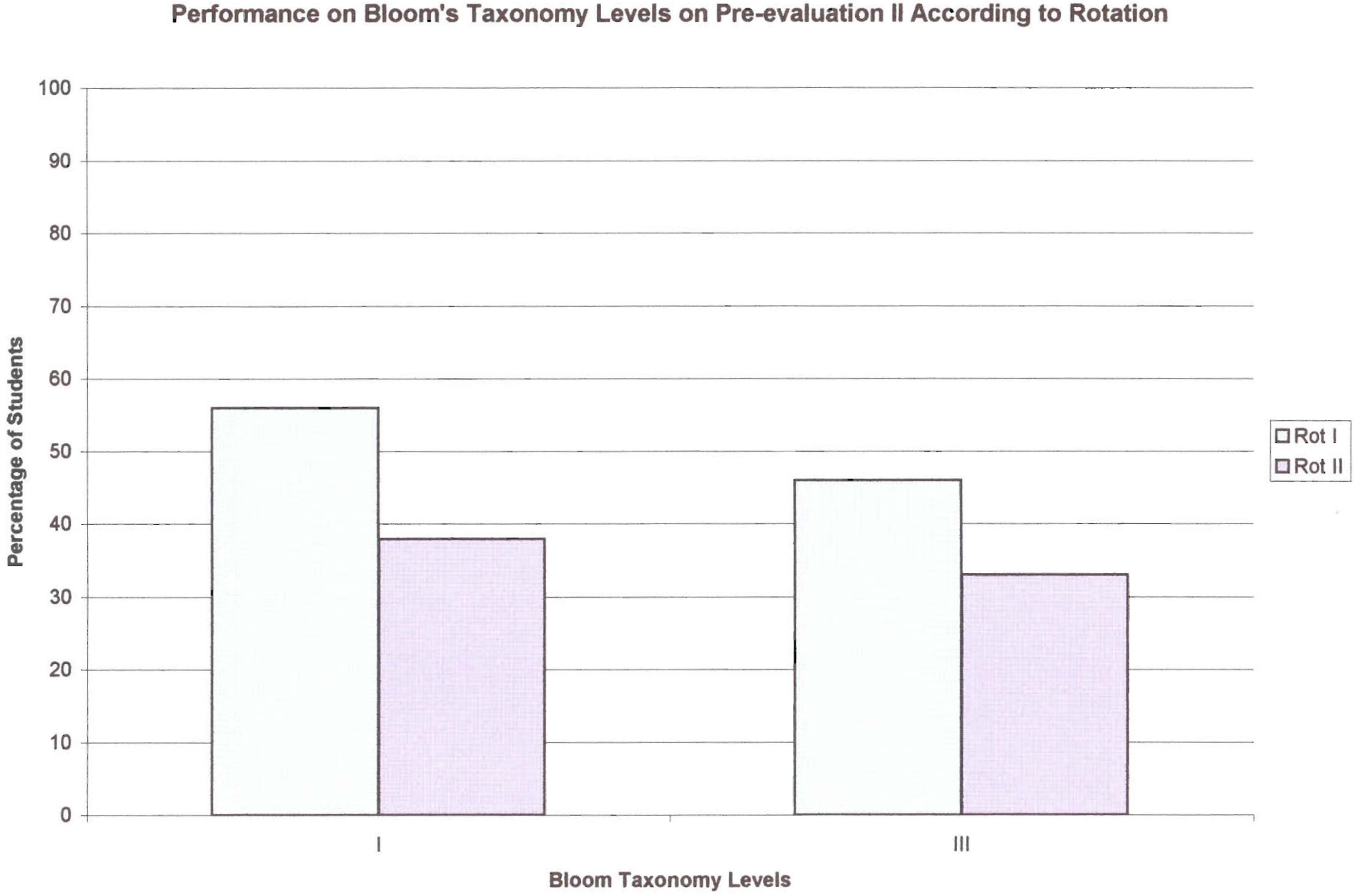
Pre –evaluation and Pre-evaluation II

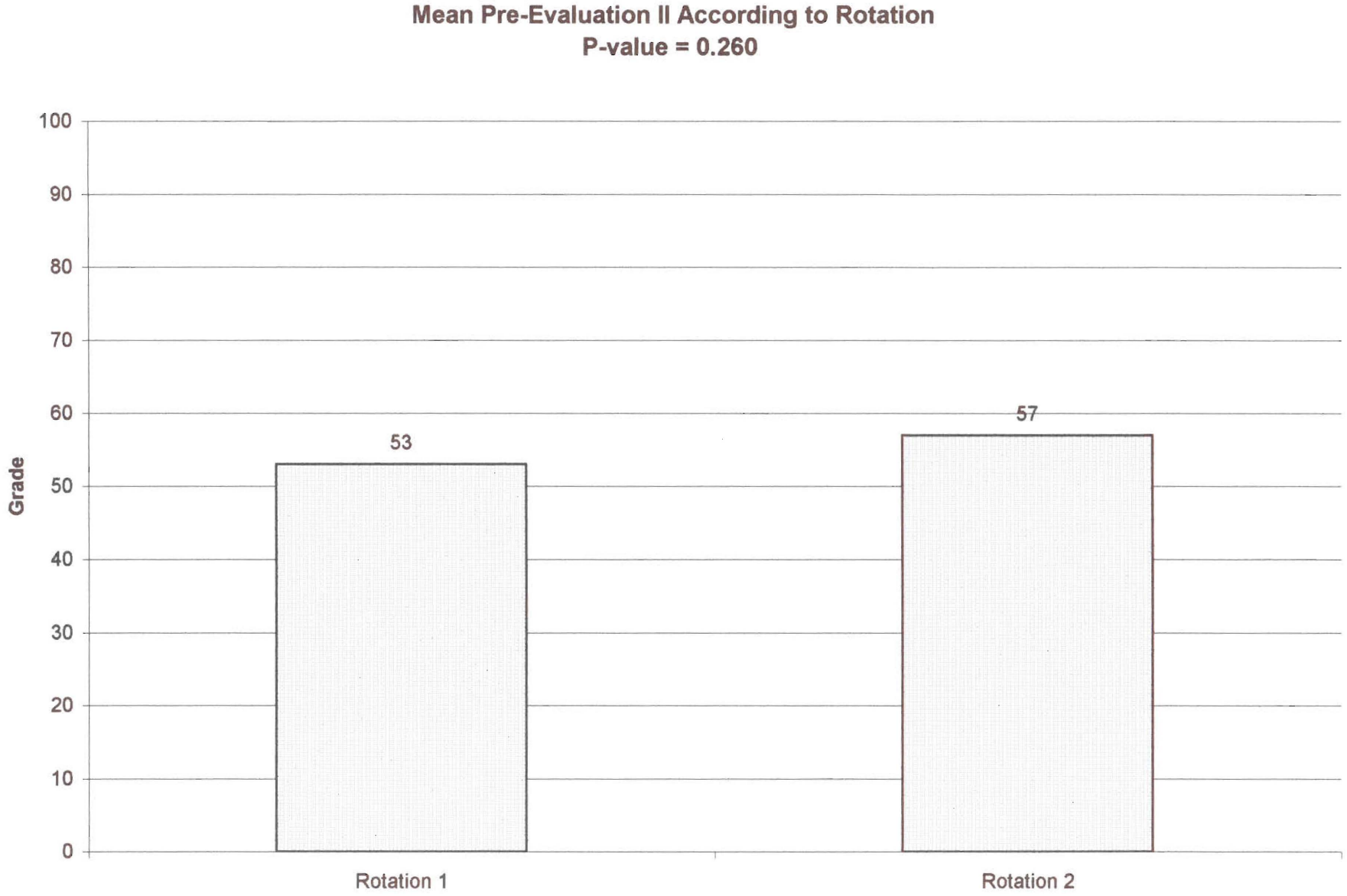
- Performance on Blooms Taxonomy Levels on Pre-evaluation According to Rotation (Topic Two)
- Performance on Bloom's Taxonomy Levels on Pre-evaluation According to Topic
- Performance on Bloom's Taxonomy Levels on Pre-evaluation According to Instructor (Topic Two)
- Performance on Bloom's Taxonomy Levels on Pre-evaluation II According to Rotation
- Mean Pre-evaluation II According to Rotation
- Mean Pre-evaluation II According to Gender
- Mean Pre-evaluation II According to Software/Lecture Cycle
- Performance on Bloom Taxonomy Levels on Pre-evaluation II According to Topic
- Pre-evaluation II According to Topic
- Performance on Bloom's Taxonomy Levels on Pre-evaluation II According to Instructor
- Mean Pre-evaluation II According to Instructor
- Performance on Bloom's Taxonomy Levels According to Topic (Pre-evaluation II)


Performance on Bloom's Taxonomy Levels on Pre-evaluation According to Rotation (Topic Two)
Percentage of Students
100
90
80
70
60
50
40
30
20
10
0
I
III
Blooms Taxonomy Levels
Rotation I
Rotation II

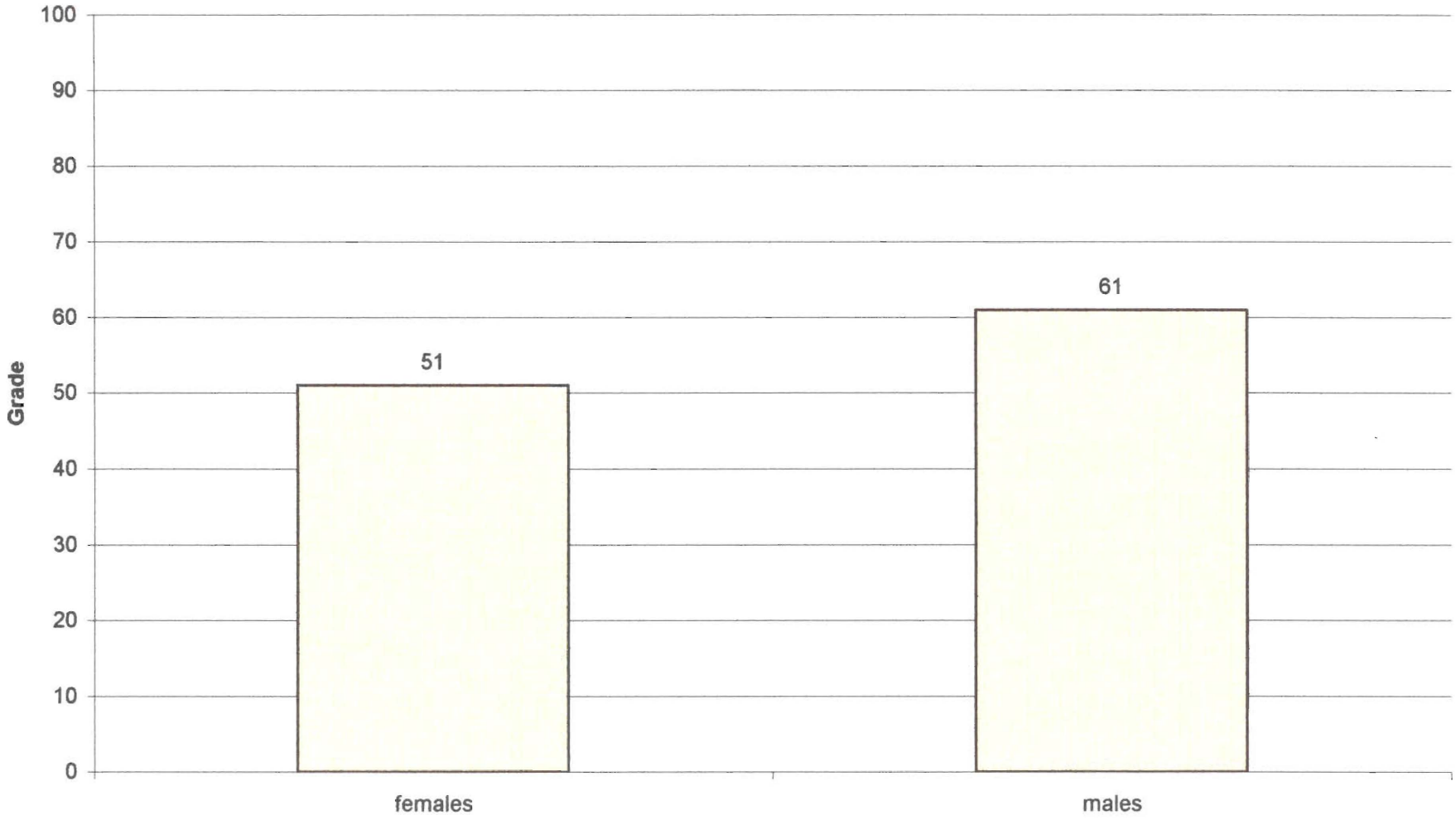

Performance on Bloom's Taxonomy Levels on Pre-evaluation According to Topic
100
90
80
70
60
50
40
30
20
10
0
Percentage of Students
I
III
Blooms Taxonomy Levels
Topic I
Topic II

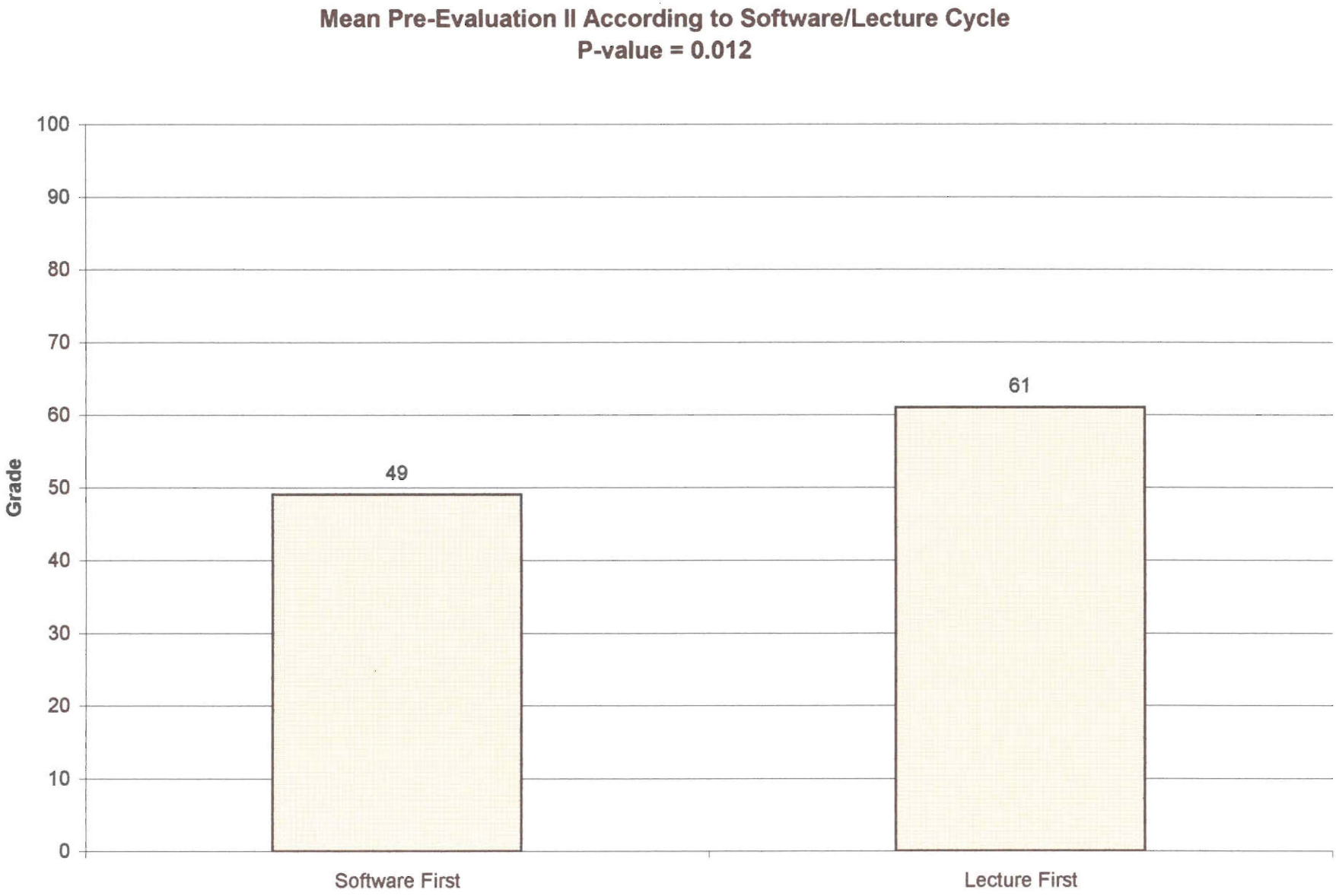

Performance on Blooms Taxonomy Levels on Pre-evaluation According to Instructor (Topic Two)
100
90
80
70
60
50
40
30
20
10
0
Percentage of Students
I
III
Blooms Taxonomy Levels
Asima
Kirk

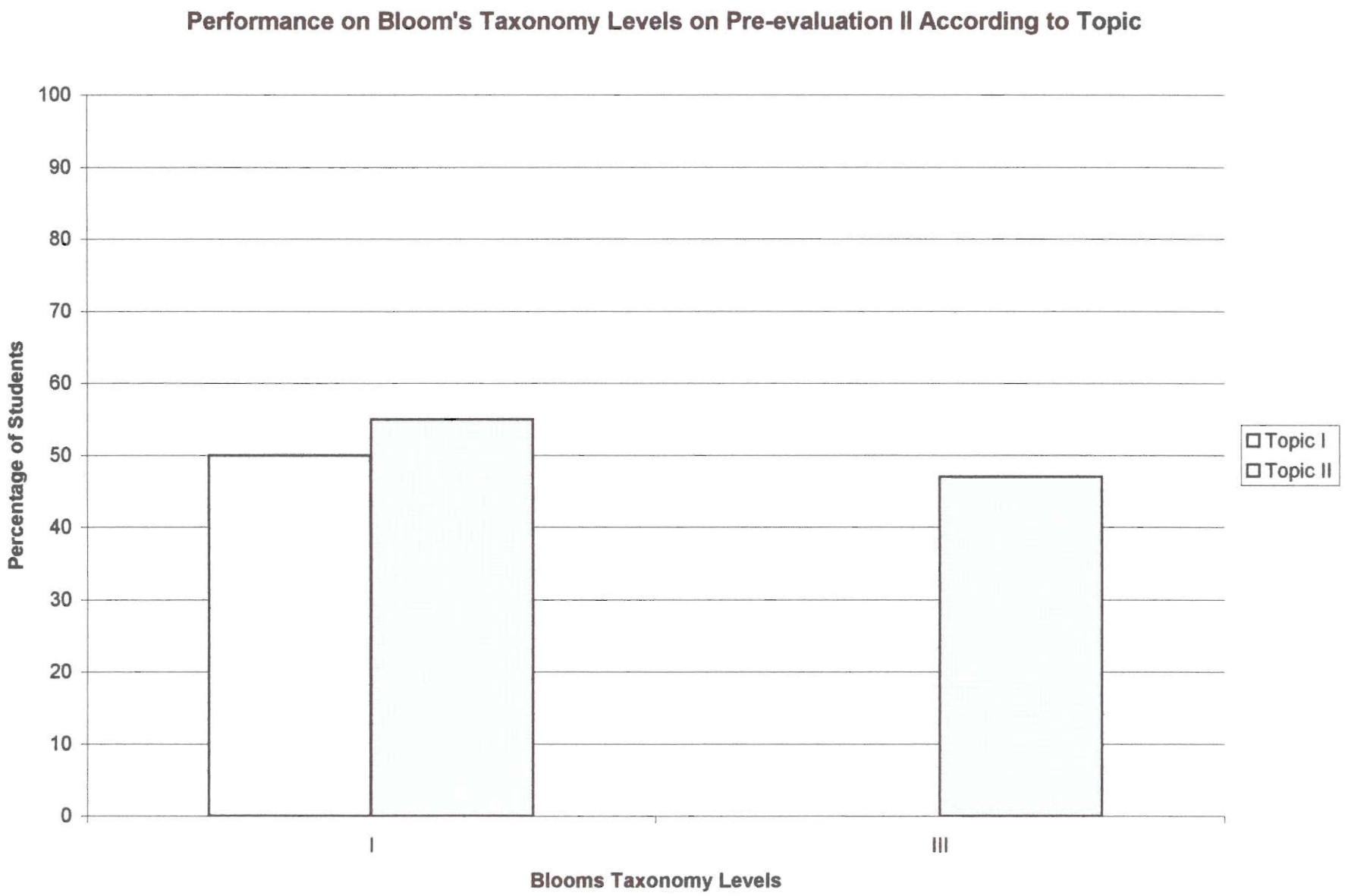

Performance on Bloom's Taxonomy Levels on Pre-evaluation II According to Rotation
100
90
80
70
60
50
40
30
20
10
0
Percentage of Students
I
III
Bloom Taxonomy Levels
Rot I
Rot II

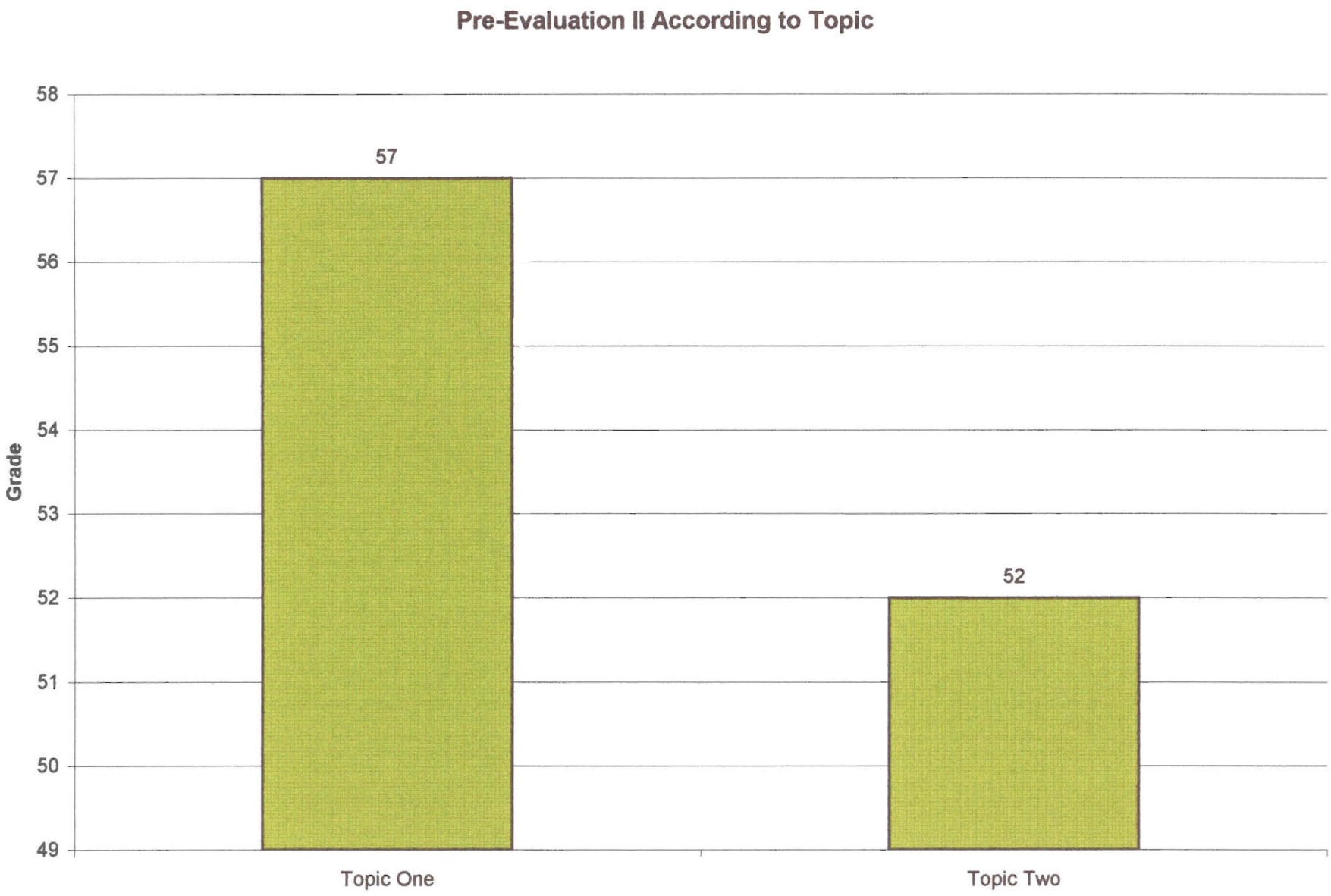

Mean Pre-Evaluation II According to Rotation
P-value = 0.260
Grade
100
90
80
70
60
50
40
30
20
10
0
53
57
Rotation 1
Rotation 2

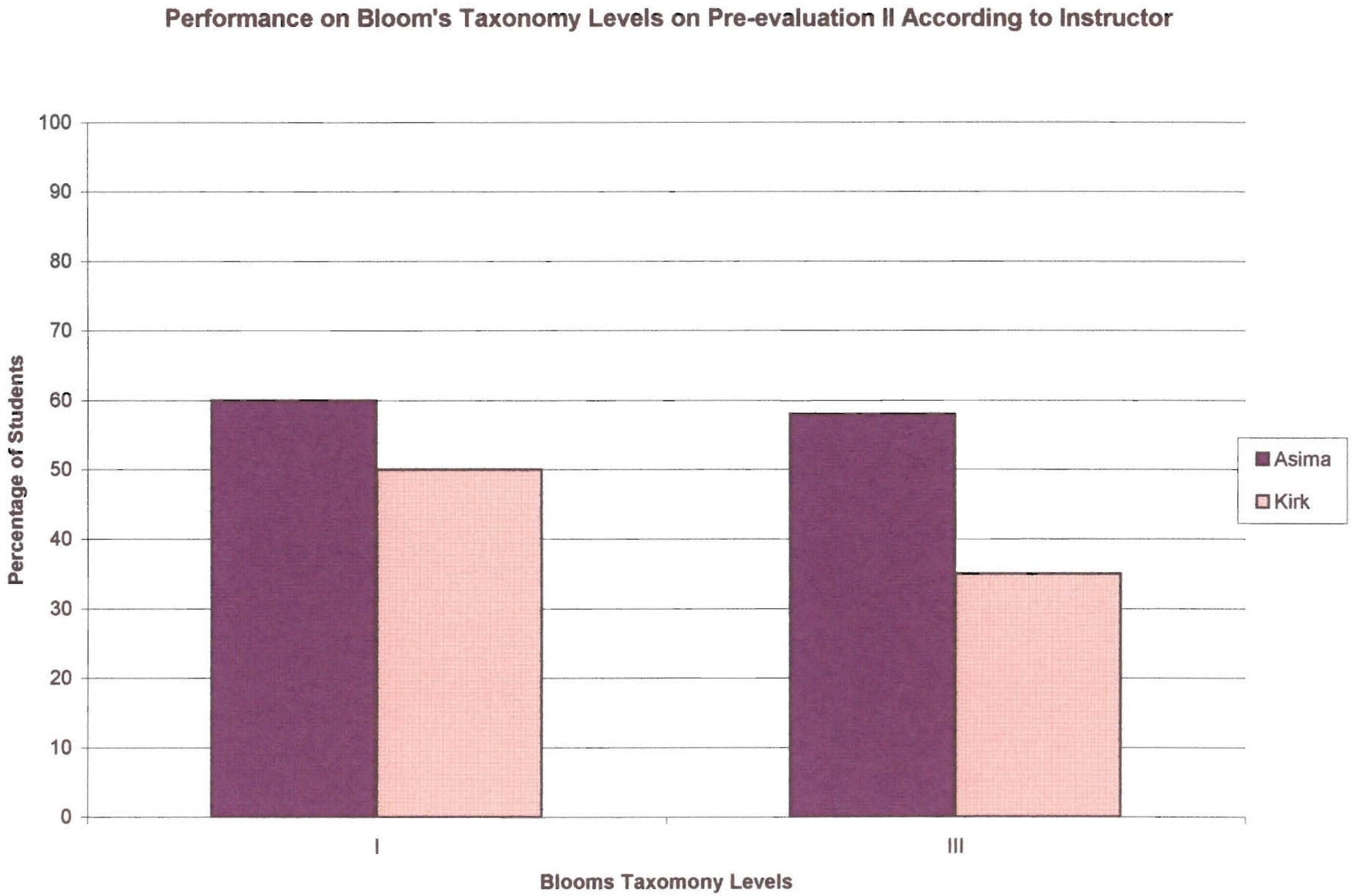
Mean Pre-Evaluation II
According to Gender
P-value = .0188

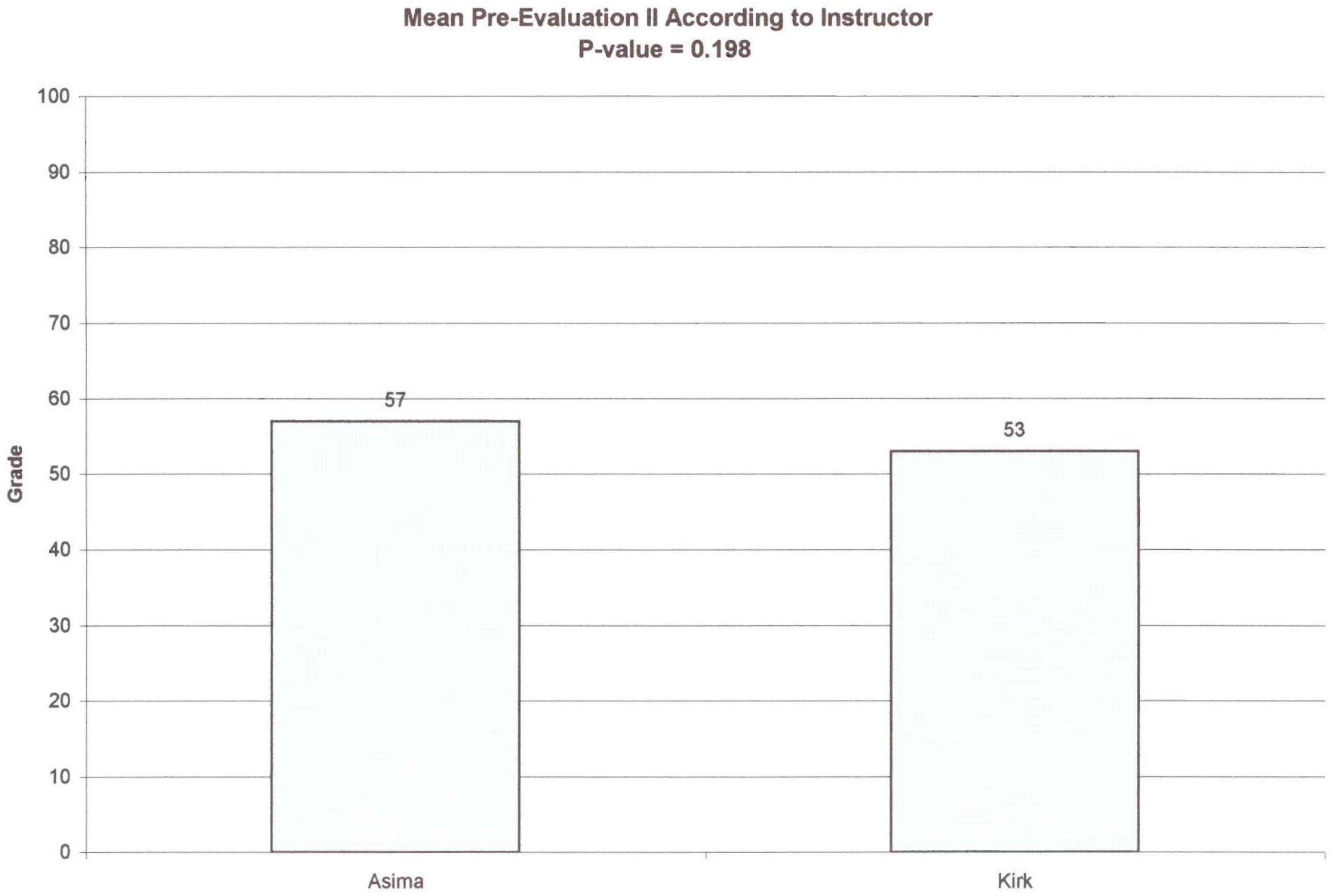


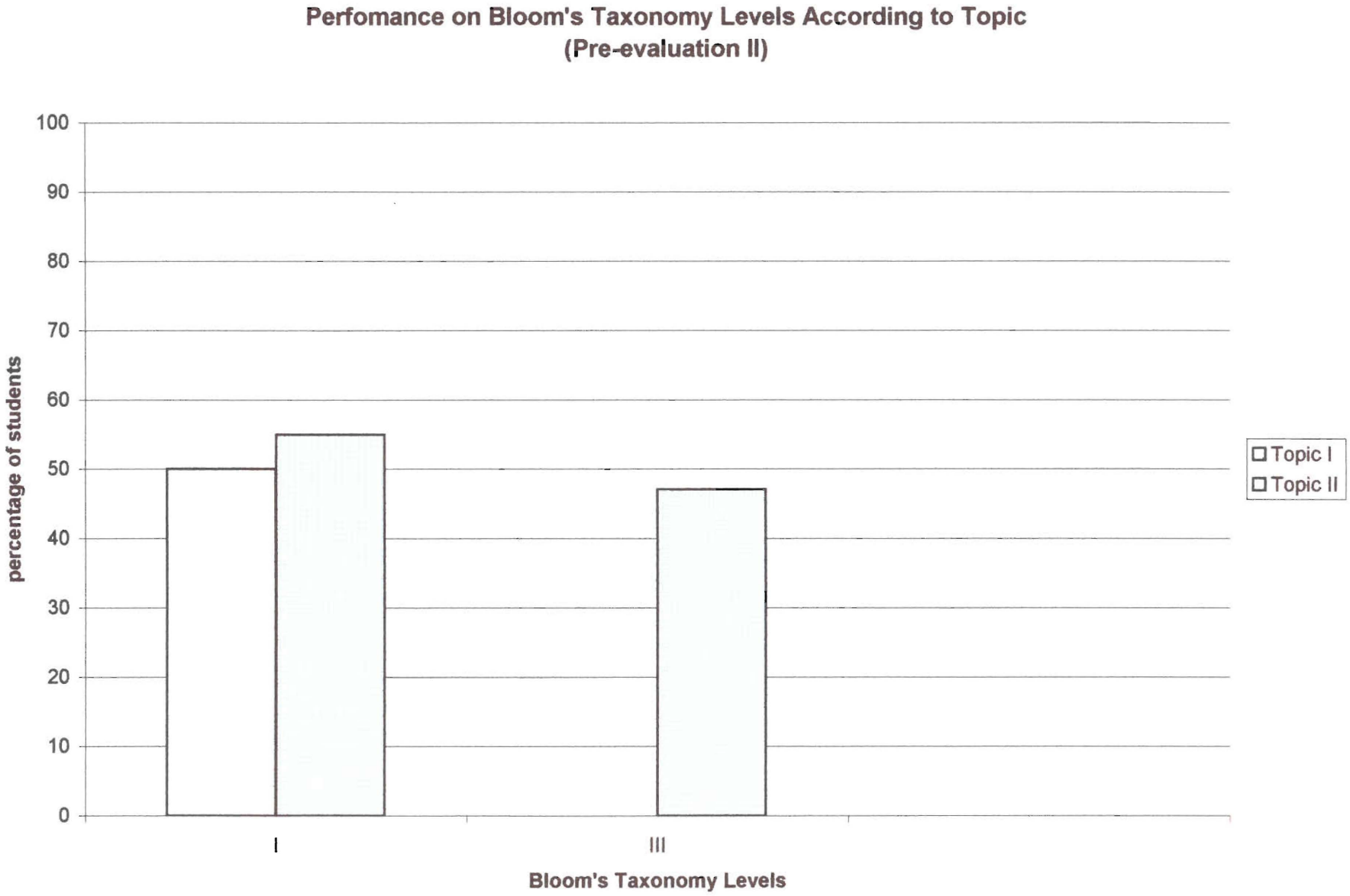

Mean Pre-Evaluation II According to Software/Lecture Cycle
P-value = 0.012
Grade
100
90
80
70
60
50
40
30
20
10
0
49
61
Software First
Lecture First


Performance on Bloom's Taxonomy Levels on Pre-evaluation II According to Topic
100
90
80
70
60
50
40
30
20
10
0
Percentage of Students
I
III
Blooms Taxonomy Levels
Topic I
Topic II


Pre-Evaluation II According to Topic
Grade
58
57
56
55
54
53
52
51
50
49
57
52
Topic One
Topic Two


Performance on Bloom's Taxonomy Levels on Pre-evaluation II According to Instructor
100
90
80
70
60
50
40
30
20
10
0
Percentage of Students
I
III
Blooms Taxomony Levels
Asima
Kirk

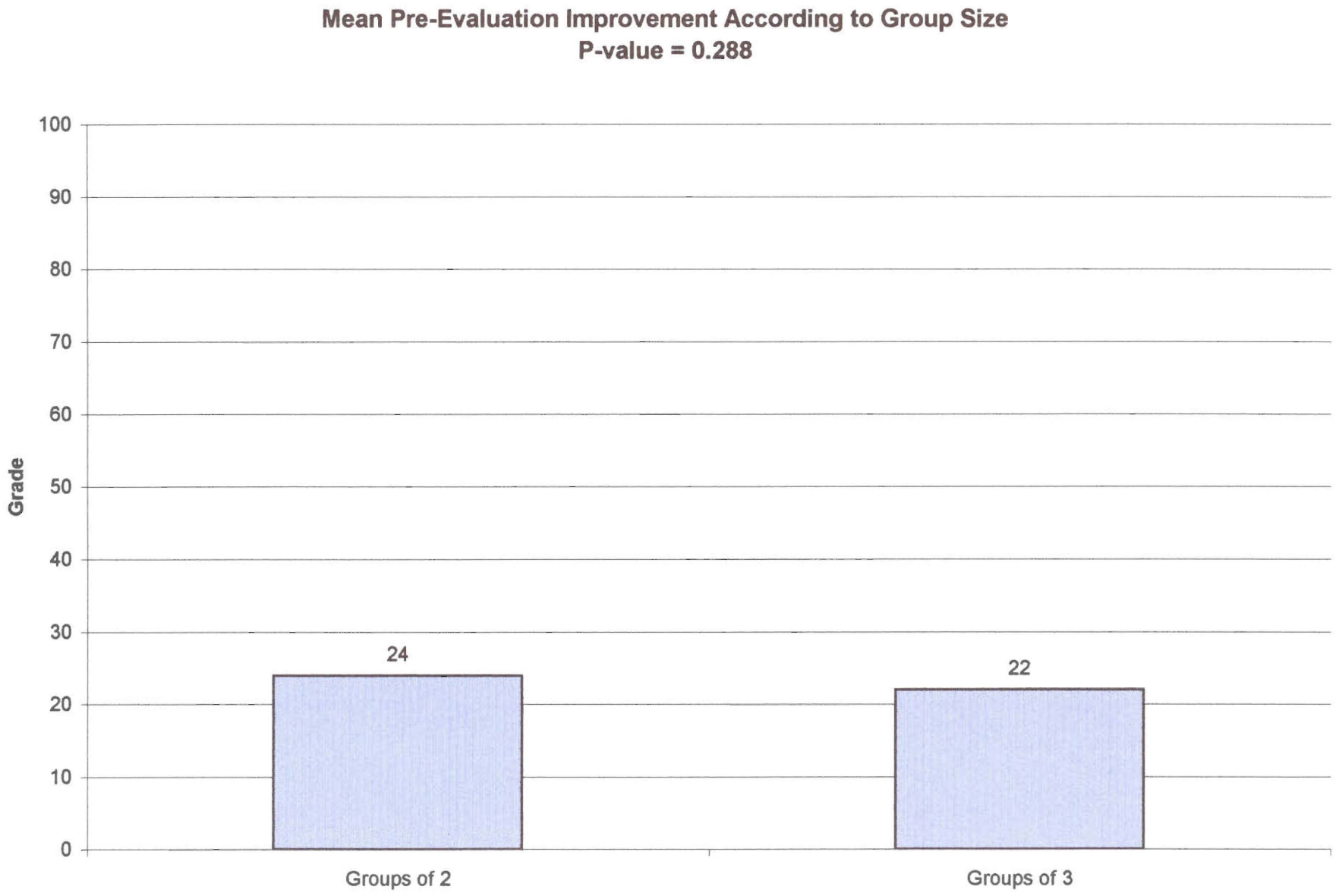

Mean Pre-Evaluation II According to Instructor
P-value = 0.198
Grade
100
90
80
70
60
50
40
30
20
10
0
57
53
Asima
Kirk

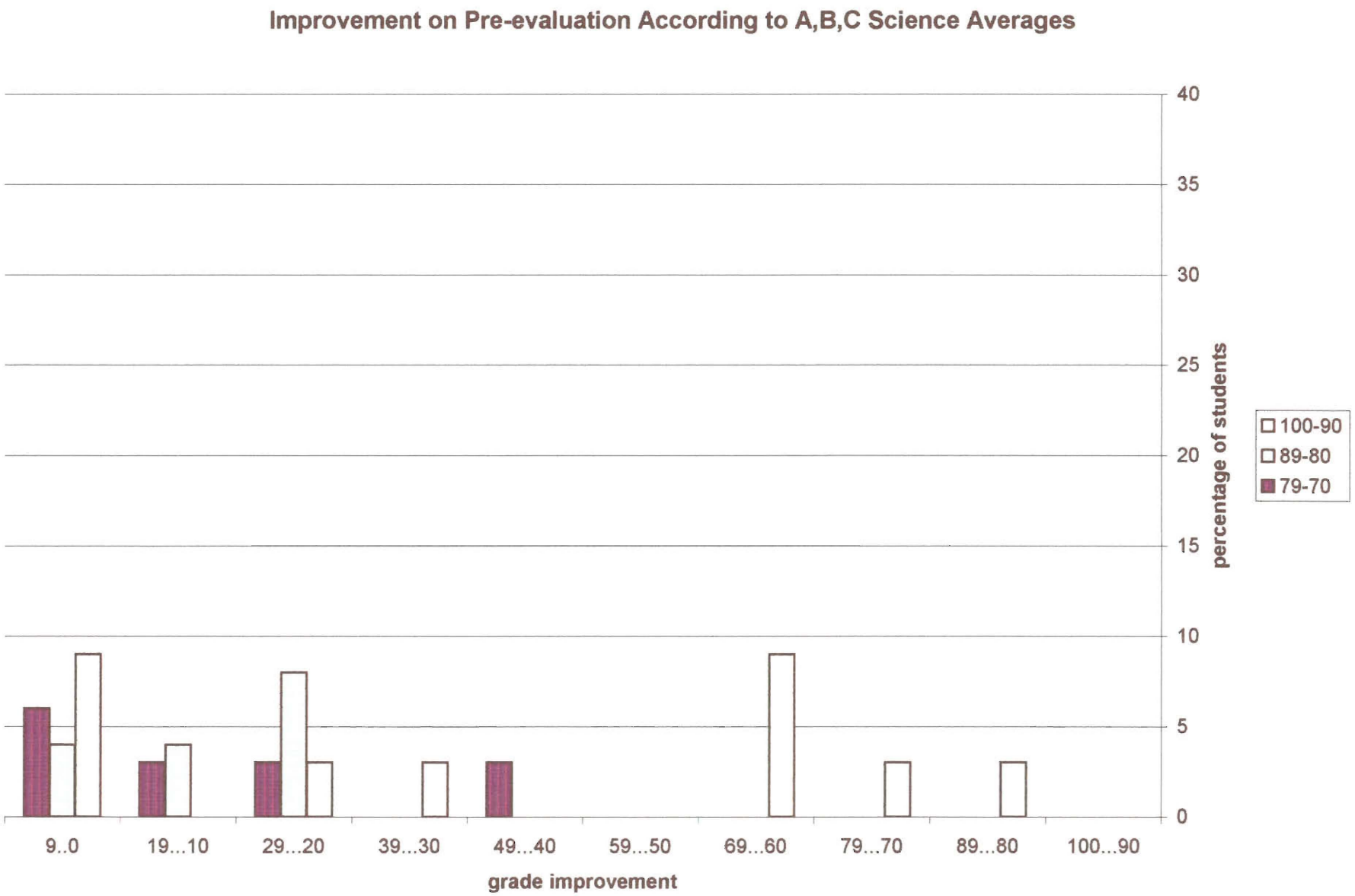

Perfomance on Bloom's Taxonomy Levels According to Topic
(Pre-evaluation II)
100
90
80
70
60
50
40
30
20
10
0
percentage of students
I
III
Bloom's Taxonomy Levels
Topic I
Topic II

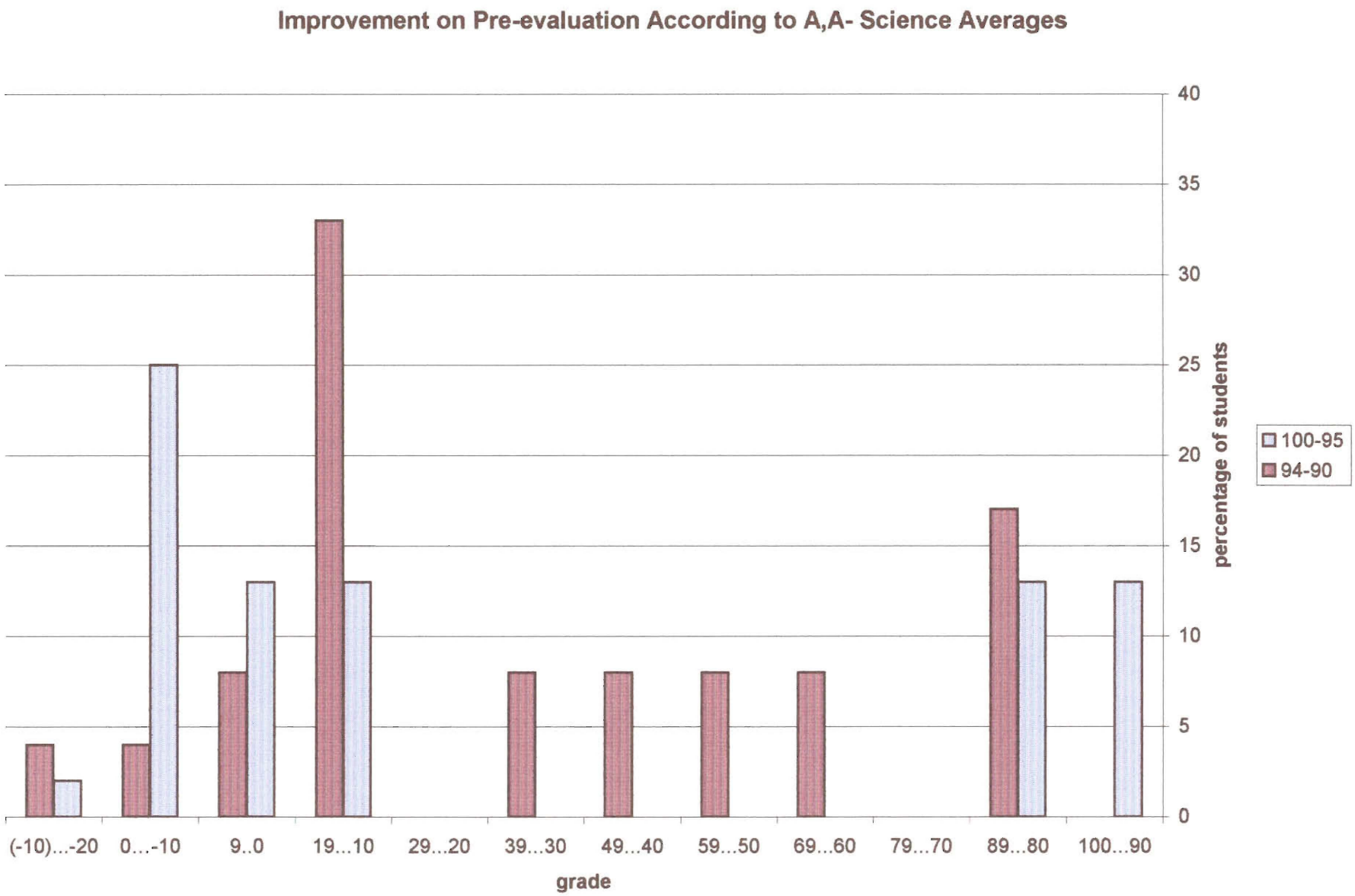
Appendix H

Improvement Graphs

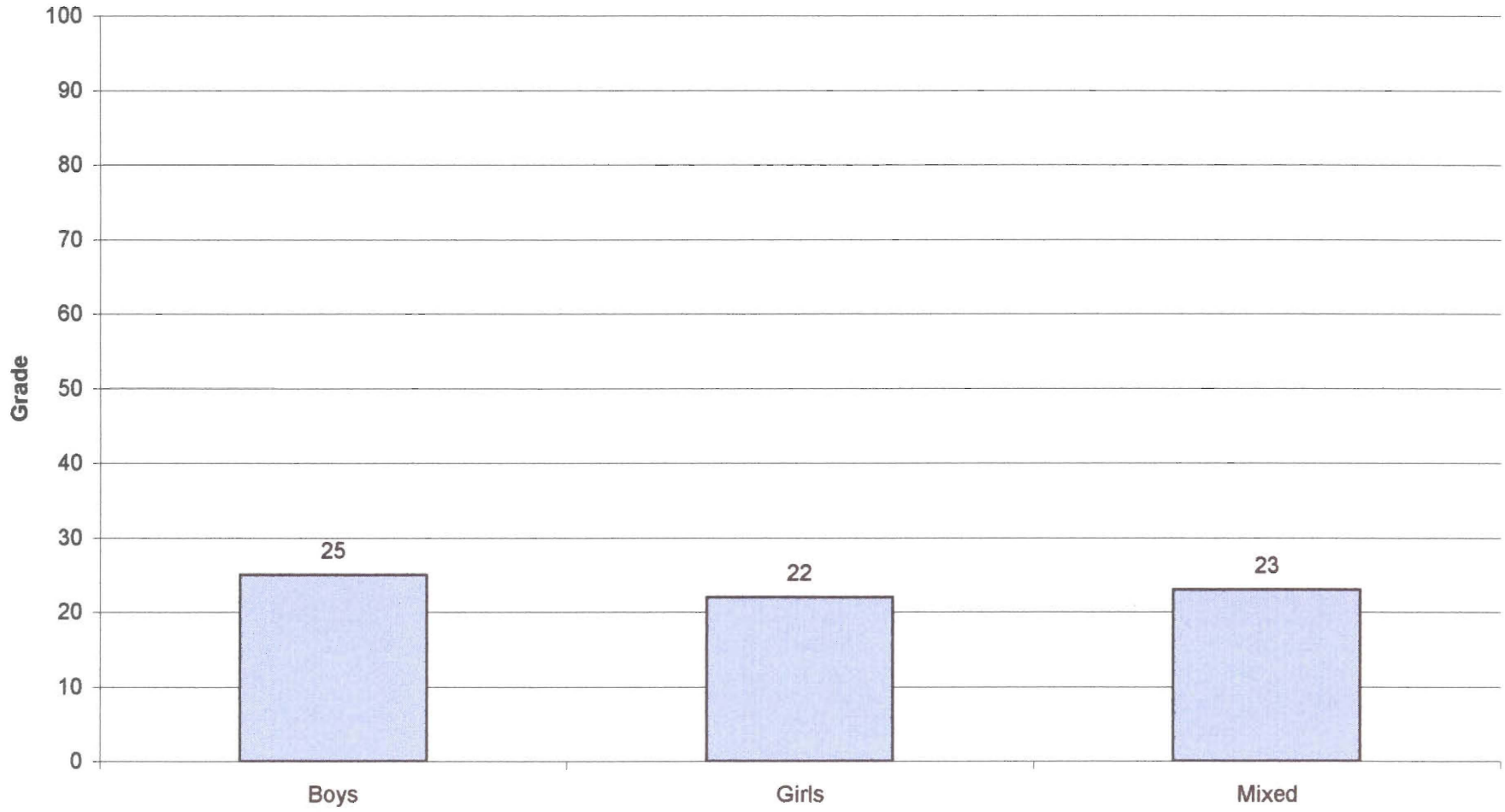
- Mean Pre-evaluation Improvement According to Group Size
- Improvement on Pre-evaluation According to A,B,C Science Averages
- Improvement on Pre-evaluation According to A,A- Science Averages
- Mean Pre-evaluation Improvement According to Group Type


Mean Pre-Evaluation Improvement According to Group Size
P-value = 0.288
Grade
100
90
80
70
60
50
40
30
20
10
0
24
22
Groups of 2
Groups of 3


Improvement on Pre-evaluation According to A,B,C Science Averages
40
35
30
25
20
15
10
5
0
percentage of students
100-90
89-80
79-70
9..0
19...10
29...20
39...30
49...40
59...50
69...60
79...70
89...80
100...90
grade improvement


Improvement on Pre-evaluation According to A,A- Science Averages
40
35
30
25
20
15
10
5
0
percentage of students
100-95
94-90
(-10)...-20
0...-10
9..0
19...10
29...20
39...30
49...40
59...50
69...60
79...70
89...80
100...90
grade

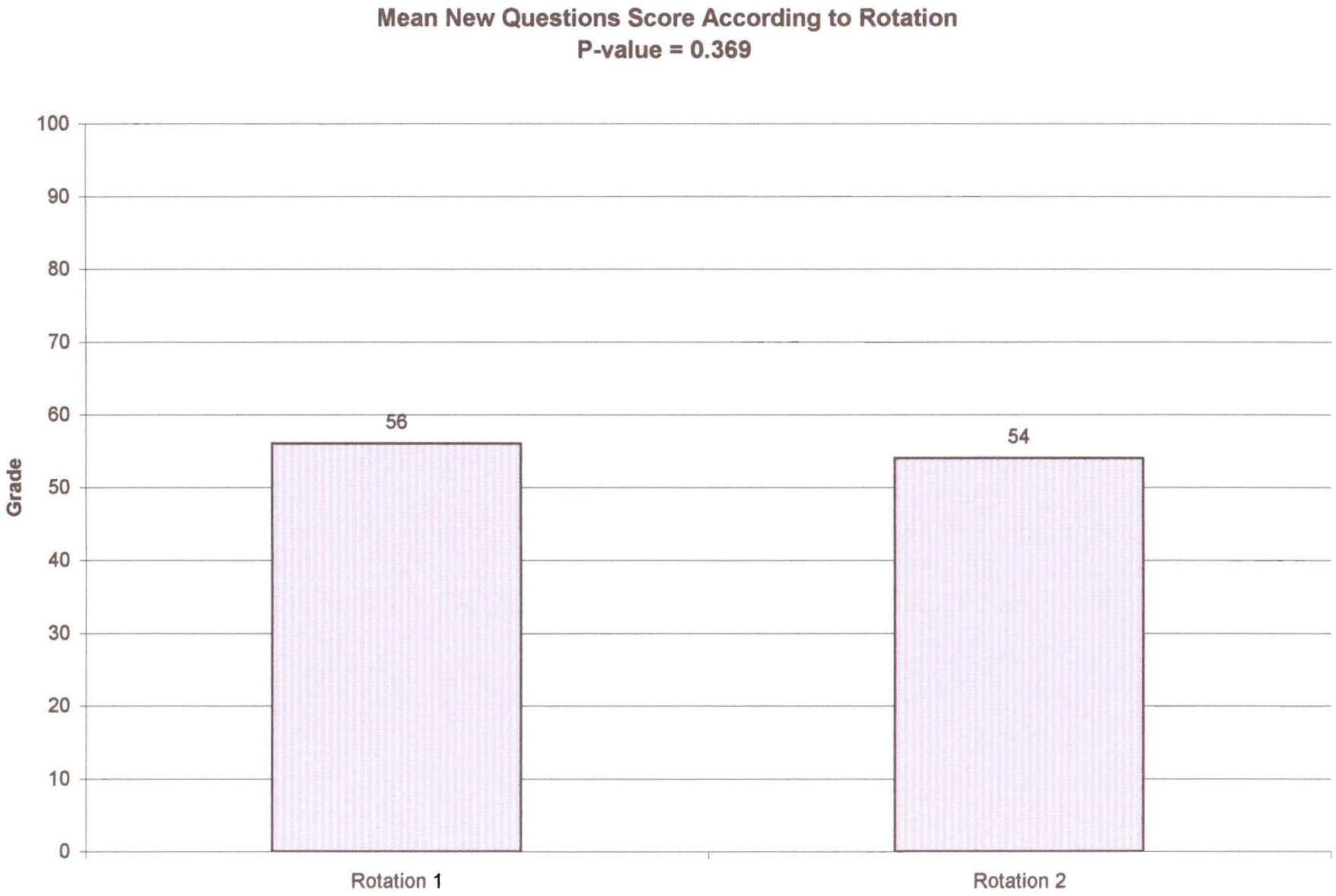
Mean Pre-Evaluation Improvement According to Group Type
P-value (boys>girls) = 0.381
P-value (boys>mixed) = 0.431
P-value (mixed>girls) = 0.405

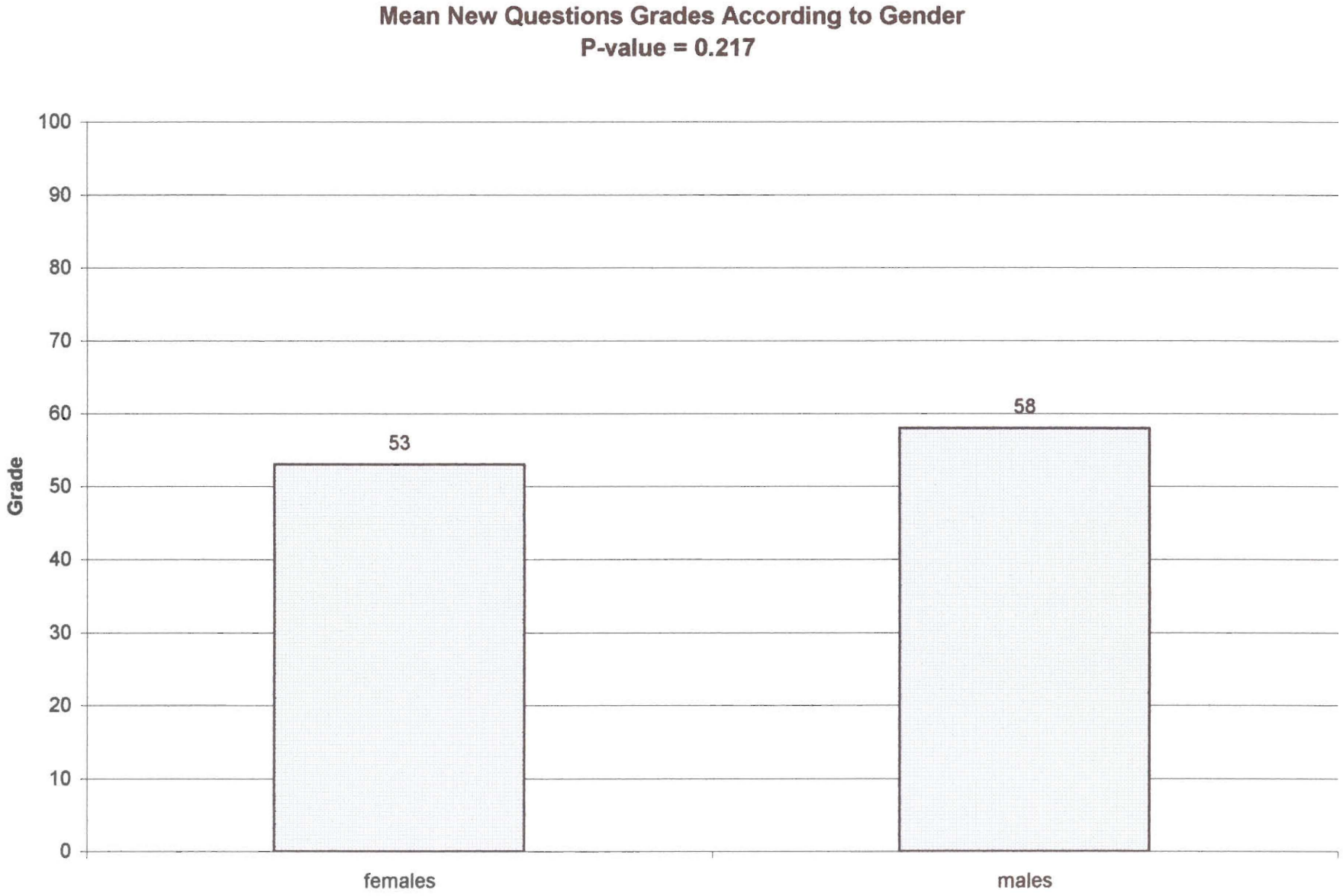


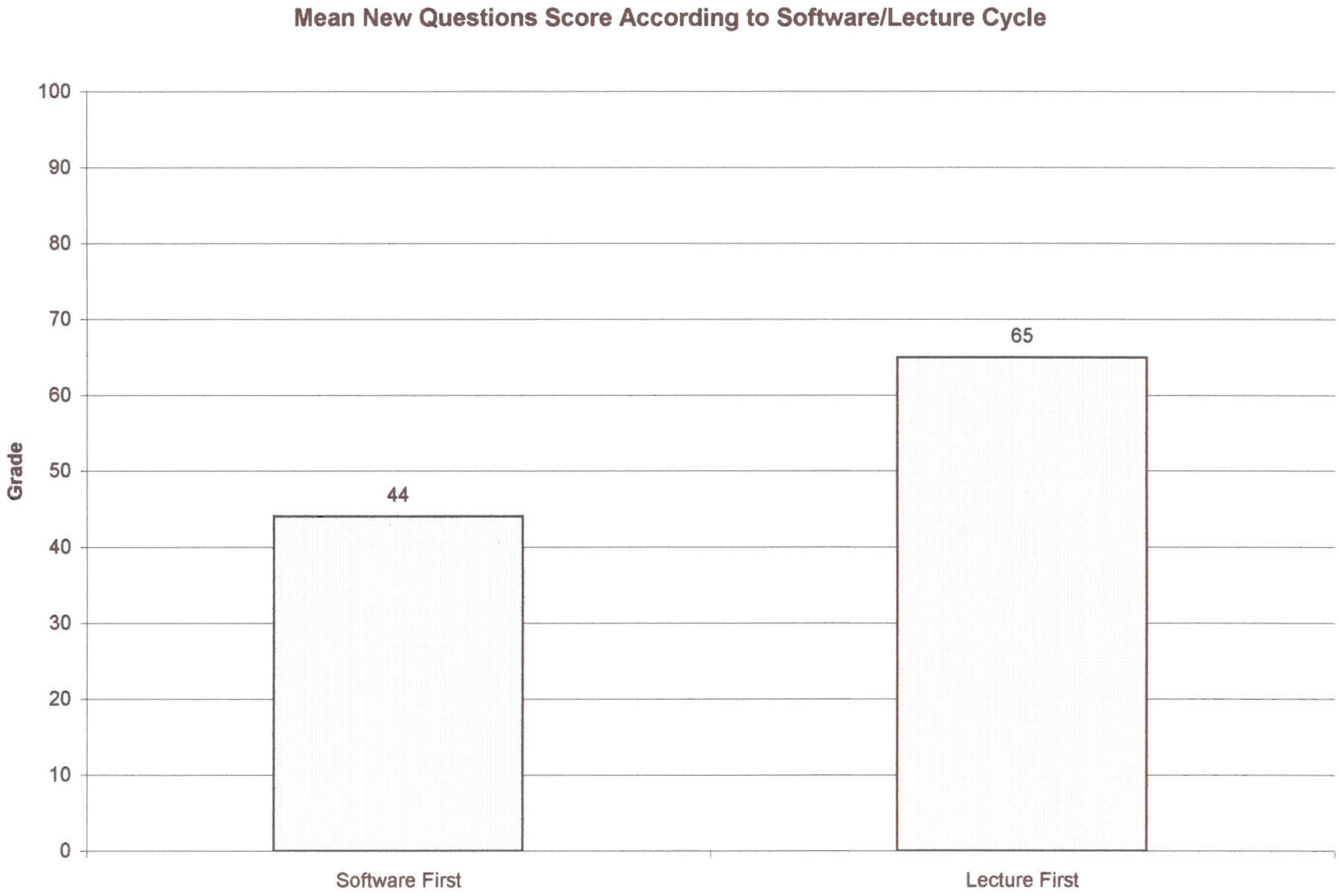
Appendix I

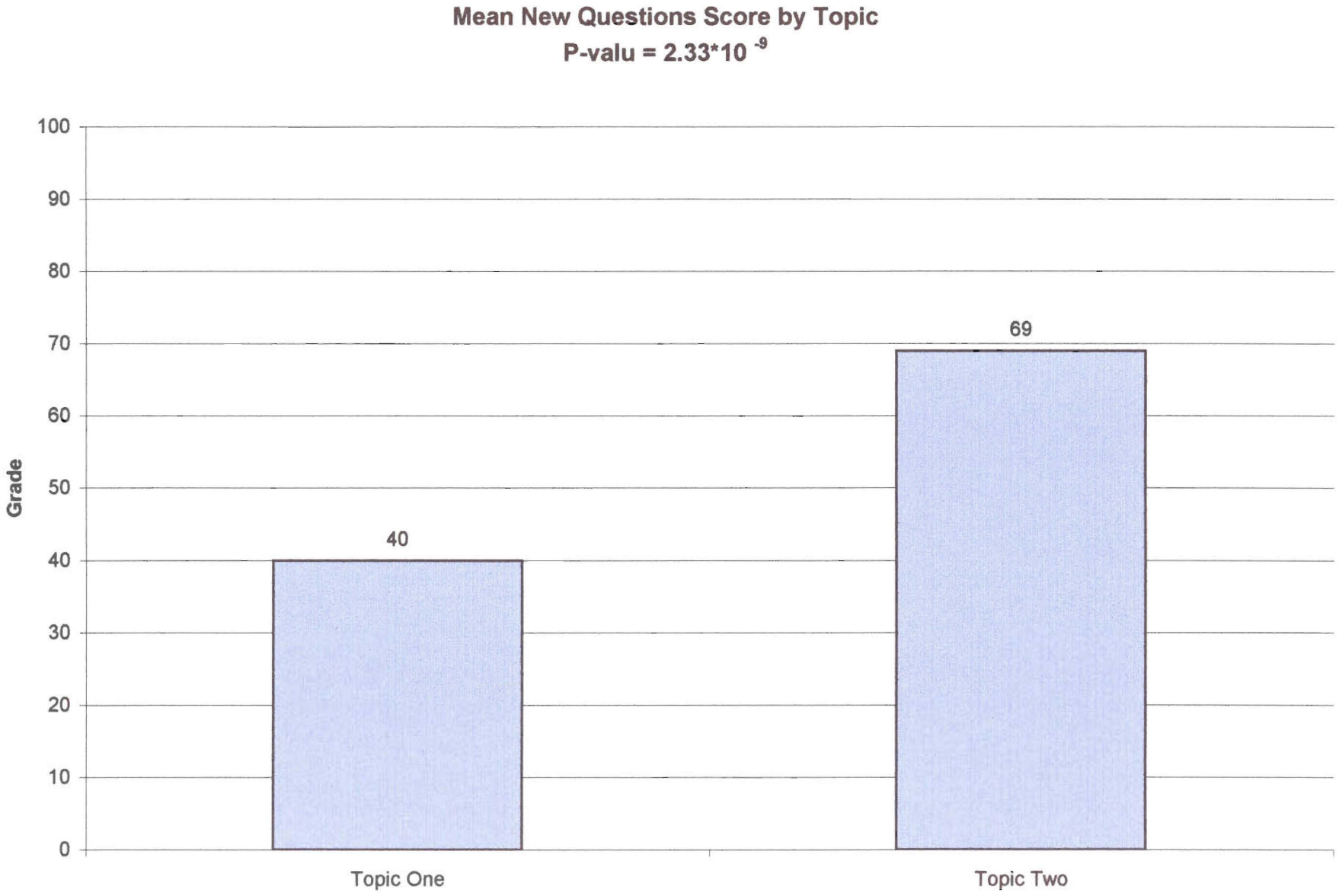
Performance Graphs

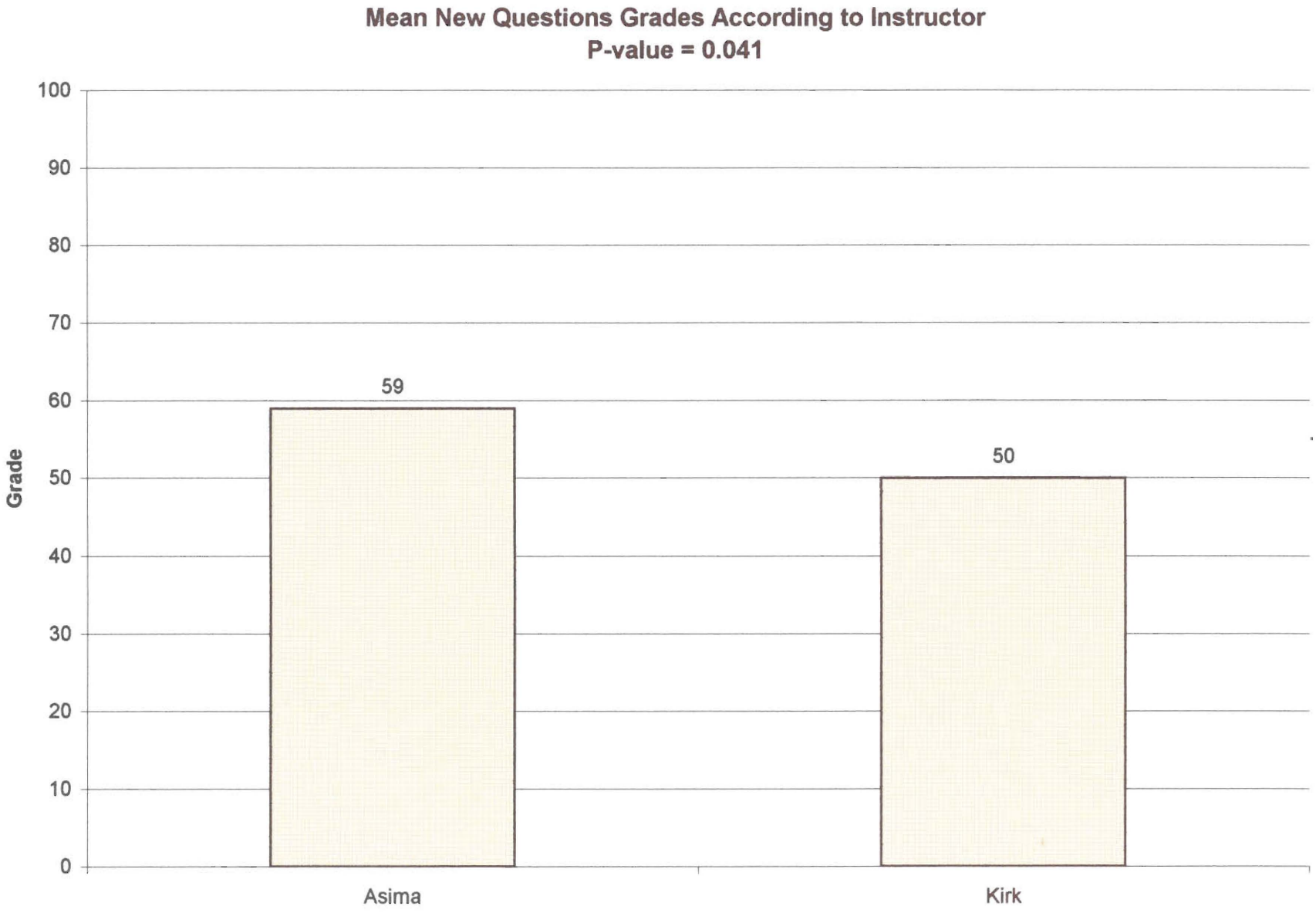
- Mean New Questions Score According to Rotation
- Mean New Questions Grades According to Gender
- Mean New Questions Score According to Software/Lecture Cycle
- Mean New Questions Score by Topic
- Mean New Questions Grades According to Instructor
- Mean Grades (New Questions) According to Group Size
- Performance on New Questions According to A,A-,B,C Science Averages
- Performance on New Questions According to A,B,C Science Averages
- Performance Higher than a B on New Questions According to A,B,C Science Averages
- Mean Grades (New Questions) According to Group Type

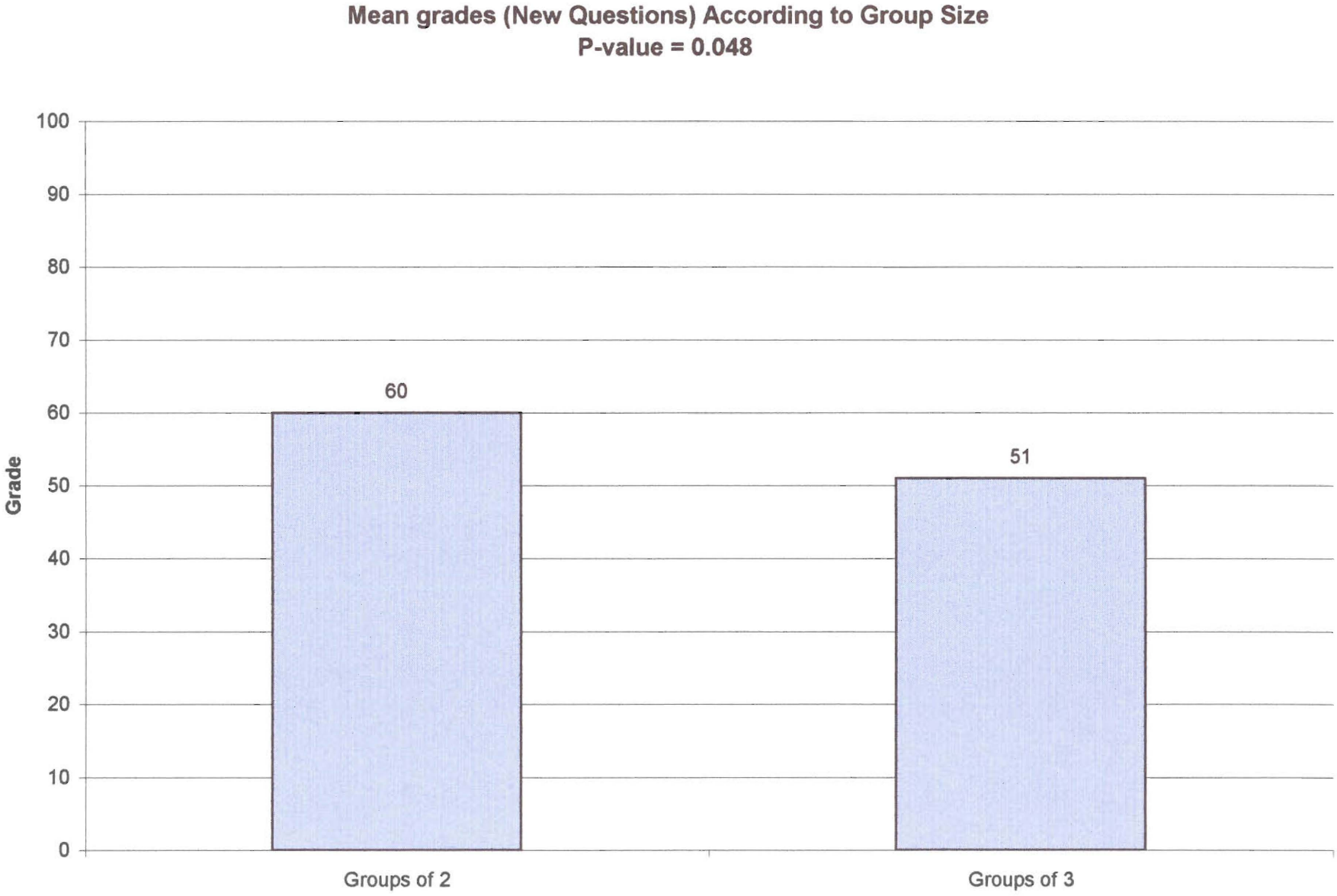

Mean New Questions Score According to Rotation
P-value = 0.369
Grade
100
90
80
70
60
50
40
30
20
10
0
56
54
Rotation 1
Rotation 2

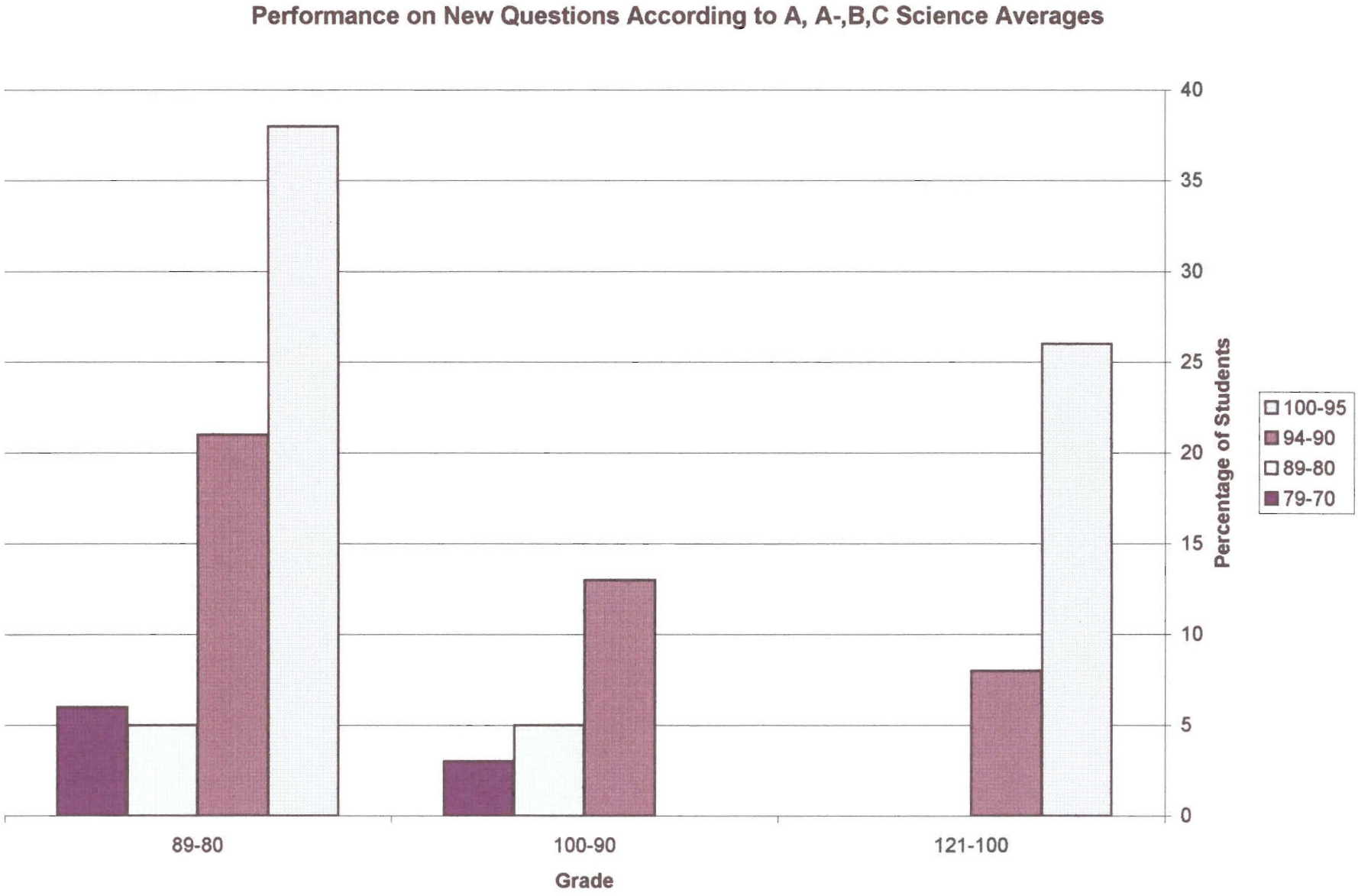

Mean New Questions Grades According to Gender
P-value = 0.217
Grade
100
90
80
70
60
50
40
30
20
10
0
53
58
females
males

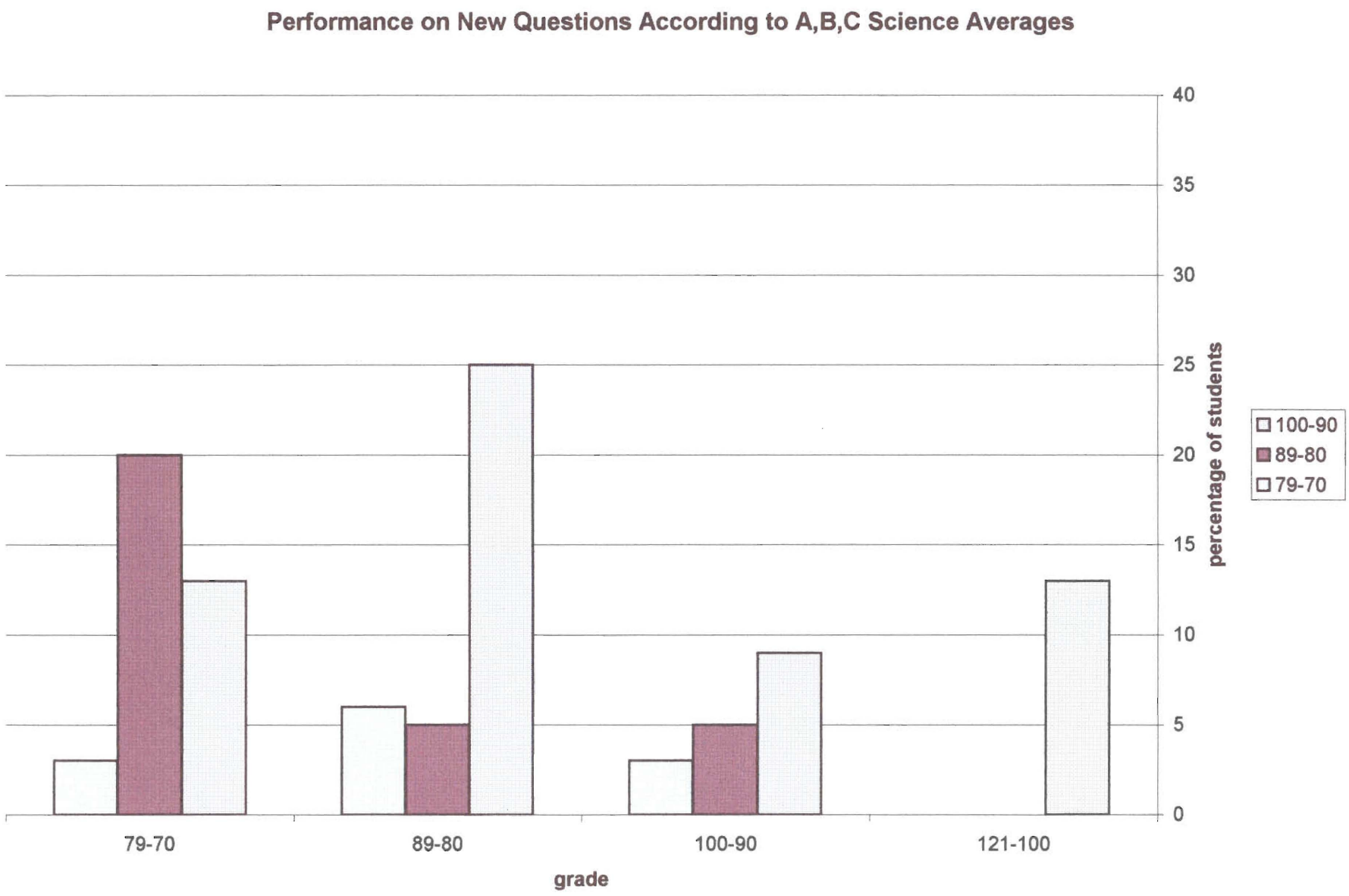

Mean New Questions Score According to Software/Lecture Cycle
Grade
100
90
80
70
60
50
40
30
20
10
0
44
65
Software First
Lecture First

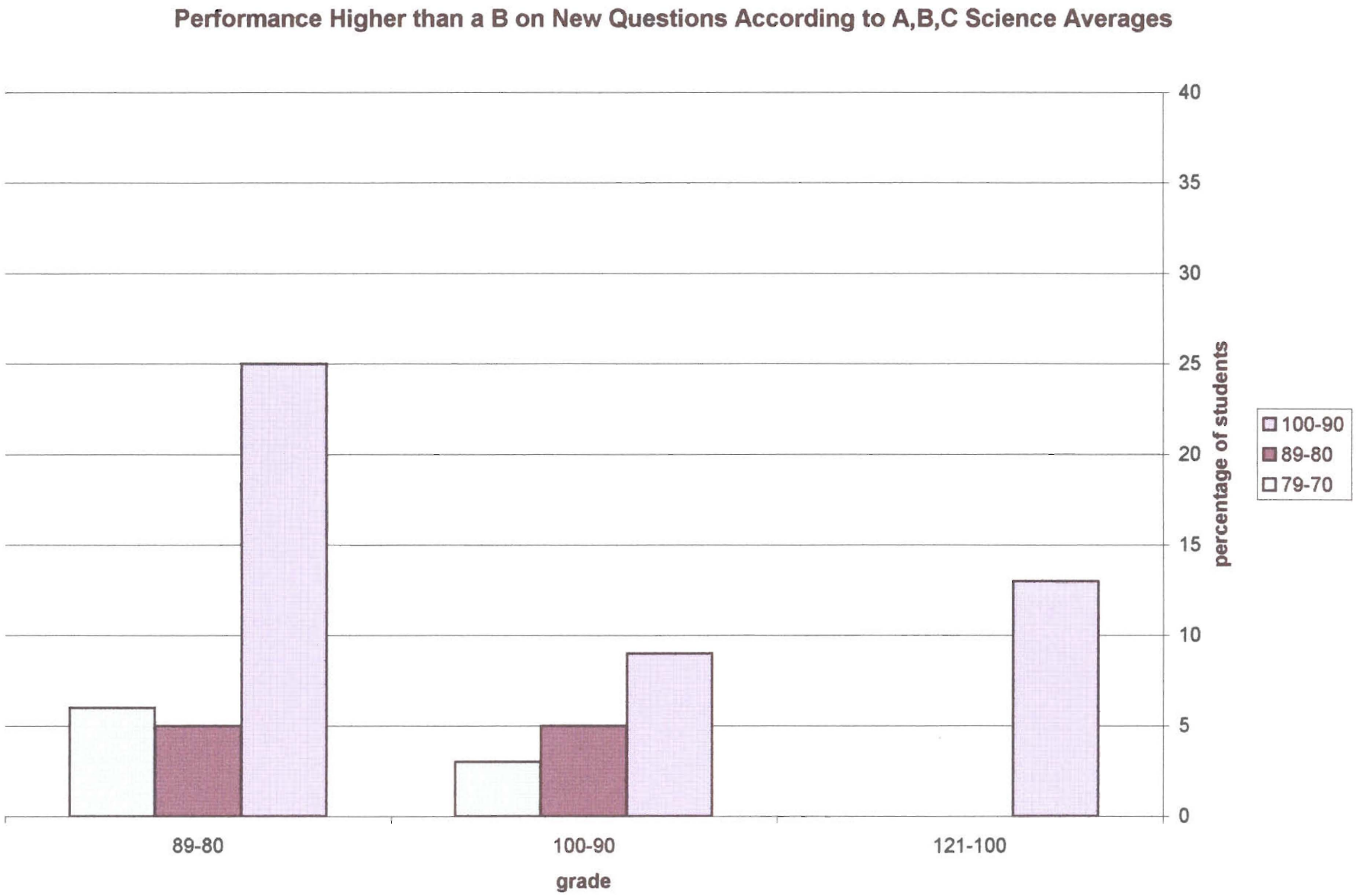

Mean New Questions Score by Topic
P-valu = 2.33*10 -9
Grade
100
90
80
70
60
50
40
30
20
10
0
40
69
Topic One
Topic Two


Mean New Questions Grades According to Instructor
P-value = 0.041
Grade
100
90
80
70
60
50
40
30
20
10
0
59
50
Asima
Kirk

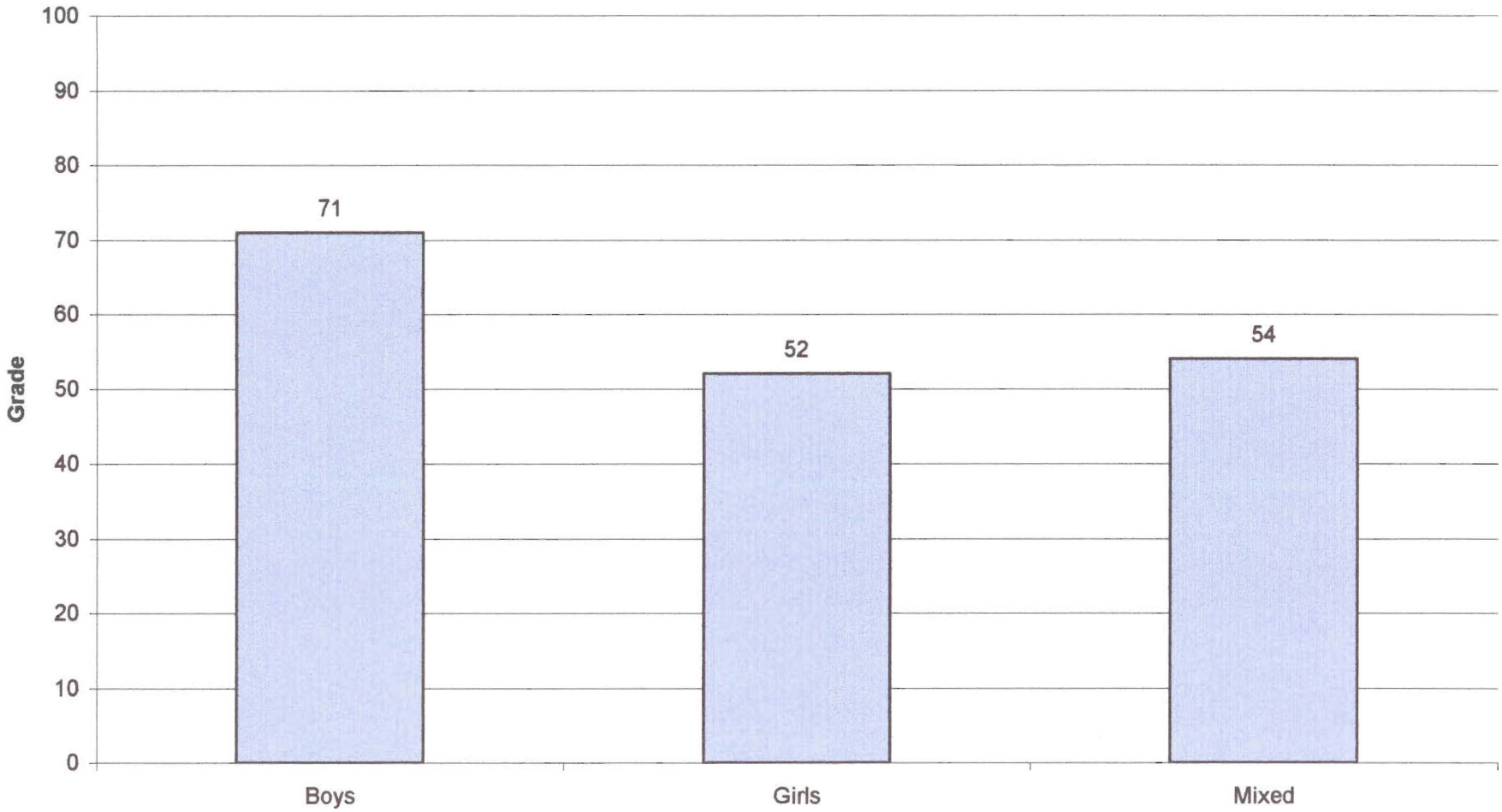

Mean grades (New Questions) According to Group Size
P-value = 0.048
Grade
100
90
80
70
60
50
40
30
20
10
0
60
51
Groups of 2
Groups of 3


Performance on New Questions According to A, A-,B,C Science Averages
40
35
30
25
20
15
10
5
0
Percentage of Students
100-95
94-90
89-80
79-70
89-80
100-90
121-100
Grade


Performance on New Questions According to A,B,C Science Averages
40
35
30
25
20
15
10
5
0
percentage of students
100-90
89-80
79-70
79-70
89-80
100-90
121-100
grade


Performance Higher than a B on New Questions According to A,B,C Science Averages
40
35
30
25
20
15
10
5
0
percentage of students
100-90
89-80
79-70
89-80
100-90
121-100
grade

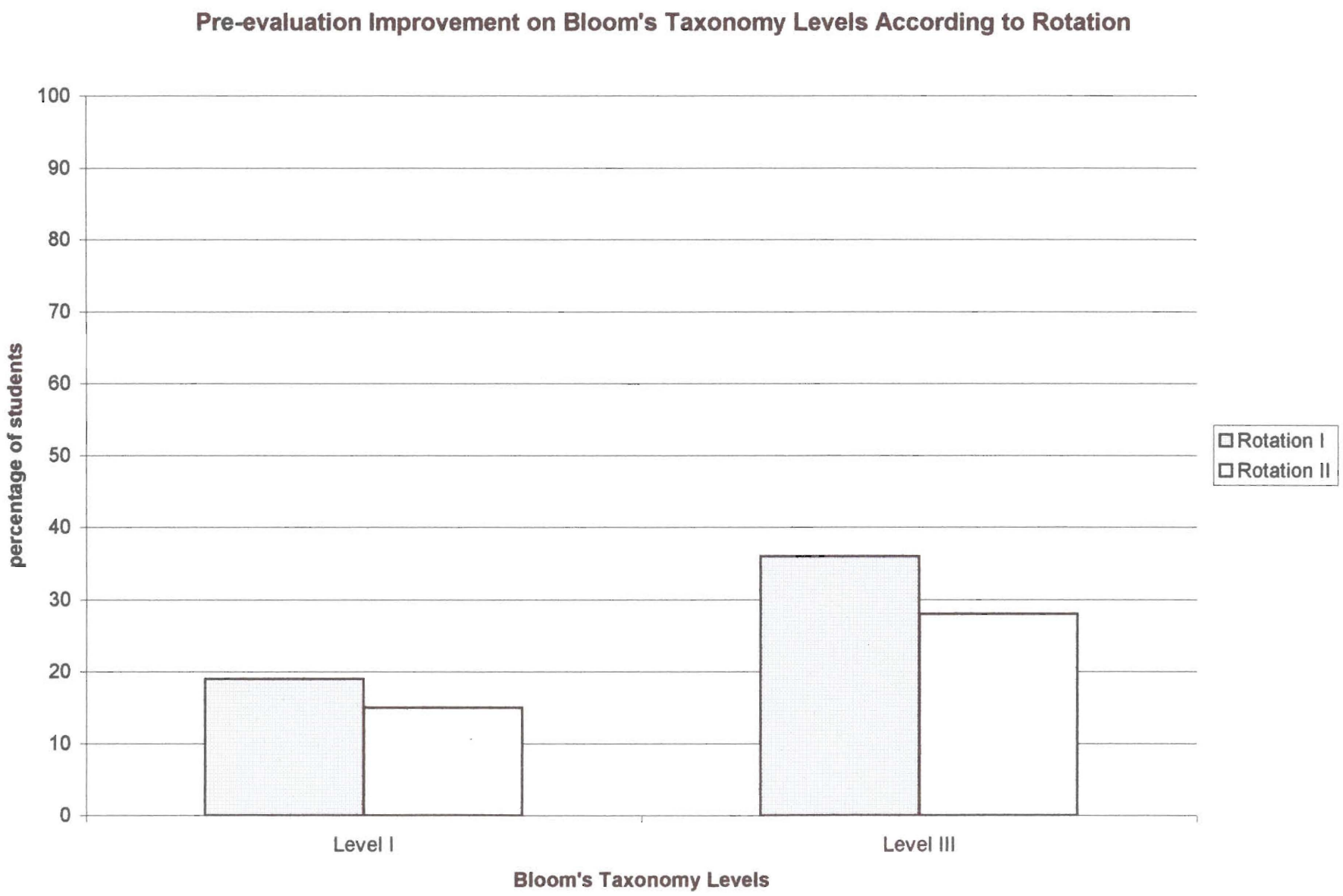
Mean Grade (New Questions) According to Group Type
P-value (boys>girls) = 0.049
P-value (boys>mixed) = 0.062
P-value (mixed>girls) = 0.401

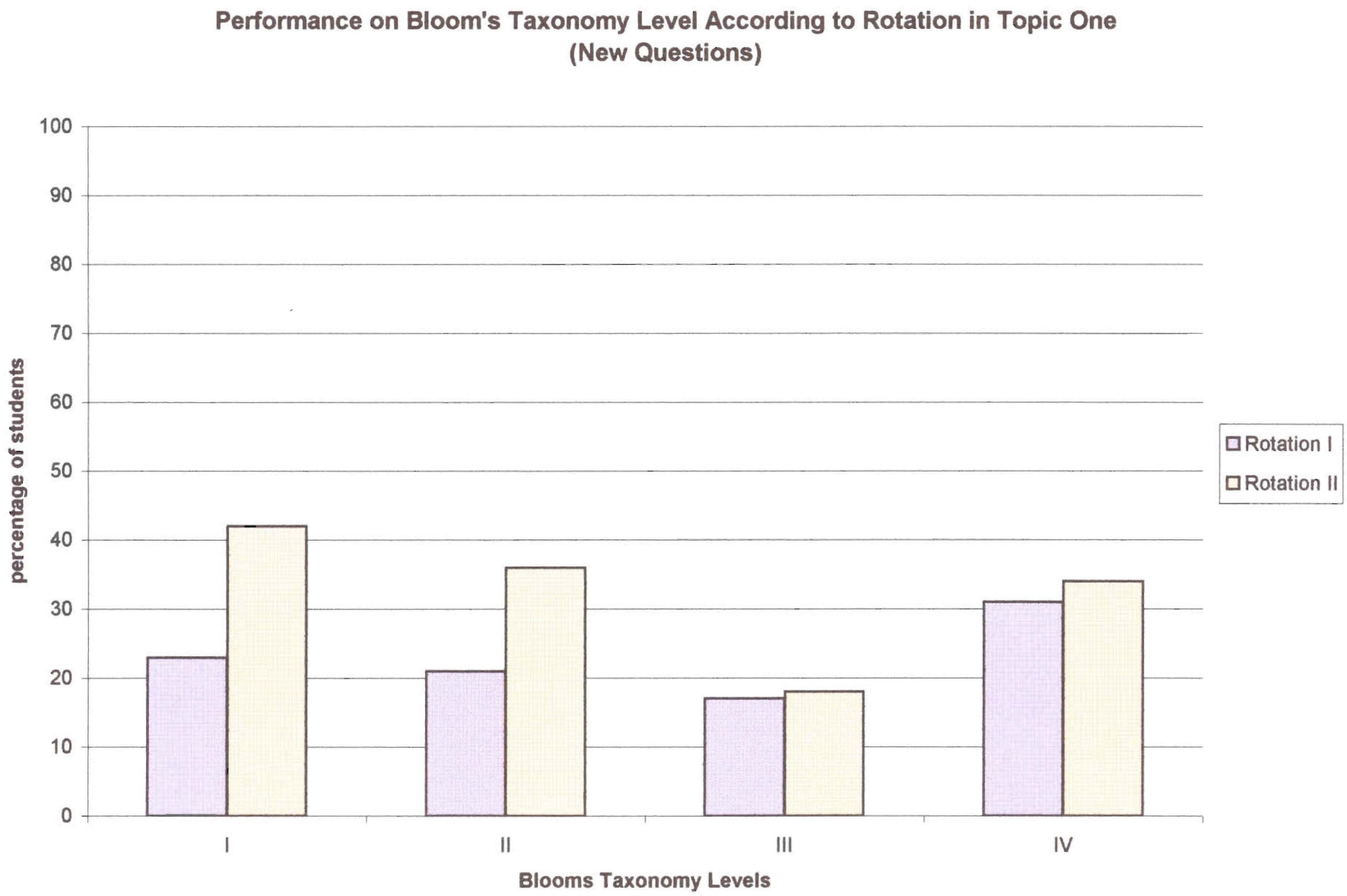


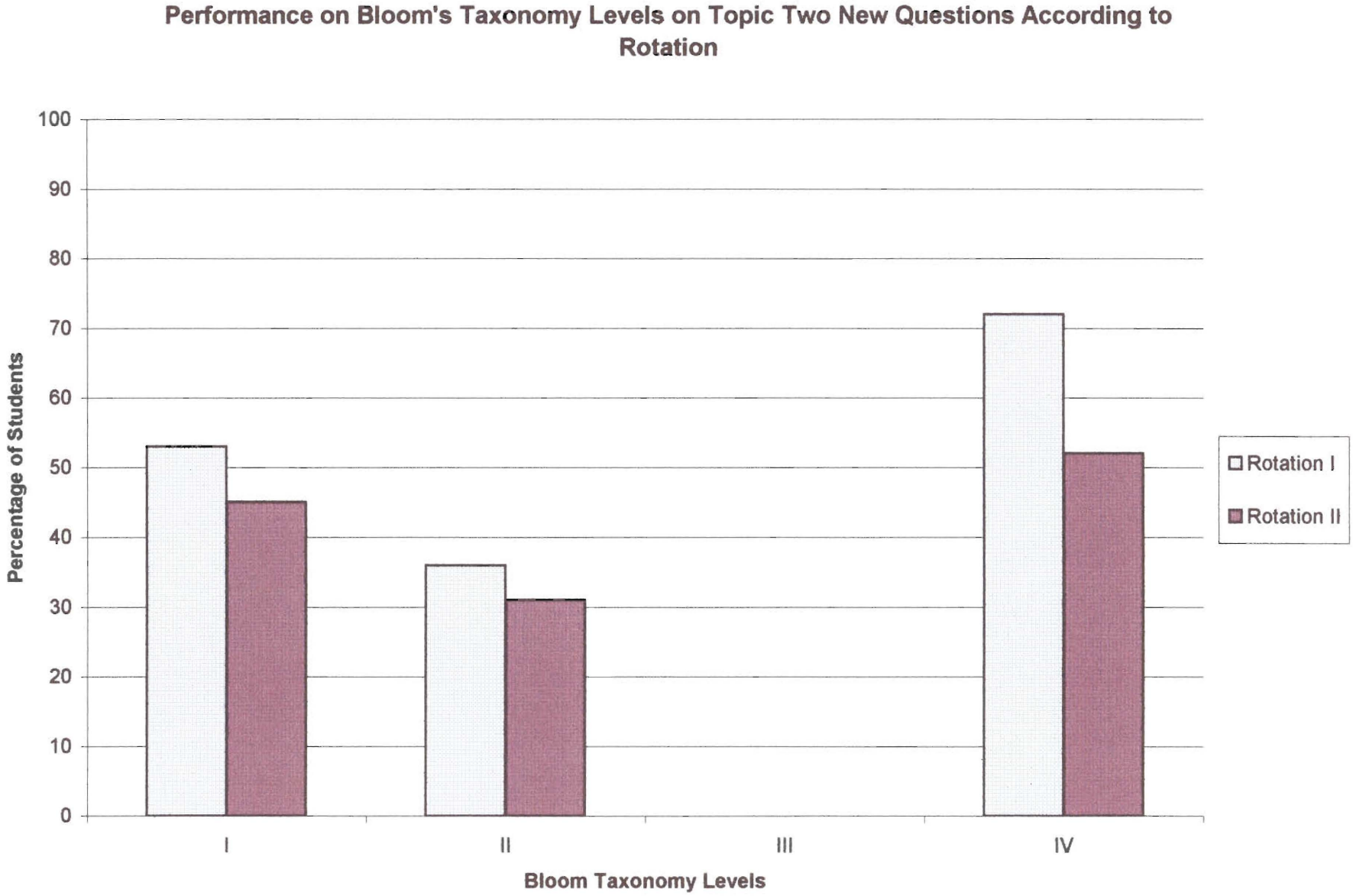
Appendix J

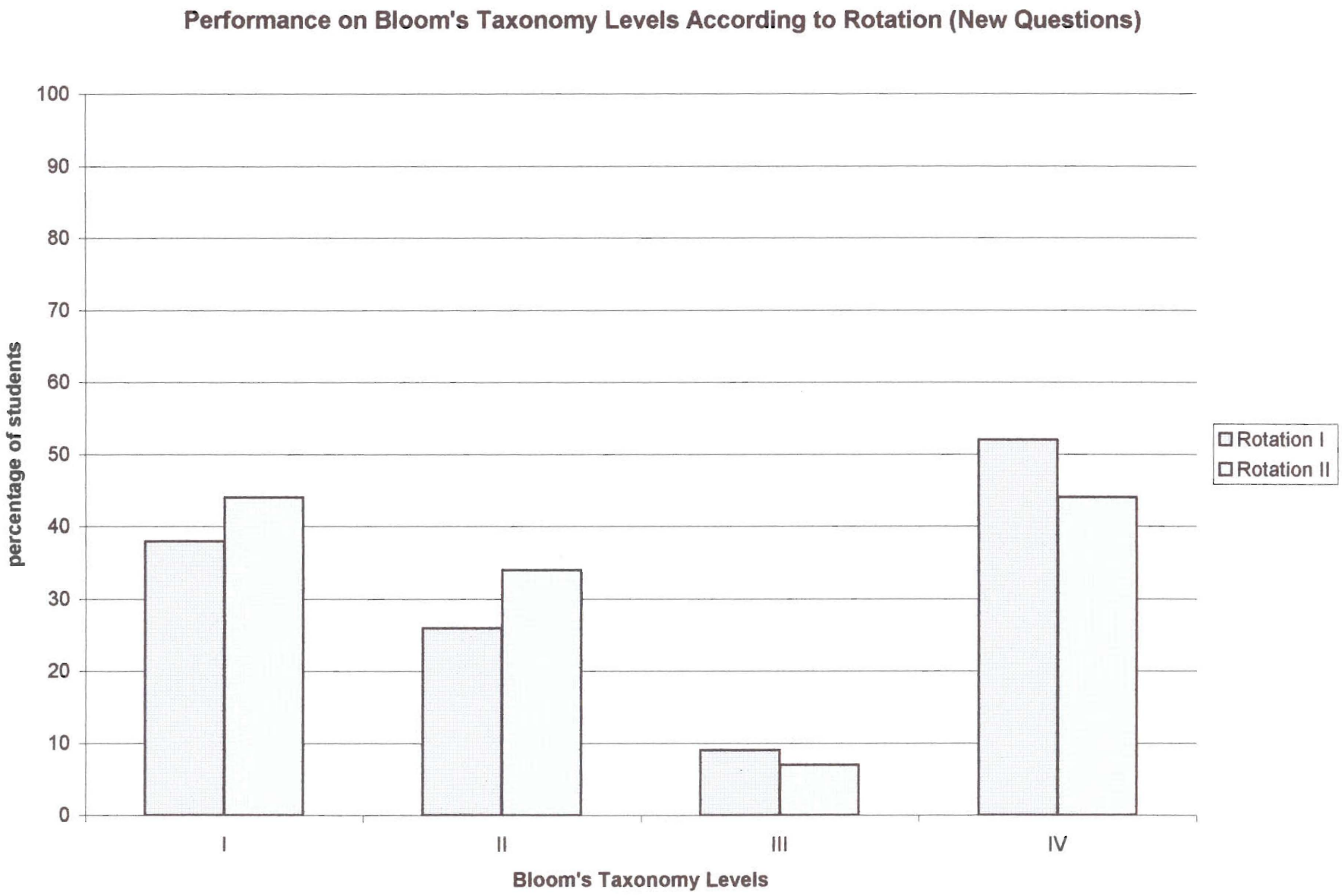
Bloom's Taxonomy Graphs

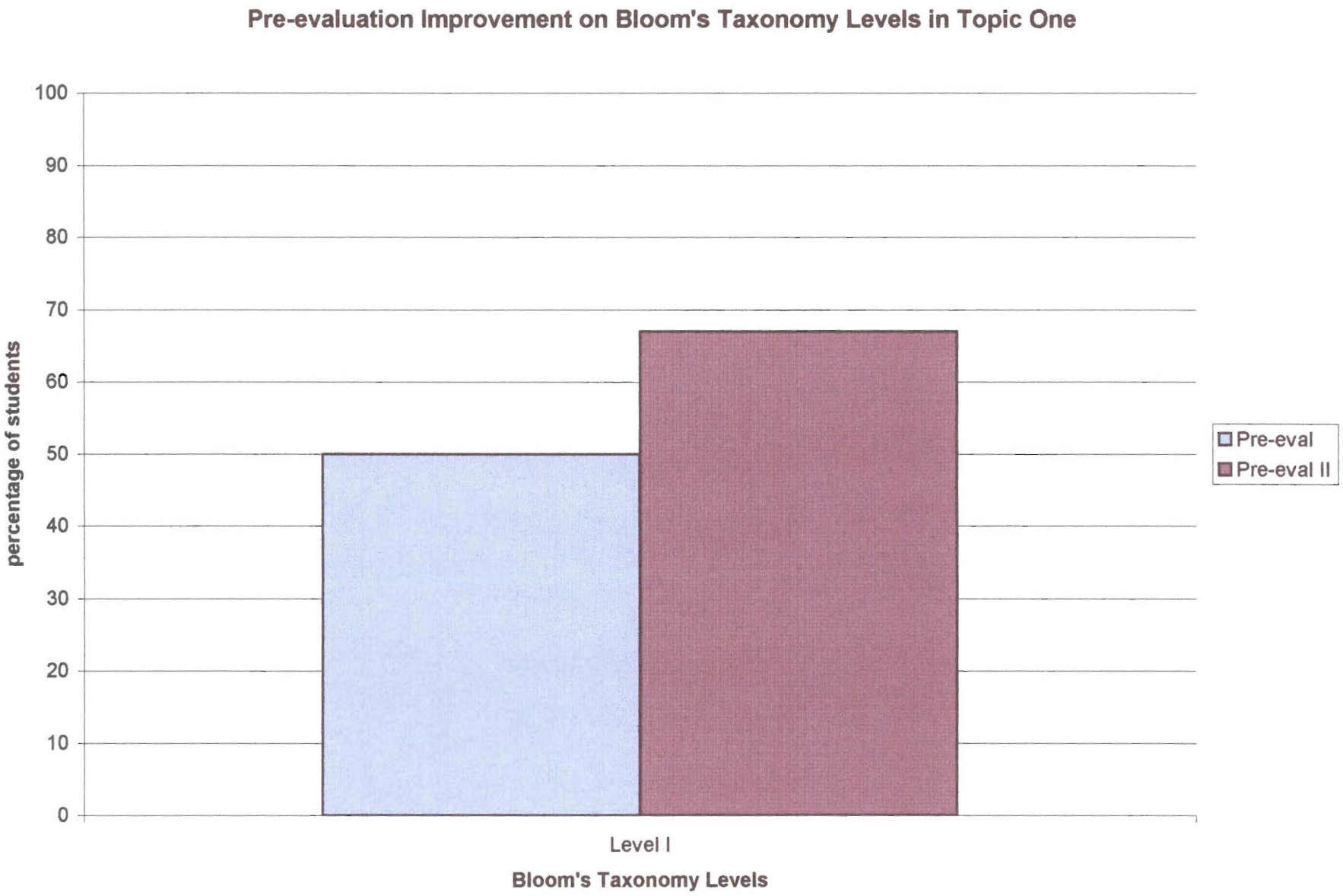
- Pre-evaluation Improvement on Bloom's Taxonomy Levels According to Rotation
- Performance on Bloom's Taxonomy Level According to Rotation in Topic One (New Questions)
- Performance on Bloom's Taxonomy Levels on Topic Two New Questions According to Rotation
- Performance on Bloom's Taxonomy Levels According to Rotation (New Questions)
- Pre-evaluation Improvement on Bloom's Taxonomy Levels in Topic One
- Pre-evaluation Improvement on Bloom's Taxonomy Level According to Topic
- Performance on Bloom's Taxonomy Levels According to Topic (New Questions)
- Pre-evaluation Improvement on Bloom's Taxonomy Levels According to Instructor (Topic Two)
- Pre-evaluation Improvement on Bloom's Taxonomy Levels According to Instructor
- Performance on Bloom's Taxonomy Levels According to Instructor, Topic One (New Questions)
- Performance on Bloom's Taxonomy Levels on Topic Two New Questions According to Instructor
- Performance on Bloom's Taxonomy Levels According to Instructor (New Questions)

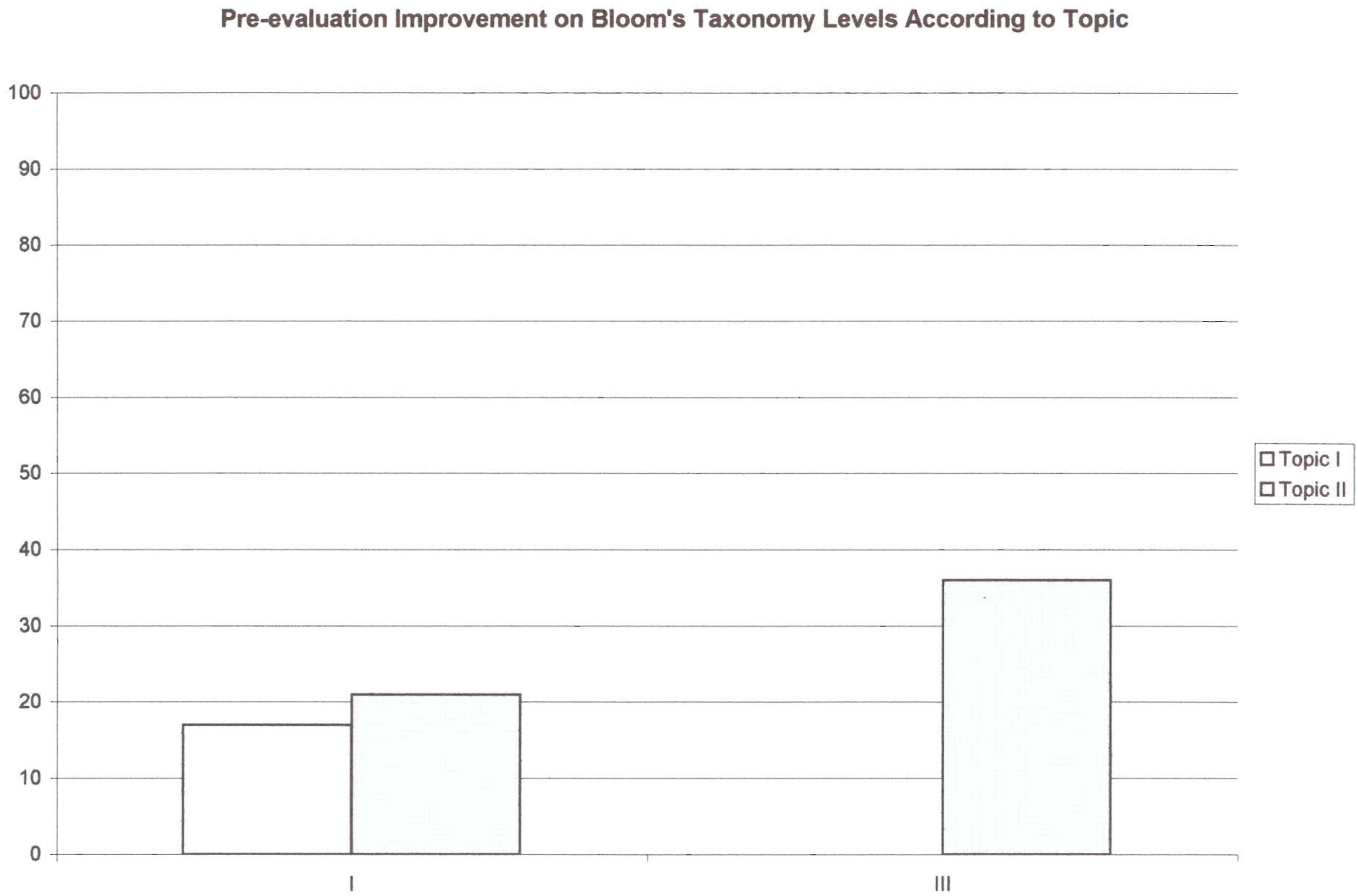

Pre-evaluation Improvement on Bloom's Taxonomy Levels According to Rotation
100
90
80
70
60
50
40
30
20
10
0
percentage of students
Rotation I
Rotation II
Level I
Level III
Bloom's Taxonomy Levels

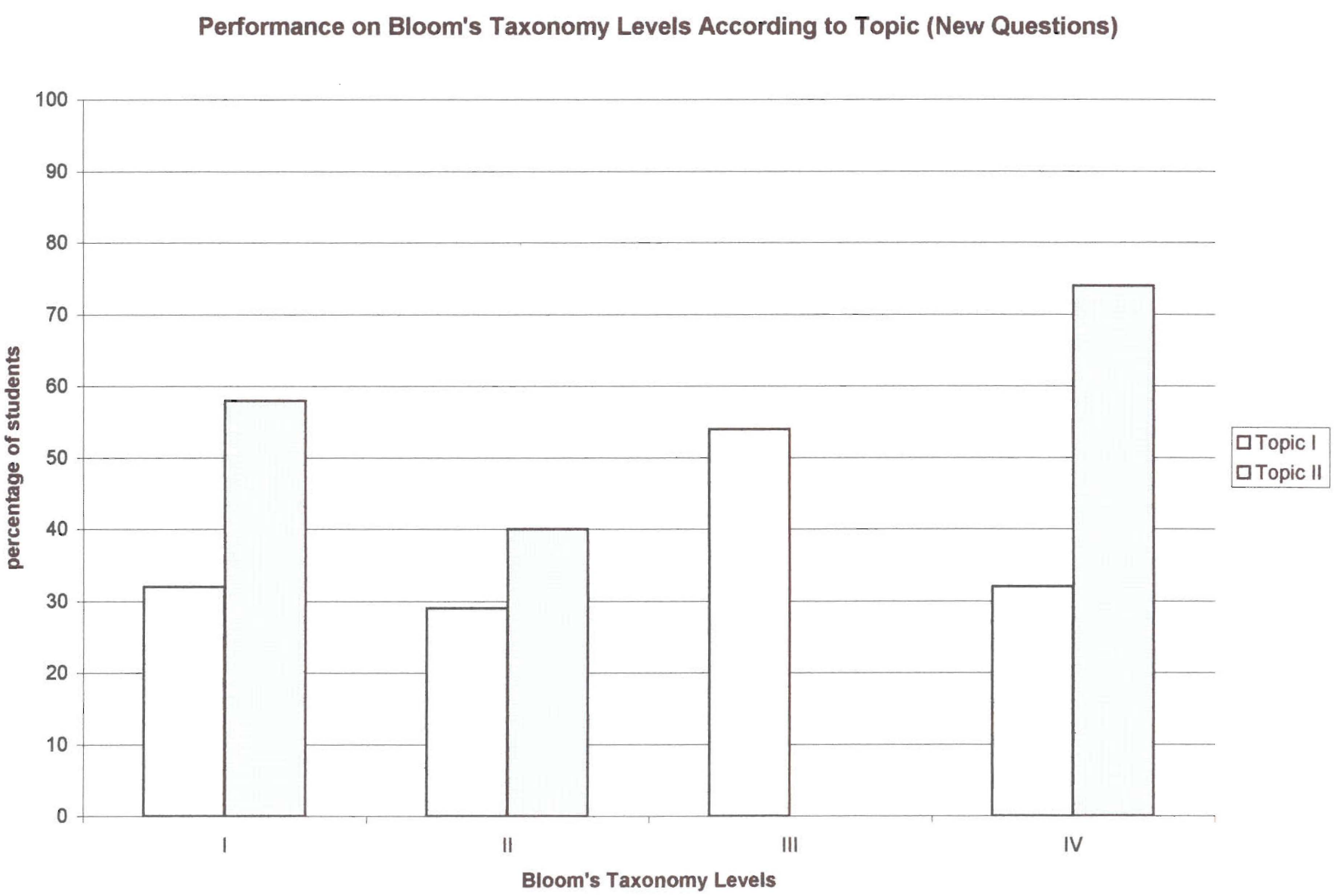

Performance on Bloom's Taxonomy Level According to Rotation in Topic One
(New Questions)
100
90
80
70
60
50
40
30
20
10
0
percentage of students
I
II
III
IV
Blooms Taxonomy Levels
Rotation I
Rotation II

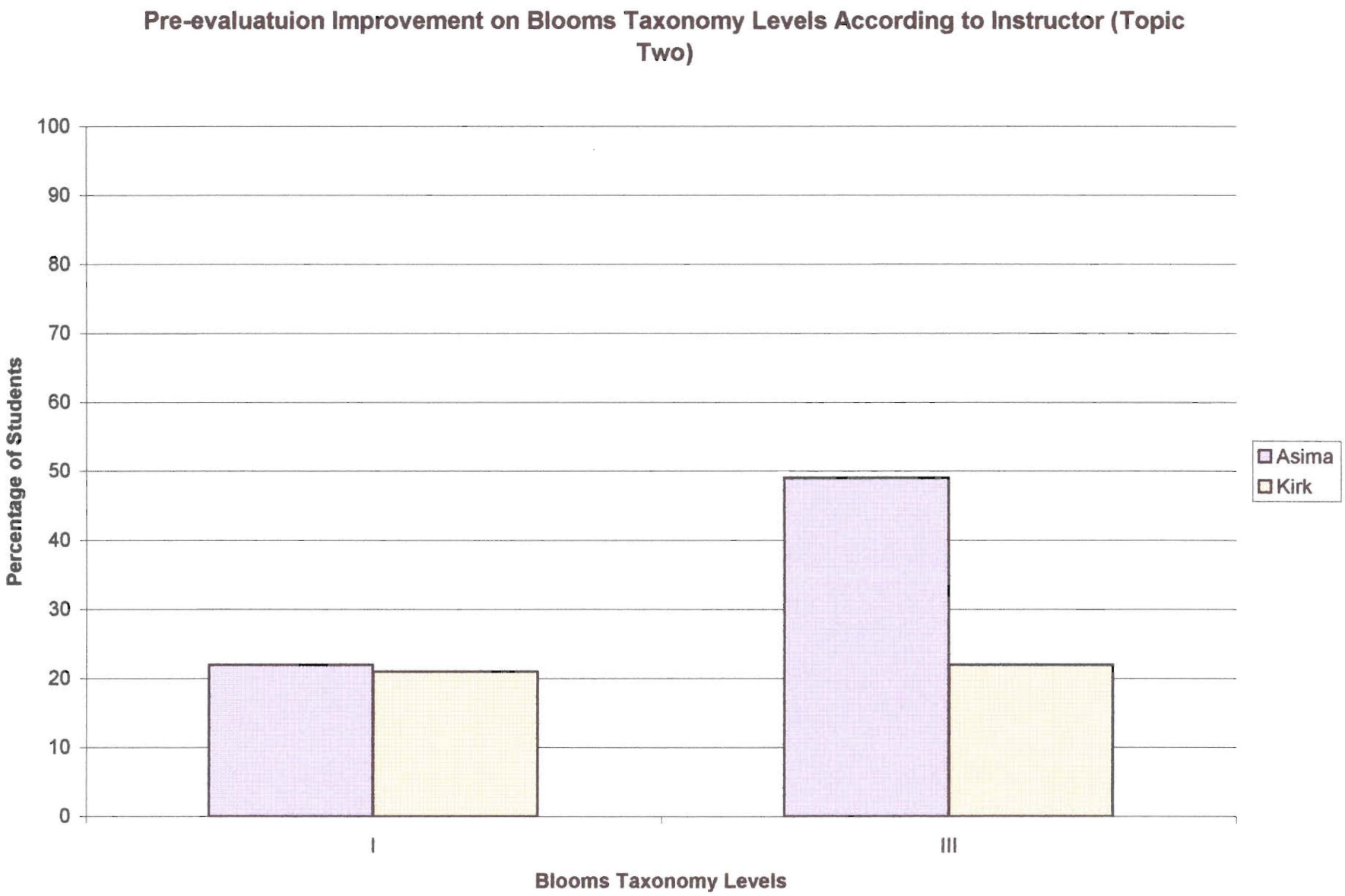

Performance on Bloom's Taxonomy Levels on Topic Two New Questions According to Rotation
100
90
80
70
60
50
40
30
20
10
0
Percentage of Students
I
II
III
IV
Bloom Taxonomy Levels
Rotation I
Rotation II

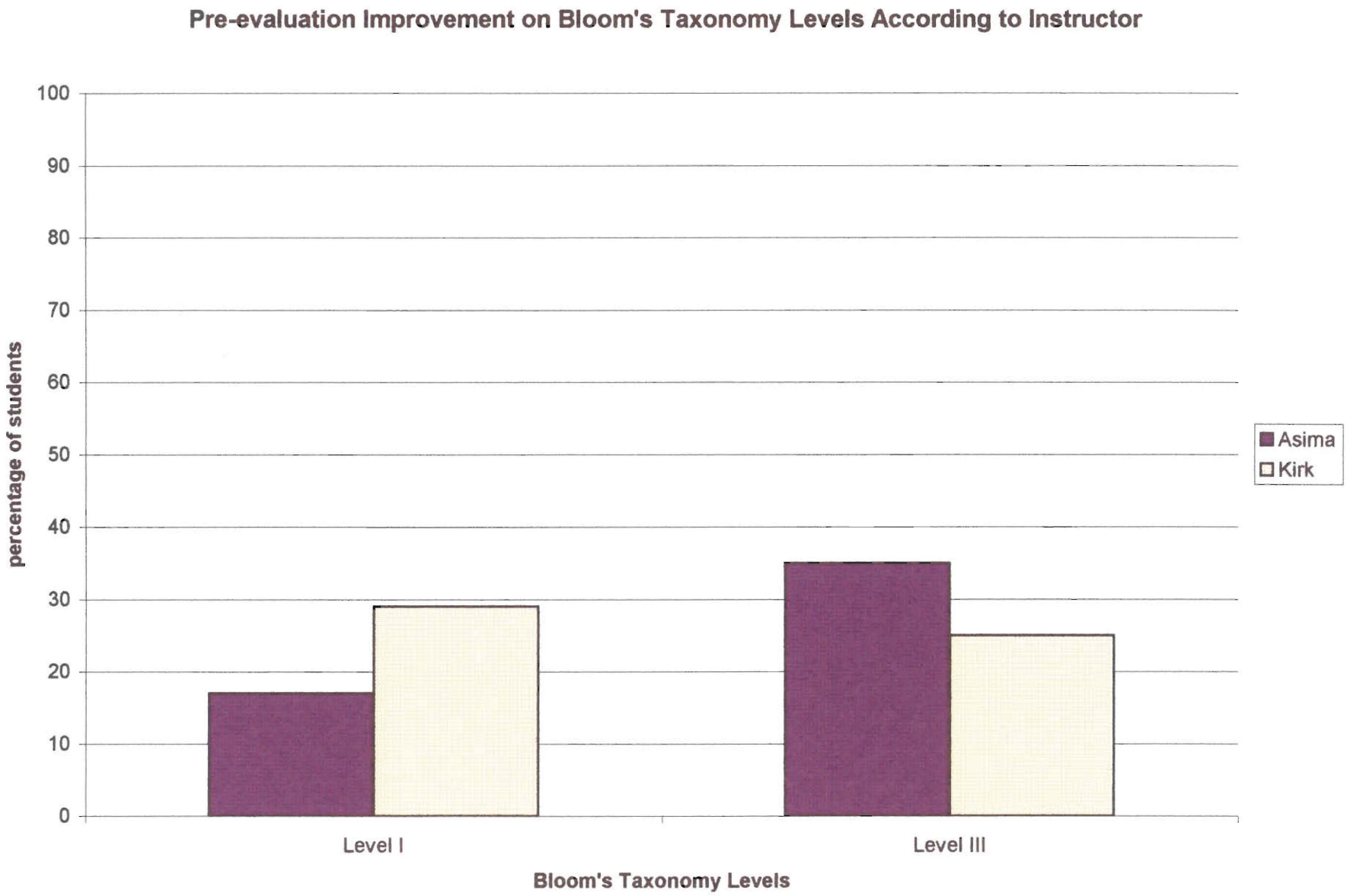

Performance on Bloom's Taxonomy Levels According to Rotation (New Questions)
100
90
80
70
60
50
40
30
20
10
0
percentage of students
I
II
III
IV
Bloom's Taxonomy Levels
Rotation I
Rotation II

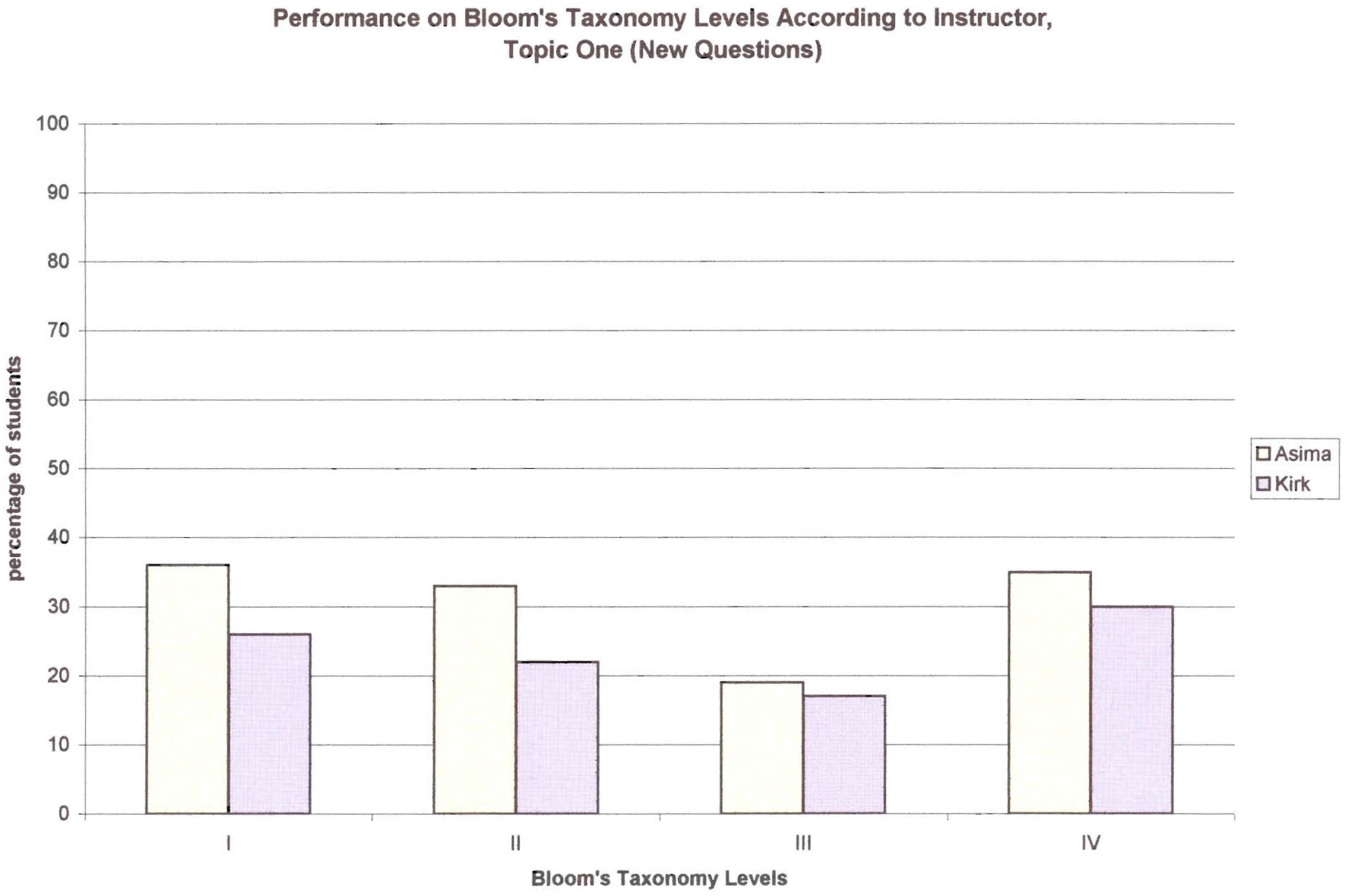

Pre-evaluation Improvement on Bloom's Taxonomy Levels in Topic One
100
90
80
70
60
50
40
30
20
10
0
percentage of students
Pre-eval
Pre-eval II
Level I
Bloom's Taxonomy Levels

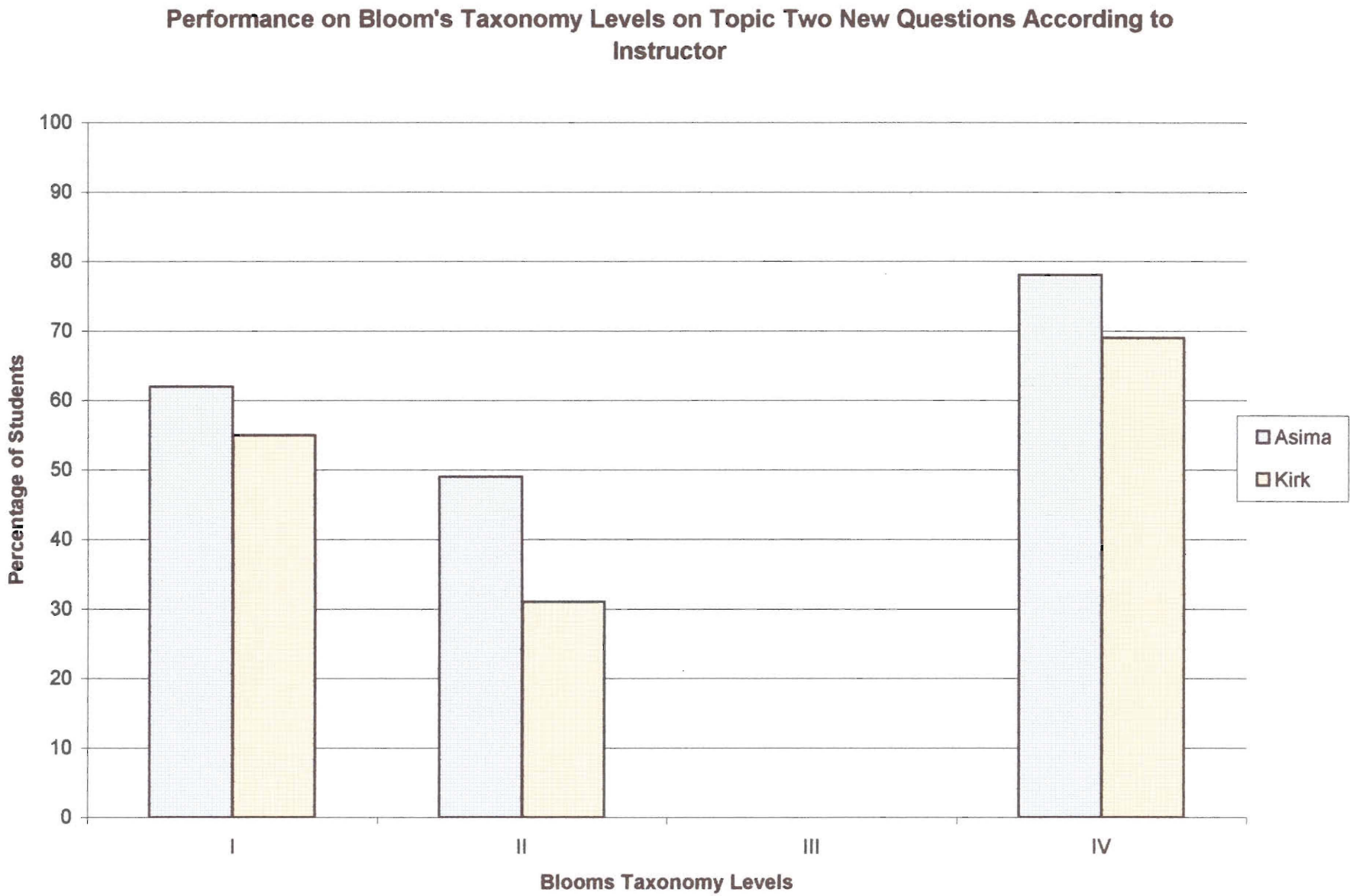

Pre-evaluation Improvement on Bloom's Taxonomy Levels According to Topic
100
90
80
70
60
50
40
30
20
10
0
I
III
Topic I
Topic II

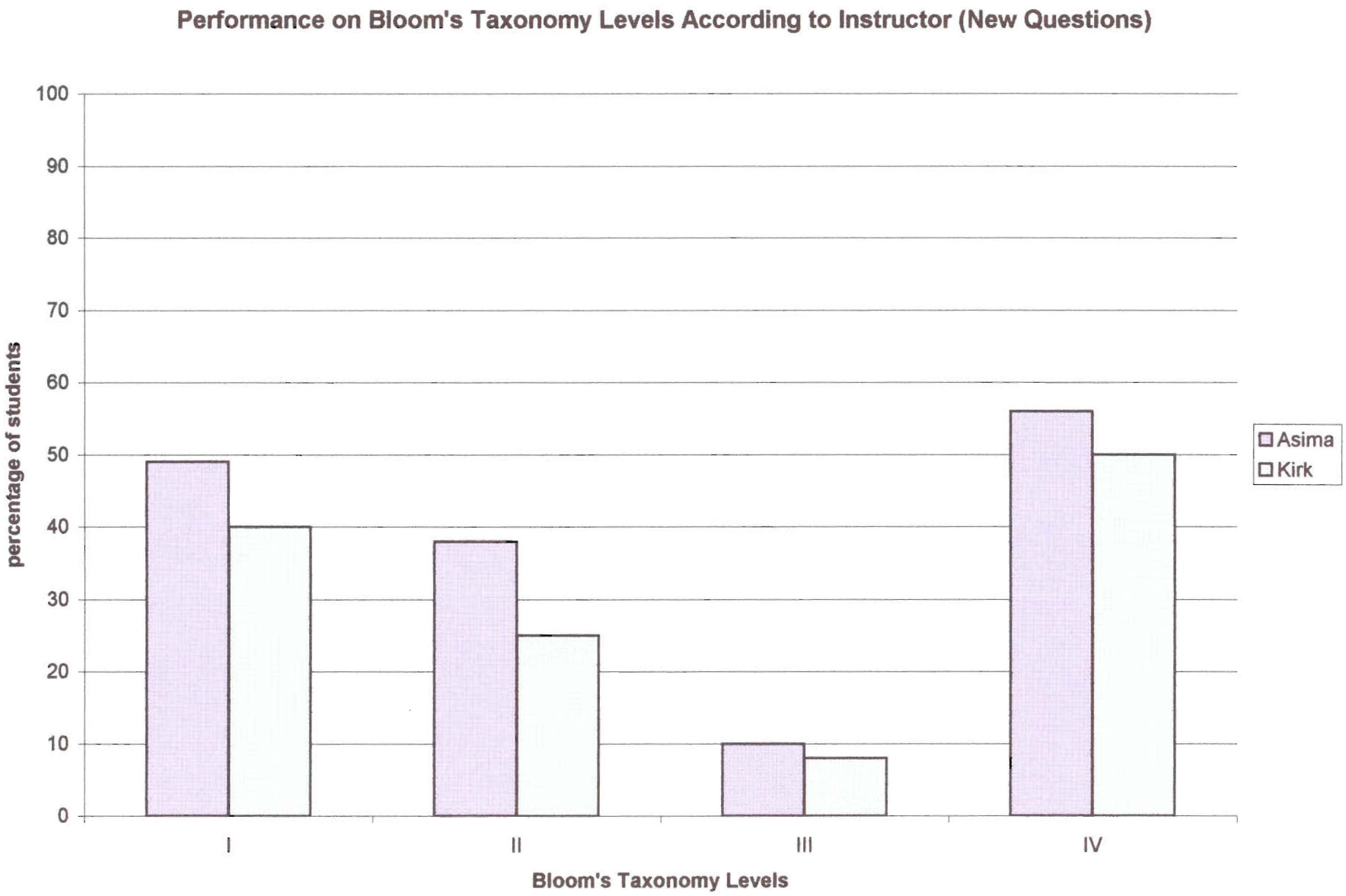

Performance on Bloom's Taxonomy Levels According to Topic (New Questions)
100
90
80
70
60
50
40
30
20
10
0
percentage of students
I
II
III
IV
Bloom's Taxonomy Levels
Topic I
Topic II


Pre-evaluatuion Improvement on Blooms Taxonomy Levels According to Instructor (Topic Two)
Percentage of Students
100
90
80
70
60
50
40
30
20
10
0
I
III
Blooms Taxonomy Levels
Asima
Kirk


Pre-evaluation Improvement on Bloom's Taxonomy Levels According to Instructor
100
90
80
70
60
50
40
30
20
10
0
percentage of students
Asima
Kirk
Level I
Level III
Bloom's Taxonomy Levels


Performance on Bloom's Taxonomy Levels According to Instructor, Topic One (New Questions)
100
90
80
70
60
50
40
30
20
10
0
percentage of students
I
II
III
IV
Bloom's Taxonomy Levels
Asima
Kirk


Performance on Bloom's Taxonomy Levels on Topic Two New Questions According to Instructor
100
90
80
70
60
50
40
30
20
10
0
Percentage of Students
I
II
III
IV
Blooms Taxonomy Levels
Asima
Kirk


Performance on Bloom's Taxonomy Levels According to Instructor (New Questions)
100
90
80
70
60
50
40
30
20
10
0
percentage of students
I
II
III
IV
Bloom's Taxonomy Levels
Asima
Kirk

Appendix K

Data for the Graphs

- Bloom's Taxonomy Pre-evaluation and Post-evaluation Data for Topic One
- Bloom's Taxonomy Pre-evaluation Data for Topic Two
- Bloom's Taxonomy Post-evaluation Data for Topic Two
- New Questions According to Gender
- Pre-evaluation Improvement According to Gender
- New Questions According to Instructor
- Pre-evaluation Improvement According to Instructor
- Survey Results According to all the Variables
- Pre-evaluation Improvement According to all the Variables
- New Questions According to Rotation
- Pre-evaluation II According to Rotation
- New Questions According to Software/Lecture Cycle
- Pre-evaluation II According to Software/Lecture Cycle
- Survey data
- New Questions According to Topic
- Pre-evaluation II According to Topic
- Mean New Questions Score By Group Size
- Mean Pre-evaluation Improvement According to Group Size
- Mean New Questions According to Group Type
- Mean Pre-evaluation Improvement According to Group Type

Bloom's Taxonomy Pre-evaluation and Post-evaluation Data for Topic One

Data for charts:

- Pre-evaluation Improvement on Bloom's Taxonomy Levels in Topic One
- Performance on Bloom's Taxonomy Levels According to Rotation in Topic One (New Questions)
- Performance on Bloom's Taxonomy Levels According to Instructor, Topic One (New Questions)
- Performance on Bloom's Taxonomy Levels According to Rotation (New Questions)
- Performance on Bloom's Taxonomy Levels According to Instructor (New Questions)
- Performance on Bloom's Taxonomy Levels According to Topic (New Questions)
- Pre-evaluation Improvement on Bloom's Taxonomy Levels According to Rotation
- Pre-evaluation Improvement on Bloom's Taxonomy Levels According to Instructor

	Pre-Evaluation										
Point value:	2	3	2	1	3	1	2	2	2	2	2
Bloom's rating:	1	1	1	1	1	1	1	1	1	1	1
Student	1	2	3	4	5	6	7	8	9	10	11
Period 2 Rotation 1											
1	0	0	2	0	0	1	0	0	0	1	1
2	2	2	2	1	1	1	0	0	0	1	2
3	0	0	1	0	1	1	0	2	0	1	2
4	1	2	2	0	0	1	1	2	0	2	2
5	0	3	0	0	1	1	0	2	0	0	2
6	1	0	2	1	1	1	0	2	0	1	2
7	0	2	2	1	1	0	0	0	0	2	2
8	2	2	2	1	1	0	0	2	0	2	1
9	0	0	2	1	1	0	1	0	0	2	1
Period 3 Rotation 1											
10	0	1	0	1	0	0	1	2	0	0	0
11	0	3	2	1	3	1	0	0	0	2	2
12	0	2	2	1	0	1	1	2	0	1	1
13	2	0	0	1	0	0	0	2	0	0	2
14	2	0	2	1	0	1	0	2	0	0	2
15	0	0	1	0	0	1	2	2	0	1	2
Period 7 Rotation 1											
16	1	0	2	1	3	1	0	0	0	1	2
17	2	1	2	1	2	1	1	2	0	2	2
18	0	2	0	1	1	1	0	2	1	2	2
19	1	0	0	0	0	1	0	0	0	2	2
20	0	3	1	1	2	1	0	2	0	2	2
Period 8 Rotation 1											
21	0	3	0	1	0	1	0	2	0	2	2
22	0	2	0	1	0	0	0	2	0	0	2
23	1	3	0	1	0	1	0	2	0	1	2
24	1	0	2	1	0	0	0	0	0	2	2
25	1	2	0	0	0	1	2	2	0	1	0
26	1	3	0	1	1	1	0	2	0	1	2
27	2	0	2	1	1	1	0	0	0	1	0
28	0	0	0	1	0	1	0	0	0	2	2
Period 2 Rotation 2											
29	0	2	0	0	0	1	2	2	0	1	0
30	0	3	0	1	0	1	0	0	0	1	2
31	1	2	2	1	1	1	1	2	0	2	1
32	1	2	2	1	0	1	1	2	0	1	1
33	1	2	2	1	3	1	0	2	0	2	2
34	1	3	2	1	1	1	0	0	0	0	2
Period 3 Rotation 2											
35	2	3	2	0	3	1	0	2	0	2	2
36	2	3	2	1	3	1	2	2	0	2	2
37	0	3	2	1	3	1	0	2	0	1	2
38	1	0	0	1	1	1	0	2	0	0	2
39	0	0	2	1	0	1	2	2	0	1	2

Period 7											
Rotation 2											
40	1	3	2	1	1	1	0	0	0	0	2
41	0	2	1	1	0	1	0	2	1	2	2
42	2	0	2	0	1	1	0	2	0	1	0
Period 8											
Rotation 2											
43	0	0	2	0	2	1	0	0	0	0	1
44	0	1	0	0	1	1	0	2	0	1	2
45	0	0	2	0	0	0	1	2	0	1	2
46	0	2	0	1	0	1	1	2	0	1	1
47	1	3	0	1	0	0	0	0	0	1	2
48	0	1	0	1	0	0	0	0	0	2	0
49	1	2	2	1	0	1	2	2	0	0	0
50	0	3	0	1	1	0	1	0	0	2	2
Point value:	2	3	2	1	3	1	2	2	2	2	2
Bloom's rating:	1	1	1	1	1	1	1	1	1	1	1
quest #	1	2	3	4	5	6	7	8	9	10	11
Total points	34	76	58	37	41	39	22	66	2	59	78
adjusted pt. Val	17	25	29	37	14	39	11	33	1	30	39
Level I total:	275										
percentage	50										

Pre-eval II						
Level I	0					
percentage	0					

percentages	Pre-eval	Pre-eval	Pre-eval diff			
Level I	50	67	17			

Topic One						
pre-eval I	Rotation	Rotation	Topic I	Topic II	Asima	Kirk
Level I	264	1269	368	68	1066	114
pre-eval II				5		
Level I	344.5	1986.5			1475	300

Topic Two						
pre-eval I	Rotation	Rotation II			Asima	Kirk
Level I	30	38	368	68	40	28
level III	3	2		5	2	3
pre-eval II						
Level I	62	49		111	63	48
Level III	13	11		24	15	9

Topic One						
pre-eval diffimp	Rotation	Rotation II			Asima	Kirk
Level I	80.5	717.5			409	186
Level III	0	0			0	0

Topic Two						
pre-eval diffimp	Rotation	Rotation II			Asima	Kirk
Level I	32	11			23	20
Level III	10	9			13	6

Topic I and II						
pre-eval diffimp	Rotation	Rotation II			Asima	Kirk
Level I	112.5	728.5			432	206
Level III	10	9			13	6

Topic I and II						
pre-eval diffimp						
percentage	Rotation	Rotation II			Asima	Kirk
Level I	31	25			96	61
Level III	36	28			35	25

Post-Evaluation										
	2	3	1	1	1	1	1	1	1	1
	1	1	1	1	1	2	2	1	1	1
	1	2	3	4	5	6	7	8	9	10
	2	0	0	0	0	0.5	0	0	0	2
	2	3	0.5	0	0	1	0.5	0	0	2
	0	2	0.5	0	0	1	0.5	1	0	2
	1	3	0.5	0	0.5	0	0	0	0	2
	0	0	0	0	0	0.5	0	0	0	0
	1	0	0	0	0	1	0	0	0	2
	2	3	0.5	0	0.5	0.5	0.5	0	0	2
	2	3	0	1	0	1	1	0	0	0
	0	2	0	0	0	0.5	0.5	0.5	0	2
	0	1	0	0	0	1	0	0	0	0
	0	3	0	0	0	0.5	0.5	0	0	2
	2	2	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	1	0
	2	0	0	1	1	0	0	0	0	2
	0	0	0	0	0	0	0	0	0	0
	2	3	0	1	1	1	0.5	1	0	2
	2	1	0	0	0	0	0.5	0	0	2
	2	2	0	0	0	0.5	0	0	0	0
	2	0	0	0	0	0	0	0	0	0
	0.5	3	0	0	0	1	1	0	0	1
	0	3	0	0	0	0.5	1	0	0	2
	0	0	0	0	0	1	0	0	0	0
	1	3	0	0	0	1	0.5	1	0	2
	2	2	0	0	0	0.5	0.5	1	0	2
	1	1	0	0	0	0	0	0	0	2
	2	3	0	0	0	0	1	1	0	2
	2	2	0	0	0	0.5	0.5	0	0	2
	1	0	0	0	0	0	0.5	0	1	2
	1	2	1	1	1	1	0.5	1	0	2
	3	3	0	1	1	0	0.5	0.5	0	2
	3	2	0	1	1	1	1	0	1	2
	2	2	0	0	0	1	1	1	0	2
	1	3	0	1	1	1	1	0	0	2
	0	3	0	0	0	0	0	1	0	2
	2	3	0	1	1	1	0.5	1	0	2
	1	3	0	1	1	1	1	1	0	2
	0	3	0	0	0	1	0.5	0.5	0	2
	2	0	0	1	1	0.5	0	0	0	2
	0	3	1	1	1	1	0.5	0.5	0	2

	2	3	0	0	0	0.5	0.5	1	0	2
	2	3	0	0	0	0.5	0.5	0	0	2
	1	3	0	1	1	1	0.5	0	0	2
	0	0	0	0	0	0	0	0	0	0
	2	1	0	0	1	1.5	0	0	0	0
	2	0	0	0	0	0	0	0	0	2
	2	2	0	0	0	0.5	0	1	0	0
	1	0	0	0	0	0.5	0	0	0	2
	2	2	0	1	1	1	1	0.5	0	2
	1	2	0	1	1	0	0.5	0	0	2
	2	3	0	0	0	1	0.5	0	0	2
	2	3	1	1	1	1	1	1	1	1
	1	1	1	1	1	2	2	1	1	1
	1	2	3	4	5	6	7	8	9	10
Total point	65.5	91	4	14	15	28.5	19.5	14.5	3	75
adjusted p	33	30	4	14	15	29	20	15	3	75
Level I tot	528									
percentage	50									
Level II tot	115									
percentage	29									
Level III to	27									
percentage	54									
Level IV to	16									
percentage	32									

post-eval	Level I	Level II	Level III	Level IV	
percentage	50	29	54	32	
total:	0				
new quest.	Level I	Level II	Level III	Level IV	
percentage	0	29	54	32	

percentage	Levels	Rot I	Rot II	Topic I	Topic II	Asima	Kirk
	I	77	358	32	58	272	34
	II	33	224	29	40	207	14
	III	30	157	54	0	147	14
	IV	0	0	32	74	0	0

total	Levels	Rot I	Rot II	Topic I	Topic II	Asima	Kirk
Topic One	I	216	788			707	82
	II	74	394			431	27
	III	8	35			38	3
	IV	0	0			0	0

total	Levels	Rot I	Rot II			Asima	Kirk
Topic One	I	364	932			867	214
Topic Two	II	115	434			482	57
	III	8	35			38	3
	IV	20	17			20	17

percentage	Levels	Rot I	Rot II			Asima	Kirk
Topic One	I	65	173			167	45
Topic Two	II	34	143			154	20
	III	14	65			73	6
	IV	36	31			38	35

1	1	1	3	2	1	2	1	1	1	2
2	1	2	1	2	1	2	2	3	1	1
11	12	13	14	15	16	17	18	19	20	21
0	0	0	1	1	0	0	0	0	1	2
0	1	0	0	1.5	0	0	0	0.5	1	2
0	1	0	1	0	0	0	0	0.5	1	0
1	0	0	0	1.5	1	0	0	1	1	1
0	1	0	1	1	0	0	0	0.5	0	1
1	1	0	3	0	0	0	0	0.5	1	2
0.5	1	0	1	2	1	0	1	1	1	1
0.5	1	1	1	0	0	0	0	0.5	0	1
0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0.5	0	0
1	0	0	3	2	1	2	0.5	1	1	2
0	1	0	0	0	0.5	1	0	0.5	1	0
0	0	0	0	0	0	0	0	0.5	0	1
0	1	0	0	2	1	2	1	1	1	2
0	0	0	0	0	0	0	0	0	1	0
0	1	0	2	0	0	0	0.5	1	1	2
0	1	0	0	0	0	0	0	0.5	1	2
0	0	0	0	0	1	0	0	0.5	1	1
0	0	0	0	0	0	0	0	0.5	1	1
1	1	0	2	0	1	0	0	0.5	1	2
0	1	0	0	0	0	0	0	0.5	1	0
0	1	0	0	0	0	0	0	0	0	0
0	1	0	2	0	1	0	0	0	1	0
0	1	0	0	0	0	0	0	0.5	0	2
0	0	0	0	0	0	0	0	0	1	0
0	1	0.5	0	1	0	0	0	1	1	2
0	0	0	1	0	0	0	0	1	1	0
0	1	0	0	0	0	0	0	0.5	1	0
1	1	0	3	2	1	0.5	1	0.5	1	1
1	1	0	2	2	1	1	0.5	0.5	1	2
0	1	0	3	0	1	0	0	0.5	1	0
0	1	0	1	0	0.5	0.5	1	0.5	1	1.5
0	1	0	3	1	1	1.5	0	0.5	1	2
0	1	0	2	0	0	0	0	1	1	0.5
1	1	1	3	2	1	0.5	1	0.5	1	2
1	1	1	3	2	0.5	1	1	1	1	2
0	1	0	3	1.5	1	2	0	1	1	1
0	0	0	3	0	1	0	0	0	1	2
0	1	0	3	1.5	1	0	0	0.5	1	0

0	1	0	2	0	0	0	0	0.5	1	0
0	1	0	2	0	0	0	0	0.5	1	1
1	1	1	3	1.5	1	0	0.5	1	1	2
0	1	0	1	0	0	0	0	0.5	1	0
0	1	0	1	0	0	0	0	0.5	1	2
0	1	0	0	0	0	0	0	0	1	0
0	1	0	1	1	1	0	1	0.5	1	2
0	1	0	0	0	0	0	0	0.5	0	0
0	0	0	3	2	1	0	1	0.5	1	0.5
1	1	0	0	2	0	0	0.5	0	1	2
0.5	1	0	1	1	1	1	0	1	1	0
1	1	1	3	2	1	2	1	1	1	2
2	1	2	1	2	1	2	2	3	1	1
11	12	13	14	15	16	17	18	19	20	21
11.5	37	4.5	61	31.5	20.5	13	10.5	26.5	42	51.5
12	37	5	20	16	21	7	11	27	42	26

2	2	1	2	1	2	1	2	8	
1	1	2	1	1	1	1	1	1	4
22	20*	21*	22*	23	24	25	26	27	E.C.
1	2	0	0	0	2	0	1	5	0
0	2	0	0	1	2	0	2	4	5
0	2	0	0	0	1	0.5	2	1	1
0	2	0	0	1	2	0	2	5	2
0	2	0	0	1	0	0	2	4	1
2	2	0	0	0	3	0.5	0	3	2
0	2	1	0	1	2	0	0	0	2
0	0	0	0	1	1	0	1	5	2
1	0	0	0	0	1	0	1	3	0
0	0	0	0	0	1	0	0	0	3
0	2	0.5	0	1	2	0.5	2	5	1
0	2	0.5	0	0	1	0	2	3	0
0	0	0	1	0	0	0	0	0	0
2	2	0	0	1	2	0	2	6	4
2	2	0	0	0	2	0	2	0	1
0	0	1	2	1	0	1	2	7	2
0	2	1	1	1	2	0.5	2	3	3
0	2	0	0	1	2	0.5	2	3	1
0	0	0.5	0	1	0	0	2	1	2
2	2	0	0	0	2	0	2	4	0
0	2	0	2	1	2	0	2	7	1
0	2	0	0	0	0	0	2	0	0
0	0	0	0	0	2	0	2	0	1
0	0	0	0	0	2	0	2	5	2
2	2	0.5	0	1	0	0	0	5	3
1.5	2	0.5	0	0	2	0.5	2	3	3
0	2	0	0	0	1	0	0	1	1
2	2	1	0	0	2	0.5	2	6	1
2	0	1	0.5	1	1	0.5	1	5	2
2	0	0	0	1	2	1	2	5	0
1	2	0	0	1	2	1	2	5	3
2	2	1	2	1	1	0.5	1	3	2
0	2	1	1	0	2	0.5	2	4	2
2	0	0	0	1	2	0.5	2	3.5	0
2	2	1	0	0	2	1	1	6	2
0	0	1	2	0	2	0.5	2	6	3
2	2	1	2	0	0	0.5	2	5	3
0	2	0	0	0	0	0	0	5	1
2	2	0	0	0	1	1	0	4	3

2	2	0	0	1	1	0	2	5	1
0	2	0	0	1	2	0	2	5	1
0	0	0	0	0	2	1	0	6	3
0	0	0	0	0	1	0	1	2	0
0	2	0.5	0	0.5	2	0	2	0	1
0	2	0.5	0	0	0	0	2	5	1
0	2	0	0	1	1	0.5	1	5	0
0	2	0	0	0	1	0	2	3	1
2	2	0	1	0	2	1	0	4	2
2	2	0	0	1	2	1	2	4	4
0	0	1	0	0	2	1	2	4	2
2	2	1	2	1	2	1	2	8	5
1	1	2	1	1	1	1	1	1	4
22	23	24	25	26	27	28	29	30	E.C.
36.5	70	14.5	14.5	22.5	70	16	72	183.5	81
18	35	15	7	23	35	16	36	23	16

Bloom's Taxonomy Pre-evaluation Data for Topic Two

Data for charts:

- Performance on Bloom's Taxonomy Levels on Pre-evaluation According to Topic
- Performance on Bloom's Taxonomy Levels on Pre-evaluation According to Instructor (Topic Two)
- Performance on Bloom's Taxonomy Levels on Pre-evaluation According to Rotation (Topic Two)
- Pre-evaluation Improvement on Bloom's Taxonomy Levels According to Topic
- Pre-evaluation Improvement on Bloom's Taxonomy Levels According to Instructor (Topic Two)

Pre-Evaluation Results by Student and Bloom's Taxonomy Classification

BT rating	I	I	I	III	I
point value	out of 1	out of 1	out of 3	out of 2	out of 3
quest #	1	2	3	4	5
Period 2 Rotation 1					
name					
Student 1	0	0	0	0	0
Student 2	1	1	0	1	0
Student 3	0	0	1	0	0
Student 4	0	1	2	1	2
Student 5	0	0	0	0	0
Student 6	0	0	1	0	0
Student 7	0	0	3	1	1
Student 8	0	1	1	0	1
Student 9	0	0	0	0	0
Total:	1	3	8	3	4
tot % qst.	1	3	8	1	4
I	16	III	1		
Period 3 Rotation 1					
Student 10	0	0	0	0	0
Student 11	0	1	1	0	0
Student 12	0.5	1	0	0	0
Student 13	0	0	0	0	0
Student 14	0	1	0	0	0
Student 15	0	1	0	1	0
Total:	0.5	4	1	1	0
tot % qst.	0.5	4	1	0.333333	0
I	5.5	III	0.333333		
Period 7 Rotation 1					
Student 16	0	1	0	3	0
Student 17	0	1	0	1	0
Student 18	0	1	0	0	0
Student 19	0	0	0	0	0
Student 20	0	0	0	0	0
Total:	0	3	0	4	0
tot % qst.	0	3	0	1.333333	0
I	3	III	1.333333		

Period 8 Rotation 1

Student 21	0.5	1	0	0	0
Student 22	0	0	0	0	0
Student 23	0	0	0	0	0
Student 24	0	1	0	0	0
Student 25	0	0	0	0	0
Student 26	0	1	0	2	0
Student 27	0	0	1	0	0
Student 28	0	1	0	0	0
Total:	0.5	4	1	2	0
tot % qst.	0.5	4	1	0.666667	0
I	5.5 III		0.666667		

Period 2 Rotation 2

name					
Student 29	0	0	0	0	0
Student 30	0	1	0	0	0
Student 31	0	0	0	0	0
Student 32	0.5	1	2	1	0
Student 33	0	0	0	0	0
Student 34	0	0	2	1	0
Total:	0.5	2	4	2	0
tot % qst.	0.5	2	4	0.666667	0
I	6.5 III		0.666667		

Period 3 Rotation 2

Student 35	1	1	2	1	0
Student 36	1	1	0	0	3
Student 37	0.5	1	0	0	0
Student 38	0	0	0	0	0
Student 39	0	1	0	0	0
Total:	2.5	4	2	1	3
tot % qst.	2.5	4	2	0.333333	3
I	11.5 III		0.333333		

Period 7 Rotation 2

Student 40	0	1	0	1	2
Student 41	0	1	0	0	0
Student 42	0	1	0	0	0
Total:	0	3	0	1	2
tot % qst.	0	3	0	0.333333	2
I	5 III		0.333333		

Period 8 Rotation 2

Student 43	0	1	0	0	0
Student 44	0.5	0	1	0	0
Student 45	0	0	1	0	0
Student 46	0	0	1	0	3
Student 47	0	0	1	0	0
Student 48	0	1	0	0	0
Student 49	0	0	1	0	0
Student 50	0	1	0	2	3
Total:	0.5	3	5	2	6
tot % qst.	0.5	3	5	0.666667	6
I	14.5 III		0.666667		

Pre-eval	I		4	III	1			
#people	28	32		50	26	24		
Levels	Rot I	Rot II	Topic I	Topic II	Asima	Kirk	males	females
I	30	37.5		67.5	39.5	28		
III	3.333333	2		5.333333	2.333333	3		

#people					
Levels	two	three	male gr.	female gr.	mixed gr.
I					
III					

Pre-eval	I		4	III	1			
#people	28	32		50	26	24		
Levels	Rotation I	Rotation II	Topic I	Topic II	Asima	Kirk	males	females
I	27	29	50	34	38	29		
III	12	6	0	11	9	13		

#people					
Levels	two	three	male gr.	female gr.	mixed gr.
I					
III					

Pre-eval II	I		4	III	1			
#people	28	32		50	26	24		
Levels	Rotation I	Rotation II	Topic I	Topic II	Asima	Kirk	males	females
I	56	38	67	55	60	50		
III	46	33	0	47	58	35		

#people	two	three	male gr.	female gr.	mixed gr.
Levels					
I					
III					

Pre imdiff	I		4	III	1			
#people	28	32		50	26	24		
Levels	Rotation I	Rotation II	Topic I	Topic II	Asima	Kirk	males	females
I	29	9	17	21	22	21		
III	34	27	0	36	49	22		

#people	two	three	male gr.	female gr.	mixed
Levels I					
III					

Bloom's Taxonomy Post-evaluation Data for Topic Two

Data for charts:

- Performance on Bloom's Taxonomy Levels on Topic Two New Questions According to Rotation
- Performance on Bloom's Taxonomy Levels on Topic Two New Questions According to Instructor
- Performance on Bloom's Taxonomy Levels on Pre-evaluation II According to Rotation
- Performance on Bloom's Taxonomy Levels on Pre-evaluation II According to Topic
- Performance on Bloom's Taxonomy Levels on Pre-evaluation II According to Instructor
- Performance on Bloom's Taxonomy Levels According to Topic (Pre-evaluation II)

Pre-Evaluation Results by Student and Bloom's Taxonomy Classification

BT rating	I	I	I	I	I	I	I	I	I	I	II	II	II	III	IV	I
point value	out of 1	out of 1	out of 1	out of 2	out of 3	out of 2	out of 3	out of 2	out of 1	out of 2	out of 2	out of 1	out of 1	out of 2	out of 2	out of 2
quest #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Period 2 Rotation 1																
name																
Student 1	1	1	1	2	0	2	1	1	0	2	0	1	0	0	1	1
Student 2	0	0.5	1	2	3	2	3	1	1	2	0	0	1	2	2	2
Student 3	0	0	0	2	1	2	0	1	0.5	2	1	1	0.5	0	2	0
Student 4	1	1	1	0	2	2	3	1.5	0	2	0	0	0.5	1	2	2
Student 5	0	0	0	2	0	1	2	1	0	2	1	0	0	0	1	0
Student 6	1	1	1	2	1	2	3	0	0	2	2	1	0	2	2	2
Student 7	1	1	1	2	1	2	3	1	1	2	0	1	1	2	2	2
Student 8	0	0	1	2	2	2	3	2	1	2	0	0.5	0	2	1	2
Student 9	0	0	1	0	2	2	3	0	0	1	0	1	0	2	1	1
Total:	4	4.5	7	14	12	17	21	8.5	3.5	17	4	5.5	3	11	14	12
tot. % qst.	4	4.5	7	7	4	8.5	7	4.25	3.5	8.5	2	5.5	3	5.5	7	6
I	51.75	II	17.5	III	0	IV	7									
tot. Pre:																
I	23.5	II	0	III	5.5	IV	0									
Period 3 Rotation 1																
Student 10	0	0	0	2	0	2	0	1	0.5	2	0	0	0	1	1.5	0
Student 11	1	1	1	2	1	2	3	2	0	2	0	1	1	2	2	2
Student 12	0	0.5	1	2	3	2	2	0	0	2	1	1	0.5	0	2	1.5
Student 13	0	0.5	1	2	0	2	0	0	0	0	1	0	0	0	2	0
Student 14	0	1	1	2	2	2	3	1	0	2	2	1	0.5	2	1	2
Student 15	0	0	1	2	3	2	3	1	0	2	2	0	0.5	1	2	2
Total:	1	3	5	12	9	12	11	5	0.5	10	6	3	2.5	6	10.5	7.5
tot. % qst.	1	3	5	6	3	6	3.6667	2.5	0.5	5	3	3	2.5	3	5.25	3.75
I	31.75	II	10.5	III	0	IV	5.25									
tot. Pre:																
I	16.33333	II	0	III	3	IV	0									

Period 7 Rotation 1

Student 16	1	0	1	2	1	2	3	1	0	2	0	0	0	2	2	2
Student 17	1	0.5	1	2	1	2	3	0	1	2	1	0	0	2	2	2
Student 18	1	0	0	2	1	2	1	1	1	2	0	1	0	0	2	0
Student 19	0	0.5	1	2	1	2	0	1	0	2	1	1	0	0	2	0
Student 20	0	0	1	2	1	2	2	2	0	2	2	1	0.5	0	2	0
Total:	3	1	4	10	5	10	9	5	2	10	4	3	0.5	4	10	4
tot. % qst.	3	1	4	5	1.6667	5	3	2.5	2	5	2	3	0.5	2	5	2
I	29.16667	II	6.5	III	0	IV	5									
tot. Pre:																
I	9	II	0	III	2	IV	0									

Period 8 Rotation 1

Student 21	1	1	1	2	2	2	3	2	1	2	1	1	0.5	2	1	2
Student 22	0	0	1	2	1	1	0	1	0	2	2	1	1	0	2	2
Student 23	0	0	0	2	1	2	0	1	0	2	0	0	0	2	2	0
Student 24	1	0	1	2	1	2	3	1	1	2	0	1	0	2	2	2
Student 25	1	1	1	2	3	2	2	1.5	0	2	1	1	0	0	2	0
Student 26	1	1	1	2	1	2	3	2	0	2	0	1	0	2	2	2
Student 27	0	1	0	2	1	2	3	0	0	1	0	0	0	0	0	0
Student 28	1	0	1	2	1	2	2	2	0	2	0	1	0.5	1	0	1
Total:	4	3	4	10	7	10	13	6.5	1	9	1	4	0.5	5	6	5
tot. % qst.	4	3	4	5	2.3333	5	4.3333	3.25	1	4.5	0.5	4	0.5	2.5	3	2.5
I	34.91667	II	6	III	0	IV	3									
tot. Pre:																
I	13.33333	II	0	III	2.5	IV	0									

Period 2 Rotation 2

name																
Student 30	1	0	1	2	3	2	3	2	1	2	0	1	0.5	2	2	0
Student 31	1	0.5	1	2	3	2	1	2	1	2	1	0	0.5	0	1	1
Student 32	1	0	1	2	3	2	3	2	0	1	2	0.5	0.5	1	2	2
Student 33	1	0.5	1	2	3	2	2	1	0	1	1	0	0.5	2	2	2
Student 34	1	0.5	1	2	3	2	0	2	0	2	2	1	0.5	0	1	2
Student 35	1	0	1	0	0	2	2	2	0	0	1	0	0	1	2	2
Total:	6	1.5	6	10	15	12	11	11	2	8	7	2.5	2.5	6	10	9
tot. % qst.	6	1.5	6	5	5	6	3.6667	5.5	2	4	3.5	2.5	2.5	3	5	4.5
I	42	II	11.5	III	0	IV	5									
tot. Pre:																
I	11.16667	II	0	III	3	IV	0									

Period 3 Rotation 2

Student 36	1	1	1	2	3	2	3	2	1	2	2	1	0.5	1	2	2
Student 37	1	1	1	2	2	2	2	0	1	2	2	1	0.5	2	2	2
Student 38	0	1	1	2	3	2	3	1	1	2	1	1	0.5	2	2	2
Student 39	0	0	0	2	0	2	0	1	0	2	0	0	0	1	0	0
Student 39	0	0	1	2	1	2	0	1	0	2	0	0	0	1	0	0
Total:	2	3	4	10	9	10	8	5	3	10	5	3	1.5	7	6	6
tot. % qst.	2	3	4	5	3	5	2.6667	2.5	3	5	2.5	3	1.5	3.5	3	3
I	34.5	II	11	III	0	IV	3									
tot. Pre:																
I	11.66667	II	0	III	3.5	IV	0									

Period 7 Rotation 2

Student 4(	0	1	1	2	2	2	2	1	0	2	2	0	0.5	2	2	0
Student 41	0	0	1	2	1	2	3	2	0	2	1	0	0.5	0	1	1
Student 42	1	1	1	2	3	2	3	2	0	2	2	1	0.5	1	2	2
Total:	1	2	3	6	6	6	8	5	0	6	5	1	1.5	3	5	3
tot. % qst.	1	2	3	3	2	3	2.6667	2.5	0	3	2.5	1	1.5	1.5	2.5	1.5
I	36	II	7	III	0	IV	2.5									
tot. Pre:																
I	8.666667	II	0	III	1.5	IV	0									

Period 8 Rotation 2

Student 43	0	0	1	2	1	1	1	0	0	0	2	0	0.5	0	1	0
Student 44	0	0	1	2	1	2	1	0	0	1	0	0	0.5	0	1	0
Student 45	0	0	1	2	1	2	1	0	0	0	0	0	0	0	1	0
Student 46	0	1	0	2	1	2	1	1	0	2	1	0	0.5	1	2	2
Student 47	0	0	1	2	2	2	3	0	0	0	0	0	0	0	2	0
Student 48	0	0	1	2	1	2	0	0	0	1	0	0	0	1	1	0
Student 49	1	1	1	0	2	2	3	0	1	2	0	0	0.5	1	2	2
Student 5(	0	1	1	0	2	2	2	0	1	2	1	1	0.5	2	2	0
Total:	1	3	7	12	11	15	12	1	2	8	4	1	2.5	5	12	4
tot. % qst.	1	3	7	6	3.6667	7.5	4	0.5	2	4	2	1	2.5	2.5	6	2
I	31.66667	II	10.5	III	0	IV	6									
tot. Pre:																
I	17	II	0	III	2.5	IV	0									

New Questions:

# people:	28	32		50	26	24						
Levels	Rotation I	Rotation II	Topic I	Topic II	Asima	Kirk	males	females	two thre(	male gr.	female	mixed gr.
I	147.5833	144.1667		291.75	160	131.75						
II	40.5	40		80.5	50.5	30						
III	0	0		0	0	0						
IV	20.25	16.5		36.75	20.25	16.5						

# quest	I:			II:		III:		IV:						
		10			4		0		1					
# people:		28	32		50	26	24							
Blooms Le	Rotation I		Rotation II	Topic I	Topic II	Asima	Kirk	males	females	two thre	male gr.	female	mixed gr.	
I		53	45		58	62	55							
II		36	31		40	49	31							
III		0	0		0	0	0							
IV		72	52		74	78	69							

Pre-eval:	I:			II:		III:		IV:						
		4			0		1		0					
# people:		28	32		50	26	24							
Levels	Rot I		Rot II	Topic I	Topic II	Asima	Kirk	males	females	two thre	male gr.	female	mixed gr.	
I		62.16667	48.5		110.67	62.667	48							
III		13	10.5		23.5	15	8.5							

Pre-eval:	I:			II:		III:		IV:						
		4			0		1		0					
# people:		28	32		50	26	24							
Levels	Rot I		Rot II	Topic I	Topic II	Asima	Kirk	males	females	two	three	male gr.	female	mixed gr.
I		56	38	50	55	60	50							
III		46	33	0	47	58	35							

out of 1	out of 3	out of 1	out of 1
17	18	19	20
0	0	1	1
0	3	0	1
0	0	1	0
0	3	1	1
0	3	0	1
0	0	1	1
0	3	1	0
0	3	1	1
0	0	0	1
0	15	6	7
0	5	6	7
1	2	0	0
0	3	1	0
0	3	0	1
0	3	0	1
1	3	1	0
0	0	0	0
2	14	2	2
2	4.6667	2	2

0	3	1	1
0	0	0	0
0	0	1	0
0	0	0	0
0	0	1	0
0	3	3	1
0	1	3	1

1	3	1	1
0	0	1	1
0	0	1	1
0	0	1	0
0	3	0	0
0	0	1	1
0	0	0	0
0	3	1	0
0	6	3	1
0	2	3	1

0	0	0	1
0	0	0	1
0	0	1	0
0	0	1	0
1	0	0	1
0	0	1	0
1	0	3	3
1	0	3	3

1	3	1	1
1	3	1	1
0	0	0	0
0	0	1	1
0	0	1	1
2	6	4	4
2	2	4	4

0	0	1	0
0	0	1	1
0	3	1	1
0	3	3	2
0	1	3	2

0	0	1	1
0	0	0	1
0	0	0	1
0	3	0	0
0	0	1	1
0	0	1	0
0	3	1	1
0	3	1	0
0	9	5	5
0	3	5	5

New Questions According to Gender

Data for Charts:

- Mean New Question Grades According to Gender

Females	Males								
		females	males					median(f)	median(m)
29	56	53	58	p	s(f)	s(m)		54	56
20	43	mean	mean	0.217258	25.08562	28.80947			
50	48	**New Questions**							
32	20				n(f)	n(m)			
34	64					62	38		
16	18								
76	9								
4	39				SE	df	t*	estimator	
70	38				5.656107	70.18464	0.480132		-5
29	77						where α=0.1		
21	63				Now,				
43	26				Confidence interval =			-5 plus or minus	2.71568
4	81								
15	88								
39	33		t	Table indicates that 0.2>p>0.1, which is close to E3,					
32	21				-0.884		calculated directly from data.		
40	47								
9	16								
36	57								
54	98								
51	91								
61	94								
63	62								
46	104								
52	87								
33	52								
75	77								
9	121								
22	73								
63	18								
48	50								
67	103								
54	86								
76	60								
58	36								
96	56								
54	41								
111	33								
77									
84									
58									
57									
77									
75									
58									
88									
94									
88									
37									
81									

80
69
86
73
37
41
60
90
44
33
60
52

Pre-evaluation Improvement According to Gender

Data for charts:

- Mean Pre-evaluation II According to Gender

Females	Males							
		females	males				median(f)	median(m)
55	68	51	61	p	s(f)	s(m)	55	64
55	64	mean	mean	0.018821	25.59079	23.21991		
59	41	**Improvement (Pre-eval II)**						
27	32				n(f)	n(m)		
64	68				62	38		
9	50							
64	14							
41	64				SE	df	t*	estimator
68	68				4.975063	84.26787	0.480121	-10
50	66						where α=0.1	
23	77				Now,			
66	68				Confidence interval =		-10 plus or minus	2.38863
23	86							
64	77							
50	82				t	Table indicates that 0.025>p>0.01, which is close to E3,		
41	55				-2.01002	calculated directly from data.		
75	50							
55	41							
59	77							
86	95							
77	100							
82	60							
82	60							
41	100							
68	65							
77	45							
59	65							
23	100							
45	60							
68	25							
64	30							
30	90							
0	90							
70	60							
50	20							
70	60							
30	40							
100	20							
50								
90								
10								
15								
30								
10								
20								
60								
70								
70								
40								
70								

50
55
15
70
10
20
40
90
10
10
90
90

Survey Results According to all the Variables

Data for Charts:

- Preference of Teaching Methods According to Rotation
- Preference of Teaching Methods According to Gender
- Preference of Teaching Methods According to Topic
- Preference of Teaching Methods According to Group Size
- Preference of Teaching Methods According to Instructor
- Preference of Teaching Methods According to Group Type

			Gender:		Topics:		Group Num.:				Groups:		
Q#1	Rotation 1	Rotation 2	females	males	Topic I	Topic II	two	three	Asima's Classes	Kirk's Classes	males	females	mixed
a	12	12	11	13	16	8	13	11	7	17	5	10	9
b	12	17	20	9	12	17	12	22	20	9	1	12	16
c	32	15	31	16	22	25	20	22	25	22	4	22	21

			Gender:		Topics:		Group Num.:				Groups:		
Q#1	Rotation 1	Rotation 2	females	males	Topic I	Topic II	two	three	Asima's Classes	Kirk's Classes	males	females	mixed
a	21	27	18	34	32	16	29	20	13	35	50	23	20
b	21	39	32	23.68	24	34	27	40	38	19	10	27	35
c	57	34	50	42.11	44	50	44	40	48	46	40	50	46

Pre-evaluation Improvement According to all the Variables

Data for Charts:

- Improvement on Pre-evaluation According to A,B,C Science Averages
- Improvement on Pre-evaluation According to A,A- Science Averages

Pre-eval diff	Asima's Classes	Kirk's Classes	Asima's Classes Topic I	Asima's Classes Topic II	Kirk's Classes Topic I	Kirk's Classes Topic II	Topic I	Topic II	Gender: females	Gender: males	Rotations: Rot 1	Rotations: Rot 2	100-95
100...95	0	0	0	0	0	0	0	0	0	0	0	0	0
94...90	1	0	0	1	0	0	0	1	1	0	1	0	1
89...85	0	1	0	0	0	1	0	1	0	1	1	0	0
84...80	1	2	0	1	0	2	0	3	2	1	1	2	0
79...75	0	0	0	0	0	0	0	0	0	0	0	0	0
74...70	0	1	0	0	0	1	0	1	1	0	1	0	0
69...65	1	0	0	1	0	0	0	1	0	1	1	0	0
64...60	3	1	0	3	0	1	0	4	2	2	3	1	0
59...55	1	1	0	1	1	0	1	1	1	1	0	2	0
54...50	4	2	0	4	0	2	0	6	4	2	5	1	1
49...45	1	1	0	1	0	1	0	2	0	2	2	0	0
44...40	3	1	1	2	0	1	1	3	1	3	1	3	2
39...35	0	0	0	0	0	0	0	0	0	0	0	0	0
34...30	5	5	2	3	1	4	3	7	9	2	7	3	0
29...25	0	0	0	0	0	0	0	0	0	0	0	0	0
24...20	3	6	2	1	2	4	4	5	6	3	3	6	1
19...15	7	8	5	2	7	1	12	3	10	5	8	7	2
14...10	7	5	3	4	3	2	6	6	9	3	6	6	0
9...5	3	4	3	0	3	1	6	1	3	4	0	7	1
0...4	5	5	5	1	2	3	6	4	6	4	7	3	0
(-1)...-5	1	3	1	0	3	0	4	0	3	1	3	1	0
(-6)...-10	1	2	0	1	2	0	2	1	2	1	3	0	0
(-11)...-15	3	0	3	0	0	0	3	0	2	1	2	1	0
(-16)...-20	2	0	2	0	0	0	2	0	0	2	2	0	0
Total:	52	48	27	26	24	24	50	50	62	39	57	43	8

Pre-eval diff	Asima's Classes	Kirk's Classes	Asima's Classes Topic I	Asima's Classes Topic II	Kirk's Classes Topic I	Kirk's Classes Topic II	Topic I	Topic II	Gender: females	Gender: males	Rotations: Rot 1	Rotations: Rot 2	100-95
100...95	0	0	0	0	0	0	0	0	0	0	0	0	0
94...90	2	0	0	4	0	0	0	2	2	0	2	0	13
89...85	0	2	0	0	0	4	0	2	0	3	2	0	0
84...80	2	4	0	4	0	8	0	6	3	3	2	5	0
79...75	0	0	0	0	0	0	0	0	0	0	0	0	0
74...70	0	2	0	0	0	4	0	2	2	0	2	0	0
69...65	2	0	0	4	0	0	0	2	0	3	2	0	0
64...60	6	2	0	12	0	4	0	8	3	5	5	2	0
59...55	2	2	0	4	4	0	2	2	2	3	0	5	0
54...50	8	4	0	15	0	8	0	12	6	5	9	2	13
49...45	2	2	0	4	0	4	0	4	0	5	4	0	0
44...40	6	2	4	8	0	4	2	6	2	8	2	7	25
39...35	0	0	0	0	0	0	0	0	0	0	0	0	0
34...30	10	10	7	12	4	17	6	14	15	5	12	7	0
29...25	0	0	0	0	0	0	0	0	0	0	0	0	0
24...20	6	13	7	4	8	17	8	10	10	8	5	14	13

19...15	13	17		19	8	29	4	24	8	16	13	14	16	25
14...10	13	10		11	15	13	8	12	12	15	8	11	14	0
9...5	6	8		11	0	13	4	12	2	5	10	0	16	13
0...4	10	10		19	4	8	13	12	8	10	10	12	7	0
(-1)...-5	2	6		4	0	13	0	8	0	5	3	5	2	0
(-6)...-10	2	4		0	4	8	0	4	2	3	3	5	0	0
(-11)...-15	6	0		11	0	0	0	6	0	3	3	4	2	0
(-16)...-20	4	0		7	0	0	0	4	0	0	5	4	0	0
Total:	102	98	0	100	102	100	99	100	100	102	103	102	99	102

Pre-eval diff 100-95	94-90	100-90	89-80	79-70
100...90	13	0	0	0	0
89...80	13	17	3	0	0
79...70	0	0	3	0	0
69...60	0	8	9	0	0
59...50	0	8	0	0	0
49...40	0	8	0	0	3
39...30	0	8	3	0	0
29...20	0	0	3	8	3
19...10	13	33	0	4	3
9..0	13	8	9	4	6
0...-10	25	4	3	0	3
(-10)...-20	2	4	9	4	3
Total:	79	98	42	20	21

94-90	89-85	84-80	79-75	74-70
0	0	0	0	0
0	0	0	0	0
1	0	0	0	0
3	0	0	0	0
0	0	0	0	0
0	0	0	1	0
1	0	0	0	0
1	2	0	1	0
0	1	0	1	0
2	1	0	2	0
1	0	0	0	1
1	1	0	0	1
0	0	0	0	0
2	1	2	4	1
0	0	0	0	0
0	4	0	3	0
6	2	0	2	1
2	6	0	2	0
1	0	0	2	1
1	2	1	2	3
0	0	0	1	0
1	0	0	1	0
1	0	0	2	1
0	0	1	0	1
24	20	4	24	10

94-90	89-85	84-80	79-75	74-70
0	0	0	0	0
0	0	0	0	0
4	0	0	0	0
13	0	0	0	0
0	0	0	0	0
0	0	0	4	0
4	0	0	0	0
4	10	0	4	0
0	5	0	4	0
8	5	0	8	0
4	0	0	0	10
4	5	0	0	10
0	0	0	0	0
8	5	50	17	10
0	0	0	0	0
0	20	0	13	0

25	10	0	8	10
8	30	0	8	0
4	0	0	8	10
4	10	25	8	30
0	0	0	4	0
4	0	0	4	0
4	0	0	8	10
0	0	25	0	10
98	100	100	98	100

New Questions According to Rotation

Data for Charts:

- Mean New Questions Score According to Rotation

Rotation 1	Rotation 2
29	77
56	63
20	54
50	51
32	61
34	26
43	81
48	88
20	63
16	46
64	52
18	33
9	33
76	75
4	9
70	21
39	22
29	47
21	16
43	57
38	63
4	48
15	73
39	18
32	80
40	69
9	86
36	50
67	103
98	86
54	73
76	37
58	41
96	60
91	60
94	90
62	44
54	36
104	33
87	56
52	41
111	33
77	60
84	52
77	
58	
57	
77	
121	
75	
58	
88	
94	
88	
37	
81	

Rotation 1	Rotation 2
56	54

New Questions

p	s(R1)	s(R2)
0.368974	29.60158	22.25286

n(R1)	n(R2)
56	44

SE	df	t*	estimator
5.186684	97.83424	0.4801126	2

where α=0.1

Now,

Confidence interval = 2 plus or minus 2.490192

t
0.385603

Table indicates that p>0.2, which is consistent with E3, calculated directly from data. Mean difference is insignificant.

median(R1)	median(R2)
55	53

Pre-evaluation II According to Rotation

Data for Charts:

- Mean Pre-evaluation II According to Rotation

Rotation 1	Rotation 2
55	66
68	77
55	86
59	77
27	82
64	68
64	86
41	77
32	82
9	41
68	68
50	82
14	77
64	59
41	23
68	55
64	45
50	50
23	41
66	77
68	68
23	64
64	60
50	25
41	50
75	55
55	15
59	30
30	90
95	90
0	70
70	10
50	20
70	60
100	40
60	90
60	10
30	20
100	10
65	60
45	40
100	20
50	90
90	90
65	
10	
15	
30	
100	
10	
20	
60	
70	
70	
40	
70	

Rotation 1 Rotation 2 Rotation 1 Rotation 2

Pre-eval II

p	s(R1)	s(R2)	median(R1)	median(R2)
0.259664	24.78699	25.71703	59	60

n(R1)	n(R2)
56	44

SE	df	t*	estimator
5.099252	90.84281	0.4801166	-4

where α=0.1

Now,

Confidence interval = -4 plus or minus 2.448236

t
-0.78443

Table indicates that p>0.2, which is consistent with E3, calculated directly from data. Mean difference is insignificant.

New Questions According to Software/Lecture Cycle

Data for Charts:

- Mean New questions Score According to Software/Lecture Cycle

S/L	L/S
29	77
56	63
20	54
50	51
32	61
34	26
43	81
48	88
20	63
16	46
64	52
18	33
9	33
76	75
4	9
70	21
39	22
29	47
21	16
43	57
38	63
4	48
15	67
39	98
32	54
40	76
9	58
36	96
73	91
18	94
80	62
69	54
86	104
50	87
103	52
86	111
73	77
37	84
41	77
60	58
60	57
90	77
44	121
36	75
33	58
56	88
41	94
33	88
60	37
52	81

Software First 44 Lecture First 65

New Questions

p	s(S/L)	s(L/S)	median(R1)	median(R2)
2.17E-05	23.78411	25.10432	40.5	63

n(S/L)	n(L/S)
50	50

SE	df	t*	estimator
4.890625	97.71538	0.4801126	-21

where α=0.1

Now,

Confidence interval = -21 plus or minus 2.348051

t
-4.29393

Table indicates that 0.001>p, which is consistent with E3, calculated directly from data. Mean difference is highly significant.

Pre-evaluation II According to Software/Lecture Cycle

Data for Charts:

- Mean Pre-evaluation II According to Software/Lecture Cycle

S/L	L/S
55	66
68	77
55	86
59	77
27	82
64	68
64	86
41	77
32	82
9	41
68	68
50	82
14	77
64	59
41	23
68	55
64	45
50	50
23	41
66	77
68	68
23	64
64	30
50	95
41	0
75	70
55	50
59	70
60	100
25	60
50	60
55	30
15	100
30	65
90	45
90	100
70	50
10	90
20	65
60	10
40	15
90	30
10	100
20	10
10	20
60	60
40	70
20	70
90	40
90	70

Software First 49
Lecture First 61

Pre-eval II

p	s(S/L)	s(L/S)	median(R1)	median(R2)
0.012014	23.72079	25.45363	55	65.5

n(S/L)	n(L/S)
50	50

SE	df	t*	estimator
4.920494	97.51683	0.4801126	-12

where α=0.1

Now,

Confidence interval = -12 plus or minus 2.362391

t
-2.43878

Table indicates that 0.01>p>0.005, which is close to E3, calculated directly from data.
Mean difference is highly significant.

New Questions Data

Data for charts:

- Performance on New Questions According to A,A-,B,C Science Averages
- Performance on New Questions According to A,B,C Science Averages
- Performance on Higher than a B on New Questions According to A,B,C Science Averages

new ?	Rotations		Survey Q#1			Survey Q#1 Topic I			Survey Q#1 Topic II			Group Num:		Groups:			Science Averages:							
	Rot 1	Rot 2	a	b	c	a	b	c	a	b	c	Two	Three	male	female	mixed	100-95	94-90	89-85	84-80	79-75	74-70	69-65	64-60
125...121	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0
120...116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115...111	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0
110...106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
105...101	1	1	0	0	2	0	0	0	0	0	2	1	1	1	0	1	1	1	0	0	0	0	0	0
100...95	2	0	0	1	1	0	0	0	0	1	1	2	0	1	1	0	0	1	1	1	0	0	0	0
94...90	3	1	1	1	2	0	0	0	1	1	2	3	1	1	2	1	0	2	0	0	1	0	0	0
89...85	3	3	4	1	1	1	0	0	3	1	1	5	1	1	5	0	1	4	0	0	1	0	0	0
84...80	2	2	1	2	1	1	0	0	0	2	1	3	1	1	1	2	2	1	1	1	0	0	0	0
79...75	6	2	0	4	4	0	2	1	0	2	3	3	5	1	3	4	1	2	3	3	1	0	0	0
74...70	1	3	0	2	2	0	0	1	0	2	1	2	2	0	2	2	1	0	3	3	0	0	0	0
69...65	1	0	0	1	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	0	0	0
64...60	2	7	0	3	6	0	2	3	0	1	3	4	5	0	4	5	0	4	3	3	2	0	0	0
59...55	5	2	2	2	3	0	1	1	2	1	2	4	3	1	3	3	0	1	0	0	3	0	1	2
54...50	4	5	0	3	6	0	3	1	0	0	5	6	3	1	6	2	0	1	4	4	0	3	0	1
49...45	1	3	2	1	1	2	1	1	0	0	0	1	3	0	1	3	0	1	0	0	1	0	0	1
44...40	5	4	3	2	4	2	0	2	1	2	2	3	6	1	3	5	1	2	1	1	2	1	0	1
39...35	3	1	1	0	3	0	0	3	1	0	0	3	1	0	2	2	0	3	0	0	1	0	0	0
34...30	3	4	1	2	4	1	1	3	0	1	1	4	3	0	2	5	0	0	2	2	4	1	0	0
29...25	2	1	2	0	1	1	1	1	0	0	0	3	0	0	2	1	0	0	0	0	1	1	1	0
24...20	3	2	3	0	2	3	0	2	0	0	0	2	3	0	2	3	0	0	0	0	2	1	0	2
19...15	3	2	3	1	1	3	0	1	0	1	0	3	2	0	3	2	0	0	1	1	2	1	0	1
14...10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9...5	2	1	1	1	1	1	1	1	0	0	0	1	2	1	1	1	0	0	0	0	1	2	0	0
0...4	2	0	1	0	1	1	0	1	0	0	0	1	1	0	1	1	0	0	1	1	1	0	0	0
total:	56	44	25	28	47	16	12	22	8	17	25	56	44	10	45	46	8	24	20	20	24	10	2	8

new ?	Rotations		Survey Q#1			Survey Q#1 Topic I			Topic II			Group Num:		Groups:			Science Averages:							
	Rot 1	Rot 2	a	b	c	a	b	c	a	b	c	Two	Three	male	female	mixed	100-95	94-90	89-85	84-80	79-75	74-70	69-65	64-60
125...121	2	0	0	4	0	0	0	0	0	6	0	2	0	0	0	2	0	4	0	0	0	0	0	0
120...116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115...111	2	0	0	0	2	0	0	0	0	0	4	0	2	0	0	2	13	0	0	0	0	0	0	0
110...106	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
105...101	2	2	0	0	4	0	0	0	0	0	8	2	2	10	0	2	13	4	0	0	0	0	0	0
100...95	4	0	0	4	2	0	0	0	0	6	4	4	0	10	2	0	0	4	5	5	0	0	0	0
94...90	5	2	4	4	4	0	0	0	13	6	8	5	2	10	4	2	0	8	0	0	4	0	0	0
89...85	5	7	16	4	2	6	0	0	38	6	4	9	2	10	11	0	13	17	0	0	4	0	0	0
84...80	4	5	4	7	2	6	0	0	0	12	4	5	2	10	2	4	25	4	5	5	0	0	0	0
79...75	11	5	0	14	9	0	17	5	0	12	12	5	11	10	7	9	13	8	15	15	4	0	0	0
74...70	2	7	0	7	4	0	0	5	0	12	4	4	5	0	4	4	13	0	15	15	0	0	0	0
69...65	2	0	0	4	0	0	0	0	0	6	0	2	0	0	2	0	0	0	0	0	4	0	0	0
64...60	4	16	0	11	13	0	17	14	0	6	12	7	11	0	9	11	0	17	15	15	8	0	0	0
59...55	9	5	8	7	6	0	8	5	25	6	8	7	7	10	7	7	0	4	0	0	13	0	50	25
54...50	7	11	0	11	13	0	25	5	0	0	20	11	7	10	13	4	0	4	20	20	0	30	0	13
49...45	2	7	8	4	2	13	8	5	0	0	0	2	7	0	2	7	0	4	0	0	4	0	0	13
44...40	9	9	12	7	9	13	0	9	13	12	8	5	14	10	7	11	13	8	5	5	8	10	0	13
39...35	5	2	4	0	6	0	0	14	13	0	0	5	2	0	4	4	0	13	0	0	4	0	0	0
34...30	5	9	4	7	9	6	8	14	0	6	4	7	7	0	4	11	0	0	10	10	17	10	0	0
29...25	4	2	8	0	2	6	8	5	0	0	0	5	0	0	4	2	0	0	0	0	4	10	50	0
24...20	5	5	12	0	4	19	0	9	0	0	0	4	7	0	4	7	0	0	0	0	8	10	0	25
19...15	5	5	12	4	2	19	0	5	0	6	0	5	5	0	7	4	0	0	5	5	8	10	0	13
14...10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9...5	4	2	4	4	2	6	8	5	0	0	0	2	5	10	2	2	0	0	0	0	4	20	0	0
0...4	4	0	4	0	2	6	0	5	0	0	0	2	2	0	2	2	0	0	5	5	4	0	0	0

	100-9	94-90	89-80	79-70
121-100	26	8	0	0
100-95	0	4	10	0
94-90	0	8	0	4
89-85	13	17	0	4
84-80	25	4	10	0
79-75	13	8	30	4
74-70	13	0	30	0

	100-9	94-90	89-80	79-70
121-100	26	8	0	0
100-90	0	13	5	3
89-80	38	21	5	6
79-70	25	13	20	3

	100-9	89-80	79-70
121-100	13	0	0
100-90	9	5	3
89-80	25	5	6
79-70	13	20	3

New Questions According to Topic

Data for Charts:

- Mean New Questions Score By Topic

Topic One	Topic Two
29	67
56	98
20	54
50	76
32	58
34	96
43	91
48	94
20	62
16	54
64	104
18	87
9	52
76	111
4	77
70	84
39	77
29	58
21	57
43	77
38	121
4	75
15	58
39	88
32	94
40	88
9	37
36	81
77	73
63	18
54	80
51	69
61	86
26	50
81	103
88	86
63	73
46	37
52	41
33	60
33	60
75	90
9	44
21	36
22	33
47	56
16	41
57	33
63	60
48	52

Topic One	Topic Two
40	69

New Questions

p	s(T1)	s(T2)
2.33E-09	21.67101	22.99069

n(T1)	n(T2)
50	50

SE	df	t*
4.468119	97.65953	0.480113

where a=0.1

Now,

Confidence interval = -29 plus or minus 2.1452

t
-6.49043

Table indicates that 0.001>p, which is close to E3, calculated directly from data. Mean difference is highly significant.

median(A)	median(K)
39	71

estimator
-29

Pre-evaluation II According to Topic

Data for Charts:

- Pre-evaluation II According to Topic

Topic One	Topic Two
55	30
68	95
55	0
59	70
27	50
64	70
64	100
41	60
32	60
9	30
68	100
50	65
14	45
64	100
41	50
68	90
64	65
50	10
23	15
66	30
68	100
23	10
64	20
50	60
41	70
75	70
55	40
59	70
66	60
77	25
86	50
77	55
82	15
68	30
86	90
77	90
82	70
41	10
68	20
82	60
77	40
59	90
23	10
55	20
45	10
50	60
41	40
77	20
68	90
64	90

Topic One	Topic Two
57	52

Pre-eval II

p	s(T1)	s(T2)
0.163272	19.15113	29.93599

n(T1)	n(T2)
50	50

SE	df	t*
5.025791	83.35362	0.480121

t
0.994868

median(A)	median(K)
64	57.5

estimator 5

where a=0.1

Now,

Confidence interval = 5 plus or minus 2.412989

Table indicates that 0.2>p>0.1, which is consistent with E3, calculated directly from data.

Mean New Questions Score By Group Size

Data for Charts:

- Mean Grades (New Questions) According to Group Size

Two	Three
43	48
56	20
34	32
50	76
29	64
20	4
16	18
70	9
40	39
39	43
36	29
32	21
61	4
51	38
26	9
81	15
88	77
75	54
33	63
9	52
63	63
48	46
16	33
67	57
98	47
54	21
76	22
96	58
91	94
54	62
84	104
88	87
94	52
88	111
81	77

Groups of 2	Groups of 3
60	51

Mean Score (New Quest) By Group Size

p	s(2)	s(3)
0.048392	25.45797	27.14897

median(2)	median(3)
58	52

n(A)	n(K)
46	54

SE	df	t*	estimator
5.266754	97.07117	0.480113	9

where a=0.1

Now,

Confidence interval =	9	plus or minus	2.528635

t
1.708833

Table indicates that 0.05>p>0.025, which is consistent with E3, calculated directly from data.

The mean difference is significant.

69	77
86	58
50	57
103	77
86	121
60	75
90	58
44	37
41	73
80	18
52	80
	73
	37
	41
	60
	36
	33
	56
	33

Mean Pre-evaluation Improvement According to Group Size

Data for Charts:

- Mean Pre-evaluation Improvement According to Group Size

Two	Three
19	-18
13	-4
14	-14
0	19
32	4
19	0
-14	0
18	-18
20	-9
14	2
32	-5
0	-4
9	-9
22	18
18	19
9	14
-14	30
18	22
32	41
-4	18
18	14
19	5
5	22
30	59
65	9
-10	19
10	9
60	50
50	30
30	60
50	80
50	50
70	45
40	90
60	20

Mean Pre-evaluation Improvement According to Group Size

Groups of 2	Groups of 3	p	s(2)	s(3)	median(2)	median(3)
24	22	0.2879023	22.56847	25.45236	19	18

n(A)	n(K)
46	54

SE	df	t*	estimator
4.803044	97.8298	0.480113	2

where a=0.1

Now,

Confidence interval =	2	plus or minus	2.306002

t
0.416403

Table indicates that p>0.2, which is close to E3, calculated directly from data.

10	45
15	0
0	15
40	30
40	85
20	10
80	20
0	30
20	60
60	15
30	50
	55
	10
	10
	30
	5
	0
	20
	10

Mean New Questions According to Group Type

Data for Charts:

Mean Grades (New Questions) According to Group Type

Boys	Girls	Mixed
43	34	48
56	50	20
9	29	32
81	20	76
88	4	64
98	18	70
91	16	39
52	29	43
103	21	4
86	40	38
	39	77
	36	54
	32	63
	9	26
	15	46
	61	33
	51	33
	52	9
	63	57
	75	16
	63	47
	48	21
	67	22
	54	58
	76	94
	96	62
	54	104
	58	87
	57	111
	58	77
	88	84
	94	77
	88	77
	37	121
	81	75
	69	73
	86	18
	73	80
	41	50
	90	37
	80	60
	52	60
		44
		36
		33
		56
		40
		33

Boys	Girls	Mixed
71	52	54

Mean Score (New Quest.) According to Group Type

p-value (boys>girls)
0.049083

p-value (boys>mixed)
0.061691

p-value (mixed>girls)
0.400762

There is a significant difference between the performance of boys' groups and of the other groups.

Mean Pre-evaluation Improvement According to Group Type

Data for Charts:

Mean Pre-evaluation Improvement According to Group Type

Boys	Girls	Mixed
19	14	-18
13	0	-4
-18	32	-14
9	19	19
-14	0	4
65	0	18
50	-14	-9
45	-5	2
40	-4	-9
40	20	18
	14	30
	32	22
	0	41
	19	18
	14	5
	9	32
	22	22
	18	-4
	14	59
	18	5
	18	9
	19	19
	30	9
	-10	50
	10	30
	60	60
	30	80
	0	50
	15	90
	20	20
	50	50
	70	45
	40	30
	30	85
	60	10
	10	60
	15	15
	55	50
	10	0
	80	10
	60	20
	30	30
		0
		5
		0
		20
		20
		10

Boys	Girls	Mixed
25	22	23

Mean Improvement (pre-eval diff.) According to Group Type

p-value (boys>girls)
0.381272

p-value (boys>mixed)
0.43069

p-value (mixed>girls)
0.404988

None of these mean differences are significant