EFFECTIVENESS OF USING QUICKTIME MOVIES IN AN INTRODUCTORY FOOD SCIENCE AND HUMAN NUTRITION COURSE AS AFFECTED BY LEARNING STYLES

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Abstract

The purpose of this study was to evaluate the effectiveness of using QuickTime movies during lectures in an Introductory Food Science and Human Nutrition Course. The QuickTime movies are embedded in the lecture notes that are accessible through the course web site. Students completed the Gregorc Style Delineator and evaluated three QuickTime movies using a scale from one to ten, one being not effective and ten being extremely effective in helping to understand the course material. There were no significant differences between class demographics and QuickTime movie ratings or between dominant learning styles and QuickTime movie ratings. However, there were significant differences between the mean ratings for the three QuickTime movies. The overall mean ratings for the QuickTime movies for all students were favorable with means ranging from 5.9 to 7.6. QuickTime movies were found to be an effective teaching tool for all students regardless of learning style.

Introduction

Studies have shown that students exhibit preferences towards a particular learning style (Gregorc, 1979a. 1979b, 1979c, 1984a; Gregorc and Butler, 1984; Gregorc and Ward, 1977; O'Brien, 1991). As defined by Gregorc (1979c, p234), "Learning style consists of distinctive behaviors which serve as indicators of how a person learns from and adapts to his environment. It also gives clues as to how a person's mind operates." Learning styles can be inherited and acquired from experience (Gregorc, 1979c). Some students learn best in traditional lecture environments. Other students consider an optimal learning environment one in which learning is achieved through the use of class activities. It is important for both students and instructors to recognize that differences in learning style exist in the classroom. Recognition of learning style diversity will lead to the use of more effective and varied teaching strategies and increased levels of comprehension (Gregorc 1979a, 1979b, 1979c, 1984a; Gregorc and Butler, 1984; Gregorc and Ward, 1977).

Several assessment tools have been proposed for measuring learning styles, including the Myers-Briggs Type Indicator, the Knolb Learning Style Inventory, the Canfield Learning Styles Inventory, and the Gregorc Style Delineator™ (Dunn et al. 1981; Kaplan and Kies, 1993; Sewall, 1986). The Gregorc Style Delineator will be used in this study because it is a self assessment test complete with directions for an individual to follow and can be administered within fifteen minutes.

The Gregorc Style Delineator is based on the Mediation Ability Theory. The Mediation Ability Theory explains that information is received most efficiently and effectively in the human mind through certain channels. Mediation ability or style is defined as the potential for an individual to use the most efficient and effective channels to receive information. The two mediation abilities that are evaluated with the Gregorc Style Delineator are perception and ordering. Perception refers to concreteness or abstractness and explains how an individual processes information. Ordering can be sequential or random and explains the way an individual will arrange, systematize, reference, and dispose of information (Gregorc, 1982).

The Gregorc Style Delinator consists of ten sets of four words. The individual is directed to rate each word in a set of four words from one to four, with four being most like the individual and one being least like the individual. Addition of the ratings yields totals in each of four possible learning styles. The four possible combinations of perception and ordering characteristics are Concrete/Sequential (CS), Abstract/Sequential (AS), Abstract/Random (AR), and Concrete/Random (CR). Detailed descriptions of these four Gregorc learning styles is given by Gregorc (1979a, 1979c, 1982), Gregorc and Butler (1984), and Gregorc and Ward (1977).

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Table 1 summarizes some of the teaching strategies used by instructors for teaching students with each of the four dominant learning styles (Gregorc Style Delineator score between 27 and 40). The correlation between teaching strategies and learning style using the Gregorc Style Delineator has been well documented (Dunn et al. 1981; Gregorc, 1984a; Gregorc and Ward, 1977; Kaplan and Kies, 1993; Schmidt and Javenkoski, 2000; Sternberg, 1994). The CS learner prefers concrete explanations using overhead transparencies, drawings, models, hands-on materials, and computer-aided instruction. The CR learner prefers learning through games, simulations, or independent study projects. The AS learner prefers learning through extensive reading assignments followed by lectures. The AR learner prefers short reading assignments followed by class activities (Gregorc and Ward, 1977).

The way in which one learns can be thought of as a continuum from concrete to abstract experiences. Dale (1946) illustrates this continuum of learning using the "Cone of Experience" (Figure 2). The cone is composed of 10 levels, which can be grouped into three types of learning experiences: learning through doing, learning through observing, and learning through symbolizing (Dale, 1946). QuickTime movies are a form of continuous media used to focus the student's attention on particular topics within the lecture. Each QuickTime movie is preceded by a question for students to answer while watching the movie clip. Students are able to visualize a process or concept with QuickTime movies in comparison to using only symbolizing in traditional lecture styles (Javenkoski and Schmidt, 2000). When comparing cognitive learning abilities using a

Learning Style	Teaching Strategies Associated With Each Learning Style
Concrete Sequential (CS)	Prefer learning through concrete explanations using overhead transparencies, drawings, models, hands-on materials, computer-aided instruction. The use of workbooks and lab manuals as well as structured field trips will facilitate this type of learner.
Concrete Random (CR)	Prefer learning through games, simulations, independent study projects, optional reading assignments, problem-solving activities, and brief mini-lectures which precede independent exploration.
Abstract Sequential (AS)	Prefer learning through extensive reading assignments followed by lectures and instructional audio tapes in a well controlled environment.
Abstract Random (AR)	Prefer learning through short reading assignments and class activities. Class activities include group discussions, group work, movies, and assignments, which give the student time to reflect.

Table 1. Preferred teaching strategies associated with the four dominant learning styles (Gregorc and Ward, 1977).

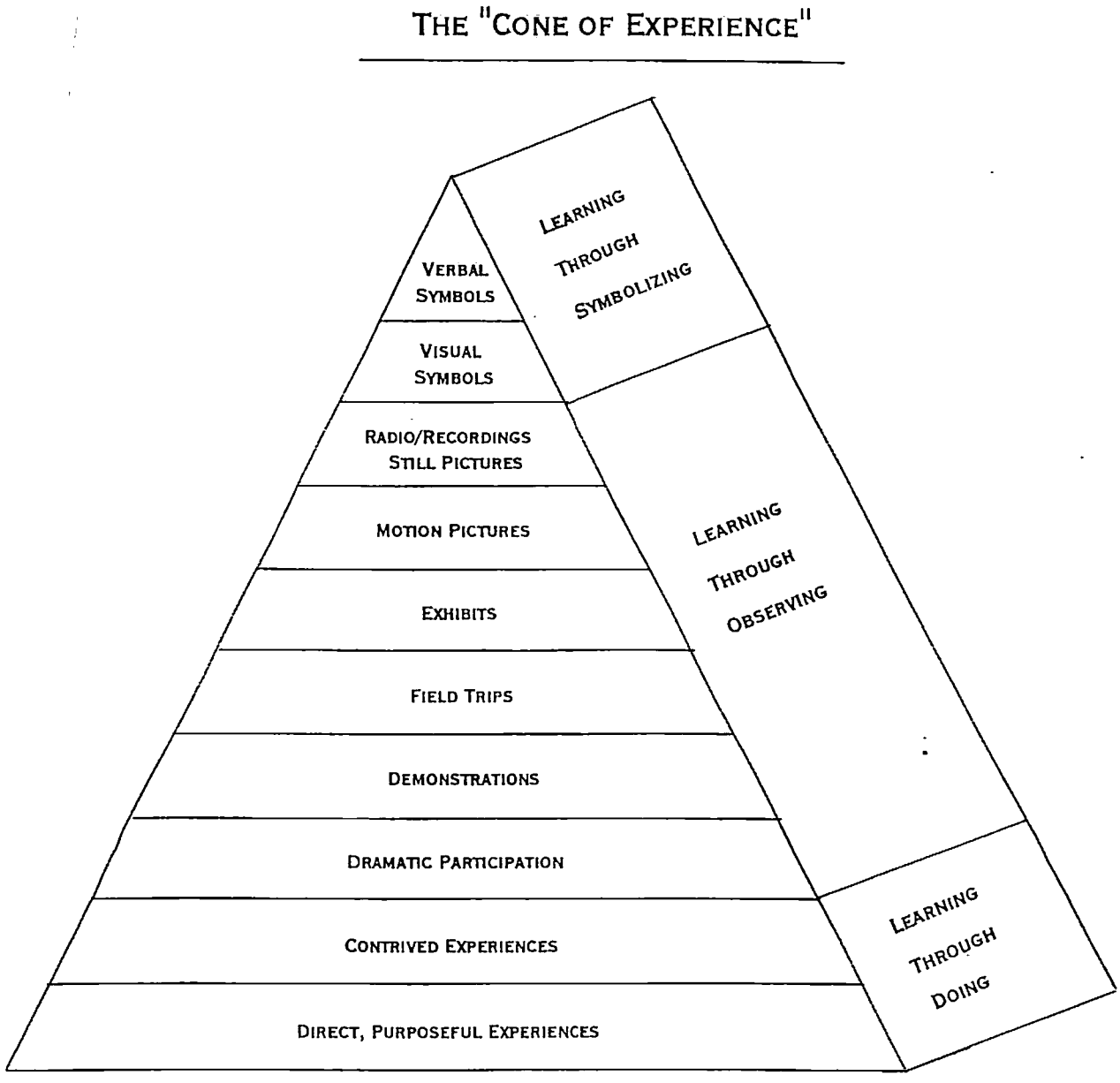

Figure 2. The "Cone of Experience" illustrates the continuum of how an individual learns from concrete (base of cone) to abstract (top of cone) experiences (based on Dale, 1946).

traditional lecturing style versus QuickTime movies, it can be seen that lecturing involves symbolizing while QuickTime movies involve observing.

Three theories which attempt to explain why images or pictures are more likely to be encoded into long term memory in comparison to verbal symbols include the dual-coding theory (Pavio, 1973, 1979, 1986), the propositional theory (Pylyshyn, 1981), and the sensory-semantic theory (Nelson, 1979). The underlying principle behind the dual-coding theory explains that images are more likely to be stored in long term memory because they can be encoded twice in comparison to verbal stimuli which will most likely only be encoded once (Pavio, 1973, 1979, 1986). The propositional theory explains that information from images is converted to propositions or phrases. The propositions or phrases can then be encoded into long term memory (Pylyshyn, 1981). In the sensory-sematic model pictoral stimuli are more likely to be stored in long-term memory because of the relative order of access for pictorial and verbal stimuli. Pictorial stimuli are directly encoded for meaning features while verbal stimuli may be encoded for phonemic features before being encoded for meaning features (Nelson, 1979).

Visual images supporting a traditional lecture increased recall of elementary students for both abstract and concrete information (Hannafin, 1983). The images provided redundancy, a second way of processing the information, and a second cue available to encode and recall the information.

Bunderson et al. (1984) conducted a study with three separate college biology classes. Each class was divided into two groups. One group of students learned the material though videodiscs while another group learned the material through traditional lectures. Videos were projected onto a computer screen using a videodisc player connected to a computer. The videodisc group performed significantly better than the lecture group with an alpha of 0.05 on the post experiment test. Integration with long-term memory stores, aesthetic and social factors of imagery, receiving information in multiple forms, and observation of a skilled performer are some of the reasons Bunderson et al. (1984) gave to explain why the videodisc group out performed the traditional lecture group.

Objectives

The purpose of this study was to evaluate the effectiveness of using QuickTime movies during lectures in an Introductory Food Science and Human Nutrition Course. Students completed the Gregorc Style Delineator and evaluated three QuickTime movies using a scale from one to ten, one being not effective and ten being extremely effective in understanding the material. Statistical comparisons were conducted between: 1) Class demographics and QuickTime movie ratings, 2) Dominant learning styles and QuickTime movie ratings, and 3) Ratings between the three QuickTime movies.

Methods

This study was conducted at the University of Illinois at Urbana-Champaign, Illinois. Students enrolled in the Spring 2000 semester of Introduction to Food Science and Human Nutrition 101 participated in this study. The Gregorc Style Delineator (Gregorc, 1984b) was distributed during class (March 3, 2000) to determine each student's learning style profile. Students were given approximately 15 minutes to complete the test. A score between 27 and 40 in any category indicates a dominant learning preference. A score between 16 and 26 indicates an intermediate learning preference. A score between 10 and 15 indicates a weak learning preference.

QuickTime movies (complete with audio and visual animation) are used in this class to reinforce major concepts presented in the lecture. Concepts are first explained through a traditional lecturing style with an overhead projector and transparencies outlining the course material. The QuickTime movies are projected to the class using an overhead projector screen with a multimedia set-up including a computer with internet access to the course web site (Web CT) in which all the information for the class is organized including the syllabus, assignments, lecture outlines, bulletin board, and review files (http://webct.cct.uiuc.edu). The QuickTime movies are imbedded within the lecture outlines. Since the QuickTime movies are http streaming, file sizes were optimized for bandwidth constraints of the University of Illinois campus network. The length of the QuickTime movies (20 seconds to 2 minutes) was also optimized for processor speeds so that movies could be downloaded and shown in a reasonable amount of time both during class and outside of class. All students have unlimited 24 hour access 7 days a week to the course web site. Therefore students have the opportunity to view all QuickTime movies multiple times at their convenience.

The students were asked to rate the effectiveness of the QuickTime movie on a scale from 1 to 10, with 1 being not effective and 10 being extremely effective. Students recorded their ratings on 4.25 inch by 5.50 inch response cards as shown in Figure 3. Students were instructed to turn the card over and explain if the QuickTime movie affected their understanding of the concept presented during lecture or not. The QuickTime movies were evaluated on March 1, 2000; March 20, 2000; and April 7, 2000. The learning style test and the evaluations of the QuickTime movies were completed during class between 11:00 AM and 11:50 AM.

FSHN 101 Daily Microtheme

Spring Semester 2000

Lecture 18: Wednesday, 1 March

Name (please print clearly): _____

Your Signature: _____

Today's Microtheme Topic: Enzymes

Instructions: Construct a response to the assigned topic using a complete paragraph, a list Of your ideas, a concept map, or a calculation. Be certain to print or write clearly so that your response can be easily read by the FSHN 101 instructor and the teaching assistant.

How well did the Enzyme QuickTime movie help with your understanding of enzyme action?

On the scale below please circle your response. 1=not effective 10=extremely effective

1 2 3 4 5 6 7 8 9 10

If so how? If not, why not?

Lecture 22: Monday, 20 March

Today's Microtheme Topic: Nutritional Value of Canned Produce vs. Fresh Produce

How well did the Produce QuickTime movie help with your understanding of the nutritional value difference between canned and fresh produce?

Lecture 29: Friday, 7 April

Today's Microtheme Topic: The Process of Drying Grapes

How well did the Drying QuickTime movie help with your understanding of the chemical and physical changes that take place during the process of drying grapes?

Figure 3. Microtheme questions used to evaluate each QuickTime movie in three classes, Spring Semester, 2000. The top microtheme (Lecture 18) shows the exact form students were given. The bottom two microthemes (Lectures 22 and 29) only illustrate the question that was given to students. Students were given forms identical to the top microtheme (Lecture 18) with a different Microtheme topic and question according to the QuickTime movie being evaluated.

The first QuickTime movie provided by Northern Illinois University embedded within lecture 17 illustrates the action of an enzyme, which is a molecular level process, and is 22 seconds in length. The second QuickTime movie provided by the Steel Packaging Council embedded within lecture 22 explains the nutritional differences between fresh and frozen vegetables in a news story format and is 1 minute 45 seconds in length. The third QuickTime movie provided by Sun-Maid Growers embedded within lecture 30 explains the process of drying grapes and is 1 minute 40 seconds in length. For this study the enzyme QuickTime movie was shown twice while the other two QuickTime movies were shown only once because the enzyme QuickTime movie was so short in length. The three QuickTime movies differ in the type of content that is presented. The QuickTime movie in lecture 17 involves the comprehension of a molecular level scientific principle, the QuickTime movie in lecture 22 is a news story covering an important issue in the field of food science, and the QuickTime movie in lecture 30 explains a process.

The general linear models procedure was used to determine significant differences at the 0.05 level within the data using SAS (Elliott, 1995). Significant differences were further evaluated using Fisher's LSD procedure.

Results and Discussion

Class Demographics vs. QuickTime movie Ratings

Only students who completed both the Gregorc Style Delineator and the evaluations for all three QuickTime movies were used in the study. This reduced the number of subjects from 201 to 122. The Gregorc Style Delineator and the three QuickTime movie evaluations were completed on four separate days. Therefore the number of students was reduced from 201 to 122 because students that missed one of the four days were taken completely removed from the study. The average attendance for each lecture during the semester was 178 students (88.6%). Class demographics were collected on the Gregorc Style Delineator form and are summarized in Figure 4.

The statistical results comparing class demographics to the ratings for each QuickTime movie are summarized in Table 2. There were no statistically significant differences within this data, however a trend seems to exist with non-science majors rating QuickTime movies higher than science majors. This is consistent with comments written by students. Some science majors indicated that they had already learned the concept in another class, so the QuickTime movie was of little value to them. While some non-science majors indicated that the visual explanation offered by the QuickTime movie helped them better understand the process or concept than only the explanation given in lecture. In addition some of the non-science majors also remarked that they would subsequently be able to recall the concept more easily on an exam because of viewing the QuickTime movie.

Dominant Learning Styles vs. QuickTime movie Ratings

Of the 122 participants, 53 had a single dominant learningstyles (score between 27 and 40). The dominant learning style data and the demographics for this population are summarized in Figure 5. The demographics for the dominant learning styles group are similar to the overall class demographics (Figure 4). Therefore the subset of students which have dominant learning styles is representative of the entire FSHN 101 class.

There were no statistically significant differences between learning style and QuickTime movie ratings (Table 3). Abstract sequential (AS) learners gave the first QuickTime movie the highest ratings (mean of 7.2 ± 1.72) while concrete random (CR) learners gave the first QuickTime movie the lowest ratings (mean of 4.8 ± 2.17). Abstract sequential (AS) learners also gave the second QuickTime movie the highest ratings (mean of 8.3 ± 0.82) while concrete sequential (CS) learners gave the QuickTime movie the lowest ratings (mean of 7.3 ± 1.65). Abstract random (AR) learners gave the third QuickTime movie the highest rating (mean of 7.4 ± 2.50) and concrete random (CR) learners gave the QuickTime movie the lowest ratings (mean of 5.2 ± 2.39). These results are not statistically significant, however there is a slight tendency for abstract learners to rate the QuickTime movies higher in comparison to concrete learners.

Comparison of Overall QuickTime movie Ratings

Table 4 summarizes the mean values and standard deviations for the three QuickTime movies (N=122). The ratings for the three QuickTime movies were statistically significantly different with a p-value of 0.0001. The second QuickTime movie was rated the highest (7.6 ± 1.60), the third QuickTime movie had the next highest mean value (6.9 ± 2.18), and the first QuickTime movie was given the lowest ratings (5.9 ± 2.15).

The first QuickTime movie illustrated the catalytic conversion of a substrate to a product using enzyme technology. The conversion was illustrated at the molecular level. Students that indicated that this QuickTime movie was effective commented that the QuickTime movie was simple and to the point, which made it easy to understand. Students that indicated that this QuickTime movie was not effective commented that the QuickTime movie was too short and did not give enough details explaining how or why certain actions took place within the QuickTime movie. These negative comments may actually indicate that this

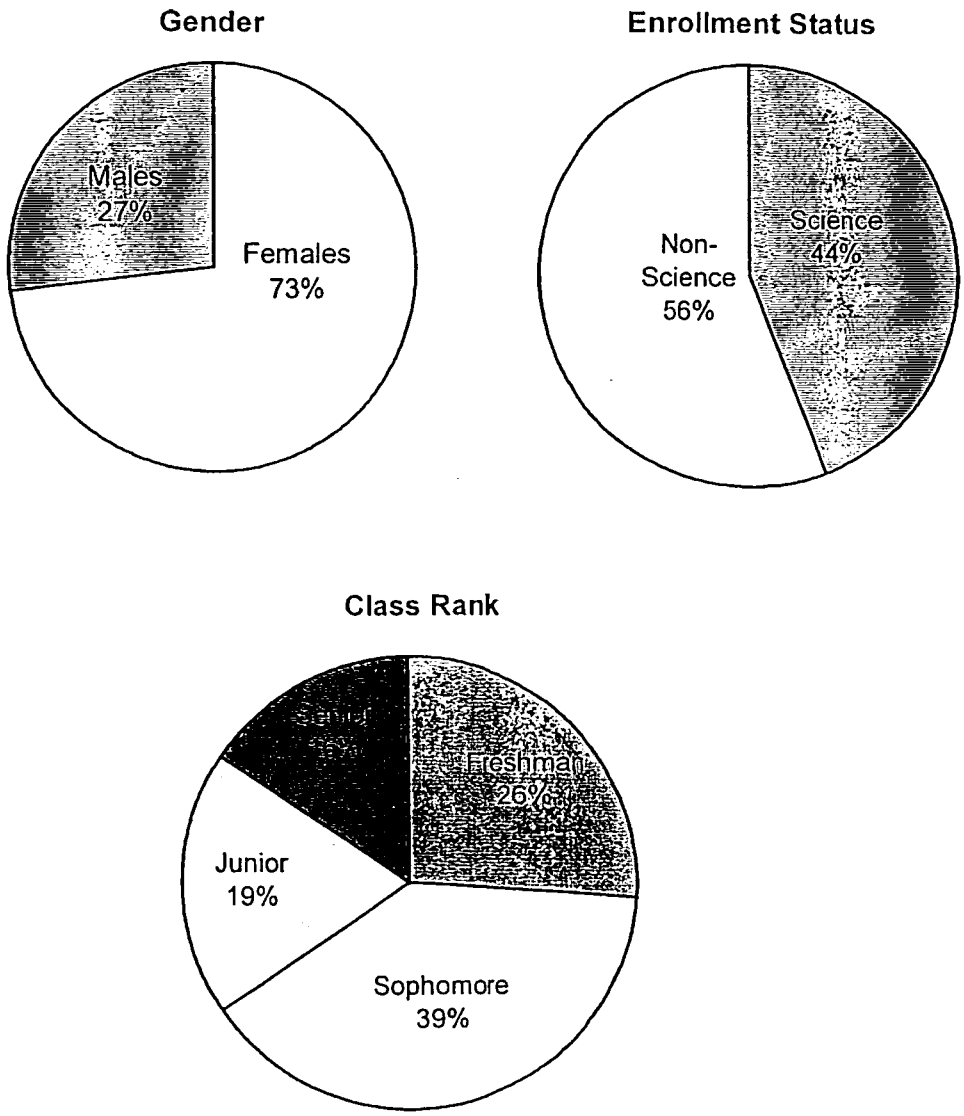

Figure 4. Class demographics for students in FSHN 101 in the Spring 2000 semester who completed the Gregorc Style Delineator and all three QuickTime movie evaluations (N=122).

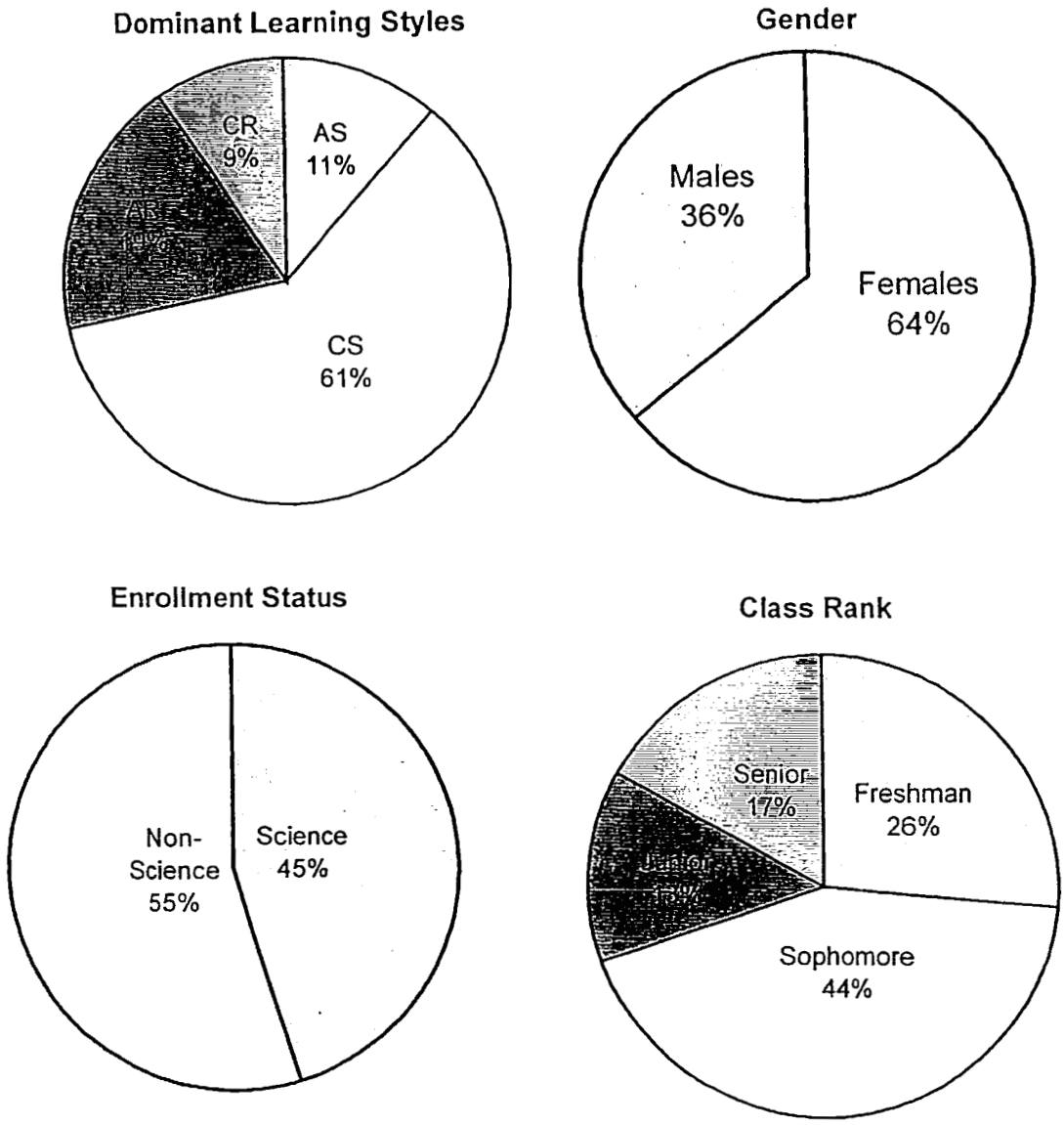

Figure 5. Class demographics for dominant learning styles in FSHN 101 in the Spring 2000 semester (N=53). Dominant learning style is defined as having a score between 27 and 40 in one of the Gregorc learning styles.

QuickTime movie caused some students to take the material another step deeper, questioning how and why the enzyme-substrate complex decomposes to the enzyme and product.

The second QuickTime movie was in a news story format and explained the nutritional differences between fresh and frozen vegetables. Students commented that they liked the format of this QuickTime movie because it was easy to understand. Negative comments were similar to the first QuickTime movie in that students thought there should be more scientific details regarding the differences between fresh and processed fruits and vegetables.

The third QuickTime movie illustrated the process of drying grapes into raisins. The ratings for this QuickTime movie fell in between the first and second. Some students indicated that the QuickTime movie was clear and they were able to visualize a process that they had never seen before, while others indicated that they would like further explanation regarding the chemical changes that take place during the process.

The overall mean ratings for the three QuickTime movies for all students were favorable (mean score > 5). The majority of students who rated the QuickTime movies less than 5 commented that the QuickTime movie left them wanting more detailed information about the process or news story that they just viewed. These comments suggest that the QuickTime movies created an inquisitive atmosphere and could be used to generate further class discussions based on students' questions. Overall, we found the QuickTime movies to be an effective teaching tool for all students regardless of learning style.

Table 3. Dominant learning styles and QuickTime movie ratings (N=53), mean ± the standard deviation. (1=not effective and 10=extremely effective)

Learning Style	AS (N=6)	CS (N=32)	AR (N=10)	CR (N=5)	p-value
QuickTime movie 1	7.2 ± 1.72	5.8 ± 2.10	5.8 ± 2.57	4.8 ± 2.17	0.56
QuickTime movie 2	8.3 ± 0.82	7.3 ± 1.65	7.7 ± 2.26	8.0 ± 1.22	0.41
QuickTime movie 3	7.2 ±1.47	6.7 ± 2.07	7.4 ± 2.50	5.2 ± 2.39	0.36

Table 4. Overall QuickTime movie ratings (N=122), mean ± the standard deviation. Significant differences were determined at the 0.05 level by the listed p-values, with mean separation by Fisher's. Means with the same letter are not significantly different. (1=not effective and 10=extremely effective)

Movie	Movie 1	Movie 2	Movie 3	p-value
Mean ± Standard Deviation	5.9 ± 2.15c	7.6 ± 1.60a	6.9 ± 2.18b	0.0001

Table 2. Class demographics and QuickTime movie ratings (N=122), mean ± the standard deviation. (1=not effective and 10=extremely effective)

Gender	Male	Female	p-value
QuickTime movie 1	6.1 ± 2.12	5.9 ± 2.17	0.70
QuickTime movie 2	7.8 ± 1.58	7.5 ± 1.62	0.16
QuickTime movie 3	6.7 ± 2.10	7.0 ± 2.20	0.91

Major	Science	Non-Science	p-value
QuickTime movie 1	5.9 ± 2.34	6.0 ± 2.01	0.57
QuickTime movie 2	7.4 ± 1.51	7.7 ± 1.68	0.45
QuickTime movie 3	6.4 ± 2.31	7.4 ± 1.96	0.08

Year	Freshman	Sophomore	Junior	Senior	p-value
QuickTime movie 1	6.2 ± 1.69	5.7 ± 2.24	6.7 ± 1.92	5.1 ± 2.60	0.18
QuickTime movie 2	8.1 ± 1.24	7.3 ± 1.68	8.0 ± 1.43	6.8 ± 1.83	0.10
QuickTime movie 3	7.7 ± 1.56	6.8 ± 2.04	7.1 ± 2.56	5.9 ± 2.58	0.11

Summary

No significant differences were found between class demographics and QuickTime movie ratings or between dominant learning styles and QuickTime movie ratings. Non-science majors and students with abstract learning styles commented that the QuickTime movies were effective for learning course material. Some of the non-science majors commented that they had never seen or heard of the concept being presented and the QuickTime movies improved their understanding of the course material. These comments suggest that using QuickTime movies can be used as an effective approach to teaching science concepts at the college level, especially for non-science majors. In general, abstract learners rated the QuickTime movies higher in comparison to concrete learners, however the differences were not significant. The overall mean ratings for the three QuickTime movies were significantly different however, all three QuickTime movies for all students were rated favorably with mean ratings of 5.9, 7.6, and 6.9 respectively. All students rated the movies as being above average in helping them to further understand the concepts already lectured about during class. QuickTime movies are short, ranging from 20 seconds to 2 minutes in length, however they provide students with another means of processing information into long-term memory stores and they provide redundancy. Using teaching strategies that incorporate images, such as QuickTime movies, provides students with an effective means of relating course material to information already in long term memory stores. Channeling course material into long term memory stores is what allows students to learn more effectively.

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