The Use of Breakout Groups as an Active Learning Strategy in a Large Undergraduate Nutrition Classroom

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Key words: active learning, breakout group, group-based learning, SoTL, higher education, nutrition

Abstract
This paper describes a study conducted to investigate whether breakout groups can be used effectively to enhance student perception of the learning experience, and which measured whether perceived effectiveness is influenced by variables including gender, year of study, overall GPA, degree major, and course grade. Breakout groups consisted of impromptu, temporary groups of 2-5 students that discussed possible answers to a specific problem set provided by the instructor over a period of 10-15 minutes, followed by a large group discussion facilitated by the instructor. In total, 220 students completed a midterm survey and 229 completed a final survey designed to measure student satisfaction. Results of both surveys revealed that over 85% of students either agreed or strongly agreed that using breakout groups enhanced their learning experience, resulted in a more engaging classroom, and enhanced their understanding of the subject matter and their ability to analyze, synthesize, evaluate and retain the subject material. Females perceived the experience more positively than males. The results of this study suggest that breakout groups can be successfully incorporated into a large undergraduate nutrition classroom despite the constraints of a lecture-only course structure.
Introduction

Active learning is commonly considered any method of instruction that effectively engages students in the learning process. While this could constitute a number of specific methods, the key is that students are active in doing things that require thought and reflection, as opposed to sitting and listening passively.\(^1\) Many in the past have argued that students are actively engaged in their learning by simply listening or taking notes, but research suggests otherwise, and shows that students must write, read, discuss, and engage themselves actively in problem solving if they are to most efficiently learn the material.\(^2\) Techniques that aim to involve students more in the learning process by fostering critical thinking skills and supporting the use of self-directed learning are important constituents of active learning models.\(^3\)

Application of active learning in life science classrooms has shown considerable potential, but most of the studies done in the past traditionally either look at only small classes or specifically at biology majors.\(^4\) More recent studies have been completed in the fields of physics and medical sciences, but very little research has been done, if at all, on the use of active learning techniques in the nutritional sciences.\(^5\) Because of the unique and universal relevance of


nutrition, the teacher of nutritional science has innumerable opportunities to personally engage their class with the material and make it directly relevant to their lives. For example, current events, such as the development of a novel functional food, can be a platform for large group discussions of topics ranging from food marketing to agriculture to clinical trials.

"Active learning" is a broad term that includes a variety of different methods teachers can apply to the classroom. A general breakdown of active learning reveals three inter-related subsets - collaborative learning, cooperative learning, and problem-based learning (PBL) - and examples of specific activities could be class debates, class discussions, or the technique "think-pair-share" that involves students’ discussing thoughts with a partner and then sharing with the class. The use of breakout groups would be an example of PBL as well as cooperative learning. Breakout groups can be defined in a variety of ways but generally involve a smaller group of students discussing one or more problems and generating a response. Sometimes used in studies as a way to garner feedback, breakout groups in this study were used within the classroom as a means for student reflection and discussion with peers.

The use of breakout groups, similar to other active learning techniques, involves dealing with a number of challenges such as class size, learning space, and limited resources. In this study, breakout groups were used in a class of 280 students that was held in an old lecture-hall filled almost to capacity, and only one teaching assistant was available to help facilitate these events. As well, in the absence of formal seminar or tutorial sessions, these temporary breakout groups had to be created and dissipated quickly and on the spot in the classroom, leading to

7 Prince, “Does Active Learning.”
8 Wood, “Innovation in Teaching.”
Potential difficulties with student participation and interaction. The course in question was Functional Foods & Nutraceuticals (FFN) at the University of Guelph, a 4th year undergraduate course that looks at the safety and efficacy of individual FFN products, and the regulatory issues that influence the development and commercialization of FFN in global markets. During the lecture period, the professor presented a question or concept for debate, at which point students were instructed to form small groups (suggested as a minimum of 2 and a maximum of 5 students) to discuss the issue and formulate potential answers. The results of the student discussions as well as instructor feedback were then discussed as a class after the allotted time period. The goal of this study was to determine whether or not the use of spontaneous breakout groups could be an effective teaching tool in a large, undergraduate nutrition classroom held in a poorly designed learning space with minimal TA support and without the addition of scheduled lab or tutorial sessions.

Methods

(i) Subjects

All of the students enrolled in NUTR 4090 in the winter 2011 semester were invited to participate in the study. Out of 280 students, 220 completed the midterm survey and 229 completed the final survey. Of the students who completed the midterm survey, 180 were female and 40 were male, whereas 184 females and 45 males completed the final survey. Approximately 33% of the students who responded to the midterm and final survey were in 3rd year, ~55% were in 4th year, ~10% were in 5th year or higher, and ~1% were graduate students.

(ii) Timetable
The NUTR 4090 course was divided naturally into a first and second half, with each half consisting of 6 weeks. Classes were offered twice per week for 1 hour 20 minutes each, for a total of 12 lectures in each half of the semester. The first half of the semester included a combination of traditional lectures and breakout groups. Guest lecturers led three of the traditional classes not utilizing breakout groups. Breakout groups were administered in classes 3, 5, 8 and 10. The second half of the semester consisted of a series of guest lectures, and there were no breakout group experiences during the latter half of the semester. For continuity with the second half, 3 guest lectures were incorporated into the first half of the semester. Survey access online was opened for two weeks following the completion of the midterm examination (held during the 12th class) and for one week following the completion of the last class lecture.

(iii) Breakout Groups

Students were given instructions to form breakout groups consisting of anywhere from 2 to 5 students, with the suggestion that 3-4 students was optimal. The instructor introduced each breakout group topic and described the questions that should be addressed during the small group discussion. Groups were given approximately 10 minutes of in-class time to generate answers to the assigned questions. Following this, a large group discussion was facilitated by the instructor, and summaries of ideas generated were written down and shown to the class using a document camera. Large group discussions ranged from 10-25 minutes, depending on the level of class participation.

Summaries of the 4 breakout group topics are described below:
Breakout Group #1: Following a lengthy discussion of the regulations of functional foods and nutraceuticals in several countries, students were asked to describe what they perceived as the strengths and weakness of the different regulatory systems.

Breakout Group #2: Students were asked to consider 3 scenarios related to functional foods, and were asked to consider whether they perceived these products as being functional (ie. Beneficial to health) or dysfunctional (ie. Harmful to health), using scientific rationale to justify their opinions.

Breakout Group #3: Following a lengthy discussion of the scientific mechanisms behind several popular FFN products, students were asked to determine where they saw these products in the future of the industry, using the science that they had just learnt to support their ideas.

Breakout Group #4: Students were shown a short news clip describing a popular weight loss supplement that had been pulled off the market due to adverse effects, as well as an abstract from one of the research studies that was used by the company to support their product. In breakout groups, students were asked to analyze the study for strengths and weaknesses and to consider issues related to the safety and efficacy of using natural weight loss products.

(iv) Surveys

Midterm Survey
The midterm survey was administered following the completion of the midterm examination. The survey was offered online and could be accessed directly through the course website. It was accessible for a period of two weeks (since the first week coincided with the reading week vacation). Students were given a 1% bonus mark on the midterm examination as an incentive to complete the survey. The survey questions were as follows:

Likert Scale Questions:

1) I feel that using breakout groups in this class enhanced my understanding of the subject matter.
2) I feel that using breakout groups in this class helped me to analyze, synthesize and evaluate the course subject matter.
3) I feel that the topics of discussion in the breakout groups were interesting.
4) I feel that the topics of discussion in the breakout groups were relevant to the study of functional foods & nutraceuticals.
5) The breakout groups were easy to create.
6) The breakout groups were easy to participate in.
7) The breakout groups enhanced my communication skills.
8) I enjoyed breakout groups and was happy to take time out of lecture to engage in them.
9) Using breakout groups used up too much time for the learning that it accomplished.
10) I would have enjoyed more time spent in breakout groups.
11) I feel that using a combination of breakout groups and lectures results in a more engaging classroom.
12) Overall, I feel that using breakout groups in this class enhanced my learning experience.
End-of-Semester Survey

The end-of-semester survey was administered following the completion of the last class. The survey was offered online and could be accessed directly through the course website. It was accessible for a period of one week. Students were given a 1% bonus mark on the examination as an incentive to complete the survey. The survey questions were as follows:

Likert Scale Questions:

1) I preferred the guest lectures to the classes with breakout groups.

2) I would have enjoyed more classes with guest lectures.

3) I would have enjoyed the classes with guest lectures more if they used breakout groups.

4) I found the course content to be as expected.

5) I found the course difficulty to be as expected.

6) I found the course layout was logical and flowed well.

7) Looking back, I feel the breakout groups used during the first six weeks of class improved my understanding of the course material.

8) Looking back, I feel the breakout groups used during the first six weeks of class allowed me to perform better in this course.

9) I feel that using breakout groups increased my retention of the material learned during the first six weeks of class.

10) Overall, I feel that using breakout groups in this class enhanced my learning experience.

Additional Survey Questions:
The midterm and final survey both contained the same short answer and multiple-choice questions.

What is your gender?

What is your program of study?

What year of study are you currently in? (a) 3 (b) 4  (c) 5 or more (not graduate) (d) graduate

What is your cumulative GPA over your entire university career? (a) < 60 (b) 60-69 (c) 70-79 (d) 80-89 (e) 90-100

How many breakout groups were you present for? (a) 1 (b) 2 (c) 3 (d) 4 (e) none

On average, how many other people were involved in your breakout groups? (a) I was by myself (b) 1 (c) 2 (d) 3 (d) 4

In your opinion, what were the major advantages/disadvantages to using breakout groups?

Do you have any further comments related to the use of breakout groups?

(vi) Statistical Analysis

All statistical analyses were performed using SPSS, version 18.0 for Windows. The non-parametric Mann-Whitney test was used to investigate the effect of gender on overall student satisfaction by analyzing the relationship between student responses to the final survey question on both the midterm and final surveys, which read "Overall, I feel that using breakout groups in this class enhanced my learning experience". The non-parametric Kruskal-Wallis test was similarly used to investigate the effect of gender, year, GPA, degree major, and course grade on
overall student satisfaction. The p value was set at p<0.05.

Results

The results of the Likert scale questions on the midterm and final surveys are shown in Table 1 and 2 respectively. A two-tailed Mann-Whitney test revealed a significant effect of gender on overall student satisfaction on both the midterm (p = 0.047; N = 220) and final survey (p = 0.044; N = 229). Figures 1 and 2 illustrate the student responses displayed by each gender on the midterm (figure 1) and final (figure 2) surveys. Kruskal-Wallis testing revealed non-significant effects of year of study (p = 0.64), degree major (p = 0.08), and course grade (p = 0.43) on student satisfaction as measured by the midterm survey. Similarly, non-significant effects of year of study (p = 0.61), overall GPA (p = 0.24), degree major (p = 0.65), or course grade (p = 0.23) were measured by the final survey. A significant effect of overall GPA (p = 0.031) was observed on the midterm survey, with mean rankings of 138.50 for <60, 123.38 for 60-69, 103.83 for 70-79, 114.34 for 80-89, and 56.00 for 90+.

Table 1: Midterm survey results for the Likert questions (N = 220).

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<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
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<tbody>
<tr>
<td>1. I feel that using breakout groups in this class enhanced my understanding of the subject matter.</td>
<td>0.45%</td>
<td>2.27%</td>
<td>9.09%</td>
<td>58.64%</td>
<td>29.55%</td>
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2. I feel that using breakout groups in this class helped me to analyze, synthesize, and evaluate the course subject material.  

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3. I feel that the topics of discussion in the breakout groups were interesting.  

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4. I feel that the topics of discussion in the breakout groups were relevant to the study of functional foods and nutraceuticals.  

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5. The breakout groups were easy to create.  

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6. The breakout groups were easy to participate in.  

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7. The breakout groups enhanced my communication skills.  

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8. I enjoyed breakout groups and was happy to take time out of lecture to engage in them.  

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9. Breakout groups used up too much time for the learning they accomplished.  

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10. I would have enjoyed more time spent in breakout groups.  

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11. I feel that using a combination of breakout groups and lectures results in a  

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more engaging classroom.

12. Overall, I feel that using breakout groups in this class enhanced my learning experience.  

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I preferred the guest lectures to the classes with breakout groups.</td>
<td>11.84%</td>
<td>34.65%</td>
<td>29.82%</td>
<td>17.11%</td>
<td>6.58%</td>
</tr>
<tr>
<td>2. I would have enjoyed more classes with guest lectures.</td>
<td>10.48%</td>
<td>42.36%</td>
<td>32.75%</td>
<td>12.66%</td>
<td>1.75%</td>
</tr>
<tr>
<td>3. I would have enjoyed the classes with guest lectures more if they used breakout groups.</td>
<td>8.37%</td>
<td>37%</td>
<td>23.35%</td>
<td>25.99%</td>
<td>5.29%</td>
</tr>
<tr>
<td>4. I found the course content to be as expected.</td>
<td>3.54%</td>
<td>12.39%</td>
<td>14.6%</td>
<td>57.96%</td>
<td>11.5%</td>
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<tr>
<td>5. I found the course difficulty to be as expected.</td>
<td>1.75%</td>
<td>13.97%</td>
<td>19.21%</td>
<td>58.08%</td>
<td>6.99%</td>
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<tr>
<td>6. I found the course layout was logical and flowed well.</td>
<td>3.07%</td>
<td>11.84%</td>
<td>19.74%</td>
<td>52.63%</td>
<td>12.72%</td>
</tr>
<tr>
<td>7. Looking back, I feel the breakout groups used during the first six weeks of class improved my understanding of the course</td>
<td>2.62%</td>
<td>4.37%</td>
<td>9.61%</td>
<td>46.72%</td>
<td>36.68%</td>
</tr>
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</table>

Table 2: Final survey results for the Likert questions (N = 229).
Looking back, I feel the breakout groups used during the first six weeks of class allowed me to perform better in this course.

9. I feel that using breakout groups increased my retention of the material learnt during the first six weeks of class.

10. Overall, I feel that using breakout groups in this class enhanced my learning experience.

| Student response displayed by gender to the survey question: "overall, I feel that using breakout groups in this class enhanced my learning experience" |
|---|---|---|---|---|
| Response | Male | Female |
| Strongly Disagree | 0% | 0% |
| Disagree | 10% | 10% |
| Neutral | 10% | 10% |
| Agree | 60% | 60% |
| Strongly Agree | 30% | 30% |
Figure 1: Student response displayed by gender to the survey question "overall, I feel that using breakout groups in this class enhanced my learning experience." (A) Question 12 from the midterm survey (N = 220). (B) Question 10 from the final survey (N = 229).

Included at the end of both surveys were questions regarding the advantages and disadvantages of using breakout groups. Student responses highlighted several commonly perceived advantages and disadvantages, which are summarized in table 3.

Table 3: Advantages and Disadvantages of Using Breakout Groups
### Advantages

- Helped summarize and apply lecture material
- Illustrates the big picture
- Makes class more interesting/breaks up class
- Interaction with peers/hearing other opinions
- Helps prepare for exams – easy to study from, forced studying in class, reduced study load come midterm
- Forces you to engage in class

### Disadvantages

- Awkward room to move around in
- Some people not willing to participate
- Students sitting spaced out
- Sitting with friends encourages conversation
- Sometimes not enough time/too much time spent on them
- Hard to hear during large group discussions

Additionally, other comments were made which are relevant to describe the effectiveness of using breakout groups as an active learning strategy in a large undergraduate nutrition classroom.

Examples of specific feedback are provided below.

“Overall I thought they were effective, especially in this type of class that is less focused on memorization of facts and more on having opinions and analyzing information.”

“It was a great break from lecture just to do something interactive.”

“I honestly was not looking forward to the breakout groups. I thought it was a waste of time for us to discuss something that we would end up discussing with the professor anyways. I was surprised however, because did end up finding the groups helpful and a unique way to learn.”
“[The instructor] did a wonderful job presenting the breakout groups and had, for most of them, interesting topics. For the not-so-interesting topics, it made it easier to understand and reinforce to prepare for the midterm exam. Wish these were in more classes!!”

“I liked the idea. It made class interesting and applying concepts immediately always helps in learning. Had these topics been given outside of class time I wouldn't have done them, so it was good to include them in class time.”

"I really enjoyed the dynamics of this class, especially with the use of breakout groups. It made the university classroom experience feel less "presented", and more "involved". I felt more integrated into the class and the material, as opposed to just listening and then leaving."

"Breakout groups greatly helped with my retention of the course material. While the breakout groups were sometimes disorganized, [the instructor] always made sure to bring the class together for a final discussion, which ultimately put everything into an understandable context. The breakout groups contributed to helping me understand the course material beyond the context of the classroom."

Discussion

Despite resource and room restrictions, students in a large undergraduate nutrition classroom reported a significantly enhanced learning experience following the use of breakout groups. The breakout groups not only provided students with the opportunity to analyze and discuss class material, but also made the class more interesting. As well, students felt the use of breakout groups improved their retention of the class material. Females were seen as responding more positively than males on both surveys, and overall GPA of students proved a significant effect on midterm survey responses but not on the final survey. It was also noted that there was a slight decrease in perceived effectiveness on the final survey from the midterm survey, which could be a result of different students responding to each survey. Overall, the results of the midterm survey strongly support the use of breakout groups as an effective learning strategy in a large undergraduate nutrition classroom and suggest that the timetable and breakout group format used in NUTR 4090 was largely effective, although students did provide some valuable feedback regarding disadvantages and suggestions for improvement in the future.
Of 220 responses from the midterm survey, 88% percent of students surveyed felt that using a combination of breakout groups and lectures resulted in a more engaging classroom and 85% of students either agreed or strongly agreed that using breakout groups enhanced their learning experience. Moreover, a similar proportion of students felt that using breakout groups enhanced their understanding of the subject matter and their ability to analyze, synthesize, and evaluate the subject material. A primary goal of using active learning strategies is to force students to think critically and to engage with the material, and the results of this study suggest that breakout groups are an effective tool with which to achieve this objective.

The vast majority of students felt that the topics of discussion in the breakout groups were interesting and relevant to the study of functional foods and nutraceuticals. Surveys on the use of popular media in the classroom have not only shown how widespread its use is, but also how positively it has been received as a pedagogical tool, and the motivational potential of using popular culture in the classroom is evident at many levels of education. However, choice and application of media should be taken into consideration to avoid sending the wrong messages. The area of functional foods and nutraceuticals is widely reported in the popular media, and the universal relevance of nutrition means that students are exposed to these products throughout their daily lives in many different environments. One of the main objectives of this course is to separate fact from fiction, and to analyze whether the information presented to the public in the popular press is supported by the scientific literature, as well as to analyze the scientific mechanisms that underlie the formulation of these food and supplement products. The ability to incorporate popular media into class and into the breakout groups is a great advantage in terms of higher order thinking abilities.

catching student’s interest, and is something that would not necessarily translate across all disciplines. The ‘interest’ factor of these breakout groups should not be underestimated as being an important predictor of overall effectiveness.

Somewhat surprisingly, the majority (approximately 70%) of students surveyed felt that the breakout groups were easy to create and participate in. One of the major disadvantages of NUTR 4090 is the lecture hall it is held in, which is very old, has poor acoustics, requires students to sit in a balcony and on a main level, and has seats that are tightly crowded together. An important objective of this research was to identify an active learning strategy that could be used successfully despite all of these obstacles, as this is a scenario faced by instructors at most academic institutions. It is likely that by keeping the breakout groups small (2-5 students), the need to get up and move around, and consequently be hindered by the physical limitations of the room, was minimized. That being said, many students provided specific feedback that the room itself was a disadvantage to using breakout groups, and that the experience would have been more positive in a larger room with more space.

The final survey featured different questions than the midterm survey, most notably a question gauging student retention of class material. Fifty percent of the students agreed that the breakout groups improved retention of the material, while almost 32% strongly agreed. Indeed, it has been shown that retention of material is amongst the benefits of group-based learning, with longer-term retention being more significantly impacted than shorter-term retention under some circumstances.11

One of the main findings of the study was a significant effect of gender on students' perception of overall effectiveness. It has been suggested that females should respond more favorably to group work than males based on cultural and evolutionary roles, where males typically engage in competition and exhibit individuality versus females who spend time in collaboration and fostering codependency. However, studies looking at gender preference for modes of learning in higher education have shown that there does not appear to be a difference. While females have been shown to prefer a broader range of stimuli than males, both genders appreciate variety in their educational. The results of our study show females as responding significantly more positively to the breakout groups than the males, although it must be considered that there were significantly more females than males in the class and who responded to the surveys, with a female:male ratio of 179:41 on the midterm survey and 183:46 on the final survey. As well, it should be noted that, due to the larger sample size of females compared to males, there is a greater degree of accuracy with the female results, whereas the male response may not as accurately represent males in general. This must be taken into consideration when suggesting gender effects.

Comparing results between the two surveys reveals a slight general decrease in student perception of overall effectiveness. The percentage of students who 'strongly agreed' with the overall effectiveness of breakout groups dropped from 31.82% on the midterm survey to 28.38% on the final survey, and those who 'agreed' dropped from 53.64% to 52.4%. This could account for the loss of statistical significance seen with overall GPA on the midterm survey but not the

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final survey. Other studies have shown an increase in course satisfaction correlating with the introduction of PBL mid-course, as well as increased satisfaction with the learning experience when enrolled in a PBL-based class compared to non-PBL controls of the same course.\textsuperscript{14} However, no studies appear to show changes in perceived effectiveness of PBL techniques from during use to after cessation of use.

Several students reported that they felt that the number and length of the breakout groups was optimal, and said they would not want to see more (or less) of them. A total of 4 breakout groups were incorporated into 11 lectures, which provided a balance of 1 breakout group every 3 lectures, with a duration of approximately 10 minutes for each. Other proven techniques have been shown as having similarly short time requirements, such as partnering and clarifying class notes, which could take around two minutes, or small groups dubbed "buzz groups" taking several minutes.\textsuperscript{15} Indeed, it has been shown that the effectiveness of active learning techniques lies in the nature of the engagement rather than simply spending more time on the topic.\textsuperscript{16} Generally speaking, had these small group discussions been able to proceed in a more optimal environment - for example, with several teaching assistants available to circulate and facilitate the discussions, in a less crowded room, or in the context of a tutorial sized class – it is possible that more and longer breakout groups could have been used successfully. However, given the


limitations of the classroom and the course structure, it may be important to use the breakout groups as an adjunct to, rather than a replacement of, traditional lectures.

Clearly, the results of this study suggest that breakout groups can be successfully incorporated into a large undergraduate nutrition classroom with minimal disruption to the traditional lecture format and despite the physical constraints of an awkward room and lecture-only course structure. As an active learning technique, this strategy effectively engaged students in the learning experience, improved their critical thinking skills, and enhanced their understanding and retention of the course material. Females reported a higher level of satisfaction than males, although the effect of gender in this study may have been influenced by the disproportionate number of male and female respondents. The practical relevance of the subject matter and the ability to incorporate popular media may be an important predictor of student satisfaction, and is an issue that should be investigated in future studies.
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