

Case-Based Student Performance: Socratic Method vs. Passive Presentation

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Abstract

Background: Presentation of patient case examples is often used in healthcare education to facilitate clinical thinking in the classroom. The question arises as to whether a passive (instructor-only presentation) or Socratic (encouraging student discussion) approach is more effective when presenting patient case examples.

Methods: Student exam performance and perceptions from passive and Socratic approaches were assessed. **Results:** Little difference was seen in examination performance using either approach; however, students subjectively preferred the Socratic approach rather than passive instruction. **Conclusions:** Socratic or passive case-based approaches provide comparable examination outcomes. Students tend to prefer the Socratic approach when presented patient cases.

Key Words: case-based learning, Socratic method

Background

Many educators in optometry (and other professions) can relate to situations where some students have displayed difficulty grasping fundamental knowledge concepts in certain areas, irrespective of academic performance. This usually becomes apparent through direct questioning of students on a one-on-one basis, or less often during their early clinical rotations. More frequently, the application of this fundamental knowledge is deficient, as certain students may not know “what to do next” for a particular patient. Encouraging discussion and feedback from students in both the didactic and clinical arenas can often be challenging, and this limits the instructor from knowing what the student or intern is truly thinking on a critical basis, and how solid his or her knowledge foundation is.

Case-based presentation has been shown to be an effective means for learning in the classroom setting.¹⁻³ For the purpose of this article, “case-based” instruction will refer simply to the use of a patient case example as the only element provided in the class. The advent of case-based or problem-based learning has helped in developing basic and applied knowledge; however, there are still students who may “slip through the cracks” in benefiting from this instructional format. Is passive classroom participation alone contributing to this learning stagnancy? Specific case-based strategies, including active discussion/debate among class participants vs. instructor-only presentation in the process of case presentation, has shown variable results.⁴⁻⁹

In contrast to an instructor-only method (i.e., without feedback or dialogue from students) the Socratic method involves inquiry and discussion, usually with varying viewpoints, among the participants in a class.^{10,11} The instructor provides questions and/or comments for debate and serves to facilitate the formulation (or ruling out) of main concepts and hypotheses from class participants, as well as foster creativity and critical thinking.^{12,13} This pedagogical approach is termed a Socratic Circle (or Socratic Seminar), in which the class is driven by student dis-

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cussion and debate, rather than by the instructor. Several formats of Socratic Seminars are possible, such as an inner and outer circle of students that debate, pairs or triads of students that consult one another, or small groups of students who self-direct discussion before sharing with the entire class. Regardless of the format, active learning is encouraged.¹⁴ While basic knowledge (that requires rote memorization of the subject matter) is a foundation for learning, the Socratic method also attempts to promote application of knowledge towards solving problems. This adaptive approach to problem-solving has shown positive correlation with medical licensing exam success, and may relate to the critical thinking that occurs in a clinical setting.^{15,16}

The purpose of this study was to compare the effectiveness of the Socratic (active) vs. passive case presentation techniques in a classroom setting, by evaluating student written examination performance after each presentation style, as well as by a student exit survey rating each style. It was anticipated that the Socratic approach would lead to better performance in basic and applied knowledge than the passive approach and would be more favorably perceived by students.

Methods

With institutional approval, optometry students in their second year and third year of academic study who consented to participating were recruited on a volunteer basis. Participants received credit (in the form of student continuing education hours required) towards their respective patient care didactic courses. The article's lead author served as the sole instructor for the students. Case-based presentations were conducted during lunch hours over the course of six weeks. After initial introduction of the case presentation schedule and weekly session expectations, a preliminary baseline multiple-choice exam (10 questions, four choices per question) was given to all participants on a novel patient case not presented in class. Half of the exam questions tested for basic knowledge (e.g., "What is the diagnosis?", "What clinical sign is this?") while the other half of the questions tested application of knowledge (e.g., "What

is the best treatment?", "What differential diagnosis can this test rule out?").

Currently at this institution, second-year students have a predominantly didactic (classroom, laboratory) curriculum, with patient exposure in the form of five weeks of half-day internal school clinical assistance as well as school optical and external community vision screening assignments. Third-year students have a relatively less heavy didactic load, which is balanced by two days per week of direct patient care (one day of which is a specialty clinic such as ocular disease, contact lenses, pediatrics, vision therapy and low vision) in the internal school clinics, as well as similar optical and external screening assignments as the second-year students. While classroom instruction is overwhelmingly lecture-based for both second- and third-year students, the third-year students also have a required 'grand rounds'-based core course that emphasizes patient case presentations and attendee discussion.

For the study, second- and third-year students were grouped together, with the option of participating in either Tuesday or Thursday lunch hour sessions. Many students were available for either day, and in this case were randomly assigned to either day, with the goal of equal size groups between days. Effort was made to equally distribute second-year and third-year students between and within the groups. (Table 1)

Four distinct patient cases were presented over the duration of the study, on which students were tested on each subsequent week. Cases presented covered the areas of pediatrics, low vision, contact lenses, binocular vision and ocular/systemic disease.

Case presentation order was from anterior to posterior anatomical location (i.e., the first case involved an eyelid

condition, the second case an oculomotor condition, the third a corneal/contact lens condition, and the fourth a retinal/neuro-ophthalmic condition) as this followed general course topic order for students. Each case was presented using PowerPoint (copyright Microsoft Corp., Redmond WA, USA) slides, and was comprised of the following elements, with special tests only pertinent to each specific case also included:

1. Case History
Patient age, sex, race, chief complaint, secondary complaint(s), ocular and medical history, surgeries, medications, allergies, habitual visual correction
2. Entrance Tests
Visual acuities, pupils, motilities, cover testing, near-point of convergence, accommodative testing, screening visual fields
3. Refraction
Objective, subjective, near add
4. Visual Function
Phorias, vergences, accommodative tests, oculomotor tests, fusional tests
5. Anterior Segment
Biomechanics findings, intraocular pressure
6. Posterior Segment
Ophthalmoscopic findings
7. Special Tests
Perimetry, anterior segment and/or retinal imaging and biometry, electrodiagnostic testing, color, binocular/accommodative tests, other
8. Assessment
9. Plan/Follow-up
10. Billing/Coding

Table 1
Participant Distribution

Participant	TuesdayGroup	Thursday Group	Total (n = 54)
Second year	14	19	33
Third year	9	12	21

In the Socratic method, specific elements above were withheld in order to better facilitate query/discussion by the class participants. Examples of facilitation by the instructor include:

“What are you suspecting as differential diagnoses based on the case history?”

“What other questions would you ask?”

“What is the most important finding with this case?”

“What is causing this finding?”

“What other tests may be helpful here?”

“Are there any other elements important to the case?”

“Please discuss with your group what the best management would be for this patient.”

“Why do you recommend that management?”

“Is there anything about the management that is questionable?”

“Would anyone like to provide another viewpoint in treating this patient?”

“Is there any other education to give the patient?”

“Any other comments/questions to share?”

Students provided both independent input as well as discussion together in pairs or small numbers (fewer than five) with their classmates and presentation to the room as a whole. The instructor was positioned in the center of the students in order to establish a more circular physical conversing arrangement. Students were encouraged to debate diagnoses and treatment strategies, as well as reasoning behind certain viewpoints. New questions and pertinent information from participants were also allowed. The instructor allowed individuals and groups who volunteered their input to speak for an equal amount of time in order to facilitate equitable discussion by both second-year and third-year students.

In the passive method, all case elements were presented to the participants by the instructor only, without student questions or discussion during or after the presentation. While the exact case

content was presented as in the Socratic presentation, the instructor did not give any further information or insight aside from providing the diagnosis, management and follow-up information. The instructor was positioned in the more traditional lecture location, at a podium in front of the students.

Each subsequent week at the beginning of each session, students were asked to take a multiple-choice exam (10 questions, four choices per question) relating to the classroom case presented the week prior. As with the baseline exam, half of the questions tested for basic knowledge, while the other half tested for applied knowledge. Questions were written for consistent difficulty level between each examination. The same case was presented using the Socratic method over one session with one group of second-year and third-year students, and presented using the passive method over another session with the other group of second-year and third-year students. In order to minimize class performance bias, each subsequent case had the student groups switch methods. The specific weekly schedule showing case-based presentation type is shown in **Table 2**.

Electronic devices were not allowed during the presentations, and students were instructed not to discuss any aspects of the presentations or exams with other students outside of their scheduled sessions for the duration of the study. However, students were allowed to take notes during each session and were each given a basic point-form summary of the case from each session

for independent home study.

At the conclusion of the last case exam, all participating students anonymously completed an online exit survey (SurveyMonkey.com, copyright SurveyMonkey, Palo Alto CA, USA) that asked the following questions to be answered using a 1 (very low) to 5 (very high) Likert scale for both active and passive instruction formats:

Which class format:

1. provided the best learning experience for you?
2. gave you the best eye condition/management information?
3. provided clinically useful pearls/tips/strategies?
4. stimulated creative approaches to patient care?
5. encouraged clinical thinking?
6. would build your confidence in the clinical setting?

The exit survey also asked for written feedback regarding the benefits/drawbacks/observations of either instruction format, as well as ways to improve either presentation style. This was in the form of open text fields in the online survey wherein students could anonymously provide free-form comments without length limitation. In order to reduce bias, students were not given the results of any of their exam scores until completion of their exit survey.

Statistical analysis utilized was a four period crossover ANOVA with two treatments, with the pre-test serving as a covariate that adjusted for individual

Table 2
Weekly Case Presentation and Exam Schedules

Week (case)	Tuesday Group Presentation	Thursday Group Presentation
0	Baseline exam for both groups on initial case (no prior presentation) Randomly assigned students into two groups of equal size	
1	Active	Passive
2	Passive; exam based on Case 1	Active; exam based on Case 1
3	Active; exam based on Case 2	Passive; exam based on Case 2
4	Passive; exam based on Case 3	Active; exam based on Case 3
5	Exam based on Case 4; exit survey	Exam based on Case 4; exit survey

Active (Socratic) or passive (instructor-only) presentations were alternated each week for equitable exposure to both presentation types for each group. The same cases were used for each group.

student differences. Results were illustrated with bar graphs indicating means and 84% confidence intervals. 84% confidence intervals were chosen because they were equivalent to the least significant difference t-test such that non-overlapping intervals were significant at an unadjusted $p < 0.05$. Analysis of exam performance between the two teaching methods was shown in the following areas:

- Overall exam scores
- Weekly exam score trend
- Basic knowledge score
- Applied knowledge score

Analysis of the exit survey was performed using t-test comparison (with statistical significance of $p < 0.05$) between passive instruction vs. active instruction styles. Written student perspectives were prioritized according to identifying the most common (three or more students having similar-themed comments) provided in the survey.

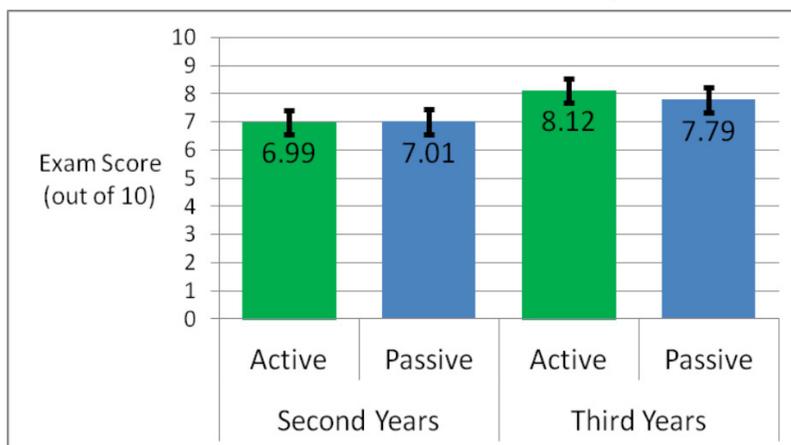
Results

Overall exam scores showed significantly better mean performance for third-year optometry students vs. second-year optometry students ($F = 12.9$, $p = .001$). There was no statistically significant difference in scores whether active or passive instruction was utilized, regardless of year of optometric study ($F = .465$, $p = 0.50$). (**Figure 1**)

Similar to the overall exam score, the weekly exam score trend showed no statistical difference in exam scores across the four weeks of case presentations whether active or passive instruction was utilized (Type by Test $F = 1.62$, $p = .187$), and regardless of year of optometric study (Class by Test $F = 1.7$, $p = .63$). The one exception was the third-year optometry student exam performance in the fourth week exam. In this case, active instruction showed a significantly better ($p < 0.05$) exam score (8.4/10) than passive instruction exam score (7.2/10). **Figure 2** shows the weekly exam score trend across the four weeks of case presentations, comparing active and passive instruction.

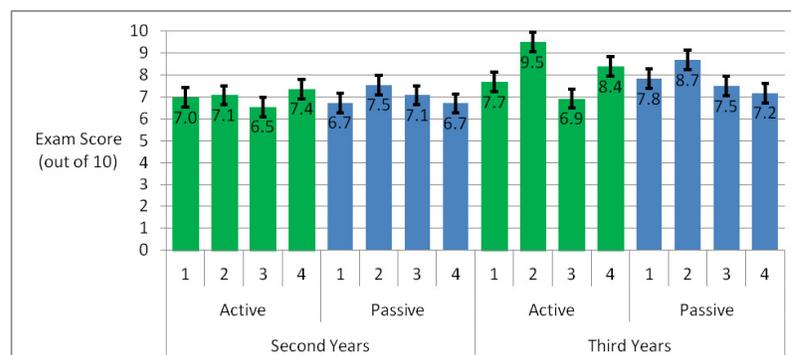
Comparison of active vs. passive instruction style with the basic knowledge question performance is seen in **Figure 3**. Basic knowledge question

Figure 1
Overall Exam Results
for Active (Socratic) vs. Passive (instructor-only) Presentation



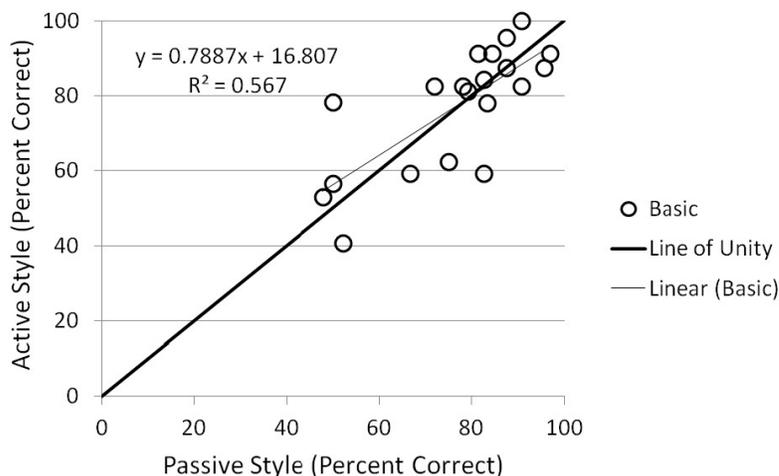
Exam average (out of 10 possible points) is noted near the top of each bar. Non-overlapping vertical bars (84% CI) indicate significant differences at an unadjusted $p < 0.05$.

Figure 2
Exam Result Trend



Numbers along the horizontal axis indicate weekly exam number. Exam average is noted near the top of each bar. Non-overlapping vertical bars (84% CI) indicate significant differences at an unadjusted $p < 0.05$.

Figure 3
Active vs. Passive Instruction Style: Basic Knowledge



Each point represents the percent correct answers for each basic knowledge question ($P = 0.81$). Points falling on the heavy black line represent questions with the same score on either type of presentation. Scores falling above the heavy line suggest better performance with the active style presentation. The lighter black line is the best fitting straight line.

performance was statistically similar regardless of the instruction style utilized.

Figure 4 compares the active and passive instruction styles with applied knowledge question performance. In this analysis, the linear regression line suggests a greater advantage towards the active style for more difficult (i.e., lower percent correct) applied knowledge questions, although the slope was not significantly different from 1 ($t=.65, p>.10$).

In the exit survey, students showed a strong preference ($p<0.001$) for the active instruction style. Questions focused on clinical applicability and were ranked according to a 1-to-5 Likert-based scale. The results were consistent in preference regardless of year of optometry school. Overall survey results are seen in **Figure 5**.

The exit survey revealed numerous comments from students regarding each presentation style. A total of 45 comments were received, of which the main themes (those where there were at least three similar comments among participants) were:

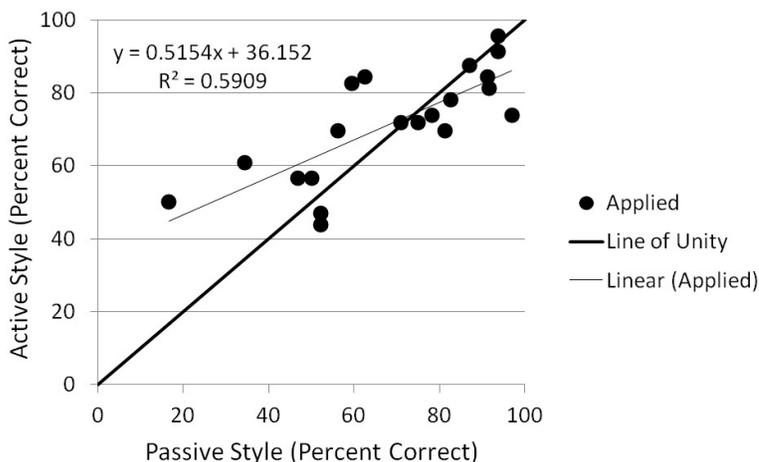
- Increasing clinical/critical thinking with the Socratic method
- Bringing clarity of case elements using the Socratic method
- Deviation off the main topic using the Socratic method
- Longer time involved when using the Socratic method

The comments in **Table 3** represent a sample of the comments along with the main associated theme each comment supports.

Discussion

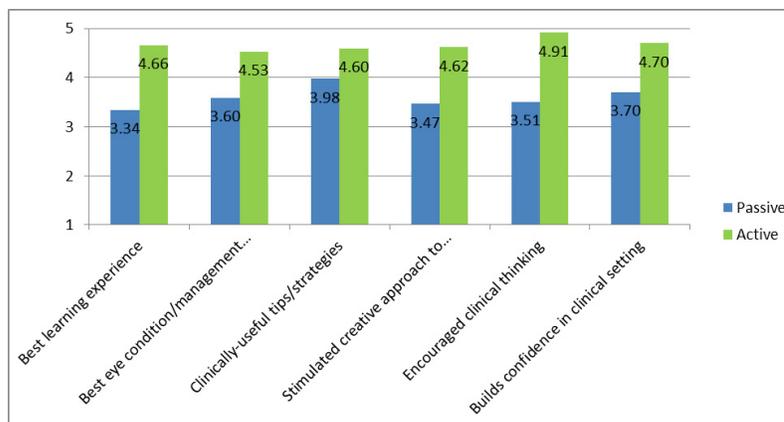
The results of this study demonstrated that overall examination performance did not significantly differ between the Socratic and passive instruction styles. This finding is consistent with those of Cao and colleagues, who evaluated exam performance from traditional vs. case-based learning with ophthalmology students,¹⁷ as well as those of Adamas-Rappaport and colleagues, who compared surgical intern exam performance from unguided vs. guided case-based instruction.¹⁸ In addition, our study found (aside from one third-year exam result) that the trend of all exam

Figure 4
Active vs. Passive Instruction Style: Applied Knowledge



Each point represents the percent correct for each applied knowledge question ($P = 0.38$). Points falling on the heavy black line represent questions with the same score on either type of presentation style. Scores falling above the heavy line suggest better performance with the active style presentation. The lighter black line is the best fitting straight line.

Figure 5
Exit Survey



Exit survey Likert-based preference scale results comparing active vs. passive instruction (1 = very low, 2 = low, 3 = neutral, 4 = high, 5 = very high). Average is noted near the top of each bar. Statistical significance between each instruction style was $p<0.001\%$ for each question (x-axis).

Table 3
Representative Student Comments on Socratic Instruction

Main Theme Associated with Student Comments	Student Comment Example from Exit Survey
Increasing clinical/critical thinking with the Socratic method	"It was interesting to kind of bounce ideas off of one another and the presenter. Because we were asked to participate, it really made us think of how we would handle the situation."
	"I appreciated the input from other students, especially third year students who have clinical experience. Their ideas helped me think more clinically."
Bringing clarity of case elements using the Socratic method	"The group discussion brought points of emphasis and allowed for clarity of points that may have been ambiguous."
	"The discussion made the case far more memorable and more likely to be retained for clinical purposes."
Deviation off the main topic using the Socratic method	"I enjoyed both learning formats, however sometimes I preferred the more straightforward presentations because in a discussion format at times it's easy to skew away from the format and get a bit distracted."
Longer time involved when using the Socratic method	"I do like having the discussion aspect- but it definitely does take longer to get through a case."

Main themes regarding Socratic-based instruction obtained from written student comments in the exit survey. Example comments representing each theme are shown.

performance over four weeks did not show an advantage to either presentation format. In relation to our findings, Mounsey and Reid noted long-term stagnancy of exam performance from case-based instruction of medical students, suggesting only short-term immediate benefit.¹⁹ A meta-analysis of 104 papers summarized that case-based presentation alone does not commonly increase learning, but that additional instructional factors may play a role in building foundational knowledge.²⁰

When one looks at basic knowledge vs. applied knowledge, our study suggested (though not statistically significantly) that the Socratic approach may provide a slight advantage for performance with complex applied knowledge questions. This potential for improved application of knowledge using the Socratic method has been discussed in prior research. A recent study evaluating multiple instructional techniques found that a Socratic Seminar technique showed significant critical thinking disposition over other techniques, when quantified through tests.²¹ Current findings from Yadav and colleagues support this conceptual understanding advantage,²² as do those of Yang and others, who noted enhancement of critical thinking skills using the Socratic method.^{23,24} An occupational medicine study noted improved test performance when applying interactive case-based instruction vs. paper-form only cases.²⁵ While basic knowledge was not shown to improve regardless of instruction style in our study, there did appear to be potential for enhancement of critical thinking and applied knowledge using the Socratic approach.

Based on the exit survey quantitative results, student perception of the instruction styles was statistically significant in preference for the Socratic case-based style over the passive case-based style (all questions $p < 0.001$). Questions were posed to primarily address clinical applicability over academic learning, and students preferred the Socratic approach for each of these questions. This trend was seen in numerous prior studies. Burder and colleagues found that, along with improved critical thinking exam scores, students felt an improved understanding of science and reviewing scientific literature, and a more positive

attitude towards the material when Socratic discussion was utilized.²⁶ Similar exam and instruction perception results were noted by Lee and colleagues in a medical clerkship setting.²⁷ Other authors found less favorable evaluations of case-based learning when the instructors reverted to a less interactive presentation style.^{28,29}

Along with Likert rating, students' written survey responses showed preference for the active case-based instructional style, based on the number and type of comment themes received. These comments, some of which were seen in the results, were similar to comments obtained from students by Brown in his study evaluating case-guided inquiry in an undergraduate setting.³⁰ One of his student responses illustrated this theme: "This class forces you to involve yourself with others as a means of problem solving, which is an ideal environment for anyone going on to professional school or, like myself, graduate school."

Student comments brought up the occasional deviation from subject matter by participants during the Socratic sessions, as well as the greater amount of time involved in Socratic instruction. This emphasizes the importance of instructor facilitation in the Socratic format, both in terms of maintaining content focus as well as time management. As Robertson commented, the ideal instructional approach for student motivation to learn may be a balance of the traditional instructor-only and Socratic Seminar styles.³¹

Limitations of this study include its small number participants and a short timeline for longitudinal analysis. The small number and variety of patient cases may also have been a limiting factor, as well as the limited number of examinations. While presentation by a single instructor allowed for consistency, this prevented any inter-instructor analysis of each presentation method. Assessment using more instructors and student participants over a longer duration of instruction, with greater variety of cases and examinations, is recommended.

Conclusions

While case-based/grand rounds or problem-based learning has been shown

to be a strong instructional tool, the importance of active vs. passive audience participation using this tool needs further evaluation. In this age of unprecedented access to information, creativity and adaptive thinking may become more valuable in helping patients in a clinical setting. In addition, it may allow students further self-direction through discussion and query, providing a more active means of learning. This study serves as a starting point to explore this teaching pedagogy in optometry further, and opens additional future avenues to evaluate direct benefit to patient care.

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