Case: Office Hours Field-Test Version

Contact shauk@wested.org prior to use.

Facilitator's Guide

Overview

The nature of interaction between instructor and student during office hour time can be different from that during whole class or group work. In an office hour, instructors have an opportunity to explore and diagnose challenges students are facing and to get a sense of where a student is in terms of needed prerequisite knowledge. One common comparison is to medical office visits: the first part of determining the treatment for a patient is asking questions, maybe running a few tests, to figure out what is wrong. Medical questions include things like "Where does it hurt? When does it hurt? On a scale of 1-10, how bad is the pain?" A diagnosis is an attempt to identify the causes of a condition, situation, or problem to inform decision-making about response (treatment). For instruction, what corresponding mathematical questions might we use to "diagnose" when working with students during office hours?

Learning Goals for Participants:

- Develop awareness of questions to ask for instructional diagnosis, in the context of office hour interaction.
- Practice noticing and probing for student thinking.

Video Content / Context

The video clips in this case come from the office hours of two instructors: Eric and Kristen. Each of them was the instructor of record for a Calculus I class whose students are shown. The focus is on noticing the challenges of tasks and asking diagnostic questions based on the particular task and the particular student in an office hour interaction.

Activity Timeline (*approximately* 45 minutes)

Preview: 10 minutes
View: 10 minutes
Discuss: 15 minutes
Reflect: 10 minutes
Extend: Depends on choice of extension

Facilitator's Guide

Case: Office Hours

There are several challenges and many rewards in learning how to use office hour time effectively to support students. Research suggests that it is often counter-productive to student learning to focus on making things "easier" for the student. While students may have a vicarious feeling of success by witnessing the instructor work out the answer during an office hour, it rarely leads to student learning. The whole point of one-on-one (or few-on-one) time in an office hour is that the student is allowed to struggle productively. The goal for the instructor is to learn how to make sure that struggle will *be productive for the student*.

When a problem turns out to be strategically demanding (as opposed to computationally difficult), a learner can become indecisive and may not know where to start or to go next. During an office hour we can probe a particular student's struggles to determine how to provide scaffolding. We must resist the urge to "just show them how to do it." Instead, during office hour is the time to learn about how a particular student is thinking and unpack the challenge of bringing to mind and testing strategies. Office hours are well suited for helping students develop problem-solving *schema* – collections of potential solution starts and associated thought experiment strategies that allow a possible solution path to be rapidly explored in the mind before deciding whether a particular approach is *likely* to be fruitful or is best discarded (Schoenfeld, 2010; Selden, Selden, Hauk, & Mason, 2000).

Schoenfeld, A. H. (2010). *How we think.* New York: Routledge.

Selden, Selden, Hauk, & Mason (2000). Why can't calculus students access their knowledge to solve non-routine problems? In E. Dubinsky, A. H. Schoenfeld, & J. Kaput (Eds.) *Research in collegiate mathematics education IV* (pp. 128-153). Providence, RI: American Mathematical Society.

Preview [~10 minutes]
Let participants know that they have about 10 minutes total to complete the preview questions. This includes trying to solve the problems (if they choose to do so), identifying the *prerequisite knowledge*, and identifying some *questions to ask of a student*.

Special Note to Facilitators about Process: Many participants will *not* have enough time to solve the problems AND to address Questions 1 and 2. Take care not to let them get bogged down in doing the math – the point is noticing what math needs to be done. Participants may or may not notice that without student responses it is difficult to generate a single path of questions. A key lesson to be learned here: follow-up questions will depend on what the student says and does (or avoids or does not do…).

Office Hours

Learning Goals

- Develop awareness of questions to ask for instructional diagnosis in the context of office hour interaction.
- Practice noticing and probing for student thinking.

Introduction

In an office hour, instructors have an opportunity to explore and diagnose challenges students are facing and to get a sense of where a student is in terms of needed prerequisite knowledge. One common comparison is to medical office visits: the first part of determining the treatment for a patient to figure out what is going on by asking questions, maybe running a few tests. Medical questions include things like "Where does it hurt? When does it hurt? On a scale of 1 to 10, how bad is the pain?" A diagnosis is an attempt to identify the causes of a condition, situation, or problem to inform decision-making about response (treatment). For instruction, the corresponding mathematical questions might we use to "diagnose" when working with students during office hours can include a variety of what, how, and why questions.

The video clips in this case come from the office hours of two instructors: Eric and Kristen. Each of them was the instructor of record for a Calculus I class whose students are shown. The focus is on noticing the challenges of tasks and asking diagnostic questions based on the particular task and the particular student in an office hour interaction.

Preview

Problem A. Find the derivative of y with respect to x if $y = 4 - 5/x$.

Problem B. A company's new advertising campaign calls for a product to be sold in a container that has the shape of a cylinder topped with a hemisphere. Given that the volume of the container has to be 36 cubic centimeters and that the cost of producing the hemispherical part of the container is four times the cost of producing the cylindrical part, what should the height and radius of the cylinder be so as to achieve the required volume while minimizing the overall cost for the container?

In the boxes above are two problems from first semester calculus. Solve the problems and as you do so, notice the following:

(a) the *prerequisite knowledge* (i.e., before calculus) called on in solving the problem,
(b) the general *decision-making* you do about setting up and solving the problem;
(c) the specific procedures or strategies *unique to first semester calculus* that are needed to work the problem and solve it correctly.

1. What knowledge do students need in order to be successful with Problem A? Make a list. With Problem B? Make a list.

2. Suppose, for each Problem, a student has come to your office hour seeking help, saying "I can't do this problem!" For each Problem, list the questions you might ask to help diagnose and make decisions about what "treatment" to offer each student.

Facilitator's Guide

View [~10 minutes] – *Not yet captioned – refer viewers to the transcription on last page.* Before showing the first video clip, take a moment to have participants reread the information for Problem B, the *Container Problem*. Remind participants that the **goal is noticing what the student and instructor each appear to understand**. After watching twice, repeat for Problem A, *Derivative Problem*. See below for more detailed notes.

Watch the first video clip, then announce: Recall, we want to answer these two questions (read them out loud) **in terms of (a), (b), and (c).** Paying attention to those three things (repeat them), what does the student understand and what does the instructor seem to think the student understands? It might help to refer to the transcript, make a few notes on it now and then we will watch the video clip again.

Watch the *Container Problem* video again. Say: Turn to at least one other person and take a moment (give 2 minutes) to compare your observations with theirs. We'll discuss more fully, after we watch the Derivative Problem clip and do a similar noticing.

(after 2 minutes): We'll go ahead and look at the next video. This is Eric with Jake, who has come in asking about Problem A, the Derivative Problem. Take a minute to read the "Derivative Problem" information on your sheet.

Allow time to read the background information. Then, watch *Derivative Problem* clip TWICE, again with a pause for participants to flesh out notes between viewings. Pause again at the end, before the *Discuss* prompts, for participants to pair up and discuss what they noticed for Eric and Jake.

View

The video clips in this case come from the office hours of instructors Kristen and Eric. You will have the opportunity to watch each video twice.

Container Problem. Here we see an instructor who is not sure if her student understands the background geometry needed to correctly set up the problem. Specifically, she wants to know if he remembers and/or understands these things:

- the basic idea of what surface area measures
- the formula for the circumference of a circle
- the formula for the surface area of a cylinder

For each of the above ideas, pay attention to the diagnostic questions the instructor asks and the student's responses.

1. Given the student's responses, what does the student appear (to you) to understand? How do you know (what is the evidence in the video)?

2. What does the instructor seem to think the student understands? How do you know (what is the evidence in the video)?

Derivative Problem. Here we see an instructor whose student has come in right before the exam. The student is struggling to take basic derivatives. The instructor wants to know if he remembers and/or understands these things:

- the existence of various differentiation rules
- which rules would be applicable in this case
- how to use the relevant ones

For each of the above ideas, pay attention to the diagnostic questions the instructor asks and the student's responses.

1. Given the student's responses, what does the student appear (to you) to understand? How do you know (what is the evidence in the video)?

2. What does the instructor seem to think the student understands? How do you know (what is the evidence in the video)?

Facilitator's Guide

Discuss [~15 minutes]

Possible prompts to direct the work of participants in addressing the questions:
a. What prerequisite knowledge does each student appear to have (or not have)? Remember to point to the evidence in the video for your assertions.
b. Who is responsible for identifying and/or carrying out procedures? How do we know? For strategizing? How do we know?

Potential Extension activities (if there is extra time (e.g., your session lasts longer than an hour). Skip these if needed to ensure time for the Reflect activity!

1. Though the students are not especially articulate about what they know, suppose that the students in the videos could *do* all of the necessary procedures, what opportunity did each student have to demonstrate their knowledge?
2. For each instructor, re-view the video. What is the evidence in the video (what do you see, hear, witness) that suggests the student is or is not building strategic knowledge for problem solving? What did the instructor do (or not do) that may have led to that evidence being present?

Reflect [~10 minutes]
Verbalize the prompt: Given what you've just seen, write a note about two things it might be helpful to keep in mind for working with students in office hours.

Participants may not readily explore the relationship between the cognitive demand for *computation* versus that for *identifying a solution approach*.

Examples of things participants may write:

Keep in mind student prereq knowledge and how long ago maybe it was used

Have the student do the writing

Give students time to think about the answer to the question before you answer for them.

Extend [as time allows – also see notes above under *Discuss*]

Responses may include reference to wait time and the potential positive and not so positive effects of handing the whiteboard pen or paper and pencil to the student, or turning the book to the student. Note that if we want to call on a student in class (someone who came to office hours) to see if they can demonstrate their knowledge, it is best to clear it with the student first, before class.

Example response to Extend Item 2: When I get back to class, pay more attention to the idea to see if others in the class are also struggling with it; maybe with an activity or quiz or informal assessment of some kind.

Discuss

Pair up with one other person and discuss the following for each office hour interaction. In each case, identify **evidence from the video clip** that supports your interpretation.

1. Describe and compare what the instructors do to identify where students are in terms of the necessary prerequisite knowledge for completing the mathematical task at hand. How are the interactions similar? How are the interactions different? [Notice the types of questions and possible answers; notice the amount of "wait time" for each instructor.[1]]

2. Describe and compare what each of the students does. Does it matter who does the writing? Why/why not?

Reflect

Write a note to yourself about **two things to keep in mind** to help you in diagnosis and treatment with a student in a personalized office hour or tutoring center interaction.

Extend

1. What does each of the instructors do to support students in learning how to choose an approach and complete the mathematical task at hand?

2. How might each instructor rely on the office hour interaction during the next class meeting – as a way of confirming new knowledge held by the student?

---

[1] The two facets to "wait time" are wait time I, the time an instructor waits for an answer after asking a question, and wait time II, the time the instructor waits, after a student gives an answer, before the instructor speaks again.

Kristen: So you know, you know what surface area is, right?
Lyle: Yes.
K: and it's?
L: Wouldn't it just be like, the area, like the area of a certain, like perimeter, or?
K: So for, yeah, for surface area of the outside-
L: Yeah.
K: So, when we do the surface area of a cylinder, you remember that you only want the surface area of, like, the cylinder part. Not the base or the top. So-
L: (nodding) So all the way around the bottom.
K: Yeah, 'kay. The nice thing about this is that we can cut it down the side-
L: Um, and unfold it-
K: Yeah, roll it out. So then it's *h*. You know, do you know what this length is?
L: Um,
K: So, it's the width-but-
L: base-
K: So, it's the base, this here. So what's the length of this (gestures around base of cylinder)-
L: radius-
K: So you have a radius. What's the length of the outside of a circle?
L: I forget what it's called...
K: The circumference.
L: Yeah, circumference.
K: So that's actually going to be 2 pi r. So it makes sense that our surface area, it's going to be the area of this, the outside, so 2 pi r times the height. You comfortable with all the information? So, we're told we want to minimize cost and we want to maximize the volume...

Eric: So, you're talking about 4 minus 5 over *x*. Is that the problem?
Jake: Um hmm.
E: So you're taking the derivative of this. So, what r-. Let's actually do it slow. What rule can you actually apply? Let's get out the book. What rule would you use?
J: I guess, I'm not sure if you're going to use the quotient rule.
E: Is this, is this a quotient? Is it something over something else?
J: No. Well, that part [E: That part is].
E: So we can one day hope to use the quotient rule. That's fine. Okay. If it's not obvious to you. Let's just go through the rules. Rule 1. Is it the derivative of a constant function?
J: N-n-no.
E: Is it a power r- Is it a power of *x*?
J: No.
E: Is it a constant multiple of some other function?
J: No.
E: Is it a sum?
J: Um. Y-yes.
E: Okay. What is it the sum of? Well, we don't have a differen- we don't have a difference rule. So, this is the sum of two functions. What are the two functions?
J: 4 and negative 5 *x*, 5 over x.
E: Excellent! Okay, so this is 4 plus negative 5 over x. And the sum rule tells you that this - I just rewrote it to make it clear [J nods]. What is this equal to?
J: Um. You mean the derivative of that?
E: Yes. This mark here means the derivative. So, the sum rule, what does the sum rule tell you, you can rewrite this as?
J: 4 ... plus ...
E: Well, what is the sum rule?
J: So, 4 over *x*?
E: No, that is- so you- I don't think you- What is- How do you read that rule? It's confusing isn't it?
J: Yeah. Would that be the derivative of *u*?
E: Which one? Okay, we gotta get back to basics here. How do we read this? So when you see something that says *d* of something...