

Purdue University

**NOMINATION FORM FOR
HELPING STUDENTS LEARN AWARD**

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Name of Nominee

Continuing Lecturer

Title

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Campus

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Building

Title of Innovation

” Beyond One-Size-Fits-All: Tailoring a Large Enrollment STEM Course to Boost Engagement and Foster Success.”

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King, Charles Samuel: Supplemental Instructor Leader (four semesters, BIOL203/204)
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& Beatriz Castro (self)

Nominations must be sent electronically to cie@purdue.edu. Nominations must be received no later than 5 pm, Monday, January 29, 2024.

STATEMENT

1-Pedagogical Approach and Method

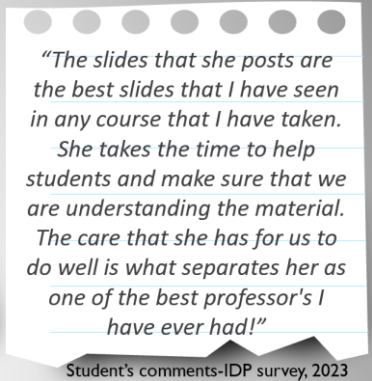
Imagine 1,100 diverse young minds--studying pre-med, pharmacy, nursing, kinesiology, etc.— all entering BIOL-203 (the first of two consecutive Human Anatomy and Physiology courses), the gateway to their academic dreams. Yet, historically, midterms revealed alarming trends: more than 45% of students struggling (D+F exam grades), hovering around a mere 60% grade on critical but challenging topics like the nervous system (corresponding to midterm#3). I knew the time was ripe for the application of a transformative approach, one that embraced the diversity of learning styles and ignited deeper student engagement across every aspect of the lectures of the course. My teaching approach lies in innovatively addressing the two main needs of any **large enrollment STEM course**: (a) **diversifying content delivery** in accordance with Universal Design for Learning (UDL) principles and (b) **tailoring engagement to suit the individual knowledge levels and needs**.

I focused on the development of educational resources meticulously crafted to resonate with each student's needs and preferences for a more personalized learning experience. I optimized these learning resources by analyzing and implementing common students' study strategies, their use of external study tools, informal conversations with students, insights from past IDP course surveys, in combination with my enthusiasm for instructional design.

Customized Learning Resources Based Our Students' Learning Styles and Knowledge Needs

[Visual representations of these resources can be found at the end of the document.]

- **Teacher slides** (for lecturing): the slides, meticulously crafted to captivate and spark curiosity in line with my teaching philosophy, are enriched with visuals, dynamic effects (including moving objects that unveil internal content), and real-world connections. "FYI slides" bridge the gap to everyday relevance, while the interactive "Checking your understanding" sessions keep students actively engaged. For deeper dives, in-depth explanations, and video clips cater to mastery seekers. These lectures, recorded using *BoilerCast* and meticulously captioned for accessibility, become portable learning experiences through Kaltura in Brightspace.



"The slides that she posts are the best slides that I have seen in any course that I have taken. She takes the time to help students and make sure that we are understanding the material. The care that she has for us to do well is what separates her as one of the best professor's I have ever had!"

Student's comments-IDP survey, 2023

“For a magician performing magic, it is important to engage all the spectators, from the most enthusiastic to the most skeptics, creating a romance that can transform indifference into interest. And this, together with the suspense and the aroused curiosity, should be maintained not only during the show but also beyond it. This analogy provides me with a coherent framework of my approach to teaching and student learning”.

[Fragment of My Teaching Philosophy]

But not every mind learns the same way. Recognizing this diversity, I offer a smorgasbord of resources:

- **Narrated Student Notes (Podcasts, mp4):** AI-powered narration (using *ElevenLabs™*), delivered in digestible 15-minute chunks (short enough to hold a person’s attention) [1,2] caters to auditory learners, busy schedules, and language barriers. It’s learning on the go, whether at the gym or during a commute.

“The professor seems to strongly care about her student’s well being and understanding of the content. She is clear on what will be tested and what will be extra information. She organizes her slides in an incredibly engaging manner so students are engaged and actively learning the content being taught”.

- **Customizable Interactive Retrieval Practice (CIRP) Flashcards:**

Recognizing that some students prefer interactive learning strategies, such as testing rather than the repetitive reading of textbooks/notes [3] and acknowledging the widespread use of flashcards in healthcare-related fields [4,5], I transformed the entire student notes content into a CIRP flashcard format using basic HTML coding, which allowed for Brightspace integration.

“Dr. Castro is one of the best professors I have had at Purdue. She goes out of her way to create resources like flashcards that prove effective not only for exam performance, but also long-term retention of course material. Dr. Castro’s lecturing style is very unique and finds ways to cater to students of all different learning styles”.

Student’s comments-IDP survey, 2023

I craft the questions myself, ensuring they go beyond mere recall by using the "why" approach. By planting the seeds of critical questioning, I aim to empower students to apply and extend this valuable skill beyond the confines of the current course. This Spring semester, the CIRP Flashcards evolved. A new website format, accessible on any device, allows students to track progress, hide mastered material, and mix content from different lecture sections. It’s a personalized learning ecosystem, reducing reliance on external resources and maximizing comprehension.

“Dr. Castro puts her best efforts forward in ensuring an engaging, well-rounded, and inclusive learning experience for students. Dr. Castro is a wonderful teacher.”

“I LOVE YOU!! Thank you so much for posting flashcards. Please don’t stop making flashcards!!! They will be extremely beneficial for next year’s students. You are the best professor I have ever. I can tell you genuinely care about my learning. All the students deeply appreciate all the resources you provide them, it helps make anatomy much less scary. I love how you try to make lectures interesting and interactive with videos, practice questions, and FYI slides. Thank you for everything you do. I wish Dr Castro was the anatomy professor for the entire year instead of half.”

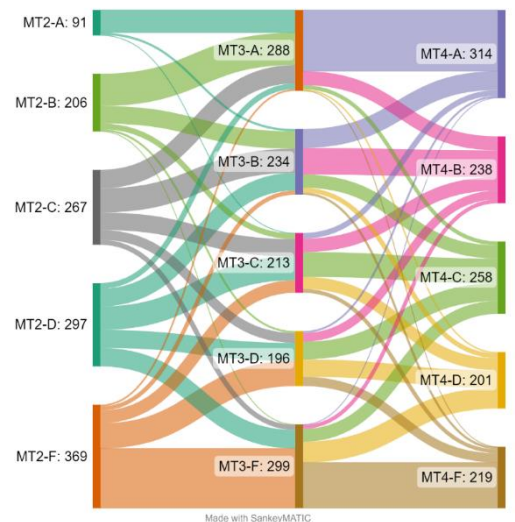
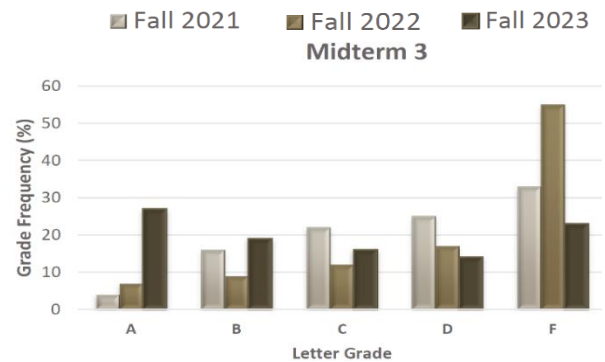
Student’s comment-IDP survey, Fall 2023

2-Creativity, Novelty, and Practicality

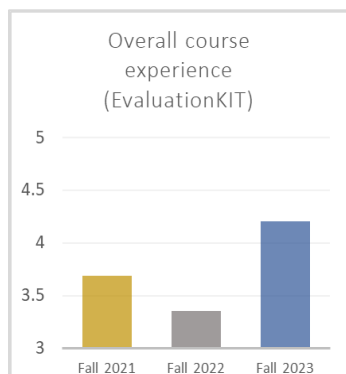
My educational approach redefines STEM education by transforming static notes into a dynamic ecosystem of personalized learning tools. Injecting creativity into every learning tool I have created, I have tailored resources to individual needs, resulting in significant improvements in student outcomes. What sets this approach apart is its effectiveness in large enrollment courses that accommodate students from diverse majors and varying levels of knowledge. The low-cost technology I use makes personalized learning accessible, paving the way for wider adoption and equity in STEM education. My CIRP flashcards offer a scalable model for fostering critical thinking, inspiring other educators to empower students beyond exam success.

3-Evidence of Student Learning & Satisfaction

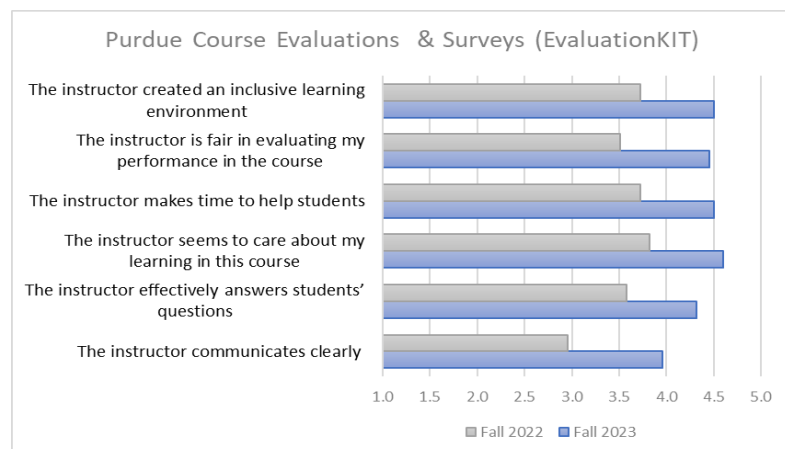
This graph illustrates Midterm #3 scores since I started teaching the course in Fall 2021. The course content and learning objectives (LOs) have remained consistent over these three years with minimal alterations, and the examination challenges have persisted. The Nervous System, a central aspect of this exam, has consistently posed a challenge for students, as evidenced by both instructor observations on exam scores and other authors [6]. Comparing Fall 2022 to the previous semester (Fall 2023), a noteworthy improvement is evident. The decrease in the number of students failing the exams is considerable, and there is a substantial increase in the number of students scoring an A in the exam. The MT3 average for Fall 2022 was 57%, whereas in Fall 2023, it rose to 74.8%. MT4 results also increased from 60% (Fall 2022) to 76%, but the simultaneous comprehensive exam last year might have led to divergent study efforts and influenced the poor outcomes. The Sankey diagram (on the right) specifically underscores the efficacy of these strategies in comparison to traditional teaching methods, as exemplified by Midterm 2 (MT2), which



was instructed by another lecturer and adhered to the conventional practice of providing student notes solely in PowerPoint format, as typically done in this course. Apart from test scores, my approach nurtured a sense of care and engagement in the large class setting that might have also contributed to the overall increase in student satisfaction with the course. This was evident in the end-of-semester IDP course survey evaluation (results below; response rate ~60%).



[The overall course experience includes course organization, assignments, laboratories, and exams]



"I really appreciated all Professor Castro did this semester especially as a student who had to retake this course I was able to see the changes made from last year to this year. You can really tell she cares a lot about us students succeeding and wants to provide sources to help us".

Student's comment-IDP survey, 2023

Enhanced study habits and reduced anxiety were reported as benefits. Increased engagement with the material led to better study habits, while diverse formats and accessible resources eased stress, especially for students struggling with traditional lectures. These qualitative observations reveal the transformative power of this approach, not just in terms of test scores, but in fostering a more confident, engaged, and critical learning environment for the diverse student population of BIOL-203.

4-Broader Impact: Reaching Beyond the Classroom and Institution

The ripples of this innovative approach extend far beyond the walls of BIOL-203:

- **Impacting over 1,100 students** across diverse majors through adaptable learning formats, catering to their varied needs and academic goals.
- **Applicability beyond BIOL-203** with core principles- personalized content, active learning, and technological integration - adaptable to other courses and disciplines. [I'm applying this approach in BIOL204, Spring 2024].
- This approach contributes to the **national dialogue** on effective STEM education practices, demonstrating the value of catering to individual learning styles and fostering active engagement.

Examples of Teacher Slides

LO1: List the parts of the NS that constitute the central NS (CNS) and those that constitute the peripheral NS (PNS)

CENTRAL NERVOUS SYSTEM (CNS)
 Brain: Central processing center
 Spinal cord: Gateway between brain and trunk/limbs

PERIPHERAL NERVOUS SYSTEM (PNS)
 Nerves: Conducting wires → Cordlike structures that conduct information. They are composed of axons (=nerve fibers) of neurons.
 Ganglia (sing. ganglion)
 Knotlike swelling in a nerve where the cell bodies of neurons are concentrated

Hey Neuron! Are you comfortable?

Astrocytes
 Provide neurons with nutrition
 Recycle important chemicals, Help to filter blood (BBB)
 Maintain and clean the surroundings of neurons

Microglia
 Patrol the brain, killing of any invader that dares to enter this VIP organ

Ependymal Cells
 (CSF)
 0.5 TO 10 μm/s
 150 μm/s
Oligodendrocytes

Did You Know...? FYI

Semantic memory
 Facts and general knowledge
 "To remember that Madrid is the capital of Spain."

Episodic memory
 Personally experienced events
 "Where did I leave my car in the parking lot?"

Many studies have shown that the brain remains capable of regrowth and of learning and retaining new facts and skills throughout life, especially for people who get regular exercise and frequent intellectual stimulation

Exam Question Example

Which of this sensory modalities (sensory information) is NOT carried by the spinothalamic tract?

a) Pain
 b) Temperature
 c) Crude touch
 d) Proprioception

→ d) Proprioception

The spinothalamic tract conveys pain, temperature, and crude touch.

Noxious stimulus (pain, temperature)

Study tip:
 Spino-thalamic
 Pain Pressure 2ps 2ts Touch (crude) Temperature
 "Pa-Te-La" (Pain, Temperature via Lateral spinothalamic)

Does this sound familiar? Recop

Fascicles
 Spinal nerve
 Nerve fibers (sensory & motor axons)

- A peripheral nerve is a cordlike organ
- the spinal nerves classify as a part of the peripheral nervous system.

Nerves carry currents in opposite directions, they are mixed nerves!

Within a peripheral nerve, the individual _____ are grouped together in bundles called _____ surrounded by a layer of connective tissue called _____

Perineurium binds axons into bundles
 AXONS of many n
 PERINEURIUM

Checking your Recall... Fill the blanks

Applying Your Knowledge...

An infant has been diagnosed as having **hydrocephalus** (abnormal buildup of fluid in the ventricles). By using brain imaging techniques such as computed tomography (CT), or magnetic resonance imaging (MRI), it was detected a blockage in the ventricular system between the third and lateral ventricles.

The blockage therefore must have involved the _____

Answer: Interventricular foramen (or foramen of Monro)

Lateral Ventricles
Interventricular foramen
3rd Ventricle
4th Ventricle
Central Canal

Exam Question Example:

Where can you find the cerebral peduncle?
 a) Cortex
 b) Forebrain
 c) Midbrain
 d) Hindbrain

Could you please remind me which was the sentence of the first ppt slide?

Study tip:
 "The snails come out in the middle of the day"

MID-BRAIN
 Cerebral peduncle
 colliculi

FRONTAL lobe
 Social Interaction
 Voluntary motor control
 Planning judgment production
 "executive functions": Decision-making, impulse control, and reasoning

PARIETAL lobe
 Integrates general senses (pain, temperature, touch, pressure, vibration, and proprioception), & taste information (Somatosensory cortex)

INSULA
 Visceral sensation
 Empathy (hidden by other regions)

OCCIPITAL lobe
 Principal visual center of brain

TEMPORAL lobe
 Language comprehension
 Hearing Smell
 Verbal, visual, auditory memory

Cognition (integration of information) is accomplished by association areas of the cerebral cortex.

Section A: Brain waves, sleep, and circadian clock

What does the EEG record? How? Does the EEG detect postsynaptic local potential or action potentials?

It can be determined with an EEG, it will be flat (lack of brain waves).

What is the definition of brain waves? What two parameters differentiate brain waves?

How do you define frequency referring to a brain wave? And amplitude?

Flashcard format (Fall 2023)- Integrated in Brightspace

Lecture 13: Urinary System I

What are the four main organs of the urinary system?

What are the three primary functions of the kidneys? Give examples.

What is the functional unit of the kidney responsible for filtering the blood and producing urine?

What are the two major parts of a nephron?

Flashcard (Spring 2024)- Website format with multiple functionalities

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- [1] Stuart J, Rutherford RJ. Medical student concentration during lectures. *Lancet* 312: 514–516, 1978. 10.1016/S0140-6736(78)92233-X.
- [2] Svinicki MD, McKeachie WJ. *McKeachie's Teaching Tips: Strategies, Research and Theory for College and University Teachers*. Boston, MA: Houghton-Mifflin, 2013.
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