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# The Science of Learning: Understanding the Learning Process and its Implementation into the Classroom

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# The Science of Learning: Understanding the Learning Process and its Implementation into the Classroom

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**ABSTRACT**

College and higher education is often seen as the next step for many students pursuing a particular career or field. These institutions strive to facilitate learning and maintain a rewarding academic environment. However, students often face various challenges when first attending college which is reflected by high levels of dropout and withdrawal from general education courses, especially for first-time students. In fact, according to the education data initiation, "at 4-year institutions, 18.4% of first-time, full-time college freshmen dropped out between 2019 and 2020" (Hansen & Checked, 2022). One of these challenges is understanding the process of learning on a fundamental level. If more students had knowledge of how this process worked, it would lead to better habits of how they should learn the material and content, allowing students to have more success in their courses even among different subjects.

**KEYWORDS:** Learning, Learning Process, Pedagogy, Classroom Active Learning, Exploratory Learning

College and higher education is often seen as the next step for many students pursuing a particular career or field. These institutions strive to facilitate learning and maintain a rewarding academic environment. However, students often face various challenges when first attending college which is reflected by high levels of dropout and withdrawal from general education courses, especially for first-time students. In fact, according to the education data initiation, "at 4-year institutions, 18.4% of first-time, full-time college freshmen dropped out between 2019 and 2020" (Hansen & Checked, 2022). One of these challenges is understanding the process of learning on a fundamental level. If more students had knowledge of how this process worked, it would lead to better habits of how they should learn the material and content, allowing students to have more success in their courses even among different subjects.

This article will illuminate the foundations of how the learning process begins and will focus on how professors use these principles to guide their students towards more effective learning. In order to achieve this, we learning process begins and will focus on how professors use these principles to guide their students towards more effective learning. In order to achieve this, we interviewed Dr. Marci DeCaro, Dr. Deborah Yoder-Himes, and Dr. Geoff Bailey to discover more about the learning process and how it can be better utilized by students to increase their learning retention.

We spoke with Dr. Marci DeCaro, a professor in the Psychology Department at the University of Louisville, who provided us insight into this process. Post graduation, Dr. DeCaro found an interest in cognitive psychology- the study of how people think. She looked into multidisciplinary experiences and started to explore cognitive aging, working memory, and problem solving. Dr. DeCaro was able to further study this at the University of Louisville, along with piecing these concepts together with classroom research. Her laboratory studies exploratory learning, a subtype of active learning, and she uses these concepts to improve student learning. Dr. DeCaro explained active learning as "anything students do to construct their own learning and knowledge" to a particu-lar topic. Instead of the traditional lecturing style, exploratory learning takes into account that students should be provided a task to complete beforehand. This enables students to form their own ideas about the content which allows them to explore the material themselves and to recognize gaps in their knowledge. This way of processing information allows students to become more familiar with the content beforehand and facilitates learning in a more efficient manner. One of the best ways to understand how the brain accomplishes this feat is through a psychological perspective with a biological lens.

The central nervous system, and more specifically the brain, acts as the control center for processing information. Our brain is composed of neurons, the most basic unit of our neurological system. Through neurons, our brain can use neurotransmitters to

communicate with itself, and over time, we are able to encode information to be recalled. It accomplishes this process using synapses. A synapse is an area that "connects" the end, or terminal, of one neuron with the beginning of another. The area between the neurons using synapses. A synapse is an area that "connects" the end, or terminal, of one neuron with the beginning of another. The area between the neurons is known as the synaptic cleft. When a signal, or action potential, is received by a neuron, it will send out neurotransmitters to travel across the synaptic cleft to the receiving neuron. When the brain makes new synaptic connections between neurons, it allows for new pieces of information to be attained, and this constitutes the process of learning. Although this is vastly oversimplified, understanding how our brain functions in learning and retaining information is incredibly important.

## Learning within the Classroom

Not only is understanding the psychological and biological aspects important, but applying these concepts in the classroom is necessary, too. Dr. DeCaro provided insight into how professors and instructors should use these concepts within their classrooms. She explained how these exploratory learning and active learning tasks should not only be tailored to meet a class's learning needs, but also mindful of the time and effort required for the students to complete the tasks in order to not overwhelm them. These tasks should not be too challenging nor too straightforward, but an intermediate difficulty should be in place to bring the most out of the task.

Next, we interviewed Dr. Deborah Yoder-Himes, a professor in the Biology Department at the University of Louisville, to find out more about how she utilizes these active and exploratory learning concepts, along with her own research, in her classroom. Dr. Yoder-Himes has extensively studied the foundations of learning with her research in teaching,also known as pedagogy. She has published multiple papers regarding not only how students learn in different settings, but also how teaching and testing have been poorly administered through the use of online proctoring tools such as Respondus Lockdown Browser and Monitors. Along with her research, Dr. Yoder-Himes has previously worked with the Delphi Center for Learning and Teaching at the University of Louisville. Dr. Yoder-Himes utilizes her research findings and experience within the numerous Biology classes she instructs at the University.

The first step in having an enriching learning environment is the prior arrangement of the classroom. Dr. Yoder-Himes emphasizes group learning and arranges her classes to exemplify her pedagogical techniques. Dr. Yoder-Himes explains how she begins each class period with "pre-knowledge checks within groups" to then be discussed together as a class. She uses active learning exercises (ALEs) to create positive learning environments and experiences to enhance how students learn within her classroom. For instance, one ALE consists of a small phase of group work that then is opened to the class for an "acting-out" section of the ALE where groups work together to answer questions and to accurately act out a biological process. Another ALE has groups work together to create their own virus using the concepts covered in class to create the most virulent virus possible. These ALEs utilize both exploratory and active learning techniques that make students focus on particular areas of the material and apply it to scenarios outside of the classroom. When taken collectively, the strategies employed by Dr. Yoder-Himes allow for active learning to take place within her courses and for students to build upon each other to better understand the content and material. Dr. Yoder-Himes and her fellow faculty are the forerunners in leading a change in how students learn.

## Learning Resources for Students

To support learning beyond the classroom, the University of Louisville offers students many resources, one of which is the REACH Learning Resource Center (LRC). Located within the Belknap Academic Building, a newly built state of the art center designed for facilitating active learning, the REACH LRC focuses on strengthening student learning through a variety of strategies. We met with Dr. Geoff Bailey, Executive Director at the REACH LRC, to get an insight into how the center accomplishes this goal. Dr. Bailey has an extensive background with the learning community and found an interest in teaching others how to learn. He used this interest to transition into academic and student affairs and became involved with the REACH LRC at the University of Louisville.

Dr. Bailey explained how he uses active learning strategies as well as structured learning assistants (SLAs) within classes to facilitate better learning. SLAs have been increasingly utilized in DFW (D-grade, F-grade, or withdrawal) courses, typically general education STEM courses, such as biology or chemistry. These SLAs have also been implemented within flipped classrooms to help with using these active learning strategies and to teach students how to study efficiently on their own through various methods. One technique used by SLAs

within the classroom is working through problems with students, providing guidance and encouragement when necessary. Another strategy is having after-hours SLA tutoring sessions where students can drop in to ask more specific questions about material they need to better grasp. In fact, the REACH LRC has been so successful with the implementation of SLAs that "Biol-240-01 [SLAs]decreased the number of DFW grades from Spring 2019 (46%) to Spring 2022 (27%)" (Bailey, 2022). In addition to SLAs, the REACH LRC also provides numerous other services such as drop-in tutoring, PAL (peer assisted learning) tutoring, and graduate exam tutoring that students can all use. Drop-in tutoring is offered for courses ranging from anthropology to mathematics. This tutoring is free of cost and often does not require a scheduled appointment, making accessing this resource even easier. PAL tutoring is provided in many lower-level courses. The PAL tutors will review custom-made worksheets during their tutoring sessions that allow for students to engage and practice with the material. Graduate exam tutoring is also provided by the REACH LRC. Offered are full-length practice exams which include the MAT, GRE, LSAT, and MCAT, along with virtual tutoring sessions. Additionally, the REACH LRC also provides students with discounts through the Princeton Review.

Dr. Bailey emphasizes how learning is an intended and purposeful process, rather than just a mechanism in order to pass tests or get a certain grade. He also explains how the new Belknap Academic Building has provided an environment that has helped faculty use active learning strategies in their courses. However, he mentioned that any classroom can be an active learning environment if faculty encourage active learning methods. As a message to students, Dr. Bailey expressed that students shouldn't wait until they have difficulty or trouble, but rather should "use it even when they don't need it; use it until you are at a point where you have the output". He welcomes all students to come to the REACH center and find out more about how they can use the services provided by the organization to better how they learn. The learning process can be difficult to understand, and perhaps even more difficult to apply to one's own studying. This article aimed to illuminate various learning strategies, and we encourage students to utilize these strategies to help their own learning and studying habits. For example, some simple techniques to begin practicing active learning include writing specific details in the margin of your notes during a lecture or quizzing one another over the content in a group setting. Once you begin to feel more comfortable with those strategies, consider transitioning to making in-depth questions over the material and discussing each answer choice, making sure to explain why each answer is correct or incorrect. We hope that, through the efforts of researchers and instructors alike, these concepts of the learning process have been made easier to apply and practice.

If you are looking to become involved with any of the research listed within this article or simply want to inquire more about their learning and teaching philosophies, feel free to contact Dr. DeCaro or Dr. Yoder-Himes, or visit their respective Louisville.edu webpages for additional information. If you want to utilize the REACH LRC, contact Dr. Bailey or visit the REACH center in the Belknap Academic Building to learn more. Also, if you are looking for more resources, be sure to visit the Delphi Center for Learning and Teaching. All of the accompanying websites for each of the professors or faculty listed in this article will be located within the section below. For further information into the resources provided by the REACH LRC or the Delphi Center for Learning and Teaching, or to learn more about the professors and faculty described in this article, please visit the websites below:

Dr. Marci DeCaro:

https://louisville.edu/psychology/decaro

Dr. Deborah Yoder-Himes:

https://yoderhimeslab.weebly.com/

Dr. Geoff Bailey:

https://reach.louisville.edu/About/staff/

The Delphi Center for Learning and Teaching:

https://louisville.edu/delphi

The REACH LRC:

https://reach.louisville.edu/

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