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Preparing Faculty Using an Assessment for How Clinical Laboratory Students Learn

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Preparing Faculty Using an Assessment for How Clinical Laboratory Students Learn

Abstract

Purpose: Students interpret and learn information in different ways. Whether students develop deep or surface learning depends in large part on the transmission of information from their educator, which activates their domains of learning. Knowing students' learning styles as either visual, auditory, psychomotor, or mixed, professors can develop teaching resources that benefit the learning diversity of their students by using different instructional delivery methods. This study examines survey results for how students learn best to enhance the student experience within the Clinical Laboratory Science (CLS) program at a university in Detroit, MI, USA. **Method:** To determine the resources needed to enhance learning for students and to prepare faculty, the cognitive learning styles of students within the last four cohorts of the CLS program were examined. To obtain this data, CLS students, from the 2018-2021 cohorts, participated in an online survey to discuss which cognitive learning styles they identified with based on the survey questions. **Results:** The majority of students did not just identify with one learning style. However, when presented with two or more learning styles, their retention of the material and experience was enhanced. **Conclusion:** Creating teaching resources for educators that revolve around multiple learning styles is necessary. Once established, the use of these resources can help enhance learning retention and thus encourage faculty members to thrive within the Clinical Laboratory Science program.

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Preparing Faculty Using an Assessment for How Clinical Laboratory Students Learn

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ABSTRACT

Purpose: Students interpret and learn information in different ways. Whether students develop deep or surface learning depends in large part on the transmission of information from their educator, which activates their domains of learning. Knowing students' learning styles as either visual, auditory, psychomotor, or mixed, professors can develop teaching resources that benefit the learning diversity of their students by using different instructional delivery methods. This study examines survey results for how students learn best to enhance the student experience within the Clinical Laboratory Science (CLS) program at a university in Detroit, MI, USA. **Method:** To determine the resources needed to enhance learning for students and to prepare faculty, the cognitive learning styles of students within the last four cohorts of the CLS program were examined. To obtain this data, CLS students, from the 2018-2021 cohorts, participated in an online survey to discuss which cognitive learning styles they identified with based on the survey questions. **Results:** The majority of students did not just identify with one learning style. However, when presented with two or more learning styles, their retention of the material and experience was enhanced. **Conclusion:** Creating teaching resources for educators that revolve around multiple learning styles is necessary. Once established, the use of these resources can help enhance learning retention and thus encourage faculty members to thrive within the Clinical Laboratory Science program.

Keywords: learning styles, auditory, visual, psychomotor, mixed

INTRODUCTION

Learning styles is a term used to refer to the way in which students learn information. In higher education, learning is dependent upon the approach, motive, and what students experience when presented with information to activate their learning styles. Therefore, knowing the learning styles of each student can lead to a successful academic performance. Students comprehend information in diverse ways, and they learn differently according to their age, gender, and their past circumstances. Both the student's perception of the instructional content and the processing of the information are key to active learning.¹ This knowledge can be achieved through a combination of visual, auditory, or psychomotor learning styles.² Students who are visual learners learn best with videos, pictures, flowcharts, or reading the words in a book. Auditory learners prefer the spoken word, where the information can be explained in a professor's lecture or by reading a book aloud to hear the words. Psychomotor learners obtain knowledge best with a hands-on approach, with learning activities conducted in a student laboratory, for example, performing the skills they may need in their future profession.³ Mixed-learning styles help learners use different strategies to transmit, assimilate, and give meaning to the content the professor is teaching.¹ Students who learn best this way need auditory, visual, and psychomotor styles at different intervals in the learning process. With the knowledge of their student's learning styles, professors can develop teaching strategies to benefit the learning diversity of their students with different methods of instructional delivery.⁴

Students in the Clinical Science program are taught specific clinical material to develop them into highly skilled laboratorians, whose main role is to develop and conduct laboratory tests in the medical field. Such laboratorians analyze blood, tissue, and body fluids using analytical techniques, and thus need to draw on strong problem-solving skills and attention to detail to make critical health care decisions. Faculty in the Clinical Laboratory Science (CLS) program prepare students with the skills necessary to succeed in this profession, which thus helps to drive students' motivation, spark their passion, and in turn drive their overall experience.² Whether students develop surface or deep learning depends in large part on the transmission of information from their instructors which activates their learning styles.⁵ Given the frequent interactions between faculty and their students in the CLS program, this is an excellent opportunity to explore student learning styles in the health professions.

Previous studies have examined how students learn by either addressing their cognitive levels, perceptions of learning, or learner awareness. However, few have examined these learning styles to develop curriculum or teaching tools based on students' learning needs.^{2,6,7} To address this gap, a qualitative study was conducted to determine students' perceptions of learning by combining the cognitive aspects of learning with students' experiences in order to understand how to help prepare professors in the classroom to produce long-lasting content retention for today's learners. Specifically, students from the Clinical Laboratory Science Program at Wayne State University were surveyed to determine their learning styles, experiences, and their requirements as students to enhance their learning in higher education. Constructivist theorists such as Vygotsky, Dewey, and Knowles were modeled to understand how to adapt the Study Skills Survey Questionnaire from the University of Houston to construct a well-rounded survey to gain in-depth information about student learning styles, environments, and experiences. Drawing on these models of learning, we can theorize an understanding of how the learning styles of today's students impact their knowledge retention and develop their perceptions of the world. Since only three learning styles were used in this study, future exploration of other learning styles may need to be conducted if there is no change in student outcomes.

The results from this study can guide the development of training tools and resources for faculty within the Clinical Laboratory Science program to help provide better instruction, which in turn creates better learning retention for students. Furthermore, since the challenges in preparing faculty with an understanding of today's learners are not unique to CLS and occur in many disciplines, the results can also be used to help develop resources for faculty in other academic disciplines.

METHODS

The purpose of this study is to understand how students best learn information in order to enhance the Clinical Laboratory Science (CLS) student experience at Wayne State University, Detroit, MI, USA. The CLS program, located in the Eugene Applebaum College of Pharmacy and Health Sciences, is a cohort program. Only four professors provide instruction for the entire cohort. Given the frequent interactions between faculty and their students, this is an excellent opportunity to explore student learning styles to potentially enhance their learning and their overall experience.

To determine the resources needed to enhance student learning and to prepare faculty to teach specific learning styles, the cognitive learning styles of students within the last four cohorts of the CLS program at Wayne State University were examined. The qualitative exploration of this study was aimed at understanding how students learn today and thus improve teacher preparedness in the classroom. The study focused on one research question:

RQ1: How can knowing the cognitive learning styles of CLS students at Wayne State University enhance teaching preparation and learning retention?

To obtain this data, CLS students participated in an online survey, adapted from the Study Skills Survey from the University of Houston. The questions from this survey prompted responses regarding which cognitive learning styles they identified with when asked about prior learning experiences, what type of learner they are, how different learning styles work for them, and what strategies they used to overcome learning obstacles.

PARTICIPANTS

Study participants included four cohorts of students in the CLS program at Wayne State University (WSU) from the years 2018 to 2021. Each cohort consisted of approximately eighteen to twenty-four students per year, for a total of eighty students. Since the number of CLS students at WSU is relatively small, all of the students in these cohorts were asked to participate. Among the four cohorts, seventy-nine students (98.8%) responded to the survey, including 15 (19%) males and 64 (81%) females with ages ranging from 19-40 years old. Only active students were included in this study, who were surveyed during their first semester (i.e., junior year) of their Bachelor of Science in Clinical Laboratory Science degree at WSU. Students from other CLS programs globally or CLS alumni from WSU were excluded. Approval from the WSU Institutional Review Board (IRB) was obtained prior to the study. Study details, including the description of procedures, protection of confidentiality of participants, the role of the researcher, and interview protocol were submitted to the IRB for review and approval.

DATA COLLECTION/ANALYSIS

The participant's point of view was collected by using a modified version of the Study Skills Survey Questionnaire from the University of Houston. The survey was constructed in a way to gain as much in-depth information about student learning styles, environments, and experiences that would help create teaching resources based on the answers provided. The survey was sent electronically via WSU's Canvas Learning Management System to each cohort in the years 2018 to 2021. The students were given one week to complete the survey, which was estimated to take approximately 20-30 minutes to complete. The survey consisted of nine questions for the 2018 and 2019 cohorts. For the 2021 and 2020 cohorts, a tenth question was added to determine if and how the COVID-19 pandemic affected their learning. Understanding the challenges in learning or new experiences resulting from the pandemic warrants exploration, as the pandemic may have altered students' perceptions of learning styles. Participation was voluntary, and consent was implied if the student completed the survey. All participants' names were de-coded to protect their identities.

The survey results were coded into themes based on participants' recurring perceptions and experiences of their optimal learning styles using a deductive study method, which was then entered into an Excel database. The modified survey from the University of Houston allowed the authors to approach the data with these predetermined themes based on established evaluation questions. A two-step approach was used for coding the data. First, both authors manually reviewed the information to identify overlapping themes, which were entered into an Excel database. Overlapping theme data consisted of information that participants received and with general perceptions of learning styles. The information was then sorted and placed into the learning style themes for this study; each author sorted two years of data. Once completed, the information was assessed by one author and cross-checked for validity by the other author.

Table 1. Modified Study Skills Survey Questionnaire

Study Skills Survey Questions
Q1. What do you do to be successful as a learner?
Q2. What are your strategies when you encounter obstacles as a learner?
Q3. As your instructor, what can I do to help you learn?
Q4. What can other students do to help you learn?
Q5. What else do you want me to know about you as a learner?
Q6. What's a prior experience that you think will help you in this course?
Q7. What are you most hoping to learn from this program?
Q8. Does reading the textbook help you learn or hinder your learning? Explain
Q9. What type of learner are you, visual, auditory and/or psychomotor? Explain how these different learning styles work for you?
*Q10. Did COVID-19 effect your learning? In what way(s)? ONLY for 2020 and 2021 cohorts

RESULTS

The students had different perceptions and experiences with the learning styles in which they identified. The survey results showed that the majority of students did not just identify with one learning style but rather responded to a combination of learning styles that enhanced their learning experience and retention of material. The self-identification of learning styles was linked to the

questions regarding how the students learn from prior educational experiences in their undergraduate classes and from life experiences. Furthermore, students were asked what makes them successful learners and what strategies they employed. Although several students identified with either a visual or psychomotor learning style, no student identified with an auditory learning style alone. Moreover, the majority of the responses from the 2021 and 2020 cohort about the COVID-19 pandemic expressed challenges and difficulties that affected their learning, which pushed them into a strictly auditory learning mode. Analysis of the qualitative data revealed four themes regarding learning styles: auditory, visual, psychomotor, and mixed-learning styles, as described in the following section.

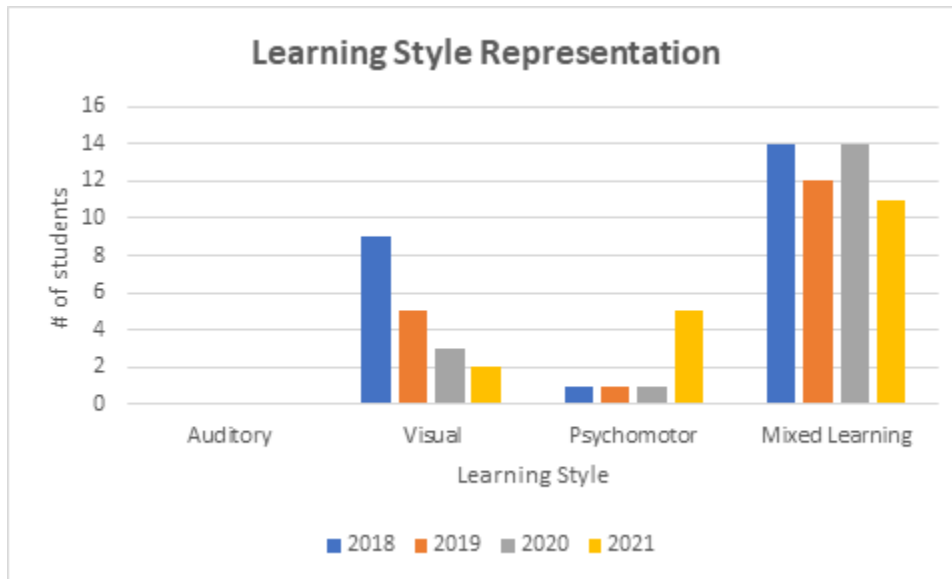


Figure 1. Learning Style Representation

Auditory Learning Style

Of the 79 responding students, none claimed to be just auditory learners. Even though the students did not indicate auditory as their sole learning style, many wanted an aural component to enhance their learning when combined with visuals and/or psychomotor activities. Aural components are helpful when a professor lectures about key aspects of the material or highlights important sections of the content. Not only had the students discussed the need to focus on large sections of content aurally in a classroom setting but also at their leisure. Some students claimed to have wanted to listen to the content either before or after the lecture to study for exams. Another student commented that having recorded lectures to refer back to helps with learning retention.

"The auditory learning style is also very helpful as the instructor will ask valuable questions and highlight key points in class. Carefully keeping my ears on what the instructor explains and teaches during lectures and lab sections will help me obtain significant information other than reading materials given."

Visual Learning Style

Of the 79 responding students, nineteen (24%) identified solely as visual learners. If visual diagrams, pictures, or graphs on paper were present, they were more likely to remember the information. When visual information is displayed, the retention of information is enhanced because a connection is formed. For the students who reported that they learned best in a mixed-learning environment, the visual learning style was the most preferred by 46 students (58%). The students reported that visual images presented during a professor's lecture such as pictures in a PowerPoint presentation or in a video recording served as excellent visual learning tools. Information in the form of pictures, graphs, diagrams, and charts helps the students to remember and process information better. One student reported needing a visual when listening to a lecture in order to help solidify the point or context of the material. In this case, if the student did not see a visual first, the student had problems with psychomotor activities following the lecture. One student commented on being a visual learner:

"I am a dominant visual learner. Seeing how skills are performed and reading texts to supplement my learning are my main solutions to succeeding in college classes."

Psychomotor Learning Style

In the first three student cohorts, which comprised 60 students in the years 2018-2020, only one student per year (5%) chose psychomotor as their preferred learning style despite participating in a heavy laboratory-science-based program. However, in the 2021 cohort, five students (28%) chose psychomotor as their preferred learning style. Students who identified primarily as psychomotor learners said that they understood the material best when they had applied it. Once the lecture is completed, the students can see and perform the laboratory procedures, which was important for retaining information. Physically grasping or touching the objects in the laboratory expanded their knowledge by using their senses. When reading lab procedures prior to the laboratory session, these students learned better when they performed tasks themselves, not while watching someone else perform them. A student from the 2021 cohort explained,

"I would say I am more of a psychomotor learner. I love being able to physically do things and it helps me piece the things together that we learn in class."

Mixed Learning Styles:

Within the four cohorts, fifty-one students (65%) identified with more than one learning style. These students identified with multiple mixed-learning styles, including visual and psychomotor, psychomotor and auditory, visual and auditory, or a mix of all three. These students believed that multiple learning styles were needed to successfully retain the information. Students reported that listening to lectures with images, watching YouTube videos or lecture recordings, rewriting their notes, and physically drawing diagrams, tables, and charts best helped them learn information. Many students liked to see visuals during an aural lecture and then physically participate in the process in order to fully understand it. For these students, the scientific concepts are difficult to grasp without incorporating with all three learning styles. One student commented on the process of learning how to use a manual pipette:

"I think I learn best by a combination of all three methods. It depends on what I am learning. I would not be able to pipette properly by the verbal words alone. I would have to see and feel how much pressure is needed to be applied and how far the bulb needed to be attached to the pipette."

(See Table 2 in APPENDIX)

Effect of COVID-19 Pandemic on Learning

Students in the 2020 and 2021 cohorts (37 students in total) were asked if the COVID-19 pandemic affected their learning and retention, but only 10 out of the 37 students (27%) responded. The responding students described difficulty in maintaining focus, self-accountability, and motivation in online coursework, especially when other family members were either working or learning online in the same dwelling. One student reported having a very effective system of taking notes, attending lectures, and being in study groups before the pandemic shutdown, but transitioning to online coursework, especially while dealing with the stress of the pandemic and the health of their family, was very difficult. Zoom® sessions for the lecture component had led to difficulty in concentration, which often led to sleepiness. Pre-pandemic, a student was full of energy and excitement when the program started but was emotionally set back due to the loss of a family member from COVID-19.

Even though no data was collected to compare pre-and post-pandemic effects, this study determined that prior to 2020, more students had identified as visual learners. However, students performing coursework during the pandemic timeframe, using the 2021 cohort data, reported identifying more closely with a psychomotor learner style.

"COVID-19 definitely affected my learning. Online is not the same and makes it much harder to understand and retain the material. The semester before everything was moved to online learning, I had a great system of taking notes, attending lectures, study groups, etc. But going online, especially through the stress of the pandemic and the health of my family was very hard. Especially if a relative passed away, or was hospitalized, my focus wasn't always there. All of that started to create a wedge in my learning and my beneficial academic habits. Even to this day, I find that I'm not as motivated as I was before and that my routines aren't as productive."

DISCUSSION

Learning greatly depends on the direct transmission of information by the faculty member and the approach they use to deliver it.⁵ Educators should possess an understanding of the science behind learning⁶, as it can help create teaching resources for faculty within the Clinical Laboratory Science program to provide better instruction, which in turn increases learning retention for students. Results from this study showed that creating resources from a mixed-learning style is preferred; however, this does not negate resources created in either auditory, visual, or psychomotor styles as long as there are multiple options for each learner. Creating teaching resources for educators that incorporate these learning styles is important. Students require multiple resource options for

successful outcomes. Once established, the use of such resources can help with enhanced learning retention, which will encourage faculty members to thrive within the Clinical Laboratory Science program at Wayne State University. To help students to retain knowledge, the blended learning method is recommended. Blended learning allows for flexible instructional delivery methods in order to make learning convenient for the student.⁸ Such methods can include lectures (either in-person or recorded) with images, and a psychomotor component, if possible. In consideration of student motivation when returning to in-person classes post-pandemic, on-demand resources for students should be made available at any time, including recordings of lectures, extra videos, and visuals on the topics of discussion that are placed in the university's Learning Management System for later use. The on-demand resources should have a minimum of two learning style components available. For example, for visual and psychomotor learners, instructors should encourage students to draw complex ideas, such as creating the classifications of Hemopoietic cell lines or drawing an algorithm for microbiology bacterial identification, because it helps the retained learning material to be used as a recollection aid.⁹ Additionally, for WSU's Clinical Laboratory Program, such resources should include a simulation where students can practice using real-life scenarios in various disciplines to stimulate critical thinking and to learn laboratory safety.⁸ Such resources should include an active engagement component that stimulates each of the learning styles.

In consideration of student focus and self-accountability post-pandemic, active participation can only solidify academic success. For example, instructors can encourage students to discuss concepts in a classroom setting after having previously watched recorded lectures or videos or reading the information on a topic before coming to the classroom. During class time, instructors guide the students with a discussion or questions about the learning material to engage students' critical-thinking capabilities.¹⁰ This method increases student engagement and communication skills by focusing on what was viewed before class, enabling them to prepare and answer questions during class.

Furthermore, educators should encourage students to recognize their own learning styles and preferences for best retaining information. Failing to identify students' learning styles could place some students at a disadvantage. However, if educators focus on the learning style of the majority of the students, those students might not try to adapt to new ideas of learning and thus could miss potential learning opportunities that could affect their future careers.

Lastly, the benefits and value of knowing student learning styles can be applied beyond students in the CLS professions. For example, medical students primarily learn best using the psychomotor style followed by aural learning. Medical professionals frequently discuss health records with their patients, and thus medical students should discuss the learning styles of their patients in order to best communicate treatment plans and achieve the best patient outcomes.¹¹

Limitations

This study has two limitations. First, the study was conducted at one American university within a specific health-related program, which may lead to a lack of generalizability to other programs or professions. Although four cohorts were surveyed, the sample size was small due to the small number of students in each cohort. Second, since the study explored the learning styles of the CLS cohorts from 2018 to 2021, the shifts in learning due to the pandemic may significantly change future results. Future studies need to be conducted to better understand how to prepare faculty for a "new pandemic normal", as well as consider the method of teaching, such as in-person, hybrid, and online learning.

CONCLUSION

This study showed that students learn in a variety of ways. Surveys from a cohort of students between 2018-2021 showed that students rarely identified with one individual learning style, i.e., only auditory, psychomotor, or visual. Instead, most students needed more than one learning style to successfully retain the knowledge presented in their highly science-based classes. Therefore, learning resources, prepared by faculty, to guide students through their higher education are recommended. The Clinical Laboratory Science program at Wayne State University must provide the guidance needed for students to become highly skilled laboratorians, and thus faculty in this program should develop instructional tools based on a mixture of learning styles. Successful students, in turn, give the Clinical Laboratory Science program and the university a good reputational standing. Well-prepared faculty with a large toolbox of resources can have a positive impact on students' success.

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APPENDIX

Table 2. Student Quote to Theme Mapping

Student Responses			
Auditory	Visual	Psychomotor	Mixed
Auditory is not bad. However, it depends on the voice of the speaker it should be very enthusiastic for me to keep following. I would also recommend it for specific classes, not for any class	I'm more of a visual learner than a reading person. I like PowerPoint the most since it gives information in a simpler way. Due dates for an online class are very effective, it makes me on time with my submission.	I'm a hands-on learner.	I am definitely a psychomotor and auditory learner, I like to switch places while I am learning and it helps me concentrate more. I also like listening to lectures, listening does help me understand my concepts.
The auditory learning style is also very helpful as the instructor will ask valuable questions and highlight key points in class. Carefully keeping my ears on what the instructor explains and teaches during lectures and lab sections will help me obtain significant information other than the ones in the reading materials.	I am a very visual learner. I like to look at tables, graphs, and pictures of things we're talking about. Slides with lots of text and nothing else are way less helpful to me than slides that help compartmentalize the material in some way.	I would say I am more of a psychomotor learner. I love being able to physically do things and it helps me piece things together that we learn in class.	I would say that I am mostly a visual and psychomotor learner. Not too much of an auditory learner. Sometimes I would zone out during a lecture and not be able to remember what the professor had said, but I will remember the words written on the board or the images very well. I also like to write out all my notes by hand because the action of writing the notes and looking at them helps me remember and study very well. Looking at notes online or typing them up does not help me at all. I also learn very well during hands-on activities. Once I have done an activity using my hands I can remember it well and it can stick with me a lot longer than if I had listened to someone explain that same task.
	I am a visual learner and like to see how things are done. It can be difficult for me to comprehend certain topics from just reading words in a textbook. I try my best to make everybody around me proud, but sometimes when I have a lot on my plate, I get frustrated, extremely stressed out, and just shut down. So, I like to take things at my pace to try to avoid a mental breakdown for my own sanity.	Psychomotor, I like to use several senses when learning.	I'm a visual/auditory learner. I also like to explain to anyone what I learned afterward which helps me to remember the material and understand it more. I will usually know then what I still need to improve on.

Student Responses			
Auditory	Visual	Psychomotor	Mixed
	I am a dominant visual learner. Seeing how skills are done and reading texts to supplement my learning are my main solutions to succeeding in college classes	I am a psychomotor learner, but I can still learn from the other forms of learning as well. I just find it easier to learn from doing hands-on activities myself.	I think I learn best by a combination of all three methods. It depends on what I am learning. Pipetting if you just told me the steps to pipet. I would be able to do it but not correctly until I try it several times. I would have to see and feel how much pressure needed to be applied and how far the bulb needed to be attached to the tube etc. If listening to a lecture they are monotone it requires a lot more attention than one who is changing pitch and tone while proposing questions while speaking. Powerpoint help as well as having pictures and words at the same time helps to complete the lesson.