

# Undergraduate Student Researchers, Preferred Learning Styles, and Basic Science Research: A Winning Combination

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**Abstract:** In basic science research, student researchers are often challenged with not only the technical portion of the research design but also the team dynamic. Understanding how a student prefers to learn can provide an advantage for mentors to better meet these challenges. In this article, the authors describe the experience of working with student researchers with different preferred learning styles and how knowing this information contributed to creating a positive learning environment resulting in a winning combination for the research team.

**Keywords:** learning efficacy, preferred learning styles, student researchers

The combination of undergraduate students and basic science research experiences outside of the traditional classroom can be exciting and rewarding. Because students come prepared at different levels of technical expertise and knowledge, there is sometimes a steep learning curve for both the students and the investigators until minimal competencies can be reached and students become more comfortable as contributing members of the research team.

To better meet these challenges, it is beneficial to assess the students' preferred learning style(s), as learners of all ages have different characteristic strengths and preferences in processing information. Auditory learners are more comfortable with verbal forms or spoken explanations. Visual learners tend to focus on visual facts, data, and algorithms. Kinesthetic learners prefer to learn actively with movement (Kolb 1984). The information gained from such analyses enables the design of learning resources to be tailored to the needs of the learners. After identifying the students' preferred learning style(s), an instructor can use

a variety of strategies to create an intriguing learning environment on a consistent basis. Developing an environment directly connected to individual learning styles is important. According to Lawrence (1994), engaged learners absorb more in a classroom situation; therefore, we wanted to see if this observation held true in a concentrated, basic science research environment. In addition to our current roles as both lecture and laboratory instructors, we were able to invite two students to participate in a grant-funded basic science research investigation. Having limited opportunities to participate in basic science research with students, we were excited at the chance to provide a different learning experience for these students.

Before we began working on the basic science research protocols, we determined the two students' preferred learning style(s). We did this by using a self-reported learning styles inventory (Haroun and Royce 2004). Through a series of statements, this instrument aids in the identification of preferred learning style(s) from the three different types: auditory, visual, and kinesthetic. The survey takes less than ten minutes to administer and evaluate. We previously used this survey information in our traditional classrooms for allied health students. We found it to be an incredibly useful tool in developing course content, both in the classroom and laboratory portions of our courses. Over the previous four years, the learning style preferences of our classroom cohorts have been approximately 15 percent auditory, 40 percent visual, and 45 percent kinesthetic. This is the first time we used this approach outside the traditional classroom and applied it in a basic science research environment.

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### Student Researchers

The data from the self-reported preferred learning styles inventory indicated one undergraduate student researcher (SR1) had a preferred learning style of kinesthetic, whereas the other student researcher (SR2) had a preferred learning style of visual (figure 1). The data also indicated auditory learning was the least preferred by both students. We then used this information to make decisions about how to best present the instructions and facilitate discussions so each undergraduate student researcher would become a contributing member of our research team.

The nature of the basic science research required strict adherence to sterile technique, chemical hygiene protocols, quality control guidelines, and handling of microbiological specimens. Both undergraduate student researchers were completing their junior year of a four-year bachelor's degree program. Each had successfully completed several biology and chemistry classes. When asked to demonstrate various techniques needed in basic science research, both students successfully demonstrated the appropriate level of expertise for minimal competency with no further discussion needed.

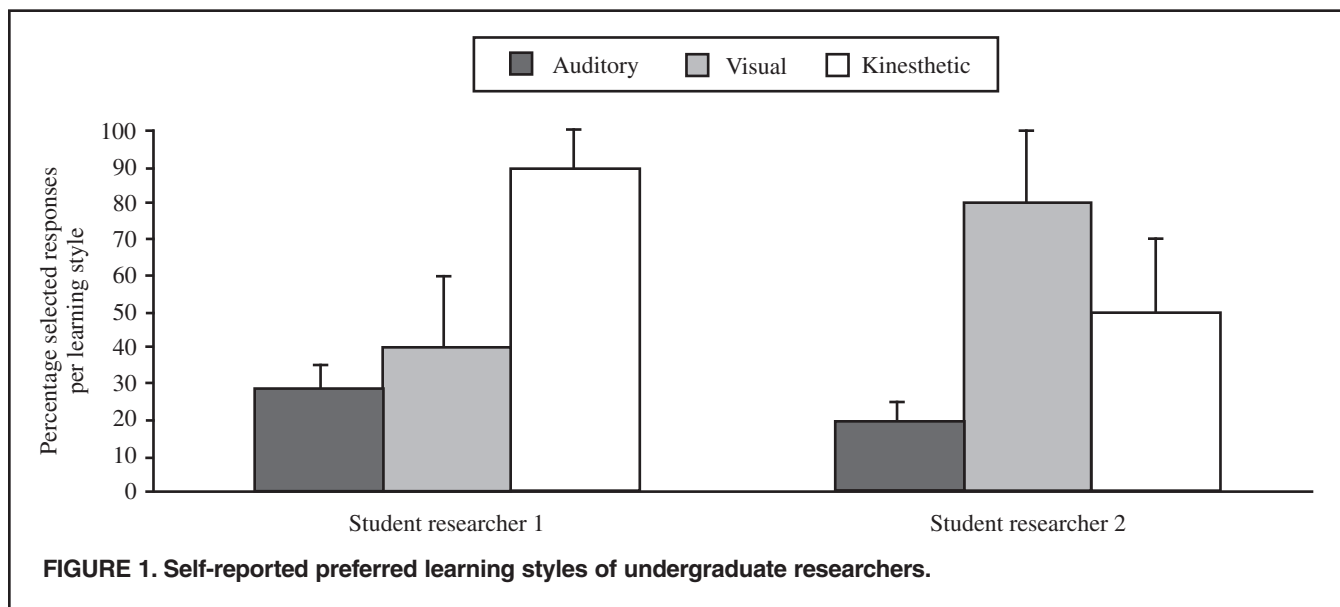
### Beginning the Project

We included the students in the preliminary discussions regarding project design. A detailed plan from the grant application was a good road map but the "nuts and bolts" of timing and scheduling needed to be worked out on a weekly basis. We encouraged the students to participate in the discussions. The basic science question for the entire project involved the timing for the adherence of bacteria to different substances. Each student was working with a different bacterium,

so although some of the work was similar, there were significant differences in their responsibilities.

One of the first problems we recognized was that SR1 was having difficulty beginning anything new. Once SR1 had worked on a particular protocol with our help, it was fairly smooth sailing with a quantifiable work product and quality results, but getting started was a barrier on a consistent basis. After much discussion and some lost time, we decided to move the weekly laboratory discussions from the office space into the laboratory, especially when the topic of what to do next was on the agenda. This allowed SR1 to have a hands-on approach when thinking about the instruments and protocols to be used. SR1 was able to manipulate items to help in the creative part of the process as we discussed it and was comfortable presenting ideas in this manner. Contributions from SR1 were significant once we employed this strategy on a routine basis. Allowing SR1 to work through different ideas using a kinesthetic component met the student's preferred learning style in a positive way. After using this approach for a few weeks, SR1 responded by affirming, "This approach works so much better. I just wasn't getting it at the very beginning; all the ideas and protocols were swimming around in my head, but now with practice, it all becomes much clearer."

SR2 did not have the same need for a hands-on experience to develop ideas for various parts of the project; however, it was clear that all of the protocols needed to be documented on paper for SR2 to follow. Although documenting is something all researchers should do on a continual basis auditory instructions for the smaller details are common. SR2 needed to write down even the smallest details either during the weekly meetings or immediately after so the information could be referred to at a later date. SR2 would always begin by



saying: "Let me get my paper so I can write this down." Comments from SR2 included, "You know when SR1 and I discuss the work, and I can see it on paper or I see it in my head, we're pretty good together. We've begun to take bigger steps forward in the process."

After we determined how to implement different strategies to best meet the preferred learning style(s) of the students involved in the project, we took great care not to deviate from the strategies. As a result, we had no problems assigning work or expanding responsibilities for either SR1 or SR2. The students successfully completed their portion of the research in the established timeframe. One of the grant outcomes required them to present their work at an undergraduate research symposium in the form of a poster session. The students were comfortable with the data they had generated but were apprehensive about answering questions from strangers regarding the data and conclusions. After some role-playing with the primary investigators acting as the audience, the students appeared to be more comfortable with the idea. The day of the research symposium arrived with the results discussed below.

### The Undergraduate Research Symposium

The students set up the poster in a large open room along with many other presentations of undergraduate work from all disciplines. They were visibly nervous before the designated hour but seemed to be taking things in stride as they assembled the poster. They waited patiently for the first members of the audience to walk by and ask questions.

As the symposium progressed, it was clear both SR1 and SR2 relied on their preferred learning style to field the questions from the audience. When asked a specific question, SR1 replied using a variety of hand motions and gestures that simulated the steps in the laboratory. SR1 would say, "This is the most exciting thing I've ever done from start to finish, and as you can see from the data, our outcomes were x," always using hand motions or other kinesthetic approaches to explain the various components. This performance was consistent throughout the entire three-hour session.

SR2 was much more reserved, providing excellent explanations of the data but always referring to the poster rather than attempting to present information off the cuff. This action spoke directly to the visual preference of SR2. Several times SR2 began an explanation with "as you can see from the data on the poster." This performance was consistent throughout the entire three-hour session.

Participation in the research symposium was a positive experience for both students. SR1 stated, "I've learned so much about myself in addition to the actual scientific data we obtained. I feel so much more comfortable in a small group atmosphere." SR2 acknowl-

edged, "Working with someone who learned and processed information differently than I did was really interesting. We really spoke to our strengths and the combination was probably much better than anything we could have done individually."

### Discussion and Conclusion

As the primary investigators, we used the information about the students' preferred learning styles to help overcome many hurdles when addressing the individual needs of the undergraduate student researchers. The feedback from the two student researchers was positive. As a result of this experience, the preferred learning styles of all students involved in our future research will be determined before beginning a project.

The most salient dimension differentiating the learning styles is the degree to which it can be observed and articulated. An enduring question for educational research is the effect of individual differences on the efficacy of learning. Such differences present a profound challenge for instructional designers because research has shown the quality of learning material is enhanced if the material is designed to take into account the students' learning styles. However, providing a learning experience to accommodate the three learning styles is often a significant challenge. A designer tends to design learning events that appeal to his or her own preferences (Stahl 1998). By assessing student learning styles, the successful designer is forced to employ a variety of teaching techniques in an effort to provide an optimal learning environment.

Although some critics may feel this is too time consuming or too complicated, a learning-centered approach can be identified as a distinct stream of style-based research differing from the psychological orientation of cognitive-perceptual research. Those in education addressing the diversity of the environment in which learning takes place have motivated this approach. It is driven by process-based concerns regarding individual differences and learning needs (Riding and Rayner 1995). The focus has shifted from concentrating on the constructs of intelligence and processing of information to an increased interest in the students' active responses to the learning task in the learning environment. The strength of the learning-centered approach attempts to contextualize the construct of learning styles, with the ultimate goal of improving pedagogical practice.

Jonassen and Grabowski (1993) identified the three following fundamental truths of successful learning:

- Learners who command their own learning often master more things than those who rely on being taught.
- Learners have a different sense of themselves, of their time, and what is worth learning and why.

- Learners learn most enjoyably by choosing from a rich array of media, methods, and experiences that mean the most to them.

Instructional design should take into account as many of the aforementioned factors as possible, especially when approaching collaborative learning experiences involving diverse learning styles. By identifying all students' preferred learning styles through a self-reported inventory, instructional designers can develop design strategies addressing the auditory, visual, and kinesthetic learning preferences. Implementation of these strategies can help motivate learners while creating a positive learning environment to achieve positive outcomes in all educational levels (Riding and Sadler-

Smith 1992). These fundamental design practices have potential application for all educators.

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