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Accommodations in the Organic Teaching Laboratory for Students with Mobility Issues

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Abstract This paper outlines a successful approach that was implemented at Butler University to accommodate a student with a mobility impairment. This student's mobility impairment functionally limited his level of strength as well as his upper body range of motion. His fine motor skills were also affected making it difficult for him to grasp small objects. The information in this paper may be applicable to students with similar disabilities at other institutions.

Keywords Academic accommodations, Mobility impairment, Organic chemistry laboratory

1. Introduction

Inclusion of more students with varying disabilities in the undergraduate college environment continues to see forward progress, especially in Science, Technology, Engineering and Mathematics (STEM) [1]. Laboratory accommodations have been described in the physical sciences that include wheelchair access, Braille labels, and audible instrumentation [2]. Other strategies have been described that remove barriers for a wide variety of students in the science classroom, but the majority of these are in the K-12 educational arena [3, 4, 5]. There have been studies that suggest that students with disabilities are less likely to ask for accommodations in the STEM disciplines [6], as well as studies showing that engineering faculty are somewhat less willing to provide accommodations for students [7]. As students with disabilities are entering STEM disciplines at almost the same rate as students without disabilities [6], appropriate accommodation schemes are needed to address a variety of disabilities. While discussions of general accommodations are helpful, individual accommodations are required for each student, regardless of challenges. We would like to address an example of how we accommodated the needs of one student as an example of how such accommodations could work in a variety of situations.

Much of the learning that takes place in the sophomore level organic chemistry laboratory courses requires the physical manipulation of glassware, equipment, and chemicals in addition to sophisticated apparatus setup for distillations and multistep reactions. Furthermore, the chemicals that are used usually pose some level of hazard with regard to reactivity, flammability, and/or toxicity. All of these factors make it difficult for a student with physical strength, dexterity, and mobility disabilities to safely and effectively master the laboratory portion of the course. The usual recommendations for adaptation to mobility impairments are to have students in the laboratory work in pairs and pair the student with a disability with a fellow student to alleviate the stigma of special considerations [2].

Field work and hands-on laboratory have been said to discourage full participation by students with dexterity limitations [4, 8]. Suggestions to adapt these laboratories have been limited to watching other students of a laboratory handle equipment or instruments for them [4, 9, 10].

"While they may be relatively easy to implement, these prescribed accommodations may undermine the full participation of STEM learners with disabilities. They have the unfortunate effect of separating the student, partly or wholly, from the intended laboratory experience of personally engaging in science. If laboratory work and related learning activities must be personally experienced for authentic STEM learning to occur, the provision of proxies such as personal assistants or helpers may represent an unacceptable solution." [2]

Pair work is only successful if it is consistent with the overall pedagogy of the course. In our organic chemistry course, individual work is required for most laboratories. We utilize this pedagogy to support individual, critical thinking, and decision-making. While hands-on manipulation is important to us at our institution, thinking about why they are performing each action is far more important. We allow actual student experience to generate an appreciation that actions, or lack of actions, have an impact on the study of science. In the Fall of 2014 and

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Spring of 2015 a student with a mobility impairment enrolled in Organic Chemistry I and II at Butler University. In this paper, we would like to describe the successful adaptations we were able to employ using a directed laboratory assistant (Miner, *et al.*) [9] in the laboratory portion of the courses so that other universities might use it as a guide when developing an individual plan for their own students with similar disabilities.

2. Description of Accommodation

Butler University students register for disability related services by first submitting appropriate documentation to the office for Student Disability Services (SDS). The student is then scheduled for an intake with an SDS staff member and an individualized accommodation letter is developed based on the student's documentation, academic history, and self-report. The letter is distributed to the relevant faculty/staff members upon the student's written release. All accommodations noted on the accommodation letter are granted unless doing so would fundamentally alter the essential requirements/objectives of the course. When an SDS student with a mobility impairment enrolls in coursework with a laboratory component, it is standard practice for SDS to proactively schedule a discussion well in advance of the start of the term. This allows ample time for SDS, professor, and student to discuss how the student's functional limitations might interface with the essential requirements of the course so that appropriate accommodations can be considered. Accommodations that fundamentally alter the nature of the course are not required.

2.1. Process

The faculty member teaching the courses, representatives from the Student Disability Services office at the university, and the student (along with his mother) all met to assess and discuss the specifics of what the student was capable of doing within the context of the specific hood space that was available for him to work. We have hoods that are six foot in length shared by two students. Students are expected to perform their own experiments in this shared space.

2.2. Initial Assessment

The initial meeting showed that the student would have a great deal of difficulty reaching to the back half of the hood where most equipment setup and manipulations of chemicals would be performed (it is recommended that all chemicals are used at a minimum distance of six inches away from the hood opening for safe containment of chemicals). In addition, due to strength limitations and limited movement in his hands, which made grasping objects securely difficult, the student frequently would carry objects by supporting them against the front of his body. While this is an effective method for transporting most objects in his daily life, the hazards associated with the materials that he would need to move from location to location caused this to be an ineffective strategy for application to the laboratory. However, we felt that simple manipulations and anything that did not involve the use of hazardous chemicals (i.e. moving an empty piece of glassware from his lab drawer to the hood, setting up basic equipment, preparing smaller samples, etc.) the student could perform on his own, without assistance.

2.3. Adaptation Plan

After the initial assessment, an adaptation plan was created in order to facilitate the successful completion of the laboratory portion of the course for the student. In this plan, we decided to use funds available in the Student Disability Services Office to hire an upper-level student to serve as a special assistant to the student during lab. The proper selection of the student assistant was crucial to the success of this adaptation as this person would serve as a surrogate set of hands when necessary. The assistant was not to perform any manipulation without being told to do so by the student and specific instructions were required as to not only what to do but how and where to perform the manipulation. For example, if a glassware setup was necessary for the current experiment the student could not simply say "build the glassware setup for this lab" but instead had to give step by step instructions including: which pieces of glassware to use, how to set them up correctly using the appropriate clamps and holders, how to attach water hoses, where connections were to be made, etc.

If at any point, the instructions were not specific enough to the point where it was clear that the student understood what was to be done, the assistant would prompt the student for additional information before proceeding. For example, if the student didn't tell the assistant to place the outlet hose in the sink on the reflux condenser, the assistant might ask "Look over the setup before we proceed and tell me if everything is setup to the point where you can now turn on the water". It was absolutely crucial that the assistant understood that they were only to do manipulations that they were instructed to perform by the student and nothing more. The best illustration of the execution of this in action was during a reflux experiment. The instructor was walking around the room inspecting the students' apparati and noticed that the heat had not been turned on to begin the reflux even though most students had already been heating for 10 minutes. Upon asking the student why he wasn't heating as of yet he looked at the assistant and the assistant simply said "I don't know, why aren't we heating yet". The assistant knew that the heat hadn't been turned on but since he hadn't been told to do so, he waited for instructions from the student.

The assistant that we chose was a bright, capable, and experienced 4th year student who had served as a laboratory teaching assistant in the past. As such he was able to manage the balance between adding additional questions when necessary, doing nothing if not explicitly told to, and knowing when to ask the student to think about what would happen when each manipulation was performed. This

allowed the student to assess potential problems involved in specific manipulations just like every other student in the lab even though he did not physically carry them out himself. For example, in setting up a distillation apparatus, it is important that the glassware align properly so as to make complete connectivity and not place undue torque on the joints while connected. The assistant might ask for the student to be specific with where the setup should begin or for the student to explain where they wanted the clamp placed to ensure optimal alignment.

2.4. Assessment

At the midway point of the first semester and at the end of first semester we asked for feedback from both student and assistant as to how the adaptation was working and what could be done differently to make the experience better. Both student and assistant thought that the arrangement was a very good adaptation as was laid out and the student even offered the following summary to the office of Student Disability Services:

"I wanted to inform you about my organic chemistry lab experience with [name of assistant] so far this year. To begin, I'd like to say that [name of assistant] is great, he's funny, knowledgeable, and very helpful. That is not to say he does anything without first asking me how he should do it. We have done quite a few things that were unnecessary due to my misunderstanding of the lab, [name of assistant] went along with it since he did not want to "cheat" in any way, which was great. I guess to give the experience an appropriate analogy, I would say that [name of assistant] being my assistant is like me being in a laboratory setting with a pair of appendages that work as they should. I am understanding the labs well, as [name of assistant] will constantly ask me questions about how to do each and every task we have before us, this way I cannot say, "pour that into there." and instead I must say, "decant that mixture into the 500 ml Buchner funnel so the Celite pad does not clog." In this way I feel that I am getting probably the best lab experience I've had in school and I am very thankful to everyone involved in devising this plan."

3. Conclusions

The adaptation that was designed for our student with extreme strength and mobility disabilities was employed successfully for both a first semester and second semester sophomore level organic chemistry laboratory course. The adaptation allowed the student to complete every experiment without losing any of the essential learning components for the laboratory course and did not require any modification to the existing lab space. We feel that the adaptations described herein could serve as a successful model for other institutions while creating a plan to accommodate other student's with similar disabilities in their chemical laboratory courses. The key to the successful implementation of this adaptation is the employment of an experienced assistant that is capable of performing the manipulations they are instructed to do without running the experiment for the student.

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REFERENCES

[1] W. S. McCann. (1998) Science classrooms for students with special needs. ERIC digest. Document ED433185. [Online]. Available: http://www.ericdigests.org/2000-2/science.htm.

[2] N. W. Moon, R. L. Todd, D. L. Morton, and E. Ivey. (2012) Accommodating students with disabilities in science, technology, engineering, and mathematics (STEM): Findings from research and practice for middle grades through university education. [Online]. Available: http://www.catea.gatech.edu/scitrain/accommodating.pdf.

[3] K. Norman, D. Caseau, and G. P. Stefanich, 1998, Teaching students with disabilities in inclusive science classrooms: Survey results, Sci. Educ., 82(2), 127-146.

[4] G. Stephanich, Ed. The Ontogeny of Inclusive Science. 2007. Dubuque, IA: Kendall-Hunt Publishing Company. [Online]. Available:http://www.uni.edu/~stefanic/Ontogeny_Inclusive_Science.pdf.

[5] S. Burgstahler. Making science labs accessible to people with disabilities. [Online]. Available:http://www.washington.edu/doit/making-science-labs-accessible-students-disabilities.

[6] A. Lee, 2011, A comparison of postsecondary science, technology, engineering, and mathematics (STEM) enrollment for students with and without disabilities, Career Dev. Exceptional Individ., 34(2), 72-82.

[7] S. Rao and B. C. Garten, 2003, Attitudes of university faculty toward accommodations to students with disabilities, J. Vocational Special Needs Educ., 25(2), 47-54.

[8] T. Hall, M. Healy, M. Harrison, 2002, Fieldwork and disabled students: discourses of exclusion and inclusion, Trans. Inst. Br. Geogr., 213-231.

[9] D. L. Miner, R. Nieman, A. B. Swanson, and M. Woods, Eds. Teaching Chemistry to Students with Disabilities: A Manual for High Schools, Colleges, and Graduate Programs, 4th Ed. 2001. The American Chemical Society. ISBN 0-8412-3817-0.

[10] K. W. Webb, K. B. Patterson, S. M. Syverud, and J. J. Seabrooks-Blackmore, 2008, Evidence based practices that promote transition to postsecondary education: Listening to a decade of expert voices, Exceptionality, 16(4), 192-206.