Innovative STEM Mentor Training: Podcasts

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To better understand how the combination of Project-Based Learning (PBL) and mentoring can provide middle and high school (grades 7-11) students with visual impairments (VI) experiences necessary to pursue STEM subjects and careers, PBL and developmental, dual-tiered mentoring experiences (i.e., e-mentoring with an industry mentor with VI and a university mentor) were used to explore students' attitudes and to support their interests in STEM-related careers. Individuals with disabilities are underrepresented in the STEM fields (Leddy, 2010; National Science Foundation [NSF] Division of Science Resource Statistics, 2015). Yet little systematic research has been undertaken to explore the underlying reasons, or more importantly, what strategies can effectively be used to close the gap (Powers, Schmidt, Sowers, & McCracken, 2015). This paper will report the multi-method results from an evaluation of the podcast mentor training. The training was adapted from the successful Entering Mentoring curriculum developed out of another National Science Foundation funded project. Baseline data on mentoring knowledge was collected from both university and industry mentors. The evaluation includes formative surveys after each podcast along with a final evaluation of the mentor training. In addition, interviews with mentors provided findings about how mentoring is learned and practiced for visually impaired individuals.

Introduction

Individuals with disabilities are under-represented in the STEM fields (Leddy, 2010; National Science Foundation [NSF] Division of Science Resource Statistics, 2015). Yet little systematic research has been undertaken to explore the underlying reasons, or more importantly, what strategies can effectively be used to close the gap (Powers, Schmidt, Sowers, & McCracken, 2015). Can project-based learning (PBL) in combination with mentoring stimulate STEM interests among middle and high school (grades 7-11) students with visual impairments (VI)? This paper presents preliminary findings on the mentoring aspects of Project POEM.

The purpose of Project POEM is to develop and evaluate a STEM-based intervention that develops a curriculum focusing on Earth and planetary science in conjunction with mentors. The overarching aim is for students with VI to increase their STEM awareness, knowledge, persistence, and resilience. The curriculum will be disseminated nationally through the American Printing House for the Blind (APH).

The funded Project POEM addresses two broad questions: (1) What roles might business and industry workforce members play in motivating students to become aware of, interested in, and prepared for careers in the STEM-related workforce? and (2) Given the shifting demographics reflected in our current classrooms and in our country, what are effective and productive ways to ensure broadening participation by engaging diverse underrepresented populations in STEM programs and careers? The overarching question of interest for this paper is how effective is mentoring training in preparing mentors?

Literature

Visual Impairments and STEM

According to the U.S Department of Education (2017), approximately 28,000 students with visual impairments (VI) received services under the Individuals with Disabilities Education Act (IDEA). For students with VI to access their general education curriculum, accommodations are essential (Moon, Todd, Morton, & Ivey, 2012). The availability of accessible formats beyond visual and graphical information allow students to integrate tactile, auditory, and proprioceptive learning channels within their learning experiences. Recent advances in assistive technology and accessible curriculum design have enabled students with VI to access STEM education. Innovative research among students with visual impairments has been conducted in the areas of science (Supalo et al., 2016; Supalo & Kennedy, 2014; Wedler et al., 2013), technology, (Howard, Park, Remy, 2012; Ludi & Reichlmayr, 2011), engineering (Park & Howard, 2013), and mathematics (Marson, Harrington, & Walls, 2013; Rosenblum & Herzberg, 2011; Smith & Rosenblum, 2013).

Visual Impairments and Mentoring

Development and implementation of assistive technology and accessible curriculum is important in encouraging VI students in STEM. Extending networking opportunities also plays a vital role in students with VI seeking post-secondary education and employment opportunities. Students with VI have been found to extend their social interactions and connections through positive social interactions through employment while in high school (McDonnall, 2011) and through participating in summer camps and learning experiences (Goodwin, Lieberman, Johnston & Leo, 2011). Among transition age youth (ages

16-26), mentoring has been identified as an effective tool to increase career-decision efficacy, positive personal hope, and self-perceived positive attitude about blindness (Bell, 2012). Antonelli, Steverson, and O'Mally (2018) found the facilitation of mentorship pairs between adults with VI less than 35 years of age seeking employment post college graduation was associated with mentees independently seeking employment with increased assertiveness after mentor guidance. Antonelli, O'Mally, and Steverson (2018) reported that college graduates with VI valued career guidance, support, encouragement and knowledge of resources from their mentorship experiences and mentor/mentee relationships.

Training Design & Implementation

Project Based Learning Opportunities and Exploration of Mentorship for students with visual impairments (Project POEM) is a National Science Foundation (NSF) ITEST strategies project with the overall goal of exploring and advancing the awareness, persistence, and resilience of middle and high school students with VI to pursue STEM related careers. The nine young scientists with VI who participated in Project POEM will take part in a 14-month intervention, which contains a Readiness Academy, Exploration Activities, and an Enrichment Institute.

Project POEM Program Structure

There are three main components to the intervention: a week-long Readiness Academy, nine-month long Exploration Activities, followed by a week-long Enrichment Institute.

The Readiness Academy focused on outdoor science education and introduced the young scientists to each other, to their mentors, and to the program expectations. The Academy was held at the University of Arizona's Sky School, on the top of Mt. Lemmon (9,000-foot elevation) near Tucson, Arizona in June, 2018. During the Academy, the nine young scientists participated in place-based and inquiry-based strategies. Through project-based learning, the participants designed hypotheses, collected and analyzed data, and designed and presented their projects at the end of the week. Each young scientist was paired with two mentors: one from the university and one from industry (who was VI). On the last day of the Readiness Academy, the participants met their business/workforce mentors for the first time with either face to face, or via video conference.

While both mentors have opportunities to work with the young scientists on their Exploration Activities (see below), university mentors will primarily assist the mentees with a series of nine monthly assignments. In addition to completing projects and assignments aligned with science standards during the Enrichment Institute, participants will complete additional monthly assignments regarding industry mentor experiences. For example, mentees might virtually job shadow their industry mentor, or inquire about how his or her industry mentor negotiates transportation as a VI person.

The Exploration Activities is the second component of Project POEM and will continue throughout the academic year. Each month, students will receive accessible assignments that align with Next Generation Science Standards (NGSS) and submit these assignments electronically. In addition to the monthly assignments, the young scientists will also work on a self-selected research topic for the duration of the academic year.

The Enrichment Institute culminates the Project POEM experience for the nine young scientists. During this final week, the young scientists will visit local laboratories, STEM related job sites, and student resource centers at higher education institutions. The young scientists will work in small groups and present their final presentations at the Project POEM Symposium to family, friends, business/workforce mentors, university mentors, and a small panel of community judges. Students with the highest scores will receive talking scientific calculators.

Mentor Training

The mentor training was adapted from the NSF funded Entering Mentoring curriculum. There were eight modules for the mentors that covered these topics:

• Getting Started

• Developing High Quality Relationships

• Assessing Understanding

• Establishing Expectations

• Mentoring Ethically

• Ending Well

• Learning about Visual Impairment (optional for Industry mentors)

• Mentoring through Project Based Learning (optional for Industry mentors)

Each module provided a 15 to 20 minute podcast, a worksheet to check learning, and a survey evaluating the module. The approach to the podcasts was to take an informal, conversational approach between two individuals. Most podcasts had a mentoring scholar and one of her students. The Project Based Learning podcast recorded the mentoring scholar interviewing an astronomer about PBL. The VI podcast was recorded by two VI experts.

Mentors had one month to complete the training and take a short multiple-choice quiz and answer a short answer question 'Provide a short description of what you plan to do as a mentor.' There were 23 items for the university mentors and 16 items on the quiz for the industry mentors.

Methods

Participants

University mentor participants met four inclusion criteria. University mentor participants must have: (a) been enrolled in an undergraduate or a graduate program, (b) major(s) in at least one STEM area, and (c) agreed to attend a six-hour mentoring training, and (d) agree to commit a minimum of four hours per month to project activities. Eleven university mentors completed both the demographic survey and the online mentoring training modules and quiz. The ages of university mentors ranged from 18 to 35 years old (M = 22.66). Four university mentors were male, and 7 were female. University mentor majors included Astronomy/Astrophysics, Astrophysics, Geology, Geosciences, Hydrology, Neuroscience and Cognitive Science, Physics/Mathematics, Planetary Science, Teaching and Teacher Education.

Industry mentors were adults with visual impairments employed in a STEM related career and they met three inclusion criteria: (a) a visual impairment, (b) employed in a STEM related-related field for the duration of the 14-month intervention, (c) agree to a minimum of three hours per month to fulfill project mentorship requirements. Industry mentors' ages ranged from 28 to 65 years old (M = 50.71). Three industry mentors were male, and four were female. Industry mentors reported employment in the following STEM areas: Science (n = 4), Technology (n = 2), Engineering (n = 3), Mathematics (n = 1), and one other, sensory design. Six Business/workforce mentors completed their doctoral degrees and one completed a bachelor's degree. Five mentors stated he/she received mentor training and engaged in mentorship work before beginning the project. Three industry mentors selected print with optical aides as his/her primary learning media. Three selected auditory, one selected braille, and one selected other, electronic information.

Instruments

Mentors and mentees answered a demographic quiz before the training that included questions about mentoring experience, skills, and beliefs. The instruments used in assessing the mentor training are the post-quiz and short answer question for the mentors. Mentors will have bi-monthly interviews beginning in October to check-in on the relationship and the interviews will include questions about mentoring.

Procedures

The mentor training assessments were delivered through an online learning management system (Desire to Learn). The demographic quiz was online through Qualtrics. The interviews will be over the phone.

Findings

University and Industry Mentor Training Quiz Completion Times

The average time for University mentors complete the 31-question mentor training quiz in an average of 11.20 minutes (SD = 15.40) and a median of 6.5 minutes. Industry mentors completed the 16-item mentor training quiz in an average of 16.11 minutes (SD = 12.89), with a median 10.73 minutes. The university mentoring training quiz included one disclosure item, five learning about visual impairment items, three mentoring in PBL items, and 23 mentor training items. Industry mentors completed 16 items.

Mentoring Training Quiz Scores

Eleven university mentors took the mentoring quiz, with one mentor taking the quiz twice. On the 23 item quiz, mentors scored 100% on 12 items. Industry mentors scored between 75% and 92% on 8 items. Industry mentors scored lowest on three items: YouthChall (50%), CommPosEm (50%), and SuccessEnd (33%). University mentors scored 100% on three of five Visual Impairment specific quiz items, 92% on one item, and 67% on the item, VIavoidword. University mentors respectively scored 83%, 92%, and 100% on three items specific to PBL.

Industry mentors. All industry mentors took the mentoring quiz (n = 7). Two industry mentors took the quiz twice, and both attempts were recorded. On the 16 item quiz, industry mentors scored 100% on four items (HQRelation, Mismatch, TimeExpect, and Endship). Industry mentors scored between 78% and 89% on 10 items. Industry mentors scored lowest on three items (YouthChall, Autonomy, and SuccessEnd). The scores for SuccessEnd were the lowest, with 33% of industry mentors correctly answering in overall quiz attempts (see Table 1).

Lessons Learned

Overall the quiz results from the evaluation suggest that university and industry mentors gained knowledge about mentoring and that the podcast format was an effective learning modality. We learned that we need to collect more information about assistive technologies from VI mentors and stereotypes from sighted mentors.University mentors completed the longer quiz in a shorter time. As all industry mentors (n = 7) have a visual impairment, and nine of ten university mentors did not have a visual impairment we should collect future data on assistive technology and accessibility features used by mentors with visual impairments to complete the online quiz. Especially as the researchers explore the effectiveness of podcasts and post-test measures using an online platform across multiple devices (ie., tablets, smart phones, computers, refreshable braille displays).

University mentors scored lowest on one item, VIavoidword (M= 0.67). The item, VIavoidword was a true/false item which required mentors to determine if it was socially acceptable to avoid words like ‘look' and ‘see' when working with people with visual impairments. As university mentors interact with students with visual impairments, we use this item again as a post-test at the end of the 11 month intervention to determine if this assumption changes for university mentors.

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References

Antonelli, K., O'Mally, J., & Steverson, A. (2018). Participant Experiences in an Employment Mentoring Program for College Students with Visual Impairments. Journal of Visual Impairment & Blindness, 112(3).

Antonelli, K., Steverson, A., & O'Mally, J. (2018). College Graduates with Visual Impairments: A Report on Seeking and Finding Employment. Journal of Visual Impairment & Blindness, 112(1), 33-45.

Bell, E. C. (2012). Mentoring transition-age youth with blindness. The Journal of Special Education, 46(3), 170-179.

Goodwin, D. L., Lieberman, L. J., Johnston, K., & Leo, J. (2011). Connecting through summer camp: Youth with visual impairments find a sense of community. Adapted Physical Activity Quarterly, 28(1), 40-55.

Howard, A. M., Park, C. H., & Remy, S. (2012). Using haptic and auditory interaction tools to engage students with visual impairments in robot programming activities. IEEE transactions on learning technologies, 5(1), 87-95.

Leddy, M. H. (2010). Technology to advance high school and undergraduate students with disabilities in science, technology, engineering, and mathematics. Journal of Special Education Technology, 25(3), 3-8.

Ludi, S., & Reichlmayr, T. (2011). The use of robotics to promote computing to pre-college students with visual impairments. ACM Transactions on Computing Education (TOCE), 11(3), 20.

Marson, S. M., Harrington, C. F., & Walls, A. (2013). Teaching introductory statistics to blind students. Teaching Statistics, 35(1), 21-25.

McDonnall, M. C. (2011). Predictors of Employment for Youths with Visual Impairments: Findings from the Second National Longitudinal Transition Study. Journal Of Visual Impairment & Blindness, 105(8), 453-466.

Moon, N. W., Todd, R. L., Morton, D. L., & Ivey, E. (2012). Accommodating students with disabilities in science, technology, engineering, and mathematics (STEM). Atlanta, GA: Center for Assistive Technology and Environmental Access, Georgia Institute of Technology.

Park, C. H., & Howard, A. (2013). Engaging students with visual impairments in engineering and computer science through robotic game programming (research-to-practice). In ASEE Annual Conference and Exposition (pp. 1-14).

Powers, L. E., Schmidt, J., Sowers, J. A., & McCracken, K. (2015). Qualitative investigation of the influence of STEM mentors on youth with disabilities. Career Development and Transition for Exceptional Individuals, 38(1), 25-38.

Rosenblum, L. P., & Herzberg, T. (2011). Accuracy and techniques in the preparation of mathematics worksheets for tactile learners. Journal of Visual Impairment & Blindness, 105(7), 402-413.

Rule, A. C., Stefanich, G. P., Boody, R. M., & Peiffer, B. (2011). Impact of adaptive materials on teachers and their students with visual impairments in secondary science and mathematics classes. International Journal of Science Education, 33(6), 865-887.

Smith, D., & Rosenblum, L. P., (2013). The Development of Accepted Performance Items to Demonstrate Braille Competence in the Nemeth Code for Mathematics and Science Notation. Journal of Visual Impairment & Blindness, 107(3).

Supalo, C. A., Humphrey, J. R., Mallouk, T. E., Wohlers, H. D., & Carlsen, W. S. (2016). Examining the use of adaptive technologies to increase the hands-on participation of students with blindness or low vision in secondary-school chemistry and physics. Chemistry Education Research and Practice, 17(4), 1174-1189.

Supalo, C. A., & Kennedy, S. H. (2014). Using commercially available techniques to make organic chemistry representations tactile and more accessible to students with blindness or low vision. Journal of Chemical Education, 91(10), 1745-1747.

U.S. Department of Education (2017). Digest of education statistics (NCES 2017-094). Washington, DC: National Center for Education Statistics.

Wedler, H. B., Boyes, L., Davis, R. L., Flynn, D., Franz, A., Hamann, C. S., Harrison, J. G., Lodewyk, M. W., Milinkevich, K. A., Shaw, J. T., Tantillo, D. J., & Wang, S. C. (2013). Nobody can see atoms: science camps highlighting approaches for making chemistry accessible to blind and visually impaired students. Journal of Chemical Education, 91(2), 188-194.

Table 1

Industry & University Mentor Quiz Item Scores

Items	*University Mentor Score**	*Industry Mentor Score***
MentorFunc	*9*	*8*
YouthChall	*6*	*6*
TeenChall	*11*	*7*
HQRelation	*12*	*9*
EmotTone	*7*	*-*
Mismatch	*12*	*9*
PosNegInter	*12*	*7*
ZPD	*12*	*-*
AssessUnd1	*12*	*8*
Assumptions	*10*	*8*
AssessUnd2	*12*	*-*
TimeExpect	*12*	*9*
CommPosEm	*6*	*8*
NotComPos	*11*	*-*
SchedTee	*12*	*8*
Autonomy	*9*	*6*

Beneficence	*12*	*7*
Fidelity	*9*	-
Justice	*12*	-
NonMaleficence	*12*	*8*
EndShip	*11*	*9*
SuccessEnd	*4*	*3*
TermShip	*12*	-

*The maximum score is 12. ** The maximum score is 9.