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Using a Design Project to Instill Empathy in Structural Engineering Teaching Assistants

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24 graduate schools (Wallace, 2000) and improve or expand diversity training for current and future
25 faculty (MacLachlan, 2006). In the summer of 2015, the structural engineering department at a
26 large research (Carnegie Level 1) university developed a diversity training program to be
27 included in its graduate student teaching assistant training program. While diversity training is
28 available elsewhere on campus, the department believed that localized training might be made
29 more relevant and provides greater benefit to the departments graduate and undergraduate
30 student body. This investigation seeks to determine if an engineering based diversity training
31 workshop results in increased empathetic behavior in engineering teaching assistants.

32 This article describes the development, implementation, and feedback from a diversity
33 training (DT) workshop administered to engineering teaching assistants (TAs) in the fall of 2015.
34 The training was implemented to improve the undergraduate student experience by sensitizing
35 graduate teaching assistants to the accessibility of various resources (e.g. financial, time, life
36 experiences, etc.) to which undergraduate students may or may not have access. The workshop
37 was designed around a hands-on project in which groups of participating graduate students
38 designed and fabricated small wooden trusses. However, fabrication materials were not evenly
39 distributed among the participants, which led to differences in their final designs. A guided
40 discussion was used to highlight the differences in resources among the groups, develop an
41 emotional reaction among the participants, and draw parallels to resource differentials among
42 undergraduate students. While the participants provided overwhelming positive feedback, a pre-
43 and post-training questionnaire revealed that empathetic changes in participant behavior were
44 either not statistically significant or approached significance ($p = 0.095$). Due to its low cost, the
45 authors advocate continued use of the training along with improved tools to measure changes in

46 participant empathy. Sufficient content is provided to make the workshop repeatable at other
47 universities.

48 **Methods**

49 **Program Development**

50 The typical objective of DT is to increase positive intergroup behaviors so as to reduce
51 prejudice or discriminatory conduct (Pendry, Driscoll, & Field, 2007). DT may take on many
52 forms, including instructional videos (Pinterits & Atkinson, 1998), lectures, discussions, role-
53 playing, exercises, simulations, workshops, etc. Bierema (2010) points out that not all DT is
54 equally beneficial: simply providing factual information has often been shown to be ineffective
55 at changing participant attitudes (Pendry et al.), simulations of overt discrimination may result in
56 negative experiences for participants (Byrnes & Kiger, 1990), and stressing differences or
57 assigning blame may raise intergroup tensions (Bierema). Effective DT should include some
58 sort of marginalizing experience (Bierema) that elicits emotional reactions from trainees (Pendry
59 et al.) in a positive way, such as fostering emotional empathy (Paluck, 2006; Pendry et al.).

60 Based on these findings a workshop format was selected for the current DT program. A
61 workshop could be completed in hours instead of weeks and could include group exercises with
62 follow up discussions that emphasize affective experiences (McCauley, Wright, & Harris, 2000).
63 By including more than one instructional technique (i.e. interactive exercises and reflective
64 discussions) the authors hoped to increase the training's effectiveness (Bezrukova, Jehn, & Spell,
65 2012) by generating an emotional response in the trainees, having them think and reflect on the
66 targeted experience, and finally, provide them with actionable items to use during their TA
67 tenure.

68 **Student Demographics and Workshop Objectives**

69 An attempt was made to characterize the demographics of the student population.
70 Student statistics from the previous academic year were tabulated for (a) the entire university, (b)
71 the department's undergraduate students, and (c) the department's graduate students. The
72 available results can be found in Table 1.

73 **Table 1.** Student Demographics. (Y. Wilson and C. Hurley, personal communication, June 17,
74 2015)

75 A number of internal factors led to the decision to implement a workshop highlighting the
76 effect different socioeconomic factors have on students. Socioeconomic factors, specifically the
77 lack of resources (whether time, financial resources, emotional support, etc.), cuts across gender,
78 ethnicities, and race. The objectives of the workshop were to:

- 79 • Increase undergraduate student satisfaction by developing more tolerant, understanding,
80 and relatable TAs.
- 81 • Sensitize TAs to the assumptions they make of others and how these assumptions
82 influence their behavior. (Cavaleros, Van Vuuren, & Visser, 2002)
- 83 • Demonstrate scenarios in which life experiences and opportunities may vary from student
84 to student.
- 85 • Illustrate the impacts that limited resources have on students.

86 **Measuring Success**

87 Two instruments were selected to gauge the success or failure of the workshop: a TA
88 survey, administered after the DT, and free response questions, deployed both before and after
89 the DT. The post-DT TA survey asked the participants pointed questions regarding the
90 perceived benefit of the workshop. The free response questions described three situations a TA

91 might encounter during the term. For each situation, the TAs were asked to explain the steps
92 they would take to resolve the situation and how they would interact with the undergraduate
93 student(s) involved. The same assessment was given both before and after the DT. Both
94 instruments can be found in Supplemental Appendix – A.

95 **The Participants**

96 The one hour workshop was hosted by a faculty member and senior TA within the
97 department during the first week of the fall 2015 term. The DT trainees were 35 graduate
98 students who had been assigned departmental TA positions for the fall 2015 term. The TAs were
99 hired based on their technical competency in the course in which they would assist and not on
100 any measure of diversity awareness. The TAs primary responsibilities included some
101 combination of hosting discussion sections, laboratory sections, and office hours; in each case
102 the expected interaction with undergraduate students was extensive. Trainees were surveyed
103 prior to the workshop and the demographics of the 22 respondents are shown in Table 2. The
104 universities/departments undergraduate student demographics were previously given in Table 1.
105 Participation in the workshop was mandatory for all departmental TAs.

106 **Table 2.** Trainee (TA) Demographics – Based on 22 Respondents.

107 **The Activity's Origins**

108 The implemented activity is based on the 'Creating a Mobile' activity found in the work
109 of Schniedewind and Davidson (1983). Written for pre-high school teachers and students, the
110 activity tasks groups of students to construct artistic mobiles using various types and quantities
111 of resources: some groups are given substantial resources (wire, crayons, paper, etc.) while other
112 groups are given the bare minimum. The objective of the exercise is to expose these young
113 students to the frustration that develops when resources are inequitably distributed. The activity

114 was successfully implemented by Lawrence (1998) in an undergraduate *Race, Class, Culture,*
115 *and Gender* course. The current authors wished to recreate the experiences and feelings that
116 Lawrence's students had (feelings of frustration, being underprivileged, an unjustified
117 superiority, empathy, etc.), but in a more relevant frame of reference. By restructuring the
118 activity in the engineering domain, the authors hoped to make the activity more relevant to the
119 technically-minded trainees, keep the trainees more engaged (and thus make the activity more
120 impactful), draw relevant parallels between activity resources and real-world resources, and
121 make more direct comparisons to the resource differentials that engineering undergraduate
122 students may face.

123 **The Activity**

124 Trainees were randomly assigned to one of six groups and relocated to an assigned table
125 (see Fig. 1). Trainees were informed that they were to design and fabricate a small wooden truss,
126 including sizing the individual truss members, to a known load (see the full prompt in
127 Supplemental Appendix – B).

128 **Fig. 1.** Room Layout. Low/Moderate/High Indicates Supplied Resources.

129 Each group was then given a sealed bag containing various resources needed to complete
130 the specified task. Two bags, given to groups one and two, contained significant resources that
131 would increase the accuracy of the design calculations, improve the quality of the final model,
132 and reduce the time needed to perform the activity. Two different bags, given to groups five and
133 six, contained a minimum amount of resources that, while permitting the activity to be
134 completed, made the design calculations difficult to complete and would most certainly prevent
135 the task from being completed on-time with any sort of reasonable level of quality. Lastly,
136 groups three and four received bags containing a 'moderate' amount of resources, with resource

137 quality and quantity falling somewhere between the ‘high’ resource bags provided to groups one
138 and two and ‘low’ resource bags provided to groups five and six. Additional resources were
139 openly placed on the ‘Additional Resources’ table in-between groups one and three. The
140 contents of each resource bag and resources placed on the ‘Additional Resources’ table are listed
141 in Supplemental Appendix – C. Copies of the capacity sheets and hints sheet mentioned in
142 Supplemental Appendix – C are provided in Supplemental Appendix – D and Supplemental
143 Appendix – E, respectively. After the activities 35 minute allotted time, two groups presented
144 their fabricated truss model to all workshop participants.

145 **Student Presentations**

146 Two representative groups were selected to present their fabricated truss models. Group
147 two (a ‘high’ resource group) presented first followed by group five (a ‘low’ resource group).
148 During the presentations, group two was able to display their completed truss (the provided
149 adhesive had a quicker set time) and explain a number of structural details (e.g. gusset plates)
150 they were able to incorporate in the fabricated model. Group five had a difficult time displaying
151 their truss (the provided adhesive had not set) and spent most of the presentation explaining the
152 overly conservative truss design (a consequence of not having a calculator to perform
153 calculations). An image of group four’s truss nearing completion is shown in Fig. 2.

154 **Fig. 2.** Fabricated Truss Model From a Moderate Resource Group Results.

155 **Post-Activity Discussion**

156 All workshop participants joined in a post-activity discussion following the last
157 presentation. The goal of the discussion was to highlight the objectives of the activity through a
158 guided discussion and enable participants to reflect upon the experience. The questions listed in
159 Table 3 were prepared prior to the activity and used to guide the post-activity discussion. During

160 the discussion, trainees were asked to identify the differences in activity resources, the benefit
161 that resource provided them, and to extrapolate that activity resource to a real-world
162 classification. Key resources are identified in Table 4.

163 **Table 3.** Discussion Questions.

164 **Table 4.** Identifying Resources.

165 Towards the end of the discussion, trainees were asked to identify/theorize real-world
166 situations that would act to limit resources or impair performance of the undergraduate students
167 they would soon be working with. Probing questions are listed below (Schniedewind &
168 Davidson, 1983). Some of the resulting outcomes are shown in Table 5.

- 169 • Describe a situation in which a student may have an advantage or disadvantage compared
170 to their peers. What resources are involved? What sort of feelings might that student be
171 experiencing?
- 172 • What might cause one student to start off with more resources than another student?
173 How might that affect either student's frame of mind?

174 **Table 5.** Real-World Circumstances and Relevant Resources.

175 Lastly, the objectives for the workshop were explicitly stated. Although implicitly
176 conferred during the hour long session, the workshop administrators thought it important to
177 clearly state the goals of the training. The trainees were then asked to give specific action items
178 they could implement to incorporate what they've learned into their upcoming TA assignments.
179 The resulting recommendations included:

- 180 • Try and develop better TA-student relationships: ask students about their educational and
181 career plans, what other classes they are taking, where they're from, etc.

- 182 • Reach out to underperforming students (in person or through email) to offer support and
183 help.
- 184 • Try to be more understanding of the personal circumstances students may be
185 experiencing.
- 186 • Don't make assumptions about what classes students have taken.

187 **Post-Workshop Student Feedback and Success Measurement**

188 Following the workshop, participants were asked to complete a survey regarding the DT
189 and three free response questions. The post-training survey sought general feedback from the
190 participants including whether they thought the training should be continued in future years.
191 Seventeen participants responded to the survey, the results of which are shown in Table 6.

192 **Table 6.** Post-Training Survey Results – Based on 17 Respondents.

193 Respondents generally enjoyed participating in the DT, and a majority believed there was
194 a positive change in how they would empathize with their undergraduate students. Ninety-four
195 percent of the respondents recommended repeating the DT in the following years with
196 recommended modifications generally including activities to (a) make the activity more
197 challenging and (b) make the discrepancy in resources more apparent during the activity. A
198 handful of responses from the third survey question (*In what ways, if any, did the truss
199 fabrication exercise change how you view undergraduate students?*) are provided:

- 200 • “To be more active in showing students that I am available as a resource.”
- 201 • “Being a successful undergrad, I didn't consider the differences between student
202 resources. Now I am more aware about the diversity of resources undergraduate students
203 have.”

- 204 • “No matter how a student is performing or acting, I will always discuss with him/her first
205 as to any ways I may help and be as empathetic as possible to the situation he/she may be
206 experiencing since it may be far different from what I could expect.”
- 207 • “Broadened my perspective of why a student could show signs of struggling.”
- 208 • “Understanding not all students know about the available resources they have and are
209 immediately at a disadvantage.”

210 Three free response questions were posed both before and after the DT workshop to
211 measure behavioral changes in the participants’. Once collected, both pre- and post-training
212 responses were randomly intermixed and assigned an empathy score based on a four point scale
213 – the reviewer did not know if a response was collected before or after DT. Those responses
214 showing little or no concern for outside circumstances, a preconceived notion of student
215 capabilities, and no support outside TA office hours earned a score of one. Those responses that
216 were thoughtful of personal circumstances, had no preconceived notions of student capabilities,
217 and showed active support earned a score of four. Of the 22 pre-training respondents, 11 also
218 responded to the post-training questions. The average empathy score and corresponding
219 standard deviation from these 11 (matched) respondents are included in Table 7. A two-tailed
220 paired t-test was performed to check for statistical significance between the pre- and post-
221 training responses. While the difference in responses for question one and three were not
222 significant ($p = 0.509$ and 0.642 , respectively), the empathy scores for question two approached
223 significance ($p = 0.095$). It is important to re-state that these statistical results are based on 11
224 participants and hypothesis testing with small sample sizes is suspect.

225 **Table 7.** Matched Free Response Empathy Scores – Based on 11 Matched Respondents.

226 **Discussion and Future Work**

227 The results indicate that engineering TAs show increased empathetic behavior following
228 the described training workshop. While these changes were not statistically significant, the
229 workshop received a great deal of positive participant feedback. Due to this positive response
230 and the workshop's low cost, the authors intend to repeat the training in future years and
231 incorporate an improved feedback mechanism to more directly measure changes in TA behavior.

232 Although the participants gave some indication as to how they would react in a given
233 situation (i.e. the three free response questions), their actual behavior might be significantly
234 different when face-to-face with undergraduate students. Since a primary objective of the
235 workshop is to improve undergraduate student satisfaction, an undergraduate student feedback
236 mechanism should be developed and deployed to monitor actual (if any) changes in TA
237 behavior.

238 Additionally, a larger sample size is desirable to increase confidence in the statistical
239 results. Since the number of TAs participating in the training is limited to the number of TAs
240 hired each term an increased sample size would need to come from more matched pair responses,
241 perhaps obtained by expanding the program to other engineering departments including those at
242 other universities.

243 **Conclusion**

244 An empathy based diversity training program has received strong positive participant
245 feedback with over 94% of participants recommending its continued use. However, participant
246 responses on a series of pre- and post- free response questions indicates that changes in the
247 empathetic behavior of participants (graduate teaching assistants) were either not statistically
248 significant or approached significance ($p=0.095$). Continued study including an improved

249 feedback mechanism – one that more realistically and directly measures changes in the
250 participants behavior – is advocated and will be incorporated in future iterations of the
251 workshop.

252 **Acknowledgements**

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254 engineering laboratories at the University of California, San Diego, for his support during the
255 execution of the training.

256 **Supplemental Data**

257 Supplemental Appendices A through E are available online in the ASCE Library
258 (ascelibrary.org).

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