# UNDERGRADUATE STUDENTS' PERCEPTIONS OF IMPLEMENTATION OF INCLUSIVE TEACHING IN LIFE SCIENCES

**Authors:** *Ethan B. Strange M.S., Caroline Zawadi Muteti M.S., Amber Manning-Ouellette Ph.D., Donald French Ph.D., Jacinta Mutambuki Ph.D.*

## BACKGROUND AND THEORETICAL FRAMEWORK

For decades, an emphasis has existed on building comfortable avenues to science literacy and understanding for all students, especially students from identities historically excluded from science opportunities (Bianchini et al., 2000). Reinforcing inclusion promotes civic participation and builds the capacity to contribute to the nation's economy in STEM workforce, especially individuals from marginalized and less privileged backgrounds (Ocay et al., 2021). Inclusive practices have been somewhat present in the landscape of K-12 biology education and instruction; however, the status of inclusive teaching in college Life Sciences and other science, technology, engineering, and mathematics (STEM) programs is not well understood. Identities may shape student interactions in and outside of the classroom, such as gender, ethnicity, socio-economic status, first-generation identities, and other communicative elements (Henning et al., 2020). Henning et al. (2020) further state that hidden identities exist in students that are yet to either apply or acknowledge said identities in active-learning environments. Through understanding complex identity and the mosaic nature it encompasses, a lens exists where perceptions can be interpreted that provide how students feel about their present and future motives in science (Bianchini et al., 2000).

The current study was guided by the inclusive excellence framework (Salazar et al., 2010). Specifically, a 5-point Likert scale survey structure (Never = 1, Rarely = 2, Sometimes = 3, Often = 4, Always = 5) was formulated around four of the five dimensions, namely: intrapersonal awareness, interpersonal awareness, curricular transformation, inclusive pedagogy, and inclusive learning environments, after conducting exploratory factor and confirmatory factor analyses with data collected from different STEM programs. Intrapersonal awareness was excluded as the dimension emphasizes reflections on one's beliefs, values, perceptions, and analyzing biases in teaching (Salazar et al., 2010); thus, students are not able to perceive practices related to the instructor perceptions or beliefs. Items assessing curriculum transformation and inclusive learning environment were lumped into one factor, labeled as "curriculum and inclusive learning environment (CLE)." This was the first factor/construct. The classroom is both a space for providing equity in both materials and perspectives that touch on truths to strengthen inclusive ethics. This level of inclusive practice touches on the space's ability to connect to local or regional history to promote awareness within and outside curriculum. Students come from diverse spaces and the room should welcome any that may bring knowledge to the table (Salazar et al., 2010). The CLE construct items measured the presence of identities and respect for such, culturally accurate or appropriate materials in the classroom, or incorporation of support tactics that bolster learning strategies for students from marginalized communities. The second generated factor/construct was labeled as," inclusive pedagogy (IP)," and recognizes student specific potential and perspective beyond cultural assumption. This space includes bringing in life histories and student-led building to incorporate their experiences into the content they cover. Items that assessed IP centered on inclusive student participation, student value incorporation, structured collaborative learning environments, and student agency. The last factor/construct was “interpersonal awareness (IA),” which describes a sense of validation and invitation into newer cultural ideas and perspectives, all which are representing the student base inside and outside the classroom. This factor organizes dialogue and resolution to better conduct collaborative work without an existence of bias perpetuated by the instructor or space (Salazar et al., 2010). To assess IA practices, the survey items asked whether students had opportunities or experiences that fortified belongingness in an academic space, or whether conversations could take place without regressive tactics that exclude perspectives from marginalized communities.

With limited instruments for assessing inclusive instruction and learning environments in undergraduate STEM classrooms, it is difficult to gauge the state of inclusive teaching. However, with the availability of the inclusive learning environment (ILE) survey, we investigated the following research questions: 1) Are there variations in the students’ perceived instructor use of inclusive teaching between lower and upper course levels within Life Sciences? 2) Are there variations in the students’ perceived instructor use of inclusive teaching between demographic groups, such as gender, sexual orientation status, race/ethnicity, and first-generation status?

## METHODOLOGY

This study was approved by the authors’ institutional review board (IRB) and the procedures complied with the approved protocol. The study was conducted at a R1 Minority-Serving Institution located in the south-central region of the United States of America. A quantitative research approach was employed. Although students from different STEM programs at the institution in question completed the ILE survey mentioned previously, data considered in this proposal were primarily from participants enrolled in the Life Sciences courses. A total of 229 participants from the Life Sciences completed the survey. Demographics of the participants are provided under the data analysis section.

## ANALYSIS

Data analysis and results based on each research question are presented in the subsequent sections.

### RQ1) Are there variations in the students’ perceived instructor use of inclusive teaching between lower and upper course levels within Life Sciences?

### Results by Course Level: Lower- Versus Upper- Course Level

From 229 total responses, 125 represented lower-level courses and 104 represented upper-level courses. Multivariate results showed no statistically significant difference in participants’ reported perceptions of inclusive teaching on the three constructs based on the course level, $F(3, 225) = 1.282$, $p > .05$; Wilk's $\Lambda = 0.983$. Between-subjects tests showed no statistical significance between the lower-course and upper-course level on the constructs—[CLE ($F(1, 227) = 3.266$, $p = 0.072$), IA ($F(1, 227) = 1.077$, $p = 0.300$), IP ($F(1, 227) = 2.279$, $p = 0.133$)]. Descriptive statistics revealed that upper-course level reported slightly higher mean scores [CLE (mean = 2.63, SD = 1.23), IP (mean = 3.47, SD = 1.13), IA (mean = 3.36, SD = 1.16)] than lower-level courses in all three factors—[CLE (mean = 2.38, SD = 0.90), IP (mean = 3.33, SD = 0.98), IA (mean = 3.14, SD = 0.97)]. Overall, students reported slightly higher mean rating scores on practices related to IP (mean = 3.24, SD = 1.06) and IA (mean = 3.39, SD =

1.05) than CLE (mean = 2.49, SD = 1.06). These results suggest a lower perceived use of inclusive teaching in lower-level courses compared to upper-level courses.

**RQ2) Are there variations in the students' perceived instructor use of inclusive teaching between demographic groups, such as gender, sexual orientation status, race/ethnicity, and first-generation status?**

**Results by Gender**

216 responses, females (n=181) and males (n=35), were included in multivariate analysis. Results showed no statistically significant difference in participants' reported perceptions of inclusive teaching on the three constructs based on gender, $F (3, 212) = 1.712$, $p > .05$; Wilk's $\Lambda = 0.976$. Between-subjects results also showed there were not statistically significant difference on CLE ($F(1, 214) = 0.043$, $p = 0.836$), IP ($F(1, 214) = 2.051$, $p = 0.154$); IA ($F(1, 214) = 0.070$, $p = 0.791$)]. However, higher mean rating scores were associated with the IP construct for the gender categories [Female (mean = 3.35, SD = 1.07, Male (mean = 3.63, SD = 0.99)], while CLE construct indicated relatively lower mean rating scores in both gender categories [Female (mean = 2.50, SD = 1.00, Male (mean = 2.54, SD = 1.09)]. These data suggest that males reported slightly more positive perceptions on the instructor use of inclusive practices than females.

**Results by Sexual Orientation**

Sexual orientation was measured with 212 responses: 157 from straight students and 56 responses from non-straight individuals. Multivariate results showed no statistically significant difference in participants' reported perceptions of inclusive teaching on the three constructs based on sexual orientation, $F (3, 209) = 0.818$, $p > .05$; Wilk's $\Lambda = 0.988$. Additionally, between-subjects results revealed no significant difference on all three constructs [CLE ($F = 0.308$, $p = 0.579$), IP ($F = 0.255$, $p = 0.614$); IA ($F = 0.456$, $p = 0.500$)]. Descriptive statistics indicated slightly higher mean rating scores were associated with the non-straight group on the CLE (mean = 2.57, SD = 1.36) and IP (mean = 3.44, SD = 1.25) constructs compared to the straight group [CLE (mean = 2.48, SD = .98), IP (mean = 3.36, SD = 1.00). However, the straight group reported slightly higher mean rating score on the IA construct (mean = 3.26, SD = 1.01) compared to the non-straight group (mean = 3.15, SD = 1.24). The CLE construct indicated the lowest mean rating scores. Also, the non-straight group perceived more use of inclusive teaching than the straight group.

**Results by Race/Ethnicity**

The ethnicity question received 217 responses from students in life science courses, with 181 identifying as non-minority and 36 as minority. Multivariate results showed the means on the three constructs between minority and majority group were approaching statistical significance, $F (3, 213) = 2.567$, $p = .06$; Wilk's $\Lambda = 0.965$. Additionally, between-subjects results showed statistically significant differences between the two groups on all the constructs: CLE ($F(1, 215) = 5.804$, $p = 0.017$), IP ($F(1, 215) = 6.995$, $p = 0.009$), and IA ($F(1, 215) = 4.753$, $p = 0.030$). Specifically, minority participants reported higher mean rating scores in all three constructs [CLE (mean = 2.88, SD = 1.09); IP (mean = 3.80, SD = 0.88); IA (mean = 3.58, SD = 0.90)] than non-minority students [CLE (mean = 2.41, SD = 1.05); IP (mean = 3.30, SD = 1.07); IA (mean = 3.16, SD = 1.08). The CLE construct showed the lowest mean rating scores over the

IP and IA constructs. This finding also suggests that the minority group perceived the classrooms to be more inclusive compared to their counterparts.

### Results by First-Generation Status

First-generation status was reported from 220 students, with 163 students representing non-first generation and 57 first-generation. Multivariate results showed statistically significant difference in reported perceptions on the three constructs based on race/ethnicity, $F(3, 216) = 4.767$, $p = .003$; Wilk's $\Lambda = 0.938$, partial $\eta^2 = .062$. Between- subject test revealed statistical significance between the two groups on IP ($F(1, 218) = 11.736$, $p = 0.001$), but non-significance on the other two constructs [CLE ($F(1, 218) = 2.285$, $p = 0.132$); IA ( $F(1, 218) = 1.69$, $p = 0.195$)]. Overall, first-generation students reported lower mean rating scores in all three constructs [CLE (mean = 2.32, SD = 1.07); IP (mean = 3.01, SD = 1.18); IA (mean = 3.10, SD = 1.12)] compared to non-first-generation students (CLE (mean = 2.60, SD = 1.08); IP (mean = 3.55, SD = 0.98); IA (mean = 3.31, SD = 1.06)]. This finding suggests that non-first-generation students perceive more use of inclusive teaching than the first-generation students. Overall, the results suggest the need to level the playing field for all students in the Life Sciences by encouraging the instructors to incorporate inclusive teaching in the curriculum and instruction, creating a welcoming learning environment, and promoting inclusive instructor-student relationships to establish rapport with all students.

### Limitation of the Study

Data were collected from one institution and therefore the sample size for some demographic groups are small to draw generalizations of the results to other institutions of the same ranking and type. There is a need to replicate this study at other institutions with a larger sample size for generalizations on the status of the inclusive instruction and learning environment in Life Sciences across different institutions in the United States of America. Additionally, data were collected through a survey to answer the “what” questions. Thus, future studies should incorporate triangulation of different data sources, such as follow up interviews, open-ended questions, and classroom observations to gather rich descriptions on the status of inclusive teaching in the college Life Sciences classrooms.

## IMPLICATIONS FOR PRACTICE

Our results indicate the “rare” use of practices related to CLE—curriculum and learning environment, as well as little use of IP and IA practices in Life Sciences courses at the institution where this study was conducted. One explanation for this finding may be partly due to instructor unawareness of inclusive teaching practices. This gap can be addressed by engaging STEM instructors with teaching development workshops focused on inclusive teaching practices. Institutions should take advantage of orientations for new faculty and graduate teaching assistants to socialize these instructors with inclusive teaching practices they can employ in their teaching assignments. We note that while recognition and rewarding of teaching is less valued compared to research and that instructors might be reluctant to create time for professional development opportunities, institutions should find mechanisms for rewarding and incentivizing faculty engagement in teaching development programs related to inclusive teaching. The teaching development programs should strive to model practical tips for revamping the curricula to be more inclusive and strategies for creating inclusive learning environments. Incorporating research contributions of scholars from marginalized groups in teaching (Salazar et al., 2010;

Schinske et al., 2015; Schinske et al., 2016), enhancing content relevance by highlighting local histories and real-world contexts that connect to students' daily experiences and career aspirations, and incorporating familiar examples to students are some examples of curriculum transformations (Salazar et al., 2010). Assistance in the classroom by others with experience creates positive dynamics in the learning environment through comfortable support (Clement et al, 2022). We recognize that in-class collaboration is one of the strongest means to promote inclusion across classrooms, and to open discussions on what inclusion means to both teachers and students (Slavit et al., 2016). Students can also find value in participations in conservation efforts to bolster individual values and ideological beliefs through action (Hill et al. 2020). It is essential that both instructors and students are aware of a definition of inclusion, so that both parties can appreciate if a space provides equity and awareness to their suppressed identity (Hicks and Santhanam, 2002). Detailed results and implications for practice will be presented.

## SELECTED LITERATURE

Bianchini, J. A., Cavazos, L. M., & Helms, J. V. (2000). From professional lives to inclusive practice: Science teachers and scientists' views of gender and ethnicity in science education. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *37*(6), 511-547.

Clements, T. P., Friedman, K. L., Johnson, H. J., Meier, C. J., Watkins, J., Brockman, A. J., & Brame, C. J. (2022). "It made me feel like a bigger part of the STEM community": Incorporation of Learning Assistants Enhances Students' Sense of Belonging in a Large Introductory Biology Course. *CBE—Life Sciences Education*, *21*(2), ar26.

Henning, J. A., Ballen, C. J., Molina, S. A., & Cotner, S. (2019). Hidden identities shape student perceptions of active learning environments. In *Frontiers in Education* (p. 129). Frontiers.

Hicks, O., & Santhanam, E. (2002, July). Student perceptions of inclusivity in lecturing at university. In *Proceedings of the 2002 Annual International Conference of the Higher Education Research and Development Society of Australasia* (pp. 9-11).

Hill, E., Plag, H. P., Lobova, T., Zajchowski, C., & Desocio, A. (2020). Assessing High-Impact Practices: The Role of Triple Loop Learning in Fostering Future Conservation Leaders. *Journal of Outdoor Recreation, Education, and Leadership*, *12*(2).

Ocay, J., Agaton, S. I., & Villote, A. (2021). Inclusion in Education: Ensuring Educational Equity in Relation to Gender, Class, Race and Ethnicity. *SABTON: Multidisciplinary Research Journal*, *3*(1), 49-59.

Salazar, M. D. C., Norton, A. S., & Tuitt, F. A. (2010). 12: Weaving promising practices for inclusive excellence into the higher education classroom. *To improve the academy*, *28*(1), 208-226.

Schinske, J., Cardenas, M., & Kaliangara, J. (2015). Uncovering scientist stereotypes and their relationships with student race and student success in a diverse, community college setting. *CBE—Life Sciences Education*, *14*(3), ar35.

Schinske, J. N.; Perkins, H.; Snyder, A.; Wyer, M. (2016). Scientist spotlight homework assignments shift students' stereotypes of scientists and enhance science identity in a diverse introductory science class. *CBE—Life Sci. Educ.*, *15* (3), ar47.

Slavit, D., Nelson, T. H., & Lesseig, K. (2016). The teachers' role in developing, opening, and nurturing an inclusive STEM-focused school. *International Journal of STEM Education*, *3*(1), 1-17.