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1 **On Faculty Development of STEM Inclusive Teaching practices**

2 Bryan M. Dewsbury¹

3 Abstract

4 Faculty development of inclusive teaching practices has become more common in
5 response to significant differences in STEM student retention between
6 underrepresented minorities in the United States and students from other ethnic groups.
7 Approaches to solve this have shifted from focusing on student deficits, to changing
8 campus culture, including the mindsets of instructors who teach STEM courses. In this
9 manuscript I argue that based on the literature informing the conceptual frameworks
10 used for faculty development in inclusive teaching, faculty developers should reframe
11 the message of their workshops to focus participants more on the scope of the journey,
12 and shift the direction of overall efforts some to redevelop pedagogical training at the
13 graduate and postdoc levels. Informed by historical as well as recent theories on the
14 role of higher education to society, I highlight the areas of the literature that can
15 effectively inform our current approaches to inclusion. I also briefly review the reasons
16 why this approach is needed, and include suggestions for new faculty development
17 approaches for long-term sustainable change in STEM inclusive education at the
18 postsecondary level.

19 Keywords – inclusive teaching, faculty development, STEM, underrepresented students

20 Introduction

21 Institutions of higher education in the United States are still struggling to retain
22 underrepresented minorities (URMs) in STEM disciplines in the first two years of
23 matriculation. A recent report by Chen and Soldner (2013) concluded that a black
24 student not retained in his/her STEM major (by virtue of failing or withdrawing from their
25 introductory STEM course) had a 67% chance of not earning a Bachelor's degree at all.
26 For a white student, this probability was 47.9%. This unfortunately is not only a recent
27 finding. Almost two decades ago, a multi institutional study was launched to investigate
28 a similarly troubling attrition rate (average 51% for the STEM disciplines; Seymour
29 2000). The authors found that the structure of the first-year learning experience might
30 possibly explain why 'switchers' (those who left the major) had low confidence in their
31 abilities to pursue careers in STEM fields. Not only has the gap in attrition rates
32 between ethnic groups remained, but more recent studies have showed that sense of
33 belonging continues to be a major predictor of success in STEM courses (Booker 2016).
34 The STEM education process may have become more equitable in its accessibility, but
35 is still inequitable in terms of success for all groups. Concomitantly, the ratio of URM

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36 students to white students are increasing at the secondary level, meaning that the ratios
37 of URMs to current majority populations in the US will adjust at the postsecondary level
38 in the years to come (Fry 2007). Therefore, as we move forward, higher education
39 administrators may have to adjust their assumptions of the traditional demographic
40 backgrounds of their incoming students. As the evidence builds for the supportive role
41 that inclusive environments and activities play in engineering success for all students
42 (Kuh et al. 2011), institutions of higher education need to provide faculty and staff with
43 professional development opportunities for them to gain expertise in this area. The
44 thinking here is that in inclusive classrooms URM students will feel more connected to
45 their peers, the instructor and the campus, and they will then be more likely to be
46 successful in their STEM major pursuit (Ostrove and Long 2007, Palmer and Gasman
47 2008). The literature on social belonging interventions in this population support these
48 ideas (Walton and Cohen 2011, Yeager and Walton 2011).

49 Inclusive pedagogy has come to represent a number of things loosely associated
50 with the retention of URM students (Florian 2010, Florian and Black-Hawkins 2011). In
51 this manuscript I define it as ‘a philosophy of teaching that provides equal opportunities
52 for all students to have a successful learning experience’. This paradigm places a
53 certain burden of responsibility on institutions and faculty to specifically understand how
54 conventional pedagogies generate inequity, and how a fuller understanding of
55 themselves and the students can better leverage the psychologies needed for an
56 engaging successful learning experience. Rightly, universities have invested in
57 supporting their faculty to shift their thinking to consider these approaches as part of
58 their teaching. In response, many faculty development opportunities on Inclusive
59 Pedagogy have emerged, a consequence not entirely dissimilar to the increase of
60 faculty development opportunities on active learning after the publication of ‘Vision and
61 Change in undergraduate biology: A call to action’ (AAAS 2011). The implied goal with
62 this push is to encourage existing faculty to think a little differently about their students
63 and their overall pedagogical approach not limited to curriculum design and greater
64 focus on affect within the classroom. There are conceptual frameworks that have helped
65 guide inclusive teaching faculty development efforts that are specific for higher
66 education. Marchesani and Adams (1992) for example proposed a model around which
67 some inclusive pedagogy workshops are developed. This quadrant model asks faculty
68 to critically analyze their own psychologies, understand more broadly situational factors
69 around their students, create inclusive classroom climates, and design curricula that
70 foster greater sense of community. This model (which I have used in my own faculty
71 development work) challenges faculty to consider the various aspects of the teaching
72 experience, arguing essentially that an overly explicit focus on one aspect is insufficient
73 to meet the needs of a truly inclusive, high quality learning experience. Other models
74 like Multiple Intelligence Theory (Barrington 2004), and Culturally Responsive Teaching
75 (Gay 2010) that overlap conceptually with this approach, and vary in terms of the
76 degree they were developed for higher education. It is not my goal here to review these
77 approaches, but to discuss a critical consideration in inclusive teaching faculty

78 development practice that is a function of a more fundamental paradigm that needs
79 shifting, than with the models themselves.

80 Current graduate training models in STEM are predicated heavily on large time
81 investments in developing the academic behavior and skills of a scientific researcher
82 (Tanner and Allen 2006). A shockingly small percentage of that time is spent developing
83 skills in pedagogy, especially considering the fact that a semi explicit goal of these
84 programs are to produce PhDs who can be effective academic faculty members, a
85 position that typically involves significant teaching (Austin 2002). There have been some
86 recent positive changes to this culture. Some postdoctoral programs offer opportunities
87 for classroom teaching along with research opportunities so that future faculty members
88 can try and fail at pedagogy and retool accordingly before becoming Assistant
89 Professors (Sales et al. 2007). Some graduate programs now offer courses in pedagogy
90 (Tanner and Allen 2006, Baumgartner 2007) or allow students to obtain 'teaching
91 certifications' in collaboration with centers for teaching and learning. While the above
92 are steps in the right direction, they are likely only a beginning if the ultimate goal is a
93 seismic shift in the role that inclusive pedagogy will play in reducing URM attrition from
94 STEM disciplines.

95 After several national reports in the United States encouraged a greater use of
96 active learning as part of postsecondary science education reform, universities were
97 tasked with training faculty on using this type of instruction. Similarly, , inclusive
98 pedagogy faculty development has gained in popularity because prior to beginning the
99 professoriate, faculty tend to have little experience in this area. In this vein, the long-
100 term goals of the inclusive teaching movement should be to provide quality professional
101 development for current faculty, and also promote the transformation of pedagogy
102 training of pre-instructors. This way, development helps engineer a paradigm shift
103 among current practitioners, and creates a pathway for inclusiveness-minded instructors
104 for the future. At its heart, inclusive teaching development frameworks focus on
105 relationships. They demand an understanding of the histories of the stakeholders before
106 teaching strategies can be determined appropriate for a situation. It would be
107 impractical to expect, within the timeframe of most professional development
108 workshops, that full understanding will be achieved. Current STEM graduate programs
109 in the United States are mostly devoid of robust pedagogical training (Tanner and Allen
110 2006), therefore, faculty development on this issue might occur only when the individual
111 is already in the classroom. This means that while inclusive teaching should continue to
112 promote best practices and proven strategies toward developing inclusive climates (for
113 examples see Tanner 2013), they should also lay out clearly the depth and scale of the
114 understanding instructors need if full competency is to be achieved in this area. Absent
115 of this, inclusive pedagogy training will only contain superficial approaches to the
116 concept. Simultaneously, inclusive teaching development should focus more on the
117 transformation of pedagogy training at the graduate and postdoc level, arguably the
118 best strategy to create a new generation of differently minded instructors. This
119 wholesale transformation might necessitate the elimination of terms such as 'inclusive

120 teaching', and rethink pedagogy training such that a full understanding of the social
121 context of learning is deeply integrated in the development process. Terminology while
122 useful, can create a sense of 'other' or 'type', where the term becomes a separate brand
123 to the main exercise. In this manuscript I discuss how faculty developers can re-
124 envision how a) pedagogy is developed at the graduate level and b) to send a clearer
125 message to existing faculty on inclusive practices. The literature suggests that we
126 dissociate broader social structure and the social dynamics of the classroom at our peril
127 (Freeman et al. 2010), and full engagement in the latter requires a deep understanding
128 of the former. I discuss that link here, focusing on why understanding the depth of the
129 relationship is a critical component of the ways in which faculty should be thinking about
130 inclusion. Through this examination I emphasize the ways in which our current
131 approaches on faculty development of inclusive pedagogy skills may need upgrading
132 and more in keeping with the realities of current and historical social structures.

133 Defining Inclusion

134 Faculty developers of inclusive teaching practices need to be clearer about what
135 the term 'inclusive' actually means. In practice, it has been used to promote strategies
136 that provide a boost to historically marginalized groups so that they can more effectively
137 engage in the learning process. The disproportionately higher attrition of URM's may
138 tempt an explicit focus on this particular group. There are a few critical issues with this.
139 Firstly, it creates an artificial sociocultural hierarchy, arbitrarily assigning the dominant
140 culture (the group currently being well-served) a normative status to which the
141 marginalized must aspire. It offers no critiques of the mainstream pedagogy and its
142 inherent exclusivity. Secondly, when interpreted out of context, in a superficial sense it
143 still somewhat subscribes to a deficit model. It can assume that there are specific
144 deficits with the marginalized which, when plugged, can eliminate the sense of
145 exclusion that STEM classrooms can create. Many of these 'deficits' include identity
146 contingencies associated with the underrepresented group (Crocker et al 2008) and
147 addressing them are certainly an important part of a holistic approach, but a hyper focus
148 on addressing 'the student' can preclude the need for other stakeholders, especially
149 instructors to examine their own contributions to the process, especially with respect to
150 their cultural competency. Thirdly, inclusive pedagogy training that creates instructors
151 hyper focused on historically marginalized groups can have the ironic effect of creating
152 *more* resentment of those groups by majority classmates and/or instructors. This is the
153 potential result when inclusiveness is defined as a focus on a subset of identities (the
154 historically marginalized) within the classroom. If inclusive pedagogy approaches do not
155 engage the social contexts of non-minoritized populations, there will remain a probability
156 for backlash. This potential effect was discussed as early as the 1960s, then with
157 respect to Affirmative Action. Kaplan (1966, but see Elden 1969 for a rebuttal) warned
158 that the legalization of identity politics will undoubtedly create a pushback effect from
159 the majority, who, without a full understanding of the law's context will themselves feel
160 discriminated against and marginalized. The effect of this contextual nuance has been
161 seen more recently in corporate diversity trainings (Von Bergen et al. 2002), where

162 some implementations of the diversity training actually increased racial resentment
163 (Kalev et al. 2006).

164 To be fully inclusive, pedagogy has to engage both majority and minority students. It
165 should consider the systemic problems that have resulted in our current URM retention
166 struggles, and also address the shared histories of all students in the classroom such
167 that the social conditions that generate identity contingencies are understood as a
168 collective responsibility. Faculty training on inclusive practices, especially components
169 that encourage a deeper understanding of the students, should strongly promote
170 intercultural knowledge. It should not solely focus on deficits of the disenfranchised, but
171 also on opportunities for students to learn and grow from the diverse authentic
172 experiences of their peers. The development of inclusive classrooms that promote
173 sense of belonging mean that *all* students must belong. The transformation of
174 classroom culture to create greater inclusion may fundamentally alter the conventional
175 characteristics of these classrooms. Specific strategies that promote inclusive
176 environments in STEM classrooms such as using multicultural examples (Chamany et
177 al. 2008), or developing targeted exercises for teaching students how to work in teams,
178 can be viewed as part of an overall structural departure from the traditional STEM
179 course delivery. An inclusive approach should be one where the histories of both the
180 privileged and disadvantaged are engaged with and understood more fully. Such an
181 engagement requires a full understanding of how the intersections of those histories,
182 with all its fractiousness and resilience, have come to inform the structure of the world
183 today. Conceptually, engaging in totality would mean placing a common identity (in this
184 case national identity) above the sub-categories (race, gender etc.) that have historically
185 informed people's American experience. Disadvantage experienced by any group in this
186 context will be viewed as an American problem, and not one defined by a particular
187 group. This paradigm shifts the focus of inclusion from the underperforming or
188 disadvantaged group in the classroom toward seeking a better understanding of shared
189 histories. Beyond a 'pedagogy for the oppressed', inclusive practices can provide a
190 platform upon which there is greater understanding between participants who exist in
191 different spheres of the social power structure.

192 Creating a classroom atmosphere where these intercultural connections are fruitful and
193 educational is no simple task, but, there is a rich history of the study of cultural
194 assimilation in America that faculty developers and instructors can learn from. This
195 scholarship underscores the fact that the ways in which new groups attempt to
196 assimilate with an existing social structure is varied (Alba and Nee 1997). However,
197 achieving equity between groups may require deep alterations of the power structure
198 that exists at any given time. Understanding the dynamics of these structural shifts is
199 critical to its replicability in other settings, including the college classroom and therefore
200 it is to this area of scholarship we now turn our attention.

201 The social context of STEM education

202 Faculty development models of inclusive teaching request participants to consider more
203 carefully the role that their own sociocultural histories and those of their students play in
204 the classroom relationship (Marchesani and Adams 1992). A full understanding of this
205 relationship requires participants to consider the sociological and psychological
206 frameworks used to study the connection between history and identity. Among faculty
207 developers these frameworks are well known. Stereotype threat (Steele and Aronson
208 1995), implicit bias (Greenwald and Krieger 2006), sense of belonging (Hurtado and
209 Carter 1997) and values affirmation (Miyake et al. 2010) to name a few are all
210 predicated on the notion that social history in the United States has had unequal
211 outcomes for different groups, and that this inequity has resulted in attitudes and
212 perceptions that potentially create social barriers within the STEM classroom. Faculty
213 development on inclusive teaching include some exposure to these conceptual
214 frameworks, but are likely to lack the time to engage participants deeply with the social
215 contexts that dictated the frameworks' development. This can perpetuate a 'best
216 practices' approach to faculty development on inclusion, which has some use, but lacks
217 the deeper understanding of social assimilation history necessary to ingrain a full
218 understanding of the subject matter. To this end, faculty developers can ask
219 practitioners to begin their journey toward a fuller understanding by asking - a) how
220 assimilation of diverse groups has occurred in the United States' social history b) the
221 relationship between that assimilation process and higher education and c) the specific
222 ways in which our understandings of this relationship can inform our praxis.

223 *Cultural assimilation in the United States* – Any practical consideration of inclusive
224 approaches should include a critical examination of the history of cultural assimilation
225 within the United States. Such an examination would include an understanding of the
226 chronological history of the assimilation of different cultures within broader US society
227 as well as a critical look at the theoretical frameworks used to better understand these
228 assimilation patterns. Some amalgamated works in this area may provide a useful
229 starting point to understanding this history. In 'A Different Mirror' (Takaki 2012) for
230 example, the author describes a multi-generational history of immigration and cultural
231 assimilation in the United States. He explains that as various ethnic and cultural groups
232 arrived, whether involuntarily or by choice, the ways in which integration occurred, or
233 the degree to which it happened at all, was largely dependent on the views of the social
234 power structures of the day. The integration process was rarely a linear one, and was
235 sometimes further complicated by now mostly antiquated views on the relationship
236 between race and intelligence. The result has been an uneven pathway for most groups
237 from immigration or slavery status to being viewed in full equality as an American (Berry
238 1997). Some might argue that for some groups this pathway is still in process (Yoon et
239 al. 2012). It is important to understand therefore that 'sense of belonging' only makes
240 sense as a concept when the normative culture serving as a reference point is clearly
241 defined. If the reference point of 'belonging' is being 'American', then the challenge is
242 figuring out what this label actually means (Schildkraut 2007). The literature suggests
243 that the social articulation of this has varied in both time and space (Phinney 1996). This
244 means that any consideration of the concept of 'belonging' must include an examination

245 of the overall social structure of the local community. Additionally, the evolution of social
246 belonging on a national scale has impacted the degree to which various subcultures
247 have been able to integrate into various social institutions. Faculty development on
248 inclusive teaching should be deeply reflective of this integration process for higher
249 education, and thus consider why the evolution of belonging in general matters for our
250 classrooms and profession.

251 *Social structure and higher education* – The relationship between higher education and
252 evolving social structures can be argued to be a cyclical one. Existing social structures
253 influence to a large degree the demographics of student populations, the chosen
254 research foci at universities, and the nature and style of the pedagogy (Naidoo 2004). In
255 turn, universities act as intellectual vehicles, broadening our understanding of ourselves
256 and our society so that we can make more inclusive, collective decisions that benefit all
257 citizens. Many authors have considered the philosophy of the relationship between
258 higher education and its role in solving or perpetuating social structures (Brennan and
259 Naidoo 2008). More practically, faculty need not look very far back into history to see
260 how society and classroom structure are inextricably linked. The passing of the Civil
261 Rights Act, the American Disabilities Act, and Title IX legislation are all examples of how
262 law profoundly influenced the demographics on college campuses (Ladson-Billings
263 2006). Prior to these bills, college classrooms were dominated by a phenotypically
264 monolithic culture. The change in legislation forced a fractious higher education
265 integration process that was historically exclusive. While legislative changes were
266 somewhat reflective of broader social upheavals that was taking place through the
267 decades, laws alone do not necessarily engineer paradigm shifts (Wilkinson III 1995).
268 Legislation helped create access, but when the historically underrepresented or
269 marginalized newly occupy a majority space all parties need to rethink how that space is
270 defined. Therefore, when faculty developers ask instructors to *know* their students, that
271 knowledge should be contextualized within the re-configuration of these social spaces.
272 It is only after there is a full engagement in this social history, that instructors can
273 reliably make deep transformations to their practice.

274 *Faculty development of inclusive practices* – Implicit in faculty development of inclusive
275 practices is an assumption of a facilitative approach to pedagogy. Freire's (1968)
276 discussion of dialoguing as a means to create equity between the instructor and the
277 instructed, and in general a more facilitative classroom is useful even in contemporary
278 contexts. It is truly unfortunate that decades after Freire argues against the 'banking'
279 concept of pedagogy as a means of oppression, national reports (in STEM) are still
280 needing to urge instructors to move away from unidirectional instruction. In Freire's
281 model, the denying of dialogue limits the scope of the education experience, and
282 perpetuates existing hierarchies. The art of dialogue as a pedagogical tool is relevant to
283 our efforts at promoting inclusion. If engaging through dialogue is inherent within the
284 pedagogy, the instructor will always be primed to consider the experiences and histories
285 of the students in the teaching process. Faculty developers of inclusive practices should
286 explicitly encourage faculty to revisit some of the earliest discussions on education

287 viewed then as a vehicle for liberation (Friere 1989), and the promoter of democracy
288 (Dewey 2004). In considering this liberation pedagogy faculty should be mindful of the
289 role that both their own psychologies and the situational factors of the students play in
290 fostering academic success. By asking instructors to engage more deeply in the social
291 history of integration and assimilation through dialogue, faculty development of inclusive
292 teaching is essentially challenging instructors to develop relationships. These
293 relationships are not necessarily with individual students, but with the social context of
294 the instructors' own selves *and* the student. This includes understanding the historical
295 and contemporary sociological frameworks that inform the social context of learning.
296 The effects of a potential paradigm shift on praxis can be significant. Some studies
297 suggest that even low level improvements in our understanding of a framework like
298 Implicit Bias for example, can augur behavioral change (Lebrecht et al. 2009). This
299 should not discount the need for specific, proven long-term strategies, but
300 understanding local contexts would put the instructor in a better position to automatically
301 determine inclusive approaches for their own particular teaching situations. Faculty
302 development on inclusive teaching may serve instructors better if, while providing useful
303 tips, focus on understanding inclusion as a journey to which the participant must
304 commit. It is here though that the demands of this engagement meet the realities of
305 available time, mental bandwidth and professional development resources for
306 practitioners (Sorcinelli 1994). It would be impossible therefore to consider a rethinking
307 of inclusive teaching faculty development without addressing the overall environment in
308 which pedagogy training generally occurs.

309 Suggestions for the future

310 The continued disparities in STEM performance between URM students and other
311 ethnic groups in the United States demands our sustained critical attention. While
312 inclusive practices in principle should be practiced across the curriculum, demographic-
313 related performance gaps in STEM points to a particular need for a deeper
314 incorporation of these approaches in science classrooms. As we shift from solely
315 addressing student deficits to transforming campus culture, faculty development of
316 inclusive practices will play an increasing role. In this vein I am suggesting two main
317 things. First, faculty development on themes of inclusion should focus more squarely on
318 the scope of work instructors need to engage in as they move toward cultural
319 competency. It should be made to clear to faculty that to effectively transform their
320 practice, they should commit to a cultural understanding that is ongoing and permanent.
321 It behooves faculty developers to point out that workshops can only serve to launch
322 participants on a journey of understanding, and that commitment to this journey is
323 mainly up to them. Secondly, greater efforts should be placed on the infusion of
324 inclusive principles in transformed pedagogical training programs, **before** individuals
325 become postsecondary instructors. This would mean a deep, purposeful transformation
326 of the training STEM graduate students receive to a) focus more explicitly on pedagogy
327 competency and b) ensure that cultural competence is a major part of that training.

328 In the long-term, inclusive teaching aims for every student in the classroom to have an
329 equal opportunity to leave the classroom having developed particular skills. To ensure
330 that possibility, the classroom environment should be one where the diverse identities of
331 the students are validated and that critical engagement in a broad range of issues,
332 including highly polarizing ones, are not only encouraged but expected. Faculty
333 development on inclusive practices should be backwardly designed from this goal to
334 hone in on the skills instructors need to enable this environment. Such a vision would
335 require instructors to shore up their understandings of the social context around diverse
336 identities (both their own and students) and social barriers that prevent equal
337 opportunities from happening. These are not simple steps to take. The emphasis on
338 'journey' in this essay is deliberate, as the mental and emotional effort required to
339 understand these barriers are great. The structure of most American instructor positions
340 often provide little space for that effort to be fruitfully expended. Faculty development of
341 inclusive practices therefore cannot focus simply on the tools. Developers should also
342 look at a more comprehensive reconfiguration of the academic system to incentivize,
343 promote and even demand a dialoguing approach to pedagogy.

344 A systemic overhaul will demand that we embrace not only inclusive teaching practices
345 but also take a critical look at the overall practice of teaching. Effective teaching by
346 definition should be structured such that it creates equitable outcomes for all students.
347 In essence, this paradigm shift for inclusive teaching faculty development requires a
348 slight shift in focus from solely promoting best practices to existing faculty, to the
349 development of future faculty's pedagogical skills at the graduate and postdoc level.
350 Some notable efforts are being made in this regard (Allen and Tanner 2006). STEM
351 graduate students and postdocs can now access a sizeable number of robust
352 professional development opportunities focused on pedagogy (e.g. Nadelson et al.
353 2012). What is unknown is the extent to which those programs currently contain robust
354 treatments of the social context of learning. Simultaneously, developers should consider
355 messaging to faculty more strongly the need to delve deeply into the literature on
356 inclusion. In this way, even if the time demands of current instructors preclude the ability
357 to fully develop competencies in this area, they remain aware of the fact that best
358 practices are only a part of the solution.

359 Ultimately, faculty development on inclusive teaching should lead us away from
360 inclusive teaching as a term and refocus our efforts on a different model of higher
361 education pedagogy training. Inclusive teaching risks becoming an approach or style,
362 separate and distinct from the craft of teaching itself. I refer to my suggested approach
363 here as 'Deep Teaching'. In the same way we challenge students to develop academic
364 skills that promote 'deep' learning for long-term retention (Chin and Brown 2000), our
365 pedagogy should reflect a deep engagement with the human aspect of the learning
366 experience. Learner-centered pedagogy can only be effective inasmuch as there is a
367 clear understanding of the learner.

368 As institutions of higher education position themselves to address the issues of URM
369 retention by rethinking their campus and classroom cultures, faculty developers will
370 continue to play an important role in assisting instructors in refining their practice. As
371 potential stewards of progressive approaches to pedagogy, it behooves faculty
372 developers to reflect on approaches to faculty development. The dogged persistence of
373 achievement gaps between URM and white students in the United States suggest that
374 in general, a lot more work needs to be done in the area of equitable STEM pedagogy.
375 The underlying frameworks that currently guide our models further suggest that our
376 current approaches to inclusive teaching training might be somewhat simplistic. The
377 training of existing faculty should be clear on the broad scope of the relationship
378 between inclusion and higher education, and instructors of the future can only be
379 positioned to serve all students if they are steeped in a critical rigorous exposure to an
380 understanding of the society they aim to serve.

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