Disciplinary Differences in Faculty Emphasis on Deep Approaches to Learning: Comparing Conceptualizations of Academic Discipline

Stephen C. Hiller

Thomas F. Nelson Laird

Indiana University Bloomington

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Abstract

This large-scale study compares how Biglan and Holland conceptualizations of academic disciplines in their ability to explain differences in faculty emphasis on deep approaches to learning in their courses. To examine these differences, several multiple regressions models are conducted 6,500 faculty and instructor responses to the Faculty Survey of Student Engagement (FSSE), using effect coding to better compare disciplinary categories. Analyses examining disciplines using Biglan's three dimensions or Holland's theory suggest differences within each conceptualization that largely align with previous research. Comparisons between these two conceptualizations, while showing some overlap, indicate that Biglan's dimensions explain slightly more variation, with a slightly greater range of magnitude in some effect sizes. These findings underscore for researchers, faculty, and educational developers the need to examine disciplinary effects on teaching practices while also suggesting for researchers the need to appropriately align disciplinary conceptualizations with their area of study.

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The importance of context in teaching and student learning in higher education is broadly accepted, with significant research in higher education in the past several decades examining numerous contextual aspects of and connections between teaching and learning (e.g., Kuh et al., 2006; Pascarella & Terenzini, 1991, 2005; Perry & Smart, 2007). It is also commonly accepted that academic disciplines strongly influence faculty views of teaching and students' learning. While substantial work examines faculty teaching and learning within specific disciplines or across a few disciplines, the systematic study of disciplinary differences in teaching and learning is less often considered compared to other contextual factors (Becher, 2006; Neumann, 2001). As higher education institutions seek to improve teaching and students' learning and do so in ways that more equitably expand access to learning, it is incumbent upon faculty, professional staff, and researchers to understand how and why disciplines differ to better inform and guide their efforts.

Digging deeper into the complexities of teaching and learning, multiple methods of conceptualizing academic disciplines have been used to consider disciplinary differences. Some scholarship examines disciplines using one or more of Biglan's (1973a, 1973b) dimensions which focus on the nature of knowledge and inquiry (e.g., Neumann, 2001; Neumann et al., 2002; Pike, 2001). Other scholarship has applied Holland's theory (Holland, 1966, 1973, 1985, 1997) to examine how socialization and individual's personalities shape disciplinary differences (e.g., Pike, 2006a, 2006b; Smart et al., 2000). While Smart et al. (2000) engage at a theoretical and conceptual level with how Biglan's dimensions and the application of Holland's theory

differ in understanding disciplinary differences, left unexplored in the literature has been an empirical examination of how the two approaches differ.

This gap is also evident in a prominent area of teaching and learning scholarship, students' approaches to learning. Early research on students' approaches to learning identified the importance of context, and in particular how teaching shapes the learning context, in influencing the approaches that students adopt (Marton & Säljö, 1976b, Entwistle & Ramsden, 1983; Entwistle, 2009). The influence of disciplines, being an especially prominent overarching context in teaching and learning, on students' approaches to learning has been examined using both Biglan's dimensions (e.g., Smith & Miller, 2005) and Holland's theory (Rocconi et al., 2015). However, again, how these two approaches compare in understanding disciplinary differences in students' approaches to learning is unclear.

These two primary conceptualizations of disciplines offer ways to not only identify where differences exist, but to begin to understand why they might exist. This opens up possibilities for understandings that go beyond simply identifying differences that exist between specific disciplines or groups of disciplines (e.g., History, Biology, humanities, STEM). What is left less clear by the literature is how different conceptualizations of academic discipline compare in their ability to explain disciplinary differences in specific areas of teaching and learning. This study seeks to expand on the prior literature by comparing how Biglan and Holland conceptualizations of discipline relate to teaching and learning, by focusing on faculty emphasis on deep approaches to learning (DAL) in their teaching. As such, this exploratory study is guided by the following research questions:

1. How does faculty emphasis on DAL differ by academic discipline, as categorized by Biglan?

2. How does faculty emphasis on DAL differ by academic discipline, as categorized using Holland's theory?
3. How do Biglan and Holland conceptualizations of discipline differ in their relationship to faculty emphasis on DAL?

Frameworks and literature

To better understand disciplinary differences in teaching and learning, and how conceptualizations of discipline compare, this study is based in two significant literatures. First, the student approaches to learning framework provides a basis for understanding student learning and how faculty teaching influences the ways that students engage with their learning. While this framework is focused on students, its attention to the process of learning, rather than learning itself, directly bears on how faculty teach within the classroom. Second, this study is framed by the literature on academic disciplines, and in particular, Biglan's dimensions and the application of Holland's theory. Each of these framings are considered below along with discussion of how teaching influences students' approaches and disciplinary differences in students' approaches to learning.

Student approaches to learning and the influences of teaching

Rather than focusing on learning itself and its outcomes, approaches to learning focuses on the process and experiences that produce learning. Among the early researchers on the subject, Marton and Säljö (1976a, 1976b) are generally credited as the first to apply the "surface" and "deep" labels to describe two primary ways that students approach learning tasks, with deep approaches focusing on the intention to understand underlying meanings of concepts and surface approaches focusing on the intention to memorize and reproduce information. Students' approaches consist of the intentions and strategies they engage in learning (Biggs, 1987;

Entwistle, 1997). For instance, if a student intends to understand ideas for themselves, they may look to connect ideas and concepts to their prior experiences or prior learning and consider the logic and evidence that supports ideas; whereas, a student who intends to pass an exam may consider knowledge as pieces of knowledge to accumulate and remember without fully making sense of connections.

Research on approaches to learning has also examined how these approaches relate to student learning outcomes. Of the two approaches, as might be imagined, deep approaches to learning are most associated with improved student learning. Early work highlighted the connection of deep approaches with better learning outcomes such as retention and transfer of learning (Biggs, 1987; Entwistle & Ramsden, 1983). Subsequent research has likewise connected deep approaches to improved outcomes such as higher grades or GPA (e.g., Gow et al., 1994; Zeegers, 2004), college satisfaction and self-reported gains (Nelson Laird et al., 2008), and cognitive development (Nelson Laird et al., 2014).

The approaches to learning framework suggests the value of examining faculty. Approaches to learning are not considered static, but are flexible orientations, and while students may have predispositions to certain approaches, the approaches students adopt are greatly shaped by contextual factors (Entwistle & Ramsden, 1983; Kember & Gow, 1989). Important factors to consider include the learning environment, the instructor, and the structure of learning tasks (Biggs, 1987; Biggs, 1989; Entwistle & Ramsden, 1983; Marton & Säljö, 1976b). For instance, in a more recent review of the literature on teaching practices, Mayhew et al. (2016) found that teaching practices related to cognitive gains in students included, among others, teaching that "ask[s] students to think critically about discipline-specific, course-related material," and that "offer[s] opportunities for students to reflect meaningfully on materials presented in class" (p.

133). While this literature was not focused specifically on students' approaches to learning, the practices identified demonstrate clear conceptual links to fostering deep approaches to learning among students.

Literature has considered not only specific teaching practices that promote student learning, and conceptually connect to deep approaches to learning, but also how faculty members' approaches to teaching. Building off Biggs' (1989) suggestion that a model of approaches to teaching would parallel student approaches to learning, Trigwell, Prosser, and Taylor (1994) articulated a framework of approaches to teaching. Under this framework, instructors may adopt one of five approaches which are often generalized to teacher-focused approaches and student-focused approaches. Student-focused approaches aim to facilitate students' construction of knowledge, with teachers designing learning environments where students' actions are the driver and focus of learning. Teacher-focused approaches position the teacher as the primary focus who provides or imparts knowledge to students. Further research established a connection between teachers' views of learning, their approaches to teaching, and student approaches to learning (Trigwell & Prosser, 1996; Trigwell, Prosser, & Waterhouse, 1999). For example, an instructor who views learning as the accumulation of knowledge will tend to adopt teacher-focused approaches for transmitting information (e.g., traditional lecture), and in turn, students will tend to adopt surface-level approaches to learning focused on remembering and reproducing information. Together this research paints a picture of teaching that focuses on fostering students' active, meaningful engagement in understanding, reflecting on, and connecting ideas to better promote student learning.

Understanding disciplinary differences in student approaches to learning

Academic disciplines to a large extent influence the content and form of teaching (Umbach, 2007), and thus the ways students engage in learning in the classroom. Umbach (2007) indicates that two approaches to categorizing disciplines have dominated in studying faculty. One approach uses one or more of Biglan's (1973a, 1973b) three dimensions to classify disciplines (resulting in two to eight categories of disciplines), and the other applies Holland's theory (1966, 1973, 1985, 1997) to distinguish five categories of disciplines. Each of these approaches are outlined here, though, substantial works have examined these models of disciplines at length (Braxton & Hargens, 1996; Becher & Trowler, 2001; Smart et al., 2000).

Biglan's research (1973a, 1973b) sought to identify characteristics that distinguish different disciplinary areas. This work resulted in three dimensions: hard vs. soft, pure vs. applied, and life vs. non-life. The first dimension reflects the level of consensus within the discipline on the scope and bounds of problems and the appropriate methods to study them, with hard disciplines (e.g., physics, mathematics) having greater levels of consensus. Biglan equated this first dimension with Kuhn's thoughts on paradigmatic development, where hard disciplines have greater paradigmatic development and soft disciplines have less. The second dimension distinguishes disciplines by whether study is concerned with application to practical problems, with pure disciplines (e.g., philosophy, chemistry) not concerned with application. The third dimension simply reflects whether the objects of study within the discipline are life-based (e.g., biology, sociology) or inanimate/inorganic (e.g., engineering, language).

While Biglan's work developed atheoretically, substantial research has lent credence to its utility in distinguishing between disciplines (Smart et al., 2000). Multiple studies have empirically validated the framework (Simpson, 2017; Smart & Elton, 1982; Stoecker, 1993),

with all three studies suggesting that the hard/soft and pure/applied dimensions account for greater amounts of variation across disciplines than the life/non-life dimension. Additionally, the work of Becher (1989; Becher & Trowler, 2001) offered a conceptual foundation, based to an extent in cultural perspectives, to the framework by drawing on Biglan's hard/soft and pure/applied dimensions to categorize disciplines.

Despite the accumulated support for Biglan's framework, Smart et al. (2000) argued for a classification of disciplines based in theory, by applying Holland's theory of occupational choice (1966, 1973, 1985, 1997) to higher education students and faculty. Where Becher (1989) argues that Biglan's dimensions align with the more cognitive aspects of disciplines[1], applying Holland's theory allows for a classification based more in socialization (Feldman et al., 2008). Applying Holland's theory to higher education relies on three core premises (Smart et al., 2000). First, academic disciplines can be categorized into six groups which are dominated by members with that personality type (Realistic, Investigative, Artistic, Social, Enterprising, Conventional). Second, one's choice of career (and by extension discipline) is an expression of their personality type. Third, the greater alignment of individuals' personality types (based on their values, interests, abilities, etc.) with their environment or discipline, the greater the satisfaction and outcomes they will experience. This third premise suggests a crucial component of Holland's theory as applied to higher education, the socialization assumption (Holland, 1997). This assumption indicates that disciplines will reward and reinforce its preferred values, interests, abilities, etc., among its members, and reward faculty members' or students' engagement in the preferred activities of the discipline (Smart et al., 2000). By doing so, this socialization

[1] However, Biglan's own work does not make this distinction and even discusses the dimensions within the context of academic social structures and organization (1973a) and finds significant differences by each dimension on measures of social connectedness (1973b).

encourages individuals to view themselves and to act in ways that are consistent with the preferred values, interests, and abilities of their distinct discipline.

Research into disciplinary differences in students' approaches to learning has predominantly relied on Biglan's dimensions, with most only using the hard/soft and pure/applied dimensions. Smith and Miller (2005) and Smyth et al. (2017) indirectly examine disciplinary differences in approaches to learning using Biglan's hard/soft and pure/applied dimensions. Smith and Miller (2005) examined the relationships of assessment types, disciplines, and gender with approaches to learning, finding that students in a soft-pure discipline showed deeper approaches than students in a hard-applied discipline. Their work, however, did not disentangle the two dimensions and samples from a very limited number of disciplines, limiting the ability to draw systematic conclusions about disciplinary differences. Smyth et al. (2017) investigated how social influences, which include disciplines in their model, affect students' approaches to learning, sampling students from six disciplines. Among their findings, they noted that soft disciplines related to deeper approaches, while hard and applied disciplines related to more surface approaches. Nelson Laird et al. (2008) more directly examined disciplinary differences in students' deep approaches to learning using all three of Biglan's dimensions, sampling students across 62 disciplines at over 500 institutions. This large-scale, systematic study found that soft, pure, and life disciplines were associated with greater levels of deep approaches among students, with the hard-soft dimension showing the greatest disciplinary variation as well as being the strongest predictor of deep approaches to learning. Taken together, these studies suggest that the hard-soft dimension differentiates disciplines the most in relation to students' approaches to learning, with disciplines that have less consensus on paradigms and

modes of inquiry, the soft disciplines, showing greater levels of deep approaches among students.

Only one study has examined disciplinary differences in approaches to learning by conceptualizing disciplines based on Holland's theory. Rocconi et al. (2015), also a large-scale study sampling students from numerous disciplines at nearly 500 institutions, investigated the relationship between deep approaches to learning and students' plans to attend graduate school, as well as how disciplinary environments related to or moderated graduate school plans. Among their findings, they noted that Holland's academic environments interacted significantly with deep approaches to learning in regard to graduate degree expectations. Specifically, increased deep approaches to learning increased students in Artistic fields' likelihood of aspiring to a graduate degree compared to students in Enterprising, Investigative, or Social fields, as well as increased the odds for students in Enterprising fields relative to Social fields. Rocconi et al.'s work highlights the strong socializing effects of academic disciplines (largely from faculty), per Holland's theory, connecting this socialization to the role faculty and academic environments play in students' approaches to learning.

While large-scale systematic investigations of disciplinary differences in approaches to learning have been limited in number, substantial research has examined students' approaches to learning within typically individual disciplinary contexts, thus not relying on Biglan's dimensions or Holland's theory. Baeten et al. (2010) reviewed this literature within student-centered environments and attempted to draw descriptive conclusions about patterns of disciplinary differences. They found that empirical evidence was largely mixed, though a pattern emerged where humanities and social sciences tended to relate to deeper approaches to learning. While these studies do not offer systematic examinations of differences across a multitude of

disciplines, Baeten et al.'s findings generally align with the findings of larger-scale systematic investigations.

Methods

Data source and sample

To address the research questions with a large-scale, systematic investigation, this study uses data from the 2019 Faculty Survey of Student Engagement (FSSE). FSSE is a companion to the National Survey of Student Engagement (NSSE) and asks instructional staff (faculty, lecturers/instructors, etc.) at four-year institutions about aspects of their teaching that relate to student learning and student engagement (FSSE, 2020). For portions of the survey, faculty responded regarding a particular course that they had taught in the 2018-2019 academic year, including items of interest related to deep approaches to learning. Many FSSE items were intentionally designed to parallel items students receive in NSSE, including items related to students' deep approaches to learning, and research has indicated that greater faculty emphasis on deep approaches to learning in their courses broadly relates to increased engagement in deep approaches to learning among students (Nelson Laird et al., 2008). As such, FSSE offers an opportunity to examine faculty practices that directly correlate to students' deep approaches to learning.

The 2019 FSSE dataset includes the responses of faculty members at 120 four-year institutions, with the initial sample including 7,788 faculty members whose disciplines could be classified using both Biglan and Holland's theory and who responded to all items related to DAL. The final sample included 6,548 faculty members from 118 institutions after removing incomplete and missing responses to individual and course characteristic control variables; examination of the sample suggested no systematic differences between the final sample and

removed respondents. While the predominant individual identities and experiences of the final sample included faculty identifying as White (72.9%), men (48.0%), straight (82.7%), or full, associate, or assistant professors (73.1%), a wider array of individual and course characteristics, were also represented. Slightly fewer faculty identified as women (46.8%) or preferred not to respond regarding their gender identity (5.2%). Six percent of faculty identified as LGBQA, with an additional 11.3% who preferred not to indicate their sexual orientation. Racially minoritized faculty were underrepresented, but included faculty identifying as Asian, Native Hawaiian or Pacific Islander (5.0%), Hispanic or Latinx (3.4%), or Black or African American (5.1%), among other identities seen in Table 1. While employment or rank was mostly represented by full (26.5%), associate (24.3%), or assistant professors (22.3%), lecturers or instructors were also represented at full-time status (12.5%) and part-time status (14.4%). Respondents had an average of nearly 18 years of teaching experience and taught an average of nearly 6 courses (undergraduate- or graduate-level).

The courses respondents taught were predominantly upper division (mostly juniors/seniors; 51.3%), small courses of 20 or fewer students (34.5%), fulfilled a general education requirement (51.1%), and were taught in classrooms on campus (82.6%). See Table 1 for additional final sample descriptive information about faculty member respondents and their courses. Faculty members are included from 54 disciplines, most frequently from soft-pure-nonlife disciplines (32%, as categorized using Biglan) or from social disciplines (29%, as categorized using Holland's theory). See Tables 2 and 3 for additional information about faculty members' disciplines. A cross-comparison of Biglan and Holland disciplinary group membership indicates some important overlaps between these disciplinary conceptualizations (see Table 4). All Realistic disciplines included were categorized as hard disciplines, with the vast majority

being hard-applied-nonlife disciplines. Similarly, over three-quarters of faculty categorized as being in Enterprising disciplines were categorized as being in soft-applied-nonlife disciplines. These two Holland discipline categories, however, account for only 16.7% of faculty in the final sample. Arguably the most disciplinary diversity was among faculty in the Investigative category (27.9% of the sample). Faculty in Investigative fields were categorized into seven of the eight Biglan categories, though predominantly in hard-pure disciplines. See Table 4 for additional detail.

Analysis and measures

The research questions were examined using multiple regression. The dependent variable for all models is a composite variable using items related to two FSSE indicators, higher-order learning (HO) and reflective and integrative learning (RI) that together represent DAL (Nelson Laird et al., 2005). These items focus on how faculty emphasize or place importance in their courses on students' application, analysis, evaluation, and synthesis of ideas and information and their connecting learning to diverse perspectives, issues, and ideas. See Table 5 for a description of these items. DAL items were measured on a 4-pt Likert scale, and DAL is the average of the 11 items (Cronbach's alpha=0.874). DAL is entered into both models as standardized Z-scores so that model coefficients function as effect sizes.

The primary independent variables of interest are the categorizations of academic discipline. By using Biglan's (1973 a, 1973b) dimensions, faculty disciplines were categorized across each dimension separately (hard vs. soft, pure vs. applied, life vs. non-life) as well as into eight categories using all three dimensions (e.g., hard-pure-life, soft-applied-nonlife). See Table 2 for the final breakdown of disciplines into these eight categories. Disciplines were also sorted into five categories using Holland's theory (Smart et al., 2000; Feldman et al., 2008). Since the

"Conventional" Holland category includes only one discipline, it is excluded from analysis (Rocconi et al., 2015; Pike, 2006a). See Table 3 for classifications of disciplines using Holland's theory. To better compare the effects on DAL of each conceptualization of discipline, effect coding is used so that coefficients are in reference to the overall average DAL score of faculty members in the model so that coefficients across all models share a common point of reference.

Due to the dimensionality of Biglan-derived disciplinary categories, as opposed to Holland-derived categories, analysis occurred in two stages. To examine Biglan-derived categories, first three models are examined, one for each separate Biglan dimension, and secondly, one model is examined using the eight categories derived from all three dimensions. Only one model was needed to examine the effects of disciplines as categorized using Holland's theory. All models include the same independent variables to control for individual (gender identity, sexual orientation, race/ethnicity, employment status/rank, years of teaching experience, course load) and course (format, size, whether it meets a general education requirement, class level of most students who take the course) characteristics. Disciplinary groupings will be entered into each model last so that the change in R-squared can be compared between the models to determine which conceptualization explains the most variance in DAL.

Findings

1. How does faculty emphasis on DAL differ by academic discipline, as categorized by Biglan?

Regarding our first research question, Biglan all individual dimensions showed significant relationships with faculty members' emphasis on DAL in their teaching (Table 6). The initial and three subsequent models were all found to be significant. The initial model (individual and course controls only) and explained 9.6% of the variance in faculty members'

emphasis on DAL in teaching these courses. Biglan's hard/soft dimension showed the greatest explanatory power, with the model explaining 21.2% of variance, a significant R^2 change of 0.116 ($p<.001$) from the initial model. Model results for the pure/applied ($R^2= 10.1\%$) and life/non-life ($R^2= 10.7\%$) dimensions also showed significant, though small, R^2 changes of 0.006 ($p<.001$) and 0.011 ($p<.001$), respectively. For the hard/soft dimension, holding individual and course characteristics constant, soft disciplines showed a large, significant, and positive relationship with DAL, with faculty in soft disciplines emphasizing DAL 0.413 standard-deviation units more ($p<.001$), compared to the overall average. Faculty in life and applied disciplines demonstrated the second and third largest, though small, respectively, effect sizes. All else held constant, faculty in life disciplines emphasized DAL 0.120 standard-deviation units more ($p<.001$) than the average faculty member, while faculty in applied disciplines did so 0.089 units more than the average faculty member. Due to the nature of effect coding with dichotomous categories, the other categories mirror their counterparts in each respective dimension (e.g., faculty in hard disciplines demonstrated a large, significant, negative relationship with DAL, $B=-0.413$, $p<.001$).

Given these results with the individual dimensions, as might be expected, the eight categories derived from the dimensions generally showed significant relationships with faculty emphasis on DAL (see Table 7). The full 8-category regression model was significant and explained 22.0% of the variance in DAL, with a significant R^2 change of 0.125 ($p<.001$). Holding individual and course characteristics constant, faculty in three of four hard discipline categories were significantly and negatively related to emphasis on DAL, compared to the average score, while all four soft discipline categories were significantly and positively related to emphasis on DAL, compared to the average score. Faculty teaching in hard-pure-nonlife

disciplines were least likely to emphasize DAL, doing so -0.625 ($p<.001$) standard-deviation units less than the average faculty member, while faculty in soft-applied-life disciplines emphasized DAL the most, doing so 0.480 ($p<.001$) units more than the average faculty member.

2. How does faculty emphasis on DAL differ by academic discipline, as categorized using Holland's theory?

Examining the effect of Holland discipline categories in our second research question, the regression analysis likewise shows significant relationships with emphasis on DAL (Table 8). The full Holland model was significant, explaining 17.5% of the variance in DAL, compared to 9.6% for the initial model, a significant R^2 change of 0.079 ($p<.001$). Holding individual and course characteristics constant, three of the five Holland discipline categories were significantly and positively related to faculty emphasis on DAL compared to the average and two categories were significantly, negatively related to emphasis on DAL compared to the average score. Faculty teaching in social disciplines emphasized DAL the most at 0.407 standard-deviation units more ($p<.001$) than the average faculty member, while faculty teaching in realistic disciplines emphasized DAL the least, -0.394 less ($p<.001$) than the average faculty member.

3. How do Biglan and Holland conceptualizations of discipline differ in their relationship to faculty emphasis on DAL?

Considering our third research question, the regression analyses suggest several differences between Biglan and Holland-based discipline categories in explaining differences in faculty members' emphasis on DAL in their teaching. First, comparing the full eight-category Biglan ($R^2=.220$, $\Delta R^2=.125$) and five-category Holland ($R^2=.175$, $\Delta R^2=.079$) models suggests that Biglan categories account for a greater proportion of variance in DAL emphasis than Holland categories, with a moderate difference in variance explained by the disciplinary

conceptualizations. Descriptively, the discipline effect sizes underscore this difference in explanatory power, with effect sizes of the eight Biglan categories showing an overall greater range compared to Holland categories. For instance, while the effect size magnitudes are similar at the positive end for both Biglan and Holland conceptualizations (0.480 vs. 0.407, respectively), the hard-pure-nonlife disciplines shows a moderately greater-magnitude effect size compared to Realistic disciplines (-0.625 vs. -0.394, respectively).

Furthermore, this is unlikely to result alone from the difference in the number of categories between Biglan and Holland. Comparing the full Holland model (R^2=.175, ΔR^2=.079) to the model of just the hard/soft Biglan dimension (R^2=.212, ΔR^2=.116), the hard/soft dimension explains slightly more variance in faculty emphasis on DAL. Looking descriptively at the discipline effect sizes in these two models, differences at the positive end are very slight to minimal, with a 0.413 effect size observed in soft disciplines compared with 0.407 in Social disciplines. Slightly greater differences are observed at the negative end, with a -0.413 effect size observed in hard disciplines compared to -0.394 in Realistic disciplines.

Discussion and significance

These results bear several important implications for researchers, faculty, and educational developers working with faculty on teaching (e.g., in teaching centers). The differences between Biglan and Holland conceptualizations of discipline in explaining faculty emphasis on DAL in their teaching suggests a need for researchers to thoughtfully examine their conceptual and theoretical approach to examining teaching and learning. The results underscore the importance of considering disciplinary differences suggested by the literature (e.g., Becher, 2006; Neumann, 2001). With both Biglan and Holland discipline categories relating to a significant increase in R^2 values, they stand apart from other faculty and course characteristics in their power to explain

differences in teaching. Considering the vast complexity of faculty teaching in different contexts, the ability of both Biglan and Holland conceptualizations to explain even moderate levels of variance is significant. When researchers, faculty, and educational developers consider teaching practices across numerous and varied disciplines, ignoring the role of discipline can greatly obscure important nuances (Hutchings et al., 2011). The results of this study provide further evidence of the significant role academic disciplines play in faculty teaching and student learning.

Regarding the findings on Biglan's (1973a, 1973b) dimensions, the analyses generally align with current research. This study provides further support for Nelson Laird et al.'s (2008) finding that Biglan's hard/soft dimension is the dominant dimension among the three in explaining disciplinary differences in deep approaches to learning. This finding aligns with Biglan's (1973a, 1973b) own work which often placed greater focus on the hard/soft dimension and its relation to paradigmatic development. Focusing on the hard/soft dimension, as with Nelson Laird et al. (2008), this study found faculty in soft disciplines placing greater emphasis on DAL in teaching their courses. As scholars have previously suggested, such findings are reasonable, if not expected, as faculty in soft disciplines are significantly more likely to engage commonly accepted good teaching practices such as promoting student-faculty contact, active learning, and diverse ways of knowing (Braxton, 1998), which conceptually align with the student approaches to learning and faculty approaches to teaching frameworks. Interestingly, with regard to disciplinary differences in DAL, an area for further research is the relative ability of Biglan's pure/applied and life/non-life dimensions to explain disciplinary differences. While neither compares to the hard/soft dimension in this regard, this study's findings that the life/non-

life dimension explains slightly more variance than the pure/applied dimension appears at odds with findings in Nelson Laird et al. (2008).

Regarding findings on categorizing disciplines using Holland's theory, our findings provide a significant contribution to the limited literature using this theory to examine disciplinary differences in faculty teaching and approaches to learning. Whereas Rocconi et al. (2015) examined the interaction of discipline with approaches to learning with regard to students' plans to attend graduate school, this study contributes a direct examination of disciplinary differences in how faculty emphasize DAL. Indeed, the results of these two studies – in terms of disciplinary differences in DAL – are largely incomparable due to these methodological differences. Rocconi et al.'s study, by using Holland discipline categories in interaction with DAL to explain a student outcome likely draws out the role and influences that group values and behaviors play in distinguishing between Holland discipline categories. Nonetheless, the findings of this study generally align with other research using Holland discipline categories to examine other areas of faculty teaching. For instance, Umbach (2006) found that faculty in Realistic and Investigative disciplines used active and collaborative learning least and that faculty in Investigative disciplines emphasized higher-order learning the least.

Notably, comparing Biglan and Holland conceptualizations of discipline in the same study allows for some understanding of some of the similarities and differences between them. The overlap observed in some of the categorizations is reflected in the results as might be expected. For instance, faculty in Realistic disciplines are also predominantly categorized in hard-applied-nonlife disciplines and effect sizes for both of these categories showed only slight differences. Similarly, effect sizes showed only a small difference between Enterprising disciplines and soft-applied-nonlife disciplines. Faculty in hard-applied-nonlife disciplines also

offer an example of how these conceptualizations differ. While faculty in hard-applied-nonlife disciplines demonstrated a moderate-to-large negative relationship with emphasis on DAL in courses, approximately half of these faculty are categorized in Enterprising disciplines, which had a small, positive relationship with DAL. Such differences between the conceptualizations help to highlight the complexities within these groupings. Future research could better explore some of the nuances in values, interests, and practices amongst faculty within the same Biglan or Holland categories.

Despite the areas of overlap, these results indicate that not all conceptualizations of discipline are empirically equal in their ability to explain differences in teaching. While differences may be small to moderate, categorizing disciplines using all three of Biglan's dimensions offers marginally greater abilities to explain variation in DAL compared to categorizations using Holland's theory. Furthermore, categorizing disciplines using only Biglan's hard/soft dimension offers approximately similar or slightly greater ability to discern disciplinary differences in DAL compared to Holland. Certainly, further study would be needed to verify these differences regarding other areas of teaching. It is possible that Biglan's dimensions align better with a focus on teaching for DAL than Holland's theory. If this is the case, this suggests a need for researchers to carefully consider the theoretical and/or conceptual framing of research to align disciplinary conceptualizations with the intended area of study. While in this study, Biglan categories showed greater explanatory power, the same may not be true with, for example, student-faculty interactions, where Holland categories, with their basis in socialization, might plausibly better explain differences.

For faculty and educational developers, the results of this study contribute to the literature identifying substantive differences in faculty teaching across disciplines, suggesting a greater

need to consider how teaching corresponds to, for example, the nature of knowledge and study of that discipline. This sort of consideration is especially important as faculty and educational developers interpret broad findings of effective education practices, such as deep approaches to learning. While such practices may be broadly effective at improving student learning, faculty and educational developers must recognize and reflect on how such practices may look within their disciplinary contexts. As such, a practical implication of these results and this literature is that one-size-fits-all faculty teaching development may not be particularly effective if it does not appropriately contextualize pedagogical techniques. This study offers a further step in better understanding how faculty, staff, and scholars can examine disciplinary differences, and thus understand teaching and learning in higher education. Better understanding of not only where differences exist, but why they exist, is an important and necessary step in improving faculty teaching and students' learning in the classroom.

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Appendix

Table 1. Individual and course characteristics of faculty members (n=6,548)

Faculty and course characteristics	
GENDER IDENTITY	
Man	48.0%
Woman	46.8%
Prefer not to respond	5.2%
SEXUAL ORIENTATION	
Straight	82.7%
LGBQA	6.0%
Prefer not to respond	11.3%
RACE/ETHNICITY	
Asian, Native Hawaiian or Pacific Islander	5.0%
Black or African American	5.1%
Hispanic or Latina/o	3.4%
White	72.9%
Another racial/ethnic identity	2.1%
Multiracial	2.6%
Prefer not to respond	8.9%
EMPLOYMENT STATUS/RANK	
Full professor	26.5%
Associate professor	24.3%
Assistant professor	22.3%
Full-time lecturer/instructor	12.5%
Part-time lecturer/instructor	14.4%
Years of teaching experience (mean)	17.8
Number of undergraduate and graduate courses taught (mean)	5.7
COURSE DIVISION	
Lower division (freshman/sophomore)	41.5%
Upper division (junior/senior)	51.3%
Other division	7.2%
COURSE SIZE	
Small course (20 or fewer students)	34.5%
Medium course (21-30 students)	31.1%
Large course (31 or more students)	34.4%
Fulfills a General Education requirement	51.1%
COURSE FORMAT	
Classroom instruction on-campus	82.6%
Classroom instruction at auxiliary location	1.6%
Distance education (online, live or pre-recorded video or audio, correspondence, etc.)	6.9%
Combination of classroom instruction and distance education	8.8%

Table 2. Categorization of disciplines using Biglan's dimensions

Biglan Category	% of faculty members	Coded disciplines	
Hard-Pure-Life (HPL)	6.6	Marine science	Botany
		Biology	Microbiology or bacteriology
		Biochemistry or biophysics	Zoology
Hard-Pure-Nonlife (HPN)	13.6	Astronomy	Mathematics
		Atmospheric science/meteorology	Physics
		Chemistry	Statistics
		Earth science/geology	
Hard-Applied-Life (HAL)	0.5	Pharmacy	
		Speech	
Hard-Applied-Nonlife (HAN)	5.9	Electrical or electronic engineering	Chemical engineering
		Materials engineering	Civil engineering
		Mechanical engineering	Computer science
		Aero-, astronautical engineering	Industrial engineering
Soft-Pure-Life (SPL)	12.2	Anthropology	Gender studies
		Ethnic studies	Political science
		Sociology	Psychology
Soft-Pure-Nonlife (SPN)	31.6	Geography	Music
		Arts, fine and applied	Theater or drama
		English (language and literature)	History
		Languages and literatures (except English)	Philosophy
Soft-Applied-Life (SAL)	14.7	Music or art education	Nursing
		Religion/Theological studies, ministry	Social work
		Elementary, middle school education	Family and consumer studies
		Physical education	Business education
		Special education	
Soft-Applied-Nonlife (SAN)	15.0	Economics	Marketing
		Finance	Communications
		Architecture	Journalism
		Management	Business administration

Note: Categorization based on Nelson Laird (2008), Biglan (1973b), Malaney (1986)

Table 3. Categorization of disciplines using Holland's theory

Holland Category	% of faculty members	Coded disciplines	
Realistic	2.1	Marine science	Materials engineering
		Electrical or electronic engineering	Mechanical engineering
Investigative	27.9	Biology	Statistics
		Biochemistry or biophysics	Pharmacy
		Botany	Aero-, astronautical engineering
		Microbiology or bacteriology	Chemical engineering

		Zoology	Civil engineering
		Astronomy	Anthropology
		Atmospheric science/meteorology	Ethnic studies
		Chemistry	Sociology
		Earth science/geology	Geography
		Mathematics	Economics
		Physics	Finance
Artistic	26.7	Speech	Music
		Arts, fine and applied	Theater or drama
		English (language and literature)	Music or art education
		Languages and literatures (except English)	Architecture
Social	28.7	Gender studies	Physical education
		Political science	Special education
		Psychology	Nursing
		History	Social work
		Elementary, middle school education	Family and consumer studies
		Religion/ Theological studies, ministry	Philosophy
Enterprising	14.6	Computer science	Management
		Industrial engineering	Marketing
		Business education	Communications
		Business administration	Journalism

Note: Categorization based on Pike (2006)

Table 4. Cross-comparison of Biglan and Holland disciplinary group memberships

	Holland Categories									
Biglan	Realistic		Investigative		Artistic		Social		Enterprising	
Categories	N	%	N	%	N	%	N	%	N	%
HPL	12	8.8%	422	23.1%	0	0.0%	0	0.0%	0	0.0%
HPN	0	0.0%	888	48.7%	0	0.0%	0	0.0%	0	0.0%
HAL	0	0.0%	21	1.2%	15	0.9%	0	0.0%	0	0.0%
HAN	124	91.2%	71	3.9%	0	0.0%	0	0.0%	191	19.9%
SPL	0	0.0%	186	10.2%	0	0.0%	610	32.4%	0	0.0%
SPN	0	0.0%	43	2.4%	1644	94.0%	380	20.2%	0	0.0%
SAL	0	0.0%	0	0.0%	67	3.8%	890	47.3%	5	0.5%
SAN	0	0.0%	193	10.6%	23	1.3%	0	0.0%	763	79.6%

Table 5. Deep Approaches to Learning variable descriptives and constituent items

Deep Approaches to Learning (DAL) (Cronbach's α=.874)

Continuous (mean=3.17, sd=0.591), average of 11 items measured on 4-pt Likert scale

Higher-order learning (HO)

In your selected course section, how much does the coursework emphasize the following? (1=Very little, 2=Some, 3=Quite a bit, 4=Very much)

Applying facts, theories, or methods to practical problems or new situations

Analyzing an idea, experience, or line of reasoning in depth by examining its parts

Evaluating a point of view, decision, or information source

Forming a new idea or understanding from various pieces of information

Reflective and integrative learning (RI)

In your selected course section, how important is it to you that the typical student do the following? (1=Very little, 2=Some, 3=Quite a bit, 4=Very much)

Combined ideas from different courses when completing assignments

Connected your learning to societal problems or issues

Included diverse perspectives (political, religious, racial/ethnic, gender, etc.) in course discussions or assignments

Examined the strengths and weaknesses of your own views on a topic or issue

Tried to better understand someone else's views by imagining how an issue looks from his or her perspective

Learned something that changed the way you understand an issue or concept

Connected ideas from your courses to your prior experiences and knowledge

Table 6. Effect of each Biglan dimension on faculty emphasis on Deep Approaches to Learning (initial and full model results) (n=6,548)

	Initial Model			Dimension 1 (Hard/Soft)			Dimension2 (Pure/Applied)			Dimension 3 (Life/Non-life)		
Adjusted R^2	0.096			0.212			0.101			0.107		
R^2 Change from Initial Model				0.116***			0.006***			0.011***		
	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.	B	SE	Sig.
(Constant)	-0.649	0.058	***	-0.640	0.054	***	-0.590	0.058	***	-0.589	0.058	***
BIGLAN DIMENSION CATEGORIES												
Hard				-0.413	0.013	***						
Soft				0.413	0.013	***						
Pure							-0.089	0.014	***			
Applied							0.089	0.014	***			
Life										0.120	0.013	***
Non-life										-0.120	0.013	***
GENDER IDENTITY (ref.=Man)												
Woman	0.267	0.025	***	0.150	0.024	***	0.267	0.025	***	0.228	0.025	***
Prefer not to respond	0.143	0.070	*	0.101	0.065		0.137	0.070	*	0.137	0.069	*
SEXUAL ORIENTATION (ref.=Straight)												
LGBQA	0.125	0.051	*	0.010	0.048		0.149	0.051	**	0.131	0.051	**
Prefer not to respond	0.080	0.050		0.071	0.046		0.088	0.050		0.089	0.049	
RACE/ETHNICITY (ref.=White)												
Asian or Pacific Islander	-0.045	0.056		0.093	0.053		-0.070	0.056		-0.010	0.056	
Black or African American	0.347	0.055	***	0.294	0.052	***	0.321	0.055	***	0.327	0.055	***
Hispanic or Latino/a	0.393	0.067	***	0.347	0.062	***	0.390	0.066	***	0.393	0.066	***
Multiracial	0.118	0.076		0.103	0.071		0.117	0.076		0.133	0.076	
Another race or ethnicity	0.139	0.084		0.180	0.079	*	0.126	0.084		0.155	0.084	
Prefer not to respond	-0.069	0.058		-0.059	0.054		-0.072	0.057		-0.056	0.057	
EMPLOYMENT STATUS/RANK (ref.=Full professor)												
Associate professor	0.023	0.035		0.013	0.033		0.017	0.035		0.017	0.035	

Assistant professor	0.108	0.040	**	0.084	0.037	*	0.083	0.040	*	0.095	0.039	*
Full-time lecturer/instructor	0.023	0.045		0.027	0.042		-0.008	0.045		0.027	0.045	
Part-time lecturer/instructor	0.024	0.044		-0.015	0.041		0.000	0.044		0.037	0.044	
Number of undergraduate and graduate courses taught	0.020	0.005	***	0.010	0.005	*	0.020	0.005	***	0.023	0.005	***
Years of teaching experience (in decades)	-0.005	0.001	***	-0.007	0.001	***	-0.005	0.001	***	-0.005	0.001	***
COURSE DIVISION (ref.=Lower division)												
Upper division	0.380	0.028	***	0.287	0.026	***	0.342	0.028	***	0.352	0.028	***
Other division	0.205	0.049	***	0.090	0.046	*	0.195	0.049	***	0.196	0.049	***
COURSE SIZE (ref.=Small course)												
Medium course	0.013	0.030		0.040	0.028		-0.007	0.030		-0.007	0.030	
Large course	-0.136	0.030	***	-0.021	0.028		-0.163	0.030	***	-0.176	0.030	***
General education course	0.292	0.027	***	0.236	0.025	***	0.320	0.027	***	0.304	0.027	***
COURSE FORMAT (ref.=Classroom on-campus)												
Classroom at auxiliary	0.213	0.097	*	0.129	0.091		0.172	0.097		0.164	0.096	
Distance education	0.332	0.049	***	0.211	0.046	***	0.300	0.049	***	0.305	0.049	***
Combination of classroom and distance	0.257	0.043	***	0.204	0.040	***	0.219	0.043	***	0.234	0.043	***

Table 7. Effect of eight Biglan discipline categories on faculty emphasis on Deep Approaches to Learning (initial and full model results) (n=6,548)

	Initial Model			Full Model		
Adjusted R^2	0.096			0.220		
R^2 Change from Initial Model				0.125***		
	B	SE	Sig.	B	SE	Sig.
(Constant)	-0.649	0.058	***	-0.550	0.057	***
BIGLAN DISCIPLINE CATEGORIES						
Hard-Pure-Life				-0.319	0.044	***
Hard-Pure-Nonlife				-0.625	0.035	***
Hard-Applied-Life				-0.025	0.132	
Hard-Applied-Nonlife				-0.441	0.047	***
Soft-Pure-Life				0.390	0.036	***
Soft-Pure-Nonlife				0.290	0.030	***
Soft-Applied-Life				0.480	0.035	***
Soft-Applied-Nonlife				0.250	0.034	***
GENDER IDENTITY (ref.=Man)						
Woman	0.267	0.025	***	0.123	0.024	***
Prefer not to respond	0.143	0.070	*	0.099	0.065	
SEXUAL ORIENTATION (ref.=Straight)						
LGBQA	0.125	0.051	*	0.016	0.048	
Prefer not to respond	0.080	0.050		0.079	0.046	
RACE/ETHNICITY (ref.=White)						
Asian or Pacific Islander	-0.045	0.056		0.117	0.053	*
Black or African American	0.347	0.055	***	0.279	0.052	***
Hispanic or Latino/a	0.393	0.067	***	0.347	0.062	***
Multiracial	0.118	0.076		0.113	0.071	
Another race or ethnicity	0.139	0.084		0.193	0.078	*
Prefer not to respond	-0.069	0.058		-0.052	0.054	
EMPLOYMENT STATUS/RANK (ref.=Full professor)						
Associate professor	0.023	0.035		0.004	0.033	
Assistant professor	0.108	0.040	**	0.065	0.037	
Full-time lecturer/instructor	0.023	0.045		0.019	0.042	
Part-time lecturer/instructor	0.024	0.044		-0.009	0.041	
Number of undergraduate and graduate courses taught	0.020	0.005	***	0.013	0.005	**
Years of teaching experience (in decades)	-0.005	0.001	***	-0.006	0.001	***
COURSE DIVISION (ref.=Lower division)						
Upper division	0.380	0.028	***	0.260	0.027	***
Other division	0.205	0.049	***	0.072	0.046	
COURSE SIZE (ref.=Small course)						
Medium course	0.013	0.030		0.027	0.028	
Large course	-0.136	0.030	***	-0.046	0.029	
General education course	0.292	0.027	***	0.252	0.025	***

COURSE FORMAT (ref.=Classroom on-campus)						
Classroom at auxiliary	0.213	0.097	*	0.090	0.090	
Distance education	0.332	0.049	***	0.199	0.046	***
Combination of classroom and distance	0.257	0.043	***	0.181	0.040	***

Table 8. Effect of Holland discipline categories on faculty emphasis on Deep Approaches to Learning (initial and full model results) (n=6,548)

	Initial Model			Full Model		
Adjusted R^2	0.096			0.175		
R^2 Change from Initial Model				0.079***		
	B	SE	Sig.	B	SE	Sig.
(Constant)	-0.649	0.058	***	-0.627	0.058	***
HOLLAND DISCIPLINE CATEGORIES						
Realistic				-0.394	0.065	***
Investigative				-0.345	0.026	***
Artistic				0.230	0.028	***
Social				0.407	0.026	***
Enterprising				0.102	0.030	***
GENDER IDENTITY (ref.=Man)						
Woman	0.267	0.025	***	0.157	0.025	***
Prefer not to respond	0.143	0.070	*	0.108	0.067	
SEXUAL ORIENTATION (ref.=Straight)						
LGBQA	0.125	0.051	*	0.054	0.049	
Prefer not to respond	0.080	0.050		0.078	0.048	
RACE/ETHNICITY (ref.=White)						
Asian or Pacific Islander	-0.045	0.056		0.085	0.054	
Black or African American	0.347	0.055	***	0.321	0.053	***
Hispanic or Latino/a	0.393	0.067	***	0.368	0.064	***
Multiracial	0.118	0.076		0.134	0.073	
Another race or ethnicity	0.139	0.084		0.208	0.080	**
Prefer not to respond	-0.069	0.058		-0.060	0.055	
EMPLOYMENT STATUS/RANK (ref.=Full professor)						
Associate professor	0.023	0.035		0.009	0.034	
Assistant professor	0.108	0.040	**	0.078	0.038	*
Full-time lecturer/instructor	0.023	0.045		0.012	0.043	
Part-time lecturer/instructor	0.024	0.044		0.004	0.042	
Number of undergraduate and graduate courses taught	0.020	0.005	***	0.016	0.005	***
Years of teaching experience (in decades)	-0.005	0.001	***	-0.006	0.001	***
COURSE DIVISION (ref.=Lower division)						
Upper division	0.380	0.028	***	0.306	0.027	***
Other division	0.205	0.049	***	0.119	0.047	*
COURSE SIZE (ref.=Small course)						
Medium course	0.013	0.030		0.029	0.029	

Large course	-0.136	0.030	***	-0.036	0.030	
General education course	0.292	0.027	***	0.270	0.026	***
COURSE FORMAT (ref.=Classroom on-campus)						
Classroom at auxiliary	0.213	0.097	*	0.133	0.093	
Distance education	0.332	0.049	***	0.243	0.047	***
Combination of classroom and distance	0.257	0.043	***	0.221	0.041	***