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Thinking Differently: Multiple Intelligences in Construction Management Education

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Over four years and seven semesters, 212 undergraduate students enrolled in a senior capstone construction management (CM) course completed an assignment directly evaluating their intellectual abilities using Howard Gardner's theory of multiple intelligences (MI). MI theory rejects the traditional premise that intelligence is broad, generic, and measurable on a linear scale flanked by "high" and "low" intelligence poles. Instead, the theory proposes that intelligence is an individualized synthesis of specific and various intellectual abilities including linguistic, logical-mathematical, kinesthetic, musical, interpersonal, intrapersonal, naturalist, spatial, and existential. Results from the study showed that on average CM students in the capstone course gave themselves high scores in kinesthetic, logical-mathematical, and interpersonal MI categories. They showed alarmingly low confidence in their linguistic ability (i.e., communication), ranking it second to last. CM students' MI scores were further analyzed by their final grade in class, sex, and total MI scores. Key takeaways from the study encourage CM educators to find ways to tailor their curricula to include more first-hand, kinesthetic-based applications and experiences. CM students should also be given many more opportunities to speak, present, and collaborate in class to help improve their linguistic abilities and confidence.

Key Words: Construction Management, Construction Education, Multiple Intelligences

Introduction

In 1983, Howard Gardner, developmental psychologist and research professor, published his book, *Frames of Mind*, in which he proposed his seminal theory of multiple intelligences (MI). MI theory states that contrary to traditional IQ-based viewpoints on intelligence, human cognition is not a single construct, rather, it's an assemblage of independent and cooperative intellectual abilities that can be used to solve problems and synthesize new ideas (Davis et al., 2011). In *Frames of Mind*, Gardner posited eight separate intelligences: linguistic, logical-mathematical, kinesthetic, musical, interpersonal, intrapersonal, naturalist, and spatial (Gardner, 1983). Since these original eight, Gardner and his contemporaries have discussed the potential for additional intelligences including moral, humor, existential—the ability to entertain questions about life, death, and love—and even cooking (Davis et al., 2011). Regardless of the specific intelligence categories espoused by Gardner and his contemporaries, the main appeal of MI theory was its challenge to prevailing thought—that intelligence is not generic, broad, undefined, and unary; rather, it is multifarious, classifiable, and ascribable. Because MI theory assumes individuals vary in their intellectual aptitudes and predilections, it is likely students will respond differently to different pedagogical approaches. In

Gardner's assessment, modern schools adequately promote only two of the eight intelligences—logical-mathematical and linguistic (Armstrong, 1994; Street et al., 2017)—two very important intellectual domains, but far from everything college students need to be prepared for their future careers, especially occupations requiring dynamic, applied, and interdisciplinary expertise. Considering these points in a construction management (CM) context, education researchers are faced with several conspicuous and salient question, principally: What are CM students' intellectual strengths and weaknesses? Once this question is sufficiently answered, researchers will then be able to determine whether prevailing pedagogical methodologies sufficiently accommodate the intellectual abilities and idiosyncrasies of CM students? If not, the question becomes what can be done by CM teachers to make the curricula and classrooms a more effective learning environment? This paper focuses on the principal question (i.e., what are the intellectual strengths and weaknesses of CM students) by reporting the results of a self-assessment on the intellectual profiles of undergraduate students in a senior-level CM capstone course across seven semesters between fall 2021 and summer 2024.

Literature Review

Much of the current literature at the intersection of construction management (CM) and Gardner's theory of multiple intelligences (MI) is motivated by finding better ways to evaluate the cognitive potential and predilections of CM students and professionals than traditional intelligence measures like intelligence quotient (IQ) tests. A popular trend is to use MI in support of other, more contemporary and precise learning theories, pedagogies, and evaluation instruments—many of them on the topic of social and emotional intelligence (Kuka et al., 2023). Songer & Walker (2004) used MI theory to support using the Bar-On Emotional Quotient Inventory (EQ-i) method of evaluating emotional intelligence of 104 employees from seven contractors. BarOn EQ-i is a self -reporting instrument measuring a respondent's social and emotional performance in key areas of life and the workplace. In a methodologically similar study, Butler & Chinowsky (2006) "buil[t] upon the concept of multiple intelligences" (p. 119) by using the BarOn EQ-i test and a survey to examine the emotional intelligence of 130 executives from Engineering News Record's (ENR) top 400 contractors in the United States. Mo & Dainty (2007) measured the emotional intelligence of CM master's students using the Schutte Self-Report Inventory (SSRI), a Likert-style self-reporting emotional intelligence questionnaire comprised of 33 self-referencing statements used to understand the relationship between emotional intelligence and various construction disciplines including civil engineering, construction engineering and management, architectural engineering and design management, and commercial management.

A few studies in CM literature on MI have focused on finding ways to improve teaching construction safety. Wall et al. (2007) and Acar et al. (2008)—two installments in the same research series conducted by the same researchers—used Gardner's MI framework to guide the development of online construction safety training resources by creating a variety of learning tools (i.e., multiple pedagogical entry points) including videos, images, statistics, narrative descriptions, and problem-solving exercises. Carney et al. (2008) completed a thematically related study to Wall et al. (2007) and Acar et al. (2008) by producing online class materials to teach construction safety based on MI principles of individualistic intelligences and learning needs. In the study, for example, students exhibiting high logical-mathematical intelligence were given the option to analyze statistical data for fall hazards and create graphical representations of the risks. Students exhibiting spatial/visual intelligence were provided illustrations, photos, cartoons, and other graphics for evaluating the safety of site layouts.

Notably, relatively few research studies on MI in CM focus on undergraduate students. Most have been focused instead of industry leadership (e.g., Butler & Chinowsky, 2006), working professionals (e.g., Songer & Walker, 2004), and graduate students (e.g., Mo & Dainty, 2007). Anandh et al. (2020) used Gardner's MI framework to support exploring the emotional intelligence of middle management in the construction industry. Alade & Windapo (2021), in a study similar to Butler & Chinowsky, relied on the fundamentals of MI theory to study the intellectual differences of senior executives in construction firms to explore correlations between various leadership styles, traits, and intelligences. In the subdomain of undergraduate CM research on MI, Wiezel & Mayo (2000) researched body-kinesthetic intelligence in response to the technological revolution at the peak of the dot-com era. They recommended that CM teachers resist the tendency to focus their instruction on only one teaching approach that serves a single MI because CM students are rarely so polarized in their cognitive tendencies. Wiezel and Mayo (2000) also mentioned that CM students seem to gravitate to six of the eight intelligences (i.e., not musical and naturalist). Lee et al., (2016) used MI theory to support the hypothesis that differentiated pedagogies—those providing broad, flexible learning conditions—will have the best results for teaching applied math to CM students. In this study, students were divided into three groups: traditional lecture, flipped classroom, and traditional lecture. The researchers found that problem-based learning resulted in the best outcomes for students, followed by flipped classrooms. Students in the traditional lecture had the lowest overall performance. In possibly the most relevant publication to this study, Street et al. (2017) authored a questionnaire based on information from Gardner's collective publications to test if aptitude in any the MIs could be used as predictors of academic performance in a sample of 156 undergraduate CM students. The study found a statistically significant positive correlation between participants with logical-mathematical abilities and higher grade point averages (P=.001). The study also found an inverse relationship between academic performance and kinesthetic ability. No studies could be found in which undergraduate CM students evaluated their *own* intellectual inclinations directly using Howard Gardner's MI terms and definitions.

Methods

Over seven semesters between the fall 2021 and summer 2024, a total of 212 fourth-year undergraduate construction management (CM) students in a senior capstone course at a major public university in the Southeast United States completed an assignment evaluating their intellectual abilities using Howard Gardner's theory of multiple intelligences (MI). The assignment included nine seven-point, Likert-style questions asking students to "Think carefully and rank [their] intelligence in each of the categories proposed by Howard Gardner below (1 = Low intelligence in this area. 7 = High intelligence in this area)". Short descriptions for each of the MIs were provided as part of the questions (Table 1). The vast majority of the students who completed the assignment were male (90.1%, n=191). The remainder were female (9.9%, n=21). The semester with the highest course enrollment was Spring 2024 with 41 students. The semester with the lowest enrollment was Summer 2024 with 17 students. Only complete student submissions were included in the final data set for analysis. Data from each student's assignment were collected from the learning management system, Canvas, and entered into a Microsoft Excel file for analysis. Two-tailed independent t-tests were performed discriminately to identify statistically significant differences between subgroups of students including, final grade in class, student sex, and total MI scores. All data provided in this paper were accessed and analyzed in compliance with The University standards of anonymity of human subjects research and based on the United States federal definition of research. The University's institutional review board (IRB) was consulted prior to data collection and analysis and verified its proper use in writing.

Table 1. Descriptions of multiple intelligences provided to CM students in their assignment.

MI	Description
Spatial	Ability to find oneself in spaces, both large and small.
Linguistic	Ability with words, written and spoken.
Logical-Mathematical	Ability to deal with logic, numbers, and reasoning.
Kinesthetic	Coordination, sense of timing, good reflexes, hand dexterity.
Musical	Sensitivity to sounds, tones, rhythms, and pitch.
Interpersonal	Sensitivity to others' moods and motives; the ability to cooperate, get along, and be "team players".
Intrapersonal	Ability to self-reflect and decipher one's own feelings.
Naturalist	Ability to make consequential distinctions in the natural world among animals, plants, clouds, and other configurations.
Existential	The tendency to raise big questions about life and to search for answers.

Results

Likert-scale point totals and averages were calculated for each multiple intelligence (MI) to provide the descending rank-ordered list in Table 2. Approximately one quarter of a percentage point (.26) separated the average scores of the first three MIs, with kinesthetic (coordination and hand dexterity) in first position, followed closely by logical-mathematical (numbers, logic, and reasoning) in second and interpersonal (teamwork) in third. Surprisingly, the linguistic MI (the ability with words, written and spoken) ranked second to last, more than a full point lower than kinesthetic (1.10), and also lower than seemingly less-applicable construction management (CM) MIs like spatial, existential, and naturalist. Only the musical MI ranked lower than linguistic.

Table 2. Overall rank ordering of multiple intelligences for all students.

Rank	MI	Total	Average
1	Kinesthetic	1177	5.55
2	Log-Math	1139	5.37
3	Interpersonal	1122	5.29
4	Spatial	1053	4.97
5	Existential	1024	4.83
*6	Intrapersonal	1019	4.81
*6	Naturalist	1019	4.81
7	Linguistic	944	4.45
8	Musical	791	3.73

*Intrapersonal and Naturalist MIs tied for 6th position.

Averages from each MI were statistically cross-analyzed with the others using independent t-tests as displayed by the matrix provided in Table 3. Results from the t-tests indicated statistically significant differences (P<.05) in 56 out of the 72 relationships (78%).

Table 3. Matrix of *P*-values for multiple intelligences.

	Spatial	Ling.	Log-Math	Kinesth.	Musical	Interp.	Intrap.	Natural.	Exit.
Spatial	N/A	<0.001	0.001	<0.001	<0.001	0.012	0.230	0.231	0.322
Linguistic	<0.001	N/A	<0.001	<0.001	<0.001	<0.001	0.008	0.008	0.006
Log-Math	0.001	<0.001	N/A	0.111	<0.001	0.514	<0.001	<0.001	<0.001
Kinesthetic	<0.001	<0.001	0.111	N/A	<0.001	0.029	<0.001	<0.001	<0.001
Musical	<0.001	<0.001	<0.001	<0.001	N/A	<0.001	<0.001	<0.001	<0.001
Interpersonal	0.012	<0.001	0.514	0.029	<0.001	N/A	<0.001	<0.001	0.001
Intrapersonal	0.230	0.008	<0.001	<0.001	<0.001	<0.001	N/A	1.000	0.867
Naturalist	0.231	0.008	<0.001	<0.001	<0.001	<0.001	1.000	N/A	0.867
Existential	0.322	0.006	<0.001	<0.001	<0.001	0.001	0.867	0.867	N/A

Analyzing the data further, CM Students were grouped by the final grade they received in the course—A-students, B-students, C-students—to evaluate if there were any differences in the rank ordering of their MIs (Table 4). All three grade groups ranked kinesthetic in either the first or second position. Logical-mathematical was ranked in the top three positions in all three groups. The musical MI was ranked last in all three groups. All three groups ranked interpersonal (awareness of and cooperation with others) higher than intrapersonal (self-reflection). A-students ranked interpersonal and intrapersonal MIs in the third and four positions in comparison with C-students who ranked them lower in sixth and seventh positions. Targeted t-tests indicated that the difference between interpersonal averages of B-students and C-students was statistically significant (*P*=.01), but not A-students and C-students (*P*=.06). C-students ranked both logical-mathematical and linguistic MIs higher than both A-students and B-students; however, a t-test indicated that the difference between the logical-mathematical averages of A-students and C-students was not statistically significant (*P*=.16) nor was the difference between B-students and C-students (*P*=.11). A-students and B-students groups ranked linguistic in second-to-last in the eighth position. C-students ranked linguistic fifth. T-tests indicated that the difference between linguistic averages of A-students and C-students was not statistically significant (*P*=.20), nor was the difference between B-students and C-students (*P*=.19).

Table 4. Multiple intelligences rank ordering by final grade in the course.

	A-students (N=86) Grade Scale 90.0-100		**B-students** (N=98) Grade Scale 80.0-89.9		**C-students** (N=28) Grade Scale 70.0-79.9	
Rank	MI	*Average	MI	*Average	MI	*Average
1	Kinesthetic	5.53	Kinesthetic	5.60	Log-Math	5.71
2	Log-Math	5.35	Interpersonal	5.48	Kinesthetic	5.43
3	Interpersonal	5.28	Log-Math	5.30	Spatial	5.04
4	Intrapersonal	4.79	Spatial	5.13	Naturalist	4.86
5	Spatial	4.76	Existential	5.02	Linguistic	4.82
6	Naturalist	4.74	Intrapersonal	4.89	Interpersonal	4.68
7	Existential	4.71	Naturalist	4.84	Intrapersonal	4.57
8	Linguistic	4.40	Linguistic	4.40	Existential	4.54
9	Musical	3.49	Musical	3.89	Musical	3.93

*Rows in the table are organized by descending rank order, not the average score relative to other group averages. Thus, average scores are not comparable across rows and the average score of one MI may be higher or lower than the average score of another MI in the same row.

CM students were divided by sex to analyze the differences between men and women in their MI rankings (Table 5). Due largely to the disproportionate number of male students (n=191) to female students (n=21) in the study, the rank order for men mirrors the rank order for all students (see Table 2), with the only exception of positions six and seven—naturalist and intrapersonal—in which naturalist scored slightly higher. The highest ranked MI for women was interpersonal with an average score of 5.95, the fourth highest MI score of any group examined in the study. Women also ranked kinesthetic in the fourth position, the only time it was not in the top three positions in the study. Targeted t-tests indicated that the difference in averages between men and women for interpersonal was statistically significant (*P* =.02), but not intrapersonal (*P*=.44). The difference in scores for logical-mathematical between men and women was statistically significant (*P*=.03). The difference in scores for linguistic between men and women was not statistically significant (*P=.48*). The difference in scores for kinesthetic was statistically significant (*P<.001*).

Table 5. Multiple intelligences rank ordering by sex.

	Male (N=191)		**Female** (N=21)	
Rank	MI	*Average	MI	*Average
1	Kinesthetic	5.67	Interpersonal	5.95
2	Log-Math	5.45	Intrapersonal	5.05
3	Interpersonal	5.22	Log-Math	4.67
4	Spatial	5.08	Kinesthetic	4.48
5	Existential	4.91	Linguistic	4.24
6	Naturalist	4.90	Existential	4.10
7	Intrapersonal	4.78	Spatial	3.95
8	Linguistic	4.48	Naturalist	3.95
9	Musical	3.80	Musical	3.10

*Rows in the table are organized by descending rank order, not the average score relative to other group averages. Thus, average scores are not comparable across rows and the average score of one MI may be higher or lower than the average score of another MI in the same row.

The highest possible score a student could achieve for answering the nine, seven-point Likert questions in the MI assignment was 63 (by selecting 7s on each of the nine questions). The lowest possible score was 0 (by selecting 0s on each of the nine questions). The student with the lowest score across the seven semesters scored 27. The student with the highest score scored 59. Grouping CM students by their total scores—20s, 30s, 40s, 50s—descriptive analyses were conducted to see if there were any differences in the rank ordering of their MIs (Table 6). These analyses focused on Group-30s, Group-40s, and Group-50s, because Group-20s only had two students. Group-30s and Group-40s ranked logical-mathematical in second position, while Group-50s ranked it in seventh position. Despite this, Group-50s average score (5.65) for logical-mathematical was still higher than the average score of Groups-30 (4.90) and Groups-40s (5.47). Targeted t-test indicated that the difference in averages of Group-30s and Group-50s for logical-mathematical was statistically significant (*P*=.01). The difference for Group-40s and Group-50s for Logical Mathematical was not statistically significant (*P*=.34). Notably, the 34 students in Group-50s ranked existential (big life questions) in second position, with an average score of 6.29, nearly double that of Group-30s (3.48) and about a point and a half higher than Group-40s (4.91). The difference in averages of Group-30s and Group-50s for the existential MI was significant (*P<.001*). The difference in averages of Group-40s and Group-50s for existential was also significant (*P<.001*).

Table 6. Multiple intelligences rank ordering by total scores.

	Group-20s (N=2)		**Group-30s** (N=42)		**Group-40s** (N=134)		**Group-50s** (N=34)	
Rank	MI	*Avg	MI	*Avg	MI	*Avg	MI	*Avg
1	Kinesthetic	4.00	Kinesthetic	4.95	Kinesthetic	5.57	Kinesthetic	6.32
2	Log-Math	4.00	Log-Math	4.90	Log-Math	5.47	Existential	6.29
3	Interpersonal	4.00	Interpersonal	4.62	Interpersonal	5.31	Interpersonal	6.15
4	Linguistic	3.00	Spatial	4.40	Spatial	4.97	Intrapersonal	5.91
5	Intrapersonal	3.00	Naturalist	4.10	Intrapersonal	4.93	Naturalist	5.88
6	Existential	3.00	Linguistic	3.69	Existential	4.91	Spatial	5.79
7	Spatial	2.50	Intrapersonal	3.60	Naturalist	4.80	Log-Math	5.65
8	Musical	2.00	Existential	3.48	Linguistic	4.49	Musical	5.50
9	Naturalist	2.00	Musical	2.93	Musical	3.56	Linguistic	5.32

*Rows in the table are organized by descending rank order, not the average score relative to other group averages. Thus, average scores are not comparable across rows and the average score of one MI may be higher or lower than the average score of another MI in the same row.

Discussion and Conclusion

Howard Gardner observed that modern schools tend to place disproportionate emphasis on logical-mathematical and linguistic multiple intelligences (MIs) at the expense of the other six (or seven if existential is included) (Armstrong, 1994; Street et al., 2017). If true, the findings from this study are evidence that this emphasis may be achieving its logical-mathematical objectives but falling short with linguistics. Regarding the logical-mathematical MI, construction management (CM) students reported high levels of confidence in their abilities, ranking them in second position out of eight with an average of 5.55 on a seven-point Likert scale. These results diverge from the findings of Street et al. (2017) who reported a statistically significant positive correlation between participants with logical-mathematical abilities and higher grade point averages (GPAs). The results of this study, in contrast, showed no correlation between grades and perceived logical-mathematical abilities. All students, regardless of their final grade in the class (i.e., A, B, or C), ranked logical-mathematical in the first three positions. C-students ranked it in first position and had the highest average score of 5.71 on a seven-point Likert scale. A-students ranked it in second position with an average score of 5.35. B-students ranked it in third position with an average score of 5.30. Regarding their linguistic abilities, CM students in this study scored themselves surprisingly very low, ranking them in the second-to-last position with an average of 4.45 on a seven-point Likert scale. If Gardner's observations are correct that modern schools overemphasize linguistics, and if CM students' self-evaluation is even moderately close to accurate, this result should be a warning that educational efforts in reading, writing, and speaking may be falling short for students with the inclination for careers in CM. This is particularly alarming when considering that linguistic abilities, i.e., communication, is among the most important skills, if not *the* most important skill, college educated construction managers should possess.

Analyzing the remaining MIs, on average CM students expressed the greatest confidence in their kinesthetic abilities, ranking it in first position. Breaking down the kinesthetic data by final grade in class, all students ranked it in either first or second place, with A-students ranking it higher in comparison with the other groups. This finding directly contradicts the results from Street et al. (2017) who report that "the bodily-kinesthetic subscale of multiple intelligences is significantly and inversely related to academic performance." (p. 321). Eight-hundredths of a scalar point below logical-mathematical, interpersonal came third in the rankings, an appropriate placement for future construction managers who must rely on working well in teams. In the middle of the rankings,

existential, intrapersonal, and naturalist MIs all came within two-hundredths of a point of one another. Remarkably, intrapersonal and naturalist were tied in their rankings with an average Likert score of 4.81 (exactly 1019 total points each), indicating that CM students believed they possess the same level of self-awareness and introspection as they do discernment of the natural world. This inclination to the *natural environment* may have some influence on CM students' interest in the *built environment*. At the bottom of the rankings was the musical MI in the last position with an average score of 3.73, about half the maximum Likert score of seven. These results mirror Wiezel and Mayo's (2000) observations that CM students typically rank naturalist and musical MIs lower in their intellectual abilities.

Evaluating differences between males and females, women believed their intellectual abilities were strongest with the two human-centered MIs—interpersonal and intrapersonal. These were the only two MIs that women assigned an average score in the five-point range on the seven-point Likert scale. The next closest MI, logical-mathematical, was nearly half a point lower in the mid-fours. Men, in contrast, believed their intellectual abilities were most pronounced with kinesthetic and logical-mathematical abilities, the MIs concerned with "things/resources" rather than people or ideas. It is possible that these findings are attributable to the milieu of an industry that is asymmetrically male by approximately a 10-to-1 ratio (Pamidimukkala & Kermanshachi, 2023). They may also be a result of more fundamental, sex-based differences. Or they may be some combination of both.

Key Takeaways

CM educators interested in applying the findings from this paper should consider the following key takeaways for their curricula and classrooms.

- CM students exhibit alarmingly low confidence in their linguistic abilities despite the importance of this skill for success in the construction industry. Teachers should assign short, focused writing assignments challenging students to communicate clearly and effectively. They should also give students more opportunities to speak in class through collaboration and group presentations, possibly in lieu of writing long papers and submission-based projects.
- CM students' intellectual abilities are sometimes poorly matched to the classical educational programming that modern schools tend to emphasize. CM students seem to prefer learning with their minds *and* their hands (Note, CM students may prefer to learn with their hands as students even if they are not interested in working with their hands as professionals). Teachers should thus optimize their course content delivery in a way that will be most beneficial to their students—for example, by focusing more on the application of construction concepts with first-hand, kinesthetic-based projects and learning experiences.
- This study found that, at scale, men and women in CM appear to exhibit different intellectual aptitudes, often complementary traits to one another that can be leveraged to build successful operations. Women reported higher confidence in their abilities to manage people. Men tend to feel more confident in their abilities to direct resources. Teachers should incorporate both people-focused and resource-focused assignments into their courses.
- Kinesthetic was the highest ranked MI in the study. Teachers should consider ways to balance classroom-based, theoretical learning with experiential learning. This does not mean converting four-year CM programs in into trade schools. It could mean more application through additional off-site industry involvement.

Limitations

Inherent to research involving multiple intelligences (MI) is the well-documented and ongoing discussion in the literature about the scientific strength of the theory (Ferrero et al. 2021). Interested scholars and educational practitioners should take the time to study and consider all informed perspectives commenting on both the merits and criticisms of Gardner's MI. Another potential limitation of the study is its methodology—asking construction management (CM) students to evaluate their own intellectual abilities openly and directly using Howard Gardner's theory of multiple intelligences (MI). The advantage of this approach was the freedom students had to draw their own conclusions about themselves without the confinement of hard experimental controls or excessively narrow questions. However, the open nature of the method also gave students the opportunity to stray from the central idea of each question, potentially formulating their own proxy metrics that could be used to construct inaccurate or incomplete definitions of the MIs. For example, with the lack of precise guidance built into the questions, some CM students may have overestimated their logical-mathematical abilities simply because they excelled in their high school calculus class. Or, they may have underestimated their linguistic abilities because they didn't like writing five-paragraph essays using MLA formatting. Hence, the usefulness of the findings hinges on the accuracy of CM student's knowledge and opinions about their own cognitive strengths and weaknesses. And it is important to reiterate that this study is only what it purports to be—a self-evaluation of CM students' perceptions of their own intellectuality. Future researchers should build on this study by finding more precise ways to control and measure specific variables about CM students' learning abilities and predilections.

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