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Cross-Cultural Comparison of Learning Style Preferences between American and Chinese Undergraduate Engineering Students*

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Student learning styles are an important factor to consider when designing pedagogy and course curriculum to optimize or maximize student learning outcomes. As online and distance education expands rapidly across national borders to reach a global audience, a cross-cultural, comparative study of learning style preferences among different nations helps provide insights into whether diverse cultural backgrounds and experiences affect student learning styles, and if so, how. The present study focuses on a cross-cultural comparison of learning style preferences between American and Chinese undergraduate engineering students. A total of 132 sophomore (second-year) engineering students from two comparable universities in the United States and China participated in the present study. The 44-item Felder–Silverman Index of Learning Styles questionnaire survey was employed to measure the students' learning style preferences. Students' exam scores in two foundational core engineering courses (statics and dynamics) were also collected. The results of statistical t-tests show that there existed statistically significant differences between American and Chinese students in four learning style dimensions: reflective ($p < 0.01$), sensing ($p < 0.01$), visual ($p < 0.01$), and verbal ($p < 0.05$). These differences represented a medium-sized effect. On average, American students had a higher preference than Chinese students in all these four learning style dimensions. The results of correlation analysis show that a statistically significant correlation ($r = 0.286, p < 0.05$) existed between American students' active/reflective learning style preferences and the average statics exam scores. It is suggested that instructors use diversified teaching styles to accommodate the diverse learning style preferences of students, and that students develop a balanced (or well-rounded) learning style preference in each learning style scale (active/reflective, sensing/intuitive, visual/verbal, and sequential/global) to accommodate the teaching styles of instructors, as well as the needs of particular engineering courses.

Keywords: learning styles; cross-cultural comparison; American undergraduate engineering students; Chinese undergraduate engineering students

1. Introduction

1.1 Student learning styles

Learning styles are the ways in which students (or in a broader term—learners) take in (or receive) and processes information when they learn new knowledge or skills. Different students have different learning style preferences [1–4]. For example, some students prefer visual learning and understand better when information is presented to them in a visual way such as pictures, photos, charts, diagrams, sketches, or illustrations. Other students prefer verbal learning and understand better when information is presented to them in a verbal way; for example, somebody tells them. When designing pedagogy and course curriculum, instructors should consider their students' learning style preferences so that teaching styles are compatible with the students' learning styles, in order to optimize or maximize student learning outcomes.

A variety of learning style models have been proposed in the past, such as Kolb's learning style model, Felder and Silverman's learning style model, the Myers–Briggs Type Indicator, and the Herrmann Brain Dominance Instrument [5–9]. Among these learning style models, Kolb's [5] and Felder and Silverman's [6] models have been widely adopted in the international education research community, especially in the engineering education research community. Therefore, the two models are briefly described in the following paragraphs.

Kolb's [5] learning style model is based on the Experiential Learning Theory. According to Kolb [5], learners rely on four learning modes to take in and internalize information: concrete experience, abstract conceptualization, reflective observation, and active experimentation. Based on certain combinations of these four learning models, learners are further classified into four categories: diverging,

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assimilating, converging, and accommodating. Kolb's model emphasizes that 'learning style is not a psychological trait but a dynamic state resulting from synergistic transactions between the person and the environment' [10]. Kolb's [5] model was developed for learners in all academic disciplines and does not target any one particular academic discipline.

Felder and Silverman's learning style model [6] includes four scales with two dimensions in each scale:

1. Active: The student retains and understands information best by doing something actively with it—discussing, applying, or explaining it to others. Reflective: The student first thinks about information quietly.
2. Sensing: The student gathers data through the senses and likes learning concrete information, such as facts and experimentations. Intuitive: The student perceives information unconsciously and prefers discovering possibilities and relationships based on abstract information such as abstract concepts and mathematical models.
3. Visual: The student remembers best what they see—such as pictures, diagrams, flow charts, time lines, films, and demonstrations. Verbal: The student gets more out of words—written and spoken explanations.
4. Sequential: The student gains understanding in linear steps, with each step following logically from the previous one. Global: The student learns in large jumps, absorbing material almost randomly without seeing connections, and then suddenly 'getting it.'

Research has been conducted to study how learning styles affect student academic performance and retention [11–15]. For example, Lau et al. [11] studied the effect of diverse learning styles on the dynamics and success of design teams in a graduate-level, project-based, multidisciplinary engineering design course. They found that 'design teams with just one converger generally performed better in their self-perception of team performance than teams with multiple convergers.' Thomas et al. [12] studied the relationship of student learning styles and exam scores in an undergraduate introductory programming course, based on Felder and Silverman's learning style model [6]. Thomas et al. [12] found that two statistically significant differences existed in the course exam: reflective learners scored higher than active learners (p = 0.015), and verbal learners scored higher than visual learners (p = 0.027). Based on mixed-methods research, Ivey [13] found that statistically significant differences in the combined abstract conceptualization–concrete experience (AC–CE) score (p = 0.06) and in the AC individual score (p = 0.05) existed between students who were retained and who were not retained in a first-year mechanical engineering program.

1.2 Impact of cultural differences on student learning styles

As online and distance education expands rapidly across national borders to reach a global audience, a cross-cultural, comparative study of learning style preferences among different countries helps provide insights into whether diverse cultural backgrounds and experiences affect student learning styles in particular and into university life and activities in general [10, 16–26], and if so, how. As examples, the following paragraphs describe several relevant studies.

Joy and Kolb [10] compared learning style preferences of 533 students in seven countries in Nordic Europe, Sub-Saharan Africa, and the Middle East, using the Kolb's Learning Style Inventory [21]. They found that a student's preference for abstract conceptualization is significantly affected by culture, gender, age, level of education, and area of specialization. Most importantly, they found that "individuals tend to have a more abstract learning style in countries that are high in in-group collectivism, institutional collectivism, uncertainty avoidance, future orientation and gender egalitarianism [10]".

McChlerya and Visserb [22] compared learning style preferences of undergraduate accounting students in the United Kingdom and South Africa based on the Felder–Silverman Index of Learning Styles instrument [23]. They found that the majority of second-year undergraduate accounting students had balanced preferences in active/reflective learning and sequential/global learning. Auyeung and Sands [24] compared learning style preferences of undergraduate accounting students in Australia, Hong Kong, and Taiwan using Kolb's Learning Style Inventory [21]. They found that as compared to Australian students, students from Hong Kong and Taiwan were more abstract and reflective and less concrete and active.

Jian et al. [25] and Sandnes et al. [26] conducted a cross-cultural comparison of Taiwanese and Norwegian engineering students' preferences for university life and activities. Based on the results of their questionnaire surveys, they found that Taiwanese students preferred non-curricular values and emphasized the university environment and the process of becoming an adult. However, Norwegian students preferred curricular values and were motivated by good grades.

1.3 Objective and research questions of the present study

The objective of the present study is to conduct a cross-cultural comparison of learning style preferences between American (Western culture) and Chinese (Eastern culture) undergraduate engineering students by implementing the Felder–Silverman Index of Learning Styles questionnaire survey [23] at two comparable American and Chinese universities. These two universities are Utah State University (USU) in the United States and Beijing Forestry University (BFU) in China. The two institutions share many common features: Both are large, comprehensive, public, research-intensive, and Ph.D.-granting institutions.

The present study has the following two research questions:

1. Were there statistically significant differences in learning style preferences between American and Chinese undergraduate engineering students? If yes, what were these differences?
2. Was there correlation between learning style preferences and academic performance of American and Chinese undergraduate engineering students?

By answering these questions, we can develop a better understanding of the differences in learning style preferences between American and Chinese undergraduate engineering students. The research results from this study can also serve as a foundation for further research on how cultural differences between the United States and China affect student learning style preferences. Because all student participants in this study were from research institutions only and did not include teaching institutions, the research results from this study can only be generalized in research institutions in the United States and China.

1.4 Novelty of the present study

The authors of this paper have performed an extensive literature review using a variety of popular databases. The results of the extensive literature review show that no existing studies have compared learning style preferences between American and Chinese undergraduate engineering students based on Felder and Silverman's learning style models [6]. Existing studies [such as 10, 16–26] focused on either a comparison of non-engineering American and Chinese students or a comparison of engineering students from other nations. The present study is novel because it is the first study to compare undergraduate engineering students in the United States and China using Felder and Silverman's learning style models.

1.5 Logic structure of this paper

First, this paper describes the research method employed in the present study, including the Felder–Silverman Index of Learning Styles questionnaire survey, student participants, and the method of statistical analysis. Then, the paper describes in detail the similarities and differences in learning style preferences of American and Chinese students, and whether and how student learning style preferences correlate with their academic performance. Next, education implications of the research findings from the present study, and the limitations of the present study, are discussed. Finally, the answers to the two research questions are summarized at the end of the paper.

2. Research method

2.1 The Felder–Silverman Index of Learning Styles questionnaire survey

In the present study, the Felder–Silverman's learning style model [6] was employed to measure students' learning style preferences. Felder–Silverman's model was chosen because it was particularly developed for engineering students and has a high degree of reliability and validity [27, 28]. Based on this model, Felder and Soloman [23] developed an online instrument to assess an individual's learning style preferences. The instrument is a 44-item questionnaire survey submitted and automatically scored on the Internet. For example, Item No. 12 asks, "When I solve math problems: (a) I usually work my way to the solutions one step at a time. (b) I often just see the solutions but then have to struggle to figure out the steps to get to them." Another example: Item No. 44 asks, "When solving problems in a group, I would be more likely to: (a) think of the steps in the solution process. (b) Think of possible consequences or applications of the solution in a wide range of areas."

Based on the response of an individual to all 44 survey items, scores ranging from 1 to 11 in each scale are provided to the individual to indicate the strength of his or her learning style preferences in each scale. A score of 1–3 on a scale indicates that the individual is fairly well balanced in the two dimensions of that scale. A score of 5–7 on a scale indicates that the individual has a moderate preference for one dimension of the scale. A score of 9–11 on a scale indicates that the individual has a very strong preference for one dimension of the scale [23].

Figure 1 shows example results of the Felder–Silverman Index of Learning Styles questionnaire survey that was completed by a student in a class

```
ACT                X                                      REF
      11   9    7   5    3    1    1    3    5    7    9    11
                              <-- -->

SEN                     X                                 INT
      11   9    7   5    3    1    1    3    5    7    9    11
                              <-- -->

VIS   X                                                   VRB
      11   9    7   5    3    1    1    3    5    7    9    11
                              <-- -->

SEQ                X                                      GLO
      11   9    7   5    3    1    1    3    5    7    9    11
                              <-- -->
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Fig. 1. Example results of the Felder–Silverman Index of Learning Styles questionnaire survey that was completed by a student.

taught by an author of this paper. The results show that the student had a moderate preference for active learning (as compared to reflective learning), a well-balanced preference for sensing learning (as compared to intuitive learning), a very strong preference for visual learning (as compared to verbal learning), and a moderate preference for sequential learning (as compared to global learning).

2.2 Student participants

Because the present study is related to human subjects, an approval from an Institutional Review Board (IRB) was secured before any data was collected. A total of 132 sophomore (second-year) engineering students from two universities, Utah State University (USU) in the United States and Beijing Forestry University (BFU) in China, participated in the present study. Table 1 shows student demographics. As seen from Table 1, American students were from different engineering majors, whilst all Chinese students were from civil engineering majors. The majority of American student participants were males (85%), whilst there were a significant number of female student participants (40%) at the Chinese university.

2.3 Research method

The web address [23] of the 44-item, online Index of Learning Styles questionnaire survey was provided to student participants in both countries. Students responded to the survey and then submitted the results (i.e., learning style preferences) to the authors of this paper for analysis. The survey was in English. No Chinese translation was provided to BFU students because it was found that BFU students had no difficulty in understanding the English contents of the survey.

Statistical descriptive analysis was performed to determine mean values and standard deviations of students in each learning style dimension. Independent sample t-tests were conducted to answer the first research question, i.e., whether there were statistically significant differences between American and Chinese students in those eight learning style dimensions. The effect size was then calculated as [29]:

$$\text{effect size} = \sqrt{\frac{t^2}{t^2 + df}} \tag{1}$$

where t is the t-value and df is the degree of freedom. An effect size of 0.10 represents a small effect (i.e.,

Table 1. Student demographics

	Major*				Gender	
Universities	**MAE**	**CEE/CE**	**BE**	**Other**	**Male**	**Female**
Utah State University, USA (n = 61)	31 (50.8%)	16 (26.2%)	9 (14.8%)	5 (8.2%)	52 (85.2%)	9 (14.8%)
Beijing Forestry University, China (n = 71)	0	71 (100%)	0	0	42 (59.2%)	29 (40.8%)

* MAE: Mechanical and aerospace engineering.
CEE/CE: Civil and environmental engineering (for USU) and Civil engineering (for BFU).
BE: Biological engineering.
Other: General engineering, pre-engineering, undeclared majors, etc.

the effect explains 1% of the total difference). An effect size of 0.30 represents a medium effect (i.e., the effect explains 9% of the total difference). An effect size of 0.50 represents a large effect (i.e., the effect explains 25% of the total difference).

Students' exam scores in two representative engineering courses—statics and dynamics—were also collected. These two courses are fundamental core courses that nearly all students in civil, mechanical, and biological engineering majors are required to take. Students' exam scores in these two courses represent, in a large part, their academic performance in the first two years of undergraduate study. Statistical correlation analysis was performed to answer the second research question, i.e., whether there was correlation between learning style preferences and academic performance for American and Chinese undergraduate engineering students.

3. Results and analysis

3.1 Comparison of learning style preferences

Table 2 shows descriptive statistics where mean values of learning style preferences for each dimension between American and Chinese student participants are compared. The strength of learning style preferences is indicated by numerical data and by letters M (moderate) and B (balanced) as well. Based on mean values, American students had a higher preference than Chinese students in six learning style dimensions: active (4.46 vs. 3.31), reflective (3.80 vs. 1.81), sensing (5.63 vs. 3.77), intuitive (3.00 vs. 1.71), visual (6.37 vs. 4.41), and verbal (3.57 vs. 1.94). The strengths of sequential (3.85 vs. 3.97) and global (2.47 vs. 3.38) learning style preferences are close between American and Chinese students.

Table 3 shows the results of independent sample *t*-tests. Based on the *p*-values, there exist statistically significant differences between American and Chinese students in the following four learning style dimensions. These four dimensions are also highlighted in bold in Table 3.

- Reflective: On average, American students had a higher preference (M = 3.80, SE = 0.47) than Chinese students (M = 1.81, SE = 0.33) for reflective learning. This difference was significant $t(60) = 3.47$, $p < 0.01$; and it represented a medium-sized effect of 0.41.
- Sensing: On average, American students had a higher preference (M = 5.60, SE = 0.43) than Chinese students (M = 3.77, SE = 0.38) for sensing learning. This difference was significant $t(109) = 3.26$, $p < 0.01$; and it represented a medium-sized effect of 0.30.
- Visual: On average, American students had a higher preference (M = 6.37, SE = 0.39) than Chinese students (M = 4.41, SE = 0.36) for visual learning. This difference was significant $t(106) = 3.70$, $p < 0.01$; and it represented a medium-sized effect of 0.34.
- Verbal: On average, American students had a

Table 2. Descriptive statistics

	American students (total 61)			**Chinese students (total 71)**		
Learning style dimensions	***n* (%)**	**Mean***	**Std. Dev.**	***n* (%)**	**Mean ***	**Std. Dev.**
Active	26 (42.6%)	4.46 (M)	2.92	39 (54.9%)	3.31 (M)	2.66
Reflective	35 (57.4%)	3.80 (M)	2.75	32 (45.1%)	1.81 (B)	1.89
Sensing	54 (88.5%)	5.63 (M)	3.15	57 (80.3%)	3.77 (M)	2.85
Intuitive	7 (11.5%)	3.00 (B)	2.00	14 (19.7%)	1.71 (B)	0.99
Visual	54 (88.5%)	6.37 (M)	2.85	54 (76.1%)	4.41 (M)	2.65
Verbal	7 (11.5%)	3.57 (M)	1.90	17 (23.9%)	1.94 (B)	1.43
Sequential	42 (68.9%)	3.85 (M)	2.34	39 (54.9%)	3.97 (M)	3.21
Global	19 (31.1%)	2.47 (B)	1.47	32 (45.1%)	3.38 (M)	2.12

* M—moderate preference, B—balanced preference.

Table 3. Independent sample *t*-tests

Learning style dimensions	***t***	***df***	***p***	***SE***	**Effect size**	**Statistically significant difference**
Active	1.650	63	0.104	0.20	0.20	No
Reflective	3.469	60.5	**0.001**	0.41	0.41	**Yes**
Sensing	3.261	109	**0.001**	0.30	0.30	**Yes**
Intuitive	1.605	7.5	0.150	0.51	0.51	No
Visual	3.704	106	**0.000**	0.34	0.34	**Yes**
Verbal	2.303	22	**0.031**	0.44	0.44	**Yes**
Sequential	–0.189	79	0.851	0.02	0.02	No
Global	–1.632	49	0.109	0.23	0.23	No

higher preference (M = 3.57, SE = 0.72) than Chinese students (M = 1.94, SE = 0.35) for verbal learning. This difference was significant $t(22) = 2.30$, $p < 0.05$; and it represented a medium-sized effect of 0.44.

Figures 2–5 further provide graphical comparisons of the strength of preferences (measured by students' numerical ratings 1–11) between American and Chinese students for the above four learning style dimensions. Fig. 2 shows that as compared to American students, a higher percentage of Chinese students were fairly well balanced (with a rating of 1) for reflective learning. Figures 3 and 4 show that as compared to American students, a higher percentage of Chinese students were well balanced (with a rating of 1 or 3) for sensing learning, but a lower percentage of Chinese students had a medium preference (with ratings of 5 and 7) for visual learning. Figure 5 shows that both American and Chinese students were well balanced (with a rating of 1 or 3) for verbal learning, and neither American nor Chinese students had strong preferences (with a rating of 9 or 11) for verbal learning.

3.2 Correlation between learning style preferences and academic performance

Figures 6 and 7 show, respectively, American and Chinese students' learning style preferences vs. average exam scores in two foundational engineering courses—statics and dynamics. In Figs 6 and 7, A stands for "active," R for "reflective," S for "sensing," I for "intuitive," Vi for "visual," Ve for "verbal," Se for "sequential," and G for "global." T-tests were also conducted to determine whether there were statistically significant differences in the average exam scores for the students in the same learning style scale but with different learning style dimensions (note that each learning style scale has

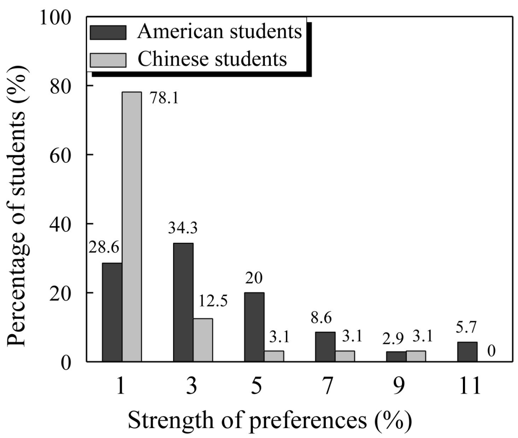


Fig. 2. Comparison of reflective learning style preferences.

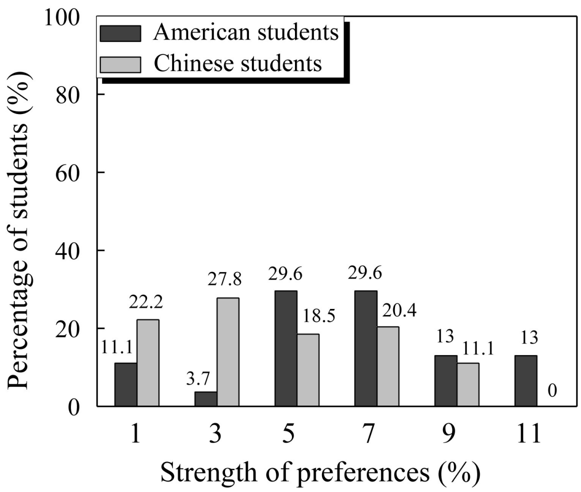


Fig. 4. Comparison of visual learning style preferences.

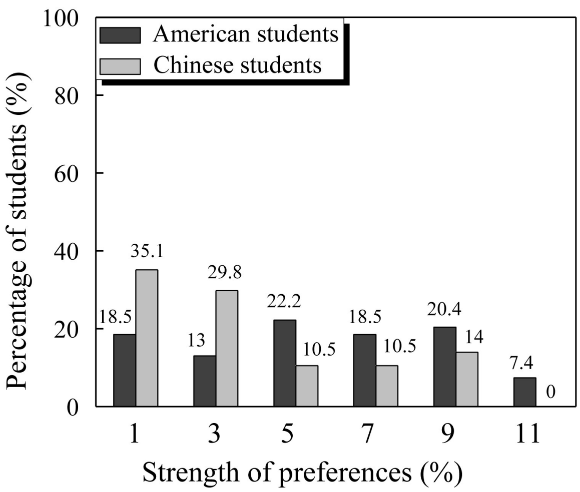


Fig. 3. Comparison of sensing learning style preferences.

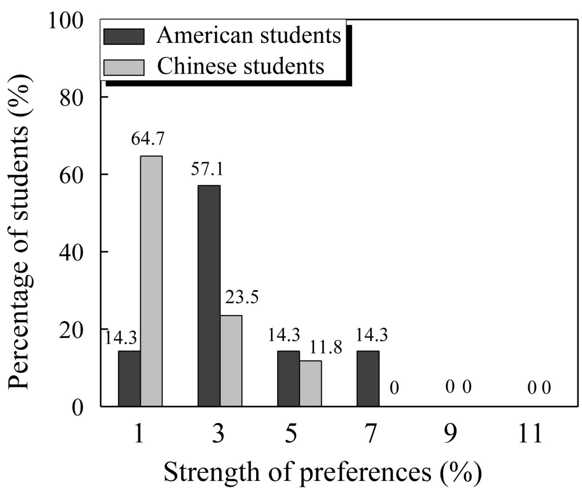
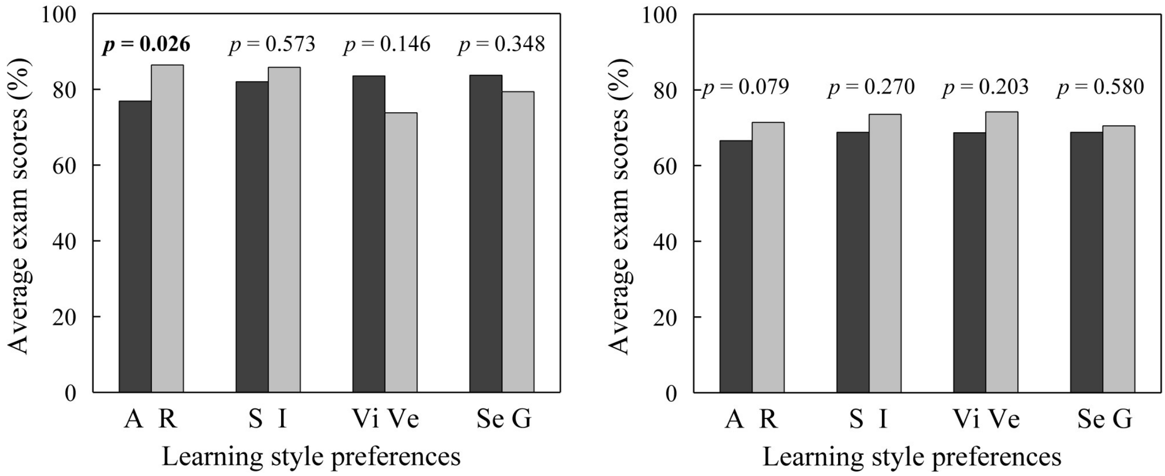
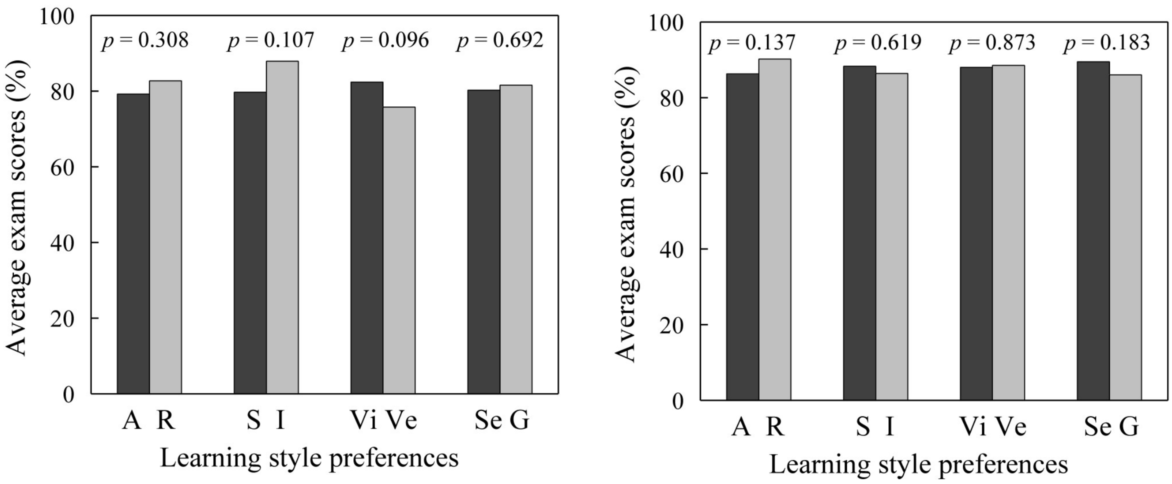


Fig. 5. Comparison of verbal learning style preferences.



(a) (b)

Fig. 6. American students' learning style preferences vs. average exam scores in (a) statics and (b) dynamics courses.



(a) (b)

Fig. 7. Chinese students' learning style preferences vs. average exam scores in (a) statics and (b) dynamics courses.

two learning style dimensions [6]). The *p*-values generated from *t*-tests are shown in Figs 6 and 7.

Based on the *p*-values, there existed a statistically significant difference in the average statics exam scores between American students who had active learning style preferences and American students who had reflective learning style preferences. No statistically significant differences in the average exam scores were found in any other cases. Correlation analysis was further performed to determine whether there was correlation between learning style preferences and exam scores for American and Chinese students. The results are shown in Tables 4 and 5, where *r* is Pearson's correlation coefficient.

Tables 4 and 5 confirm the research findings from Figs 6 and 7. As seen in Table 4, a statistically significant correlation ($r = 0.286$, $p < 0.05$) existed

Table 4. Correlation between American students' learning style preferences and average exam scores

	Average exam score (statics)		Average exam score (dynamics)	
Learning style preferences	***r***	***p***	***r***	***p***
Active/Reflective	**0.286**	0.026	0.226	0.079
Sensing/Intuitive	0.074	0.573	0.143	0.270
Visual/Verbal	–0.188	0.146	0.165	0.203
Sequential/Global	–0.122	0.348	0.072	0.580

Table 5. Correlation between Chinese students' learning style preferences and average exam scores

	Average exam score (statics)		Average exam score (dynamics)	
Learning style preferences	***r***	***p***	***r***	***p***
Active/Reflective	0.143	0.308	0.207	0.137
Sensing/Intuitive	0.224	0.107	–0.070	0.619
Visual/Verbal	–0.231	0.096	0.023	0.873
Sequential/Global	0.056	0.692	–0.186	0.183

between American students' active/reflective learning style preferences and the average statics exam scores. Again, no statistically significant correlations were found in other cases.

4. Discussions

4.1 Education implications of the research findings

The above-described data and analysis clearly show that there existed statistically significant differences in learning style preferences between American and Chinese undergraduate engineering students, and that these differences may, or may not, have affected students' academic performance in a particular course that they took. Educational implications of these research findings are twofold—for both instructors and students—which are elaborated in the following two paragraphs.

First, instructors should use diversified teaching styles to accommodate diverse learning style preferences of engineering undergraduates in both the United States and China. Evidence from previous studies [6, 30–33] has shown that students learn better when an instructor's teaching style is compatible with his or her students' learning styles. For example, a student who is a visual learner would learn better if the instructor provided many forms of visual aids (e.g., diagrams, photos, and videos) during lectures. However, students have diverse learning style preferences, as illustrated in the present study, and a single and monotonous teaching style will not meet the needs of all students. Therefore, diversified teaching styles should be used in either classroom (face-to-face) or online teaching activities.

Felder and Silverman [6] have suggested many excellent examples of teaching techniques to satisfy the needs of diverse learners who sit in the same classroom. The present study reveals that American students have a higher preference (as compared to Chinese students) for reflective, sensing, visual, and verbal learning. Therefore, engineering instructors in the United States should pay more attention to these four learning style dimensions, for instance, providing time for students to think, reflect, and discuss, either individually or collectively, during intervals of a lecture (for reflective students); offering in-class demonstrations and experimentations (for sensing students); and using a variety of multimedia instructional techniques such as interactive videos, computer simulation and animation (for visual and verbal students).

Second, students in both countries should develop a balanced (well-rounded) learning style preference in each learning style scale (active/reflective, sensing/intuitive, visual/verbal, and sequential/global) to accommodate teaching styles of instructors as well as the needs of particular engineering courses. The reason is simple: The world is not designed according to one's preferences; but one must adjust his or her preferences to adapt to the world in order to survive.

On the one hand, engineering instructors are content experts, but not all of them are trained in pedagogy, i.e. how to teach. Thus, not all engineering instructors use diversified teaching styles. On the other hand, different engineering courses have different learning objectives that prefer particular types of learning styles. For example, fundamental engineering science courses (such as statics, dynamics, strength of materials, material sciences) deal with foundational concepts, principles, and theories and require students to have "reflective" and "intuitive" learning styles, so students can develop a solid conceptual understanding of subject matters.

Other laboratory-intensive engineering courses (e.g., manufacturing processes) focus on developing students' hands-on skills (e.g., operating various machines and equipment to make concrete and tangible products) and prefer students to have "active" and "sensing" learning styles. It is obvious that if a student has a strong preference for "active" and/or "sensing" learning (other than "reflective" and/or "intuitive" learning), the student will learn better in hands-on manufacturing courses, but may not perform well in fundamental engineering science courses such as statics and dynamics courses. The converse is also true. Therefore, students should develop a balanced (or well-rounded) learning style preference in each learning style scale (active/reflective, sensing/intuitive, visual/verbal, and sequential/global) in order to survive and succeed in all engineering courses throughout their four-year undergraduate study. The process of developing a balanced learning style preference requires numerous intentional practices and is probably a painful process for some students. As a well-known proverb says, "old habits die hard."

4.2 Limitations of the present study

The present study is limited in that all student participants were second-year engineering undergraduates from large public research universities in the United States and China. Therefore, the research finding from the present study only applies to second-year engineering undergraduates in public research universities in the two countries. The future study will include recruiting students from teaching-focused universities and colleges, from private institutions, and from first-, third-, and forth-year engineering programs.

The second limitation of the present study is that gender imbalance and the imbalance in field of study might affect the research results. In the present study, American student participants were from mechanical, civil, and biological engineering majors, whilst all Chinese student participants were from civil engineering majors. The majority of American student participants were males (85%), whilst only 60% of Chinese student participants were males. Extensive evidence from past research [32, 33] has shown that student gender and disciplinary areas affect student learning behaviours. Further research is needed to study how gender and disciplinary areas affect student learning styles.

5. Conclusions

As online and distance education expands rapidly across national borders to reach a global audience, a comparative study of student learning style preferences among countries with different cultures becomes increasingly important in terms of maximizing or optimizing student learning outcomes. Based on data collected from 132 second-year engineering students from two comparable universities in the United States and China, the answers to the two research questions of the present study are:

Research question 1: Were there statistically significant differences in learning style preferences between American and Chinese undergraduate engineering students? If yes, what were these differences?

Answer: The results of statistical t-tests show that there existed statistically significant differences between American and Chinese students in four learning style dimensions: reflective ($p < 0.01$), sensing ($p < 0.01$), visual ($p < 0.01$), and verbal ($p < 0.05$). These differences represented a medium-sized effect. On average, American students had a higher preference than Chinese students in all these four learning style dimensions.

Research question 2: Was there correlation between learning style preferences and academic performance of American and Chinese undergraduate engineering students?

Answer: The results of correlation analysis show that a statistically significant correlation ($r = 0.286$, $p < 0.05$) existed between American students' active/reflective learning style preferences and the average statics exam scores. However, no statistically significant correlations were found in any other cases.

The research findings made from the present study have two educational implications for both instructors and students. Instructors should use diversified teaching styles to accommodate diverse learning style preferences of students. Students should also develop a balanced learning style preference in each learning style scale (active/reflective, sensing/intuitive, visual/verbal, and sequential/global) to accommodate teaching styles of instructors as well as the needs of particular courses.

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