Learning Styles at Hong Kong University of Science and Technology

An Interactive Qualifying Project Report

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Abstract

This research attempted to gain additional perspective on assessing the effects of learning English in a predominately Chinese-speaking country. Using survey and focus group methodologies, we conducted two studies at Hong Kong University of Science and Technology (HKUST) investigating learning styles and classroom preferences. In Study 1, we examined differences in learning styles between Eastern and Western cultures. In Study 2, we investigated whether the learning styles differed based on academic major in our Eastern population. The results of Study 2 suggest that only slight differences exist in learning styles based on academic major for our Eastern population. In Study 2, we also surveyed the learning styles of both Asian and American students to verify the cultural differences found in Study 1. From our focus group findings, we have made several suggestions to try to enhance students' learning. Putting all this together, learning styles play an important role in how students view and use information presented in the classroom.

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Authorship

All four members of the group contributed equally to the project. The written work was divided among Nam Do, Grant Fredricks, Ekaterina Ratcheva and Eleanor Terry-Welsh. The survey was mostly prepared by Nam Do and Grant Fredricks, whereas the interview protocol was mostly prepared by Ekaterina Ratcheva. Most of the general formatting and technical documents such as graphs and figures were done by Nam Do. All data analysis was done by Grant Fredricks. Eleanor Terry-Welsh was responsible for the majority of the background research and interview transcriptions. Ekaterina Ratcheva was responsible for the methodology sections, as well as focus group data analysis.

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Executive Summary

Chinese and English are the official languages of Hong Kong. Even though English is widely used in the Government and by the legal, professional and business sectors, recent census data shows that Cantonese (one of the Chinese dialects) is the most commonly used language by 90.8% of the population while only 2.8% of the population uses English in daily communication (Census and Statistics Department, 2006). In addition, while 70% of the secondary schools are conducted in Cantonese, almost all the universities in Hong Kong use English as their language of instruction (Peng, 2005). This may lead to challenges for students entering university; therefore, we wanted to examine ways to enable effective English learning for all students.

Looking at effective learning, past research suggests that the most successful way for students to learn, including learning a foreign language, is in an environment where the teaching styles match the students' learning styles (Felder & Henriques, 1995). However, this research has only been conducted with students living in English speaking countries or whose native language was English (Reid, 1987). Thus, we set out to determine whether this research can be applied effectively to students from a predominately Chinese-speaking country.

Using survey and focus group methodologies, we conducted two studies at Hong Kong University of Science and Technology (HKUST). The survey was used to investigate the four dimensions of learning styles (active/reflective, sensing/intuitive, visual/verbal, sequential/global) defined by Index of Learning Styles (ILS; Felder & Soloman, 1991). Focus groups were used to examine students' classroom preferences. In Study 1, we set out to determine differences in learning styles between Eastern cultures (e.g. Hong Kong) and Western cultures (e.g. United States). We found that Eastern students were more reflective and Western

students were more active learners. However, this was the only significant difference we found in learning styles.

For exploratory purposes, we also compared whether academic major influenced learning styles by comparing the learning styles between the academic majors of the Western students surveyed in past research (Felder & Spurlin, 2005). From this analysis, we found that Engineering students were more visual and less sequential than the other academic majors. This finding suggests that academic major may also be an important factor influencing learning styles. However, we could not examine whether the learning styles of Eastern students differed based on their academic major because our sample was limited to Eastern Engineering students.

In Study 2, we examined whether the learning styles differed based on academic major in our Eastern population. The only significant finding was that Science majors were the most reflective, whereas the Business and Management majors were the least reflective. In Study 2, we also surveyed the learning styles of both Asian and American students to verify the cultural differences found in Study 1. Since our American population was mainly Engineering majors, we only examined the differences for this major. We found that American engineers were less reflective, less visual, and more sequential than Asian engineers.

In addition to looking at learning styles, we examined students' preferences for classroom activities by conducting focus groups with our Eastern students in Studies 1 and 2. The results from the focus groups conducted in both studies suggests that students would like more opportunities to speak English inside and outside the classroom, and wanted more opportunities to interact with native English speakers. From the results of our focus groups, we made several suggestions of ways to enhance students' learning. Our recommendations included new

interactive teaching techniques and programs in order to help students practice their English skills inside and outside the classroom.

We hope that the findings in this study might help enhance students' learning in English. Past research investigating effective classroom instruction consistently shows increased learning when teachers use a wide variety of teaching methods (Felder & Henriques, 1995); (Felder & Silverman, 1988). More specifically, the more the instructors know about the students' learning preferences, the better prepared they will be to meet the students' learning needs. Putting all this together, attaining fluency in English is a valuable asset, and future research should continue to examine the effects that different factors have on learning styles.

1. Introduction/Background

Even though English is an official language in Hong Kong, most secondary schools teach primarily in Cantonese, a dialect of Chinese (Peng, 2005). However, nearly all universities in Hong Kong teach in English. Many students begin their university career with limited instruction in English. This may be detrimental to their academic success, especially since late immersion in English has been shown to adversely affect students' academic performance (Hau, Marsh, Kong, & Poon, 2000). And while Hau et al. (2000) state "there should be a consistently strong emphasis on English in English courses" (p. 28), they do not make any suggestions on how to accomplish this. Thus, we set out to examine methods of enhancing English instruction in university classrooms.

Past research investigating effective classroom instruction consistently shows increased learning when teachers use a wide variety of teaching methods. In addition, the research demonstrates that it is important that the instructors' teaching styles match the students' learning styles (Felder & Henriques, 1995); (Felder & Silverman, 1988). Research on learning styles finds that students typically fall into four learning style dimensions: active/reflective, sensing/intuitive, visual/verbal, sequential/global (Felder & Soloman, Felder & Soloman: Learning Styles and Strategies).

More specifically, active learners prefer to learn by participating in activities such as class discussions or experiments, while reflective learners prefer to think about and analyze new information before applying it (Felder & Soloman, Felder & Soloman: Learning Styles and Strategies). Sensing learners prefer to learn facts or concrete information, while intuitive learners prefer to learn theory or the meaning behind the facts (Felder & Soloman, Felder & Soloman: Learning Styles and Strategies). Visual learners learn best from diagrams and pictures, whereas

verbal learners prefer to learn from words, either by reading or listening to a lecture (Felder & Soloman, Felder & Soloman: Learning Styles and Strategies). Sequential learners prefer to learn information in a linear order, while global learners like to understand the big picture first, and then learn the details (Felder & Soloman, Felder & Soloman: Learning Styles and Strategies).

The research on learning styles has also been applied to foreign language instruction (Felder & Henriques, 1995). As found in the past research on learning styles in general, Felder and Henriques (1995) found that when the teaching styles in foreign language classrooms matched the students' learning styles, the students were more motivated to learn the foreign language and performed better academically. Based on these findings, the researchers made suggestions on ways foreign language teachers could incorporate teaching methods that appeal to all learning styles. For example, in order to appeal to both sequential and global learners, they recommend balancing structured activities, such as vocabulary drills, with more open-ended activities, such as group projects (Felder & Henriques, 1995). To appeal to both active and reflective learners, the researchers suggest that teachers allow students time during lecture to either discuss or think about what they have just learned. From this research, it can be concluded that if students have a wide variety of learning styles, teachers should use many different teaching techniques. However, if most students prefer a particular style the teacher should focus more on that style, while not entirely ignoring the other side of the spectrum.

One limitation of this research is that it was conducted on English speakers learning a foreign language, and it is unclear whether these findings will apply to native speakers of other languages learning English. One study did examine cross-cultural differences in students learning English as a second language, and found that native English speakers preferred different learning styles than non-native English speakers (Reid, 1987). In particular, this study found that

Chinese students tended to be more visual learners (Reid, 1987). However, this study was conducted in a predominately English-speaking country where students were immersed in the English language (i.e., the United States (Reid, 1987)). Therefore, it is still unclear whether these findings would apply to non-English speaking students learning English in a non-English speaking country. Thus, we wanted to extend this research by examining the effects that learning English in a non-English speaking country had on preferred learning styles.

While there is limited research on cross-cultural differences of learning styles, there are studies that investigated cross-cultural differences in language processing. Using functional magnetic resonance imaging (fMRI), researchers examined brain activity during language processing in readers of different languages (Goswami, 2006). The results show that English readers process language differently in the brain than Chinese readers (Goswami, 2006). For instance, Chinese readers showed more activation in areas of the brain responsible for the processing of visual information (Goswami, 2006). Extrapolating from this, Chinese students may be more visual than verbal learners. Thus, we set out to determine whether this was the case.

In conclusion, research consistently shows that instructors who match their teaching styles with their students' learning styles promote more effective learning (Felder & Henriques, 1995); (Felder & Silverman, 1988). This research has also been applied to foreign language instruction; however, all the studies conducted focus on either native English speakers or students immersed in English in English-speaking countries (Felder & Henriques, 1995); (Reid, 1987). Thus, we set out to extend this research on learning styles by examining the effects of learning English in a non-English speaking country. In addition, research on language processing shows that Chinese readers rely on areas of the brain associated with processing visual information. Therefore, we wanted to determine if Chinese speakers were also visual learners. To

do so, we identified the learning styles of the Chinese students at the Hong Kong University of Science and Technology (HKUST), and examined whether their learning styles differed from Western students.

2. Study 1

2.1. Methodology

2.1.1. Participants

One hundred sixty-six (33 females, 132 males, 1 did not report) third-year Engineering students from HKUST participated in the survey (see Table 1). Nineteen (6 females, 13 males) of these 166 students participated in follow-up focus groups that consisted of 2-4 students per focus group session (a total of 5 focus groups were conducted).

2.1.2. Design/Materials

In order to examine the effects that learning English in a non-English speaking country had on preferred learning styles, we conducted a survey to assess students' learning styles, and conducted follow-up focus group sessions to collect student opinions on their English classroom experiences.

Survey

In order to assess participants' learning styles, we adapted the Index of Learning Styles (ILS) Questionnaire (Felder & Soloman, 1991) which classifies participants' learning styles based on four dimensions: active/reflective, sensing/intuitive, visual/verbal, and sequential/global. Active learners prefer to learn by participating in activities such as class discussions or experiments, while reflective learners prefer to think about and analyze new information before applying it (Felder & Soloman, Felder & Soloman: Learning Styles and Strategies). Sensing learners prefer to learn facts or concrete information, while intuitive learners prefer to learn theory or the meaning behind the facts (Felder & Soloman, Felder & Soloman: Learning Styles and Strategies). Visual learners learn best from diagrams and pictures, whereas

verbal learners prefer to learn from words, either by reading or listening to a lecture (Felder & Soloman, Felder & Soloman: Learning Styles and Strategies). Sequential learners prefer to learn information in a linear order, while global learners like to understand the big picture first, and then learn the details (Felder & Soloman, Felder & Soloman: Learning Styles and Strategies).

Several modifications were made to the original ILS Questionnaire. Since the survey was administered to students whose primary language is not English, some questions were slightly modified to improve comprehension of the survey questions. For instance, since many questions from Felder and Solomon's (1991) questionnaire contained complex words and terminology, we simplified the questions but tried to keep their meaning intact. In addition to simplifying the terminology, we modified the response format of the survey. Felder and Solomon's (1991) original questionnaire allowed only two choices for each learning style question. A study done by Litzinger, Lee, Wise, & Felder (2007) investigated the effects of modifying the scale of the survey in order to allow participants to indicate how strongly they identified with a particular learning style on a 5-point Likert-type scale. The validity of the questionnaire did not change, therefore we adopted the same Likert-type scale. (See Appendix B for modified survey). In order to remove repetitive questions within the survey, we eliminated four questions from the original questionnaire (see (Felder & Soloman, 1991) for the original questionnaire).

Thus, the modified survey (see Appendix B) consisted of 40 closed-ended questions. Ten questions correspond to each of the four dimensions of learning styles (active/reflective, sensing/intuitive, visual/verbal, and sequential/global). Scores in each dimension can range from -10 to 10, with zero being neutral. Negative scores correspond with one of the dimensions in the pair and positive scores correspond with the other dimension. More specifically, negative scores correspond with active, sensing, visual or sequential learning dimensions and positive scores

correspond with reflective, intuitive, verbal or global learning dimensions. We also categorized the learning style scores based on their strength of association with one side of the paired dimension, and they are strong (-10 to -4 or 4 to 10), moderate (-3.5 to -1.5 or 1.5 to 3.5), or balanced (-1 to 1).

In addition, we collected demographic information, such as participant's gender, participant's nationality (e.g., Mainland China, Hong Kong, other), if the participant ever studied outside of Hong Kong, and whether the participant attended an English Medium of Instruction (EMI) secondary school. In addition, we asked participants to indicate whether they would be willing to participate in a follow-up focus group and provide us with contact information to schedule the session.

Focus Group

In order to obtain students' opinions on their current English classes and preferences for techniques used in the classroom, we conducted focus groups with interested third-year students. In the focus group, we asked participants to tell us more about a) their feelings towards their English classes, b) their study habits for their English classes, c) any experiences with English they sought outside the classroom, and d) any suggestions and recommendations for improvements to their English classes (see Appendix C for the protocol).

2.1.3. Procedure

Survey

To conduct our survey, third-year students were recruited from 10 sections of an English Language for Engineering Majors course (LANG 306) held at HKUST. The researchers recruited participants at the end of one of their class periods. Participants were recruited from all 10 sections of the course. Before administering the survey, participants learned that its purpose

was to identify their learning styles and researchers gave instructions on how to complete the survey. Students were also informed that providing any identifying information (e.g., their email) was optional and would only be used to contact them to send them the results of the survey (e.g. their learning style) and to contact interested parties in the focus group. After completing the survey, participants were thanked for their participation.

Focus Group

After indicating interest in participating in the follow-up focus group on the survey, potential participants were contacted to schedule a focus group session. A total of five focus group sessions were held with 2-4 participants in each session (19 students total). The duration of each focus group ranged from 20-30 minutes. Before beginning the focus group, participants were informed that we were interested in learning more about their opinions of and suggestions for their English classes. In addition, all participants gave informed consent before starting the focus group and were assured that their participation was voluntary and their responses were confidential. During the focus group, the participants were asked questions assessing their English classroom experiences and demographic questions, such as their major, and whether they studied at an EMI secondary school. More specifically, we asked participants about their impressions of their classes in general at HKUST, their impressions of their English classes, the techniques they used when learning, features and activities that they liked and disliked in their English classes, questions assessing their study habits for their English classes, and how frequently they used English outside of the classroom.

2.2. Results

2.2.1. Survey

2.2.1.1. What are the learning styles of the third-year Engineering students?

In order to examine the different learning styles the students have, we analyzed the survey responses based on the four learning style dimensions (active/reflective, sensing/intuitive, visual/verbal, and sequential/global).

Active/Reflective

Past research shows that Engineering students tend to be more active (Felder & Spurlin, 2005). However, cross-cultural studies suggest that Asian students tend to be more reflective (Reid, 1987). Given the discrepancies in these findings, we predicted that Asian Engineering students would be centered in between active and reflective. Scores (M = 0.322, SD = 2.599) indicated a slight preference for reflective learning over the entire population (see Figure 1). Figure 2 also shows that there are more strongly reflective students (9.64%) than strongly active students (4.82%).

Sensing/Intuitive

Felder and Spurlin (2005) show that engineers tend to be more sensing than intuitive, thus we expected that our students will favor sensing learning. Frequencies of scores (M = -0.370, SD = 2.352) are shown in Figure 3. Figure 4 shows that there are slightly more sensing learners (33.13%) than intuitive learners (22.29%) among Engineering students, with larger number of balanced learners (44.58%). The data reveals that there is a slight preference for sensing learning among the population, as expected.

Visual/Verbal

Research has shown that Asian students tend to think more visually (Goswami, 2006), as well as engineers at other universities (Felder & Spurlin, 2005). Considering these findings, we predicted that many students in our study would be visual learners. Scores (M = -3.602, SD = 2.200) confirmed our hypothesis, shown in Figure 5. Over 90% of the respondents were visual. Figure 6 shows that 45.18% of students were strongly visual and 41.57% were moderately visual.

Sequential/Global

Hedden et al. (2008) suggest that Asian language speakers tend to process information globally. This is contrasted by findings printed in Felder and Spurlin (2005) that engineers tend to be more sequential. Consequently, we expected that our students' scores would be mostly balanced. As anticipated, the scores (M = 0.099, SD = 2.161) had the smallest absolute mean of all four dimensions, shown in Figure 7. Also, 14 students had a strong preference in either category (3.01% sequential, 5.42% global), with 48.19% of students in the balanced category (see Figure 8). Overall, there was a slight preference towards global learning.

Conclusion

The results are summarized in Table 2. For the most part, the results matched what we expected. Scores on the active/reflective and sequential/global scales were fairly neutral, although there were slightly more reflective than active students. This may mean that the Asian tendency for reflective learning is stronger than an engineer's preference for active learning, or that one's field of study does not override intrinsic partiality. There was a very strong inclination for visual learning, as anticipated. The slight tendency for sensing learning also corresponded with typical engineers' preferences.

This data suggests what teaching methods these Engineering students might prefer. A mix of both group and individual work would benefit the majority of the students. Small groups would likely be the most useful, due to the slightly higher number of reflective students that would dislike large-group work. Since most students are visual, the use of many applicable diagrams in class would help many students. Finally, course outlines would be helpful to many students.

2.2.1.2. How do HKUST students differ from students at Western universities?

In order to better understand how the HKUST Engineering students in our study differed from Engineering students in Western cultures, we used a Chi-Square analysis to compare the learning styles of our participants with the findings of Felder and Spurlin (2005) that used a Western population.

Table 3 shows that when comparing HKUST Engineering students to 16 other engineering cohorts, the differences were not statistically significant on the sensing/intuitive, visual/verbal, or sequential/global scales. However, our students were significantly less active than six out of the 16 (37.5%) cohorts. When looking at the eight non-engineering cohorts, the differences were more noticeable. In fact, three of the eight (37.5%) non-engineering cohorts were significantly less visual than HKUST Engineering students. But, only one of the 16 (6.25%) engineering cohorts was less visual. A similar pattern emerges on the sequential/global scale. Four of the eight (50.0%) non-engineers tended to be significantly more sequential than our students, versus one of the 16 (6.25%) engineering cohorts being more sequential. This suggests that the only major difference between HKUST engineers and engineering students from Western cultures appears on the active/reflective scale. However, there were more

differences between the HKUST engineers and non-engineering students from Western cultures, suggesting that major and learning styles might be related.

2.2.1.3. Does EMI/Outside study affect learning style?

Prior research suggests that using English as a second language may have an effect on learning preferences (Reid, 1987). Applying this finding to our research, we predicted that EMI might influence learning styles. However, using one-way ANOVAs, we found no significant differences between the learning styles of students who studied at an EMI secondary school and those who had Chinese medium of instruction (see Table 4). In addition, we also compared students who studied outside of Hong Kong or Mainland China with those who had not, but there was no significant difference between learning styles using one-way ANOVAs (see Table 5). One limitation to these findings was the small number of non-EMI students and students who had studied outside of Hong Kong or Mainland China.

2.2.1.4. Does gender affect learning style?

To understand if gender has an effect on learning style, we conducted an exploratory analysis using one-way ANOVAs. On the active/reflective scale, males (M = 0.542, SD = 2.644) were more reflective than females (M = 0.682, SD = 2.102), F (1, 163) = 6.092, p = 0.015 (see Table 6). There were no other significant differences in gender when looking at the other learning dimensions. Given this, we can conclude that the main difference between male and female learning styles is that females prefer to work in groups more often than males do. However, this finding was limited by the small number of females in the population.

2.2.1.5. Correlations among learning styles

For exploratory purposes, we investigated the correlations between the different learning dimensions, (see Table 7). The strongest correlation occurred between the sensing/intuitive scale

and sequential/global scale ($r = 0.317$, $p < 0.001$). This means that sensing learners tend to be more sequential, while intuitive learners tend to be more global. Two other weaker correlations occurred between the active/reflective and visual/verbal scales ($r = 0.196$, $p = 0.011$), and between the visual/verbal and sequential/global scales ($r = -0.196$, $p = 0.011$). This indicates that active learners tend to be more visual than reflective learners, and global learners tend to be more visual than sequential learners. These correlations exist regardless of other factors, (e.g. gender).

2.2.2. Focus groups

The following section presents the summary of the themes from all of the five follow-up focus-groups with 19 (6 females, 13 males) Engineering students from HKUST (2-4 students per focus group).

2.2.2.1. Students' opinions/preferences about teaching methods in their classes

Power Point

Overall, four of the 19 students (21%) said they wanted Power Point presentations in the classroom. However, they preferred PowerPoint slides that used less text, but provided explanations on figures presented. In addition, they reported that slides that repeated the textbook were not useful.

Class Projects and Group Work

Four of the 19 students (21%) wanted more projects to improve their knowledge by applying the theoretical material they had learned. They said that this would help them later in their careers. In terms of group work, three of the students (16%) preferred to work alone in their classes.

Class Organization

Two of the 19 students (10%) said they preferred classes that provided an outline at the beginning of each class, preferred it when the professors followed this outline, and preferred classes that reviewed information covered either at the beginning or end of each class. These students reported being frustrated with information which was not covered in a pre-requisite course and was assumed to be covered in their future classes. Two of the 19 students (10%) reported that they preferred instructors to leave blanks in lecture notes or hand-outs, and the only way for students to follow the class would be by filling in the blanks on the lecture notes. Overall, most of the students also mentioned that they would like more activities in the classroom such as watching movies and analyzing them afterwards, group discussions, etc.

2.2.2.2. Students' opinions/preferences about their English classes at HKUST

Class Activities

For the English classes in particular, 11 of the 19 students (58%) said that speaking would be the most effective way for them to learn and practice their English. In addition, six of the 19 students (31%) preferred more interactions during class with their classmates in order to improve their speaking skills. Another five of the 19 students (26%) liked casual in-class socializing activities with native English speakers. Most of the EMI students (68% of the participants) said that they had learned grammar in their secondary school and they did not think that it was useful to go into details about the basic grammar rules; rather they preferred practicing their speaking skills during class.

Textbooks

Commenting on the textbooks used, four of the 19 students (21%) said that they did not like the textbooks, especially when they focused on information that would rarely apply in real

life. In addition, three of the 19 participants (16%) said that the amount of credit for the English classes was not enough motivation to put a lot of time into the course because language courses are worth half the credit of normal classes.

Interactions

Three of the 19 students (16%) said they wanted more interactions between the instructors and the students, and found professors who lectured the entire time more boring than professors who engaged students in the classroom.

2.2.2.3. Students' study habits

Most of the students reported a general lack of motivation in studying, as they reported spending very little time studying for the English classes on their own. They reporting investing approximately 1-3 hours per week in class, and only studying right before assignment, presentation or exam due dates.

In order to improve their English speaking and writing skills, most of the students preferred various activities outside of the classroom. The most common response was that they liked watching movies, TV shows, and news and some of the students liked reading newspapers. Only one of the 19 participants (5%) said that they practiced their English by interacting with exchange and international students at HKUST.

3. Study 2

Study 1 examined cross-cultural differences between students from an Eastern culture (e.g., Hong Kong) and students from Western cultures (e.g., American and Britain). The results showed that the only significant difference was that Eastern students were more active learners than Western students. For exploratory purposes, we looked to see if majors also influenced learning styles. We found significant variations among majors in three of the four learning style dimensions. However, this data is limited because it compares our population, consisting only of Engineering majors, to existing learning styles data that included Engineering and other majors. Thus, in Study 2, we examined how academic major influenced students' learning styles. In addition, we conducted our study with an Asian and an American population to verify the cultural differences found in Study 1.

3.1. Methodology

3.1.1. Participants

One thousand five hundred and ninety-seven (579 females, 1008 males, 10 did not report) first-year HKUST students participated. Of these, 464 (102 female, 359 males) were Engineering majors, 430 (118 females, 310 males) were Science majors and 702 (359 females, 339 males) were Business and Management majors (see Table 8). Of the 1597 participants, 20 (7 females, 13 males) participated in follow-up focus groups that consisted of 2-4 students per focus group session (a total of 10 focus groups were conducted).

In addition, the survey was conducted in the United States with Engineering Students to make a cross-cultural comparison. Two hundred and ninety-one (132 females, 159 males) undergraduate students participated in the online survey (see Table 9). Follow-up focus groups were not conducted on this sample.

3.1.2. Design/Materials

As in Study 1, we set out to examine the effects that learning English in a non-English speaking country had on preferred learning styles. However, we also wanted to assess whether students' major fields of study influenced their preferred learning styles. To assess this, we administered the same survey used in Study 1 to students in three different majors (Engineering, Science, and Business and Management). In addition, we were interested in cross-cultural differences in learning styles. To assess this, we administered the same survey used in Study 1 to HKUST students and students from the United States. As in Study 1, we also conducted follow-up focus group sessions to collect student opinions on their current English classroom experiences. The focus groups were only conducted for the HKUST participants.

Survey

We administered the same survey that was used in Study 1, and recruited participants from three different majors (Engineering, Science, and Business and Management) and from two different cultural backgrounds (Asian and American). One additional question was added to the end of the survey to assess what methods (e.g., speaking, listening, writing, and reading) enhanced students' learning in the classroom (see Appendix B for this additional question). The survey was administered in person at HKUST and online for the participants in the United States.

Focus Group

The focus group was the same as in Study 1, and was only run for the HKUST participants.

3.1.3. Procedure

Survey

In Study 2, participants were recruited from three different English courses at HKUST: English for Engineering Majors (LANG 106), English for Science Majors (LANG 108), and English for Business and Management Majors (LABU 101). The overall survey administration procedure was replicated from Study 1. In addition, participants from universities in the United States were recruited through email invitations and completed the survey online (after providing informed consent).

Focus Group

As in Study 1, participants indicated interest in participating in the follow-up focus group on the survey, and potential participants were contacted to schedule a focus group session. A total of 10 focus group sessions were held with 2-4 participants in each session. As in Study 1, the duration of each focus group ranged from 20-30 minutes, and the content of the focus group was the same as in Study 1.

3.2. Results

3.2.1. Survey

3.2.1.1. What are the differences between the three majors?

During the cross-cultural comparison in Study 1 to the data from Felder and Spurlin's (2005) study, there were many more significant differences between engineering and other majors than there were between two given engineering cohorts. This indicated that students' majors and learning styles might be directly related. By analyzing the survey responses from each cohort at HKUST, we made conclusions about what differences, if any, exist among the

four learning dimensions (active/reflective, sensing/intuitive, visual/verbal, and sequential/global).

Active/Reflective

Using a one-way ANOVA, we found that academic major influenced how active and reflective students were, $F(2, 1593) = 12.317$, $p < 0.001$. LSD Post-hoc analyses showed that Engineering students ($M = 0.866$, $SD = 2.234$) (see Figures 10 and 13) were less reflective than Science students ($M = 1.302$, $SD = 2.470$) (see Figures 9 and 12), $t(1593) = 2.728$, $p = 0.006$, and Business and Management students ($M = 0.577$, $SD = 2.434$) (see Figures 11 and 14) were less reflective than Engineering students, $t(1593) = 3.321$, $p = 0.043$ (see Table 10). Overall, each major had a reflective preference, but Science students were the most reflective while Business and Management students were the least reflective.

Sensing/Intuitive

Using a one-way ANOVA, we found no significant difference between the scores of the three majors (Science: $M = 0.009$, $SD = 2.668$; Engineering: $M = -0.204$, $SD = 2.3494$; Business and Management: $M = 0.039$, $SD = 2.707$), $F(2, 1593) = 1.325$, $p = 0.266$. In general, there were no strong preferences in the sensing/intuitive dimension for all three cohorts, although Engineering majors were marginally more sensing (see Figure 15). Consequently, 40.08% students were categorized as balanced in this dimension (see Figure 16).

Visual/Verbal

The summary of prior research from Felder and Spurlin (2005) suggested that there might be a significant difference between majors in the proportion of visual students. However, our data did not show this trend using a one-way ANOVA (Science: $M = -2.803$, $SD = 2.676$; Engineering: $M = -2.860$, $SD = 2.513$; Business and Management: $M = -2.719$, $SD = 2.675$), $F(2,$

1593) = 0.422, p = 0.656. As in Study 1, there was a strong preference for visual learning among the entire population (see Figures 17 and 18).

Sequential/Global

All majors had very similar scores (Science: M = -0.095, SD = 2.129; Engineering: M = -0.142, SD = 2.052; Business and Management: M = -0.072, SD = 2.385), and the differences are not significant using a one-way ANOVA, $F(2, 1593) = 0.140$, p = 0.869. Overall, there was no preference either way for global or sequential learning among all three majors (see Figure 19), and 43.52% of students are categorized as balanced (see Figure 20).

Conclusion

The results are summarized in Table 11. Contrary to what we expected, there were not many differences between the three cohorts. Variations were only noticeable on the active/reflective scale. The overall trend for all majors was for reflective learning, but the preference was strongest among Science students. Consequently, students' learning styles at HKUST were mostly independent of major, and there was a large amount of homogeneity among majors. However, we could not conclusively state if this applies at all universities, as universities with more diverse areas of study may have more diverse learning styles.

3.2.1.2. What activities do students prefer most in class?

In Study 2, we surveyed participants on their preferred classroom activities, such as speaking, writing, reading, and listening. Figure 21 displays the results among the entire population. As anticipated, speaking was the most frequent response at 47.0%, followed by listening (27.3%), reading (15.3%), and writing (8.4%). Using a Chi-Square analysis, speaking was significantly more popular than listening, χ^2 (N = 1186) = 5.205, p = 0.023, and thus speaking was also significantly more popular than reading and writing. The same pattern of

decreasing percentages for listening, reading, and writing occurred when looking at each gender or major separately. Among Science majors (see Figure 22), the difference between students preferring speaking (42.3%) and listening (26.3%) was somewhat significant, χ^2 (N = 295) = 3.755, p = 0.053. Among Engineering majors (see Figure 23), 40.3% preferred speaking and 29.5% preferred listening, but the difference was not significant, χ^2 (N = 324) = 1.661, p = 0.197. However, among Business and Management majors (see Figure 24), 54.3% preferred speaking while 26.4% preferred listening, and this difference was significant, χ^2 (N = 566) = 9.669, p = 0.002. In addition, males and females exhibited a similar trend. Speaking was chosen by 43.7% of males (see Figure 25), while listening was chosen by 29.2%, but the difference was marginally significant, χ^2 (N = 734) = 2.879, p = 0.090. Females (see Figure 26) preferred speaking 52.5% of the time and preferred listening 24.2% of the time, which was statistically significant, χ^2 (N = 440) = 10.459, p = 0.001. Frequencies of responses are summarized in Table 12.

Overall, this data shows that students prefer the opportunity to speak more in their language classes. This opinion is especially strong among Business and Management majors and females.

Active/Reflective

A one-way ANOVA showed that students preferring speaking were the least reflective, while students preferring reading were the most reflective (speaking: M = 0.291, SD = 2.340; writing: M = 1.000, SD = 2.514; listening: M = 1.257, SD = 2.349; reading: M = 1.780, SD = 2.271), F(3, 1561) = 31.512, p < 0.001. LSD Post-hoc analysis also showed that students preferring speaking were less reflective than those preferring writing, t(1561) = -3.220, p = 0.001, listening, t(1561) = -6.832, p < 0.001, and reading t(1561) = -8.616, p < 0.001; students who preferred writing were less reflective than those who preferred reading, t(1561) = -3.093, p

= 0.002; students who preferred listening were less reflective than those who preferred reading, $t(1561) = -2.791$, $p = 0.005$ (see Table 13). Therefore, students who prefer speaking and writing tend to be more active learners, while students who prefer listening and reading tend to be more reflective. This may explain why more Business and Management majors and females prefer speaking, since they tend to be the most active of their respective groups.

Sensing/Intuitive

There was not a significant difference among students preferring each activity on this scale using a one-way ANOVA (speaking: $M = 0.087$, $SD = 2.583$; writing: $M = 0.071$, $SD = 2.391$; listening: $M = -0.178$, $SD = 2.580$; reading: $M = -0.257$, $SD = 2.747$), $F(3, 1561) = 1.661$, $p = 0.173$. This suggests that students' preferences on this scale do not have a large impact on their preferences for in-class activities.

Visual/Verbal

Comparison using a one-way ANOVA did not show any significant difference (speaking: $M = -2.897$, $SD = 2.572$; writing: $M = -2.485$, $SD = 2.712$; listening: $M = -2.838$, $SD = 2.663$; reading: $M = -2.461$, $SD = 2.673$), $F(3, 1561) = 2.332$, $p = 0.072$, but an interesting pattern appeared. Scores on the spoken activities (speaking, listening) had similar means that were marginally different than written activities (writing, reading). Although our data did not prove it, it may be possible that visual learners tend to prefer aural activities, whereas verbal learners tend to prefer written activities.

Sequential/Global

There were significant differences among the activities using a one-way ANOVA (speaking: $M = 0.067$, $SD = 2.273$; writing: $M = -0.187$, $SD = 2.001$; listening: $M = -0.235$, $SD = 2.244$; reading: $M = -0.357$, $SD = 2.145$), $F(3, 1561) = 3.111$, $p = 0.025$. LSD Post-hoc analysis

showed the most significant differences were between speaking and reading, $t(1561) = 2.592$, $p = 0.010$, and between speaking and listening, $t(1561) = 2.255$, $p = 0.024$ (see Table 14). This showed that students who preferred speaking were more global than those who preferred reading or listening, while students who preferred writing had a preference somewhere in between.

Conclusion

Table 15 summarizes the learning style comparisons. Speaking is preferred over any other activity in class, even though the number of reflective students outweighs the number of active students. The data also shows that reflective students are more likely to prefer non-speaking activities than active students are. Finally, reading tends to be the most sequential activity while speaking is the least.

3.2.1.3. How do HKUST students differ from students at Western universities?

During Study 1, we performed a cross-cultural comparison on the basis that learning styles might be different between cultures, as suggested by many studies such as Hedden et al. (2008) and Reid (1987). In Study 2, we surveyed both Asian and American students' learning styles. Based on the previous research and our own findings from Study 1, we expected the American students to be more active, less visual, and more sequential than the HKUST students (Hedden, Ketay, Aron, Markus, & Gabrieli, 2008)

Since the majority of respondents on the online survey were engineers, we used one-way ANOVAs to compare the engineers' responses during Study 2 with the responses online. On the active/reflective scale, American engineers ($M = -0.311$, $SD = 2.387$) were much more active on average than HKUST engineers ($M = 0.866$, $SD = 2.233$), $F(1, 753) = 47.143$, $p < 0.001$. There was no significant difference on the sensing/intuitive scale, but when comparing visual/verbal scores, American engineers ($M = -2.363$, $SD = 2.860$) were less visual than HKUST engineers

(M = -2.860, SD = 2.513), $F(1, 753) = 6.142$, $p = 0.013$. Finally, on the sequential/global scale, American engineers (M = -1.170, SD = 2.415) were much less sequential than HKUST engineers (M = -0.140, SD = 2.052), $F(1, 753) = 39.082$, $p < 0.001$. Table 16 summarizes the results.

These patterns suggest that there is a great difference between American engineering students and HKUST Engineering students. American engineers are much more inclined to do group work, since they are much more active. Both Asian and American engineers are quite visual, but the Asian students are significantly more visual than the American engineers in this study. American students also think in a more ordered way, whereas HKUST students prefer to think less sequentially. These differences matched our hypotheses, confirming what previous research has suggested.

3.2.1.4. Does the country of the secondary school affect learning style?

As a further comparison between different cultures, we decided to see if there was any difference between students at HKUST who attended secondary school in Mainland China and those who attended secondary school in Hong Kong using one-way ANOVAs. On the sensing/intuitive scale, Mainland China students (M = 0.296, SD = 2.697) were intuitive whereas Hong Kong students (M = -0.112, SD = 2.564) were sensing, $F(1, 1538) = 4.365$, $p = 0.037$. Also, on the sequential/global scale, Mainland China students (M = 0.647, SD = 2.348) were predominantly global learners while Hong Kong students (M = -0.190, SD = 2.170) favored sequential thinking, $F(1, 1538) = 25.399$, $p < 0.001$. There were no significant differences in the other two scales (see Table 17).

The data shows that students from Hong Kong tend to prefer concrete and sequential information, while students from Mainland China generally prefer the opposite. The pattern of sensing students being more sequential also corresponds with the correlation we found in Study

1. Since Mainland China and Hong Kong both have the same written language and similar spoken languages, the statistics imply that factors other than language or culture may influence learning styles. Since the learning styles of the Mainland China students at HKUST are generally the opposite of Hong Kong students in half the dimensions, different teaching methods may benefit one group more than the other.

3.2.1.5. Does EMI/Outside study affect learning style?

In Study 1, we noticed no differences between EMI and non-EMI instruction, and no differences between students who had studied outside of Hong Kong or Mainland China and those who had not. This did not correspond with prior research done by Reid (1987) and Hedden et al. (2008), who suggested that different languages may have effects on learning styles. With our larger sample size in this study (see Table 8), we may be able to see patterns more easily.

Using one-way ANOVAs, we found on the active/reflective scale that EMI students (M = 0.778, SD = 2.390) were slightly more active than non-EMI students (M = 1.041, SD = 2.438), $F(1, 1589) = 3.989$, $p = 0.046$. On the sequential/global scale, EMI students (M = -0.198, SD = 2.242) were slightly sequential whereas non-EMI students (M = 0.155, SD = 2.154) were slightly global, $F(1, 1589) = 8.401$, $p = 0.004$. However, there were no significant differences on the other two scales. Table 18 summarizes the results for the EMI comparison.

When comparing students with and without outside study, the only significant difference appeared on the active/reflective scale, where students with outside study (M = 0.196, SD = 2.4490) were much less reflective than students without outside study (M = 0.952, SD = 2.390), $F(1, 1584) = 16.318$, $p < 0.001$. The remaining comparisons are shown in Table 19.

The data shows that EMI and schoolwork completed outside of Hong Kong or Mainland China has an impact on students' learning styles. Students with prior EMI or who had studied

outside of Hong Kong or Mainland China are significantly less reflective than those who had not, suggesting that learning in non-Chinese mediums may affect students' preferences for active learning. EMI can also be tied with increased frequency of sequential learning among students.

3.2.1.6. Does gender affect learning style?

Similarly to Study 1, we looked at the effects of gender on learning styles for exploratory purposes. Previously, we had found that the only difference was that males were more reflective than females. Now that there is a larger sample size, more patterns emerge, summarized in Table 20. Using a one-way ANOVA, we saw on the active/reflective scale that males (M = 1.127, SD = 2.454) were more reflective than females (M = 0.383, SD = 2.241), $F(1, 1585) = 35.991$, $p < 0.001$. In addition, we saw on the sensing/intuitive scale that males (M = 0.199, SD = 2.636) were slightly intuitive whereas females (M = -0.461, SD = 2.489) were more sensing, $F(1, 1585) = 24.049$, $p < 0.001$. Finally, on the sequential/global scale, males (M = 0.017, SD = 2.217) were somewhat neutral whereas females (M = -0.293, SD = 2.217) were somewhat sequential, $F(1, 1585) = 7.172$, $p = 0.007$.

This analysis shows that there is more of a difference between genders than we had suspected after Study 1. Females tend to think more concretely and orderly, but males tend to think more abstractly. In addition, males would find independent study more helpful than females. The patterns agree with the correlations we found in Study 1, which showed that sensing learners tend to be more sequential, whereas intuitive learners tend to be more global. In Study 2, females are more sensing and sequential, while males are more intuitive and global.

3.2.1.7. Correlations

For exploratory analysis, we looked at correlations between learning dimensions, as we had in Study 1. Table 21 summarizes the correlations, which are similar to Study 1. The

strongest correlation still occurred between the sensing/intuitive and sequential/global scales, with sensing learners being more sequential and intuitive learners being more global ($r = 0.297$, $p < 0.001$). This pattern also occurred when looking only at one gender or one major, suggesting that overall, students who preferred concrete information were sequential learners, and students who preferred abstract information were global learners. In addition, the correlations between active/reflective and visual/verbal ($r = 0.126$, $p < 0.001$), and between visual/verbal and sequential/global scales ($r = -0.068$, $p = 0.007$) were similar to Study 1.

3.2.2. Focus groups

As in Study 1, the following section presents the summary of the themes from all of the 10 follow-up focus groups with 20 students from Engineering, Science, and Business and Management majors at HKUST (2-4 students per focus group). Overall, we found that most of the responses and suggestions from Study 2 replicated those from Study 1. However, students from Study 2 provided some additional suggestions.

3.2.2.1. Students' opinions/preferences about teaching methods in their classes

Power Point

Five of the participants (25%), regardless of major, reported that they preferred classes that used Power Point presentations. In particular, they preferred PowerPoint slides that used less text and provided explanations on the presented figures. And, 20% reported that slides that repeated the textbook were not useful. These findings replicate those from Study 1. Looking at preferences based on major, two of the Engineering majors (33%) and two of the Science majors (29%) reported that while they liked Power Point presentations, they also liked when the instructors wrote explanations on the board because it aided their retention of the material.

Class Projects and Group Work

As in Study 1, 13 of the 20 students (65%) suggested they preferred group work and in-class projects. Yet, five of the students (25%) reported more of a preference to work alone than work in groups. Looking across the different majors, five of the Business and Management majors (71%) reported preferring courses that promoted in-class presentations because they believed it would be beneficial to them later on in their careers.

Class Organization

Seven of the 20 students (35%) said they preferred classes that provided an outline at the beginning of each class, preferred it when the professors followed this outline, and preferred classes that reviewed information covered either at the beginning or end of each class. These students reported being frustrated when information was not covered in a pre-requisite course and was assumed to be covered in their future classes. These findings replicated those in Study 1.

3.2.2.2. Students' opinions/preferences about their English classes at HKUST

Class Activities

For the English classes in particular, 12 of the 20 students (60%) said that speaking would be the most effective way for them to practice their English, and 50% wanted more interactions in the classroom to practice their speaking skills. Forty percent of the participants said that writing was another difficulty they were facing in their English classes and they wanted more writing activities in class. Thirty-five percent reported difficulties with vocabulary and grammar, and preferred vocabulary and grammar exercises. Looking at class activity preferences based on majors, four of the Business and Management majors (57%) reported wanting more in-class debates to help them develop important skills relevant to their career paths. And, four of the Science majors (57%) said that they wanted more writing activities as writing is an important

skill needed in their future careers. And most of the EMI students (40% of the participants) preferred classes that allowed them to practice their speaking more than practicing the grammar they had learned in their secondary school, as found in Study 1. Overall, most of the students reported that they would like more engaging activities in the classroom, such as group discussions, interactive activities, giving presentations, watching movies and analyzing them afterwards, etc.

Textbooks

Looking at attitudes towards the textbooks being used, 20% said that they did not like the textbooks, especially when they focused on information that would rarely apply in real life. In addition, they preferred instructors who presented material that extended beyond the material presented in the textbook because they can read the textbook on their own time. These findings replicate those in Study 1.

Interactions

As in Study 1, nine of the 20 students (45%) said they wanted more interactions between themselves and their English instructors, and 10% reported that their English professors who lectured the entire time were more boring than professors who engaged students in the classroom.

3.2.2.3. Students' study habits

As in Study 1, most of the students from Study 2 reported a general lack of motivation in studying, as 30% reported spending very little time studying for the English classes on their own. They reported investing approximately 1-3 hours per week in class, and only studying right before assignment, presentation or exam due dates. Two participants (10%) reported that they

were not motivated to invest a lot of time into their English classes due to the fact that this class was worth less credit-wise than their other classes. These findings replicate those from Study 1.

In order to improve their English speaking and writing skills outside the classroom, 20% of participants reported practicing their English by interacting with exchange and international students at HKUST. And, most of the participants reported that they practiced their English outside the classroom by reading newspapers and magazines, watching TV, listening to radio, chatting, and playing video games.

4. Discussion

Past studies done on learning styles focused on either students immersed in English speaking countries or students whose native language was English. Thus, our study attempted to expand this research by assessing the learning styles of students trying to learn English in a non-English speaking country, and comparing whether the learning styles differed based on culture and academic major.

Over the course of two studies, as predicted from past research showing that Eastern students relied more heavily on areas of the brain responsible for processing visual information (Goswami, 2006), we consistently found that Eastern students preferred a visual learning style. Looking at preferred in-class activities to enhance their learning, we found that participants wanted more speaking activities in the classroom. In addition, we found that learning styles significantly differed based on cultural background. In particular, the results from our two studies showed that Western students were much more active, less visual, and more sequential than Eastern students. This finding extends past research that found that Chinese students, in particular, were more visual learners (Reid, 1987). In order to extend past research, we also examined the effect that academic major had on the learning styles of our Eastern students. We only found a significant difference on the active/reflective dimension, suggesting that Science majors were the most reflective and that Business and Management majors were the least reflective[1]. For exploratory purposes, we examined the effect that gender had on learning styles, and we found that males tend to be reflective, intuitive, and global while females tend to be more active, sensing, and sequential.

Although our research investigated the differences in learning styles based on culture and academic major, it did not explore how learning styles might change over time. Thus, future

[1] Engineering majors were less reflective than Science majors and more reflective than Business and Management majors.

research could investigate how students' learning styles change over the course of their academic career, and how culture and major may influence any changes that occur. In addition, while past research has shown differences in brain activity for language processing (Goswami, 2006), neurological differences based on learning styles have not been explored. Hence, future research could investigate whether any neurological differences exist based on learning styles.

4.1. Suggestions for the HKUST classroom

In addition to assessing learning styles, we also conducted focus groups to better understand ways to enhance learning at HKUST. Based on our findings from these focus groups, our research suggests several methods for improving learning inside and outside the classroom, including encouraging interactions with exchange students and instructors, a writing tutor program, and finding ways to better advertise and promote the Language Centre at HKUST.

Program for interaction with exchange students, instructors, and in the classroom

Forty-one percent of the participants in the focus groups wanted to have the opportunity to take part in meaningful interaction with native English speakers, and 30% of the participants wanted instructors to interact with students during their English classes. Based on these preferences, we recommend that HKUST provide local students with opportunities to interact with exchange students. While some of the students reported that similar programs were in existence at HKUST, they commented that they were limited because they were only offered to certain majors and often their class schedules conflicted with the availability of these programs. In addition, we assessed the most preferred in-class activities, and found that 47% of the students we surveyed wanted more speaking opportunities in their classes. Thus, we recommend that instructors adapt their curriculum to encourage the students to interact more with each other and with the instructors and provide them with such opportunities.

Writing tutoring program

Our results show that 8% of the surveyed participants and 30% of our focus group participants reported that writing assignments in their language classes would be activities that could enhance their learning. And, three of the focus group participants (8%) reported a desire for a writing tutoring program to help with written language skills. Thus, we recommend the creation of a writing tutoring program to better assist students.

Better advertising of the Language Centre resources

In our focus groups, we also examined students' awareness with the Language Centre and the resources they provide. We found that most of the participants from the focus groups reported that they do not know about the resources that the Language Centre provides. Based on these findings, we recommend that the Language Centre find ways to improve the advertising of the resources they provide in order to help students become more aware of the vast resources available to them.

Limitations of the Suggestions and Future Research

While we make a number of suggestions for enhancing the classroom experience based on students learning styles, one limitation of our project is that we did not implement and measure the effectiveness of these suggestions. Therefore, future research should examine the efficacy of our recommendations in comparison to the current teaching styles implemented in the classroom.

In addition, while we utilized follow-up focus groups to better understand students' preferences in the classroom, the results may be limited in representing the attitudes of a majority of students because only a small percentage of the surveyed participants in both studies agreed to participate in the focus groups (only 12.73% of the participants in Study 1 and 11.40% of the

participants in Study 2). In addition, the results may be slightly limited in representing the needs of the majority of students because we found that the learning styles of the students who volunteered for the focus groups differed slightly from the learning styles of the larger population surveyed in Studies 1 and 2. For instance, focus group volunteers in Study 2 were found to be more global than the remaining surveyed participants[2]. Thus, future research should conduct focus groups on a larger sample that is more representative of the learning styles of the population to determine whether this affects the student opinions and suggestions.

4.2. Conclusion

In conclusion, this research attempted to gain additional perspective on assessing the effects of learning English in a non-English speaking country. Overall, we found that Eastern students tended to be visual learners. However, even though we expected differences in students' learning styles based on their majors, there were not many significant variations. From our focus group findings, we have made several suggestions to try to enhance students' learning. Putting all this together, learning styles play an important role in how students view and use information presented in the classroom. Future research should continue to examine the effects of different factors on learning styles.

[2] Looking at the sequential/global dimension in Study 2, focus group volunteers ($M = 0.541$, $SD = 2.6504$) were significantly more global than the surveyed population ($M = -0.181$, $SD = 2.1486$), $F(1, 1595) = 17.198$, $p < 0.001$.(see Table 22).

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Appendix A. Sponsor Description: HKUST

Our project is sponsored by HKUST's Language Centre. HKUST is one of eight public universities in Hong Kong (Hong Kong Higher Education, 2007). The Language Centre is a department within HKUST. As a public institution, the University receives funding from students, alumni, the government, and research related donations.

HKUST, along with the Language Centre, provides students with resources to help them to study independently, work in an international environment, and communicate with the world. HKUST's mission is to "advance learning and knowledge through teaching and research, particularly in science, technology, engineering, management and business studies, … and to assist in the economic and social development of Hong Kong" (Mission and Vision, 2008). The major purpose of the Language Centre is to improve foreign language education and knowledge using innovative teaching and research methods. To accomplish this objective, the Centre has utilized modern course development, received local and international cooperation, and has created an enjoyable place to study, work, and communicate in English for the students of HKUST. The Centre also wants to assist in the economic and social development of Hong Kong by providing relevant language services to students, University staff, and other organizations in Hong Kong (Mission, 2008).

The Language Centre, directed by Professor Gregory James, staffs over 80 faculty members who facilitate language education at the University. Courses are offered in nine different languages, but their main focus is on English education (Mission, 2008). The Language Centre offers a number of programs and services for students. One is the English Conversation Groups program, in which groups of students and staff practice speaking in English on pre-specified topics. Another program is the Language Exchange Program, in which students of

different languages pair up in order to practice speaking each other's language (Language Centre Handbook, 2008). With these and other programs, the Language Centre hopes to promote an interest in foreign language study at the University.

HKUST has three main groups of administration: the Council, Court, and Senate (Governance, 2008). The Council is the governing organization of the University. It is mostly responsible for the financing and management of the University's resources, as well as awarding degrees to graduates. The Council is composed of 12 members from the University, including the President and Vice-President, and up to 21 members who are not a part of the HKUST community. The Council is always run by someone who is not a member of HKUST. The Court is the University's consulting body, whose goal is to promote the interests of the University throughout the world, along with providing general direction to the University. The Court is led by the most recent ex-chairman of the Council, and also consists of two other former Council chairmen. Other appointed members, up to a maximum of 100, include other business and community leaders and four representatives from the University Senate. The Senate is made up of 54 members from the HKUST community. Most members are faculty, but it may include up to three students. The Senate is always led by the President of the University. Its main responsibilities are to set academic policies and to maintain a suitable environment for learning on the HKUST campus.

Appendix B. Student Survey

香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

HKUST Student Learning Survey

Please take a few minutes to fill out this questionnaire.

DIRECTIONS: For each question fill in the circle that represents your preference. The middle circle (③) represents a neutral opinion.							
1.	I understand something better after I _____.						
	try it out	①	②	③	④	⑤	think it through
2.	I would rather be considered _____.						
	practical	①	②	③	④	⑤	innovative
3.	When I think about what I did yesterday, I am more likely to get _____.						
	a picture	①	②	③	④	⑤	words
4.	I tend to understand _____.						
	the details of a subject	①	②	③	④	⑤	the overall structure of a subject
5.	When I am learning something new, it helps me to _____ about it.						
	think	①	②	③	④	⑤	talk
6.	I find it easier to learn _____.						
	concepts	①	②	③	④	⑤	facts
7.	I prefer to get new information from _____.						
	written directions or verbal information	①	②	③	④	⑤	pictures, diagrams, graphs, or maps
8.	Once I understand _____.						
	the whole thing, I see how the parts fit	①	②	③	④	⑤	all the parts, I understand the whole thing
9.	When studying with others, I am more likely to _____.						
	contribute ideas	①	②	③	④	⑤	listen
10.	I prefer to read something that _____.						
	teaches me facts	①	②	③	④	⑤	gives me new ideas

11.	In a book with lots of pictures and charts, I tend to focus on _____.						
	the pictures and charts	①	②	③	④	⑤	the written text
12.	When I solve math problems, _____.						
	I usually work my way to the solutions one step at a time	①	②	③	④	⑤	I know the answer, but have trouble understanding the steps
13.	In classes, I usually get to know _____ of the students.						
	none	①	②	③	④	⑤	all
14.	I prefer the idea of _____.						
	theory	①	②	③	④	⑤	certainty
15.	I like teacher who only _____.						
	spend a lot of time explaining	①	②	③	④	⑤	use a lot of diagrams
16.	It is better for me if an instructor _____.						
	gives me an overall picture	①	②	③	④	⑤	lays out the material in clear ordered steps
17.	When I start a homework problem, I _____.						
	start immediately	①	②	③	④	⑤	try to understand the problems first
18.	I am _____.						
	careful about the details of my work	①	②	③	④	⑤	creative with my work
19.	I remember best what I _____.						
	see	①	②	③	④	⑤	hear
20.	When I study, _____.						
	I learn at a fairly regular pace	①	②	③	④	⑤	I will be confused at first, but then suddenly everything makes sense
21.	I prefer to study _____.						
	alone	①	②	③	④	⑤	in a group
22.	When I am reading for enjoyment, I like writers to be _____.						
	creative and inventive	①	②	③	④	⑤	clear and straightforward
23.	When I get directions to a new place, I prefer _____.						
	written instructions	①	②	③	④	⑤	a map

24.	When considering information, I _____.						
	try to understand the big picture before getting into the details	①	②	③	④	⑤	focus on the details and miss the big picture
25.	I more easily remember something I have _____.						
	done	①	②	③	④	⑤	thought about a lot
26.	To complete a task, I prefer to _____.						
	master one way of doing it	①	②	③	④	⑤	come up with new ways of doing it
27.	When I see a diagram in class, I remember _____.						
	the picture	①	②	③	④	⑤	the instructor's explanation
28.	When writing a paper, I _____.						
	work on the beginning of the paper and progress forward	①	②	③	④	⑤	work on different parts of the paper, and then order them
29.	When I have to work on a group project, I like to brainstorm_____.						
	individually	①	②	③	④	⑤	as a group
30.	I would prefer to be _____.						
	imaginative	①	②	③	④	⑤	sensible
31.	When someone is showing me data, I prefer _____.						
	a written explanation of the results	①	②	③	④	⑤	charts or graphs
32.	When I am learning a new subject, I prefer to _____.						
	try to make connections between that subject and related subjects	①	②	③	④	⑤	stay focused on that subject
33.	I am more likely to be considered _____.						
	social	①	②	③	④	⑤	shy
34.	I prefer courses that teach _____.						
	concrete materials (facts, data)	①	②	③	④	⑤	abstract materials (concepts, theories)
35.	When I meet someone new, I remember _____.						
	what they looked like	①	②	③	④	⑤	what they said about themselves

36.	When a teacher starts a lecture with an outline, the outline is _____.						
	somewhat helpful	①	②	③	④	⑤	very helpful
37.	I _____ doing homework in groups with one grade for the entire group.						
	dislike	①	②	③	④	⑤	like
38.	When I am doing long calculations, I _____ checking my work.						
	dislike	①	②	③	④	⑤	like
39.	For entertainment, I would rather _____.						
	read a book	①	②	③	④	⑤	watch television
40.	When solving problems in a group, I would think about _____.						
	ways to apply the solution to many subjects	①	②	③	④	⑤	the steps in the solution process

What activities in class do you find most helpful? (please choose one)
O Speaking O Writing O Listening O Reading

My gender is:	My major is:
O Male O Female	O Science O Engineering O Business & Management

I attended a secondary school where English was the language of instruction.
O Yes O No

I have previously studied outside of Hong Kong and Mainland China.
O Yes O No

I attended secondary school in_____.
O Hong Kong O Mainland China O Other

If you want to receive your results of this survey please leave us your email address:
@stu.ust.hk

May we contact you for a 30-minute group interview?
O Yes O No

Thank you. 謝謝。

Appendix C. Student Interview Protocol

1. Introduction:

Hi, my name is _____; I am a student from Worcester Polytechnic Institute, majoring in _____. I am working on a project with the Language Centre at HKUST. The goal of our project is to help the University to improve their English teaching methods. We are collecting data on the learning styles of students from the following disciplines: Science, Engineering, Business & Management (The information could be more detailed if the students have any other specific questions to interviewer)

Do you have any questions before we start?

2. General Information about the student:

1. Student's name:
2. Student's gender Male ☐ Female ☐
3. What are you majoring in? Science ☐ Engineering ☐ Business & Management ☐ Specific major _____
4. Are you coming from secondary school where English was used to teach (EMI)? Yes ☐ No ☐
5. Did your secondary school teach only in English or only in Cantonese? English ☐ Cantonese ☐ Both ☐
6. Have you studied anywhere besides Hong Kong? Yes ☐ No ☐ If yes, where? _____

3. Questions about classes the student is taking at HKUST:

1. Please, describe the methods through which you learn best:

when you try to do something ☐
when you think about something ☐
when you talk about something ☐
when you hear specific information ☐
when you see a diagram or picture ☐
when you read about something ☐

Other methods: _____

In your classes in general/ in your English classes (most importantly)_____

2. What teaching methods do you like most?

outline in the beginning of the lecture ☐
oral explanation of the material ☐
diagrams ☐
PowerPoint presentations ☐
in-depth explanations of the material ☐
overall explanations of the material ☐

Other teaching methods: _____

3. What teaching methods do you like least?

outline in the beginning of the lecture ☐
oral explanation of the material ☐
diagrams ☐
PowerPoint presentations ☐
in-depth explanations of the material ☐
overall explanations of the material ☐

Other teaching methods: _____

4. What teaching methods would you like to experience in the classroom activities? (open-ended question)

5. What classes do you prefer?

classes that teach concrete material ☐
classes that teach abstract material ☐
classes based on group work ☐
classes based on individual work ☐

6. What do you like ***most*** about your English classes?

the way the material is presented ☐
the teacher's methods ☐
activities in the classroom ☐
other ☐

7. What do you like ***least*** about your English classes?

the way the material is presented ☐
the teacher's methods ☐
activities in the classroom ☐
other ☐

8. What activities in class you find most helpful? And do you think more activities would be helpful for your learning? If yes, give me examples.

Speaking ☐
Writing ☐
Listening ☐
Reading ☐

9. What difficulties do you have in learning English

Speaking ☐
Writing ☐
Listening ☐
Reading ☐

4. Questions about student's study habits:

1. How much time usually do you spend studying for your English classes? (open question)
2. How do you prefer to study? in a group ☐ alone ☐
3. What is the most effective way for you to learn English vocabulary? (open question)
4. What is the most effective way for you to learn English grammar? (open question)

5. Questions about use of English outside of the classroom

Do you use English in any of your activities during your free time outside of the classroom? watch movies/TV shows in English ☐ read books/novels in English ☐ read magazines/newspapers in English ☐ other activities involved English ☐

Tables

Table 1. Study 1: Demographics

Question	Response	Frequency	Proportion
Gender	Male	N = 132	80.00%
	Female	N = 33	20.00%
EMI Secondary School?	Yes	N = 110	66.67%
	No	N = 55	33.33%
Outside Study?	Yes	N = 19	11.52%
	No	N = 146	88.48%
Interview?	Yes	N = 21	12.73%
	No	N = 144	87.27%

Table 2. Study 1: Distribution of Scores on Each Dimension

Dimension	Active/ Reflective	Sensing/ Intuitive	Visual/ Verbal	Sequential/ Global
Mean	0.322	-0.370	-3.602	0.099
SD	2.599	2.352	2.200	2.161

	Strongly	Moderately	Balanced	Moderately	Strongly	
Active	4.82%	24.70%	35.54%	25.30%	9.64%	Reflective
Sensing	7.83%	25.30%	44.58%	17.47%	4.82%	Intuitive
Visual	45.18%	41.57%	12.65%	0.00%	0.60%	Verbal
Sequential	3.01%	19.88%	48.19%	23.49%	5.42%	Global

Table 3. Study 1: Chi-Square Comparison between Other Universities

	Percentage of Learning Styles at Various Universities					p-values of Chi-Square Test between HKUST Students and Other Universities			
University	**A**	**S**	**Vs**	**Sq**	**N**	**A**	**S**	**Vs**	**Sq**
Iowa Sate, Materials Engr.	63	67	85	58	129	0.0687	0.3572	0.4824	0.4215
Michigan Tech, Env. Engr.	56	63	74	53	83	0.2366	0.5683	0.1158	0.7417
Oxford Brookes Univ., Business									
British Students	85	86	52	76	21	**0.0003**	**0.0144**	**0.0005**	**0.0188**
International Students	52	62	76	52	42	0.4237	0.6304	0.1585	0.8165
Ryerson Univ., Elec. Engr.									
Students (2000)	53	66	86	72	87	0.3696	0.4041	0.5312	**0.0428**
Students (2001)	60	66	89	59	119	0.1205	0.4041	0.6895	0.3702
Students (2002)	63	63	89	58	132	0.0687	0.5683	0.6895	0.4215
Tulane, Engr.									
Second-Year Students	62	60	88	48	245	0.0833	0.7641	0.6351	0.8666
First-Year Students	56	46	83	56	192	0.2366	0.2886	0.3916	0.5374
Universities in Belo Horizonte									
Sciences	65	81	79	67	214	**0.0460**	**0.0389**	0.2419	0.1084
Humanities	52	62	39	62	235	0.4237	0.6304	**0.0000**	0.2429
Univ. of Limerick, Mfg. Engr.	70	78	91	58	167	**0.0156**	0.0673	0.8023	0.4215
Univ. of Michigan, Chem. Engr.	67	57	69	71	143	**0.0303**	0.9818	**0.0468**	0.0520
Univ. of Puerto Rico-Mayagues									
Biology (Semester 1)	65	77	74	83	39	**0.0460**	0.0801	0.1158	**0.0038**
Biology (Semester 2)	51	69	66	85	37	0.4829	0.2749	**0.0249**	**0.0023**
Biology (Semester 3)	56	78	77	74	32	0.2366	0.0673	0.1836	**0.0286**
Elect. & Comp. Engr.	47	61	82	67	?	0.7658	0.6958	0.3501	0.1084
Univ. of Sao Paulo, Engr.									
Civil Engr.	69	86	76	54	110	**0.0195**	**0.0144**	0.1585	0.6699
Elec. Engr.	57	68	80	51	91	0.2016	0.3141	0.2752	0.8937
Mech. Engr.	53	67	84	45	94	0.3696	0.3572	0.4358	0.6320
Indust. Engr.	66	70	73	50	56	**0.0374**	0.2395	0.0980	0.9728
Univ. of Tech., Kingston, Jamaica	55	60	70	55	?	0.2761	0.7641	0.0569	0.6017
Univ. of Wester Ontario, Engr.									
First year engr	66	59	78	69	499	**0.0374**	0.8348	0.2114	0.0758
Fourth year engr.	72	58	81	63	359	**0.0098**	0.9076	0.3113	0.2088
HKUST, LANG306, Jan. 2009*	**44**	**57**	**94**	**50**	**166**	1.0000	1.0000	1.0000	1.0000

A	Proportion of active learners
S	Proportion of sensing learners
Vs	Proportion of visual learners
Sq	Proportion of sequntial learners
N	Sample Size

*Using Modified ILS; percentages computed with respect to all non-zero scores in each dimension.

Non-engineering cohorts are highlighted.
Table uses data from Felder and Spurlin (2005).

Table 4. Study 1: Summary of One-way ANOVAs Based on EMI Secondary School Response

Dimension	Active/ Reflective		Sensing/ Intuitive		Visual/ Verbal		Sequential/ Global	
Response	Yes	No	Yes	No	Yes	No	Yes	No
N	110	55	110	55	110	55	110	55
Mean	0.073	0.745	-0.405	-0.236	-3.532	-3.755	0.036	0.345
SD	2.688	2.329	2.138	2.723	2.243	2.143	2.139	2.039
F-value	2.504		0.188		0.372		0.789	
p-value	0.116		0.665		0.543		0.376	

Table 5. Study 1: Summary of One-way ANOVAs Based on Outside Study Response

Dimension	Active/ Reflective		Sensing/ Intuitive		Visual/ Verbal		Sequential/ Global	
Response	Yes	No	Yes	No	Yes	No	Yes	No
N	19	146	19	146	19	146	19	146
Mean	-0.053	0.342	-0.895	-0.277	-3.974	-3.558	-0.026	0.161
SD	3.004	2.535	1.745	2.405	1.975	2.236	1.926	2.133
F-value	0.391		1.169		0.595		0.132	
p-value	0.533		0.281		0.442		0.716	

Table 6. Study 1: Summary of One-way ANOVAs Based on Gender

Dimension	Active/ Reflective		Sensing/ Intuitive		Visual/ Verbal		Sequential/ Global	
Response	Male	Female	Male	Female	Male	Female	Male	Female
N	132	33	132	33	132	33	132	33
Mean	0.542	-0.682	-0.242	-0.773	-3.576	-3.727	0.178	-0.015
SD	2.644	2.102	2.384	2.147	2.179	2.342	2.104	2.134
F-value	6.092		1.356		0.124		0.221	
p-value	**0.015**		0.246		0.725		0.639	

Table 7. Study 1: Correlations

		Active/ Reflective	Sensing/ Intuitive	Visual/ Verbal	Sequential/ Global
Active/Reflective	Pearson Correlation		-0.070	**0.196**	0.005
	Sig. (2-tailed)		0.371	**0.011**	0.946
	N		166	166	166
Sensing/Intuitive	Pearson Correlation	-0.070		0.014	**0.317**
	Sig. (2-tailed)	0.371		0.861	**0.000**
	N	166		166	166
Visual/Verbal	Pearson Correlation	**0.196**	0.014		**-0.196**
	Sig. (2-tailed)	**0.011**	0.861		**0.011**
	N	166	166		166
Sequential/Global	Pearson Correlation	0.005	**0.317**	**-0.196**	
	Sig. (2-tailed)	0.946	**0.000**	**0.011**	
	N	166	166	166	

Table 8. Study 2: HKUST Demographics, Split by Major

		Science		Engineering		Business and Management		Total	
	Frequency / Proportion	N = 430	26.93%	N = 464	29.05%	N = 702	43.96%	N = 1597	100.00%
Question	Response	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion	Frequency	Proportion
Gender	Male	N = 310	72.09%	N = 359	77.37%	N = 339	48.29%	N = 1008	63.12%
	Female	N = 118	27.44%	N = 102	21.98%	N = 359	51.14%	N = 579	36.26%
Activity?	Speaking	N = 182	42.33%	N = 187	40.30%	N = 381	54.27%	N = 750	46.96%
	Writing	N = 48	11.16%	N = 48	10.34%	N = 38	5.41%	N = 134	8.39%
	Listening	N = 113	26.28%	N = 137	29.53%	N = 185	26.35%	N = 436	27.30%
	Reading	N = 77	17.91%	N = 78	16.81%	N = 90	12.82%	N = 245	15.34%
EMI Secondary School?	Yes	N = 264	61.40%	N = 286	61.64%	N = 569	81.05%	N = 1120	70.13%
	No	N = 166	38.60%	N = 177	38.15%	N = 128	18.23%	N = 471	29.49%
Outside Study?	Yes	N = 35	8.14%	N = 37	7.97%	N = 114	16.24%	N = 186	11.65%
	No	N = 395	91.86%	N = 424	91.38%	N = 580	82.62%	N = 1400	87.66%
Location of Secondary School?	Hong Kong	N = 371	86.28%	N = 395	85.13%	N = 572	81.48%	N = 1339	83.84%
	M. China	N = 56	13.02%	N = 60	12.93%	N = 85	12.11%	N = 201	12.59%
	Other	N = 2	0.47%	N = 6	1.29%	N = 39	5.56%	N = 47	2.94%
Interview?	Yes	N = 39	9.07%	N = 38	8.19%	N = 105	14.96%	N = 182	11.40%
	No	N = 391	90.93%	N = 426	91.81%	N = 597	85.04%	N = 1415	88.60%

Table 9. Study 2: Online Survey Demographics

Question	Response	Frequency	Proportion
Gender	Male	N = 159	54.64%
	Female	N = 132	45.36%
EMI Secondary School?	Yes	N = 248	85.22%
	No	N = 43	14.78%
Outside Study?	Yes	N = 85	29.21%
	No	N = 206	70.79%

Table 10. Study 2: LSD Post-hoc on Active/Reflective Scale between Majors

Active/Reflective		Science	Engineering	Business and Management
Science	Mean Difference		0.436	0.725
	Standard Error		0.160	0.146
	p-value		**0.006**	**0.000**
Engineering	Mean Difference	-0.436		0.289
	Standard Error	0.160		0.143
	p-value	**0.006**		**0.043**
Business and Management	Mean Difference	-0.725	-0.289	
	Standard Error	0.146	0.143	
	p-value	**0.000**	**0.043**	

Table 11. Study 2: Summary of One-way ANOVAs Based on Major

Dimension	Active/ Reflective			Sensing/ Intuitive			Visual/ Verbal			Sequential/ Global		
Response	Sci.	Engr.	B+M	Sci.	Engr.	B+M	Sci.	Engr.	B+M	Sci.	Engr.	B+M
N	430	464	702	430	464	702	430	464	702	430	464	702
Mean	1.302	0.866	0.577	0.009	-0.204	0.039	-2.803	-2.860	-2.719	-0.095	-0.142	-0.072
SD	2.470	2.233	2.434	2.668	2.349	2.707	2.676	2.513	2.675	2.129	2.052	2.385
F-value	12.317			1.325			0.422			0.140		
p-value	**0.000**			0.266			0.656			0.869		

Table 12. Study 2: Preferred Activity Response Rates

	Speaking	Writing	Listening	Reading
Total	46.96%	8.39%	27.30%	15.34%
Sci.	42.33%	11.16%	26.28%	17.91%
Engr.	40.30%	10.34%	29.53%	16.81%
B+M	54.27%	5.41%	26.35%	12.82%
Male	43.65%	9.62%	29.17%	15.97%
Female	52.50%	6.39%	24.18%	14.34%

Table 13. Study 2: LSD Post-hoc on Active/Reflective Scale between Activity Preferences

Active/Reflective		Speaking	Writing	Listening	Reading
Speaking	Mean Difference		-0.709	-0.966	-1.488
	Standard Error		0.220	0.141	0.173
	p-value		**0.001**	**0.000**	**0.000**
Writing	Mean Difference	0.709		-0.257	-0.780
	Standard Error	0.220		0.232	0.252
	p-value	**0.001**		0.268	**0.002**
Listening	Mean Difference	0.966	0.257		-0.523
	Standard Error	0.141	0.232		0.187
	p-value	**0.000**	0.268		**0.005**
Reading	Mean Difference	1.488	0.780	0.523	
	Standard Error	0.173	0.252	0.187	
	p-value	**0.000**	**0.002**	**0.005**	

Table 14. Study 2: LSD Post-hoc on Sequential/Global Scale between Activity Preferences

Sequential/Global		Speaking	Writing	Listening	Reading
Speaking	Mean Difference		0.254	0.302	0.424
	Standard Error		0.209	0.134	0.164
	p-value		0.223	**0.024**	**0.010**
Writing	Mean Difference	-0.254		0.049	0.171
	Standard Error	0.209		0.220	0.239
	p-value	0.233		0.825	0.475
Listening	Mean Difference	-0.302	-0.049		0.122
	Standard Error	0.134	0.220		0.178
	p-value	**0.024**	0.825		0.492
Reading	Mean Difference	-0.424	-0.171	-0.122	
	Standard Error	0.164	0.239	0.178	
	p-value	**0.010**	0.475	0.492	

Table 15. Study 2: Summary of One-way ANOVAs Based on Activity Preference

Dimension	Active/ Reflective				Sensing/ Intuitive			
Response	Speak	Write	Listen	Read	Speak	Write	Listen	Read
N	750	134	436	245	750	134	436	245
Mean	0.291	1.000	1.257	1.780	0.087	0.071	-0.178	-0.257
SD	2.340	2.514	2.349	2.273	2.583	2.391	2.580	2.747
F-value	31.512				1.661			
p-value	**0.000**				0.173			

Dimension	Visual/ Verbal				Sequential/ Global			
Response	Speak	Write	Listen	Read	Speak	Write	Listen	Read
N	750	134	436	245	750	134	436	245
Mean	-2.897	-2.485	-2.838	-2.461	0.067	-0.187	-0.235	-0.357
SD	2.572	2.712	2.663	2.673	2.273	2.001	2.244	2.145
F-value	2.332				3.111			
p-value	0.072				**0.025**			

Table 16. Study 2: Summary of One-way ANOVAs between HKUST and American Students

Dimension	Active/ Reflective		Sensing/ Intuitive		Visual/ Verbal		Sequential/ Global	
Response	USA	HKUST	USA	HKUST	USA	HKUST	USA	HKUST
N	291	464	291	464	291	464	291	464
Mean	-0.311	0.866	-0.565	-0.204	-2.363	-2.860	-1.170	-0.140
SD	2.387	2.233	2.786	2.350	2.936	2.513	2.415	2.052
F-value	47.143		3.665		6.142		39.082	
p-value	**0.000**		0.056		**0.013**		**0.000**	

Table 17. Study 2: Summary of One-way ANOVAs Based on Location of Secondary School

Dimension	Active/ Reflective		Sensing/ Intuitive		Visual/ Verbal		Sequential/ Global	
Response	HK	China	HK	China	HK	China	HK	China
N	1339	201	1339	201	1339	201	1339	201
Mean	0.934	0.719	-0.112	0.296	-2.769	-2.791	-0.190	0.647
SD	2.369	2.560	2.564	2.697	2.612	2.698	2.170	2.348
F-value	1.414		4.365		0.012		25.399	
p-value	0.235		**0.037**		0.912		**0.000**	

Table 18. Study 2: Summary of One-way ANOVAs Based on EMI Secondary School Response

Dimension	Active/ Reflective		Sensing/ Intuitive		Visual/ Verbal		Sequential/ Global	
Response	Yes	No	Yes	No	Yes	No	Yes	No
N	1120	471	1120	471	1120	471	1120	471
Mean	0.778	1.041	-0.042	-0.015	-2.778	-2.794	-0.198	0.155
SD	2.390	2.438	2.597	2.607	2.619	2.656	2.242	2.154
F-value	3.989		0.036		0.012		8.401	
p-value	**0.046**		0.849		0.912		**0.004**	

Table 19. Study 2: Summary of One-way ANOVAs Based on Outside Study Response

Dimension	Active/ Reflective		Sensing/ Intuitive		Visual/ Verbal		Sequential/ Global	
Response	Yes	No	Yes	No	Yes	No	Yes	No
N	186	1400	186	1400	186	1400	186	1400
Mean	0.196	0.952	0.148	-0.061	-2.863	-2.776	-0.078	-0.105
SD	2.449	2.390	2.651	2.596	2.826	2.596	2.285	2.216
F-value	16.318		1.061		0.180		0.025	
p-value	**0.000**		0.303		0.672		0.875	

Table 20. Study 2: of One-way ANOVAs Based on Gender

Dimension	Active/ Reflective		Sensing/ Intuitive		Visual/ Verbal		Sequential/ Global	
Response	Male	Female	Male	Female	Male	Female	Male	Female
N	1008	579	1008	579	1008	579	1008	579
Mean	1.127	0.383	0.199	-0.461	-2.858	-2.641	0.017	-0.293
SD	2.454	2.241	2.636	2.489	2.638	2.612	2.217	2.217
F-value	35.991		24.049		2.516		7.172	
p-value	**0.000**		**0.000**		0.113		**0.007**	

Table 21. Study 2: Correlations

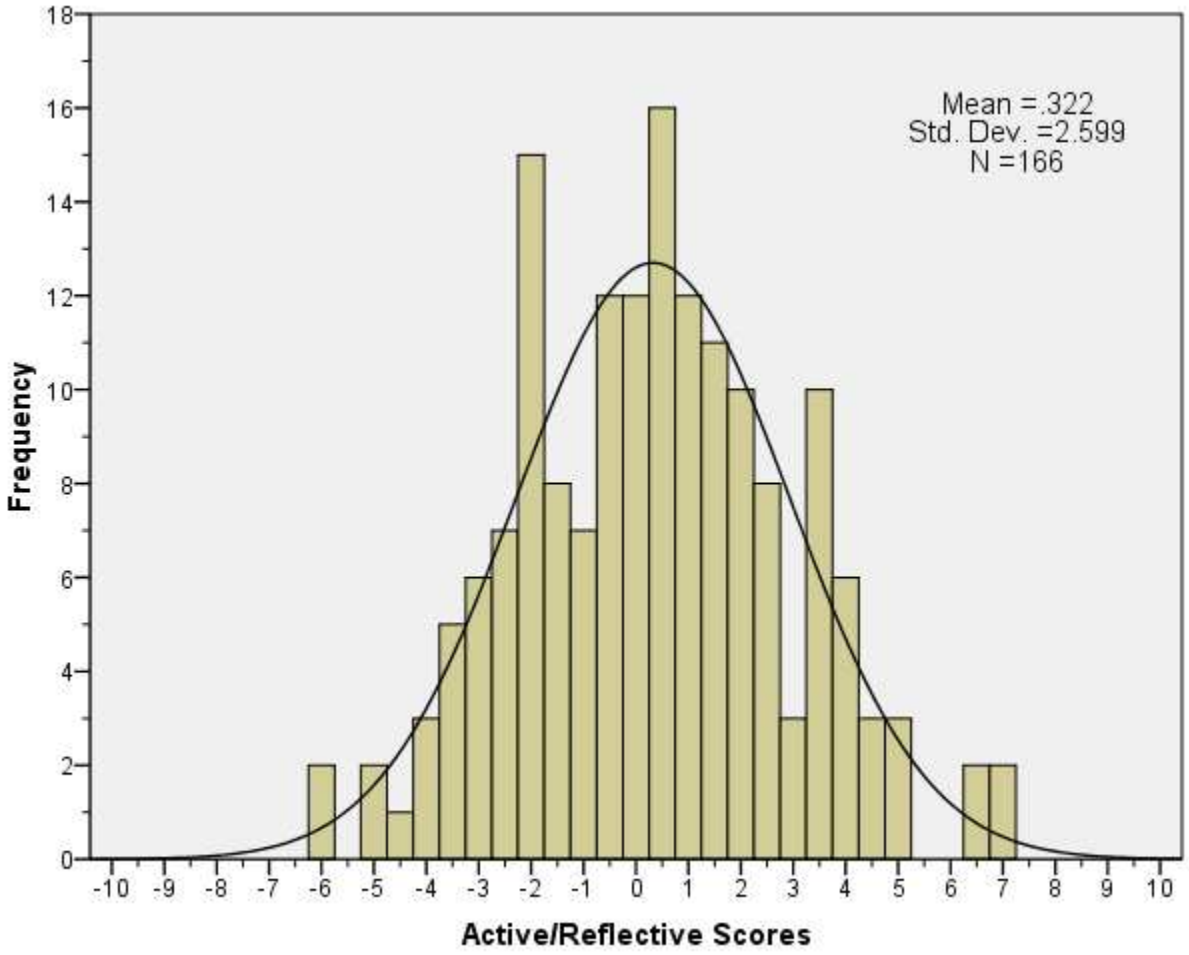
		Active/ Reflective	Sensing/ Intuitive	Visual/ Verbal	Sequential/ Global
Active/Reflective	Pearson Correlation		-0.003	**0.126**	**-0.070**
	Sig. (2-tailed)		0.902	**0.000**	**0.005**
	N		1597	1597	1597
Sensing/Intuitive	Pearson Correlation	-0.003		**-0.064**	**0.297**
	Sig. (2-tailed)	0.902		**0.011**	**0.000**
	N	1597		1597	1597
Visual/Verbal	Pearson Correlation	**0.126**	**-0.064**		**-0.068**
	Sig. (2-tailed)	**0.000**	**0.011**		**0.007**
	N	1597	1597		1597
Sequential/Global	Pearson Correlation	**-0.070**	**0.297**	**-0.068**	
	Sig. (2-tailed)	**0.005**	**0.000**	**0.007**	
	N	1597	1597	1597	

Table 22. Studies 1 and 2: Summary of One-way ANOVAs based on Focus Group Volunteers

	Dimension	Active/ Reflective		Sensing/ Intuitive		Visual/ Verbal		Sequential/ Global	
Study 1	Response	Yes	No	Yes	No	Yes	No	Yes	No
	N	21	144	21	144	21	144	21	144
	Mean	0.667	0.243	-0.619	-0.309	-2.500	-3.767	-0.595	0.247
	SD	1.866	2.676	2.641	2.303	2.308	2.152	2.206	2.076
	F-value	0.490		0.320		6.244		2.965	
	p-value	0.485		0.573		**0.013**		0.087	
Study 2	Response	Yes	No	Yes	No	Yes	No	Yes	No
	N	182	1415	182	1415	182	1415	182	1415
	Mean	0.319	0.928	0.547	-0.116	-2.665	-2.796	0.541	-0.181
	SD	2.589	2.372	2.712	2.573	2.605	2.632	2.650	2.149
	F-value	10.421		10.551		0.402		17.198	
	p-value	**0.001**		**0.001**		0.526		**0.000**	

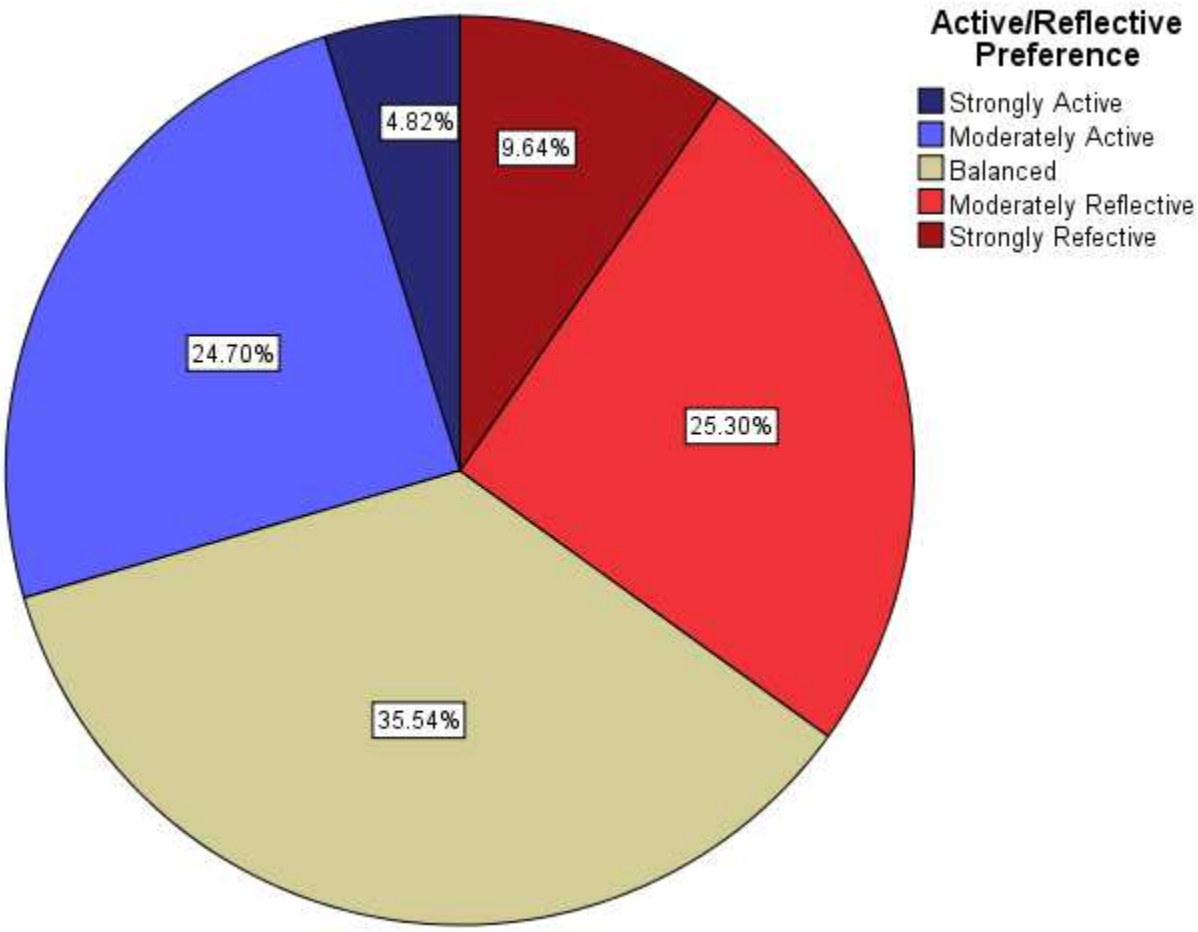
Figures

Figure 1. Study 1: Active/Reflective Histogram



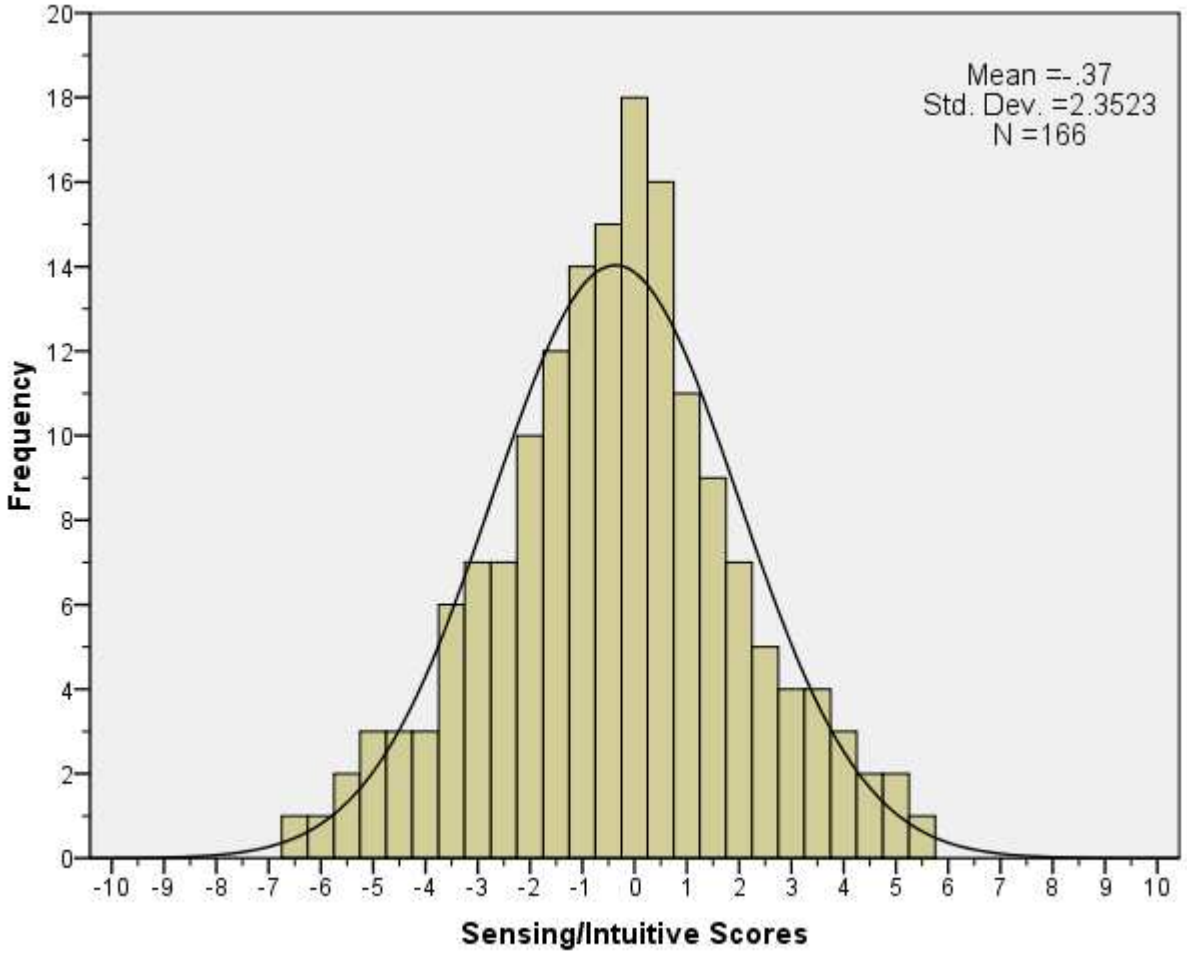
Distribution of scores on the active/reflective dimension among all students in Study 1.

Figure 2. Study 1: Active/Reflective Pie Chart



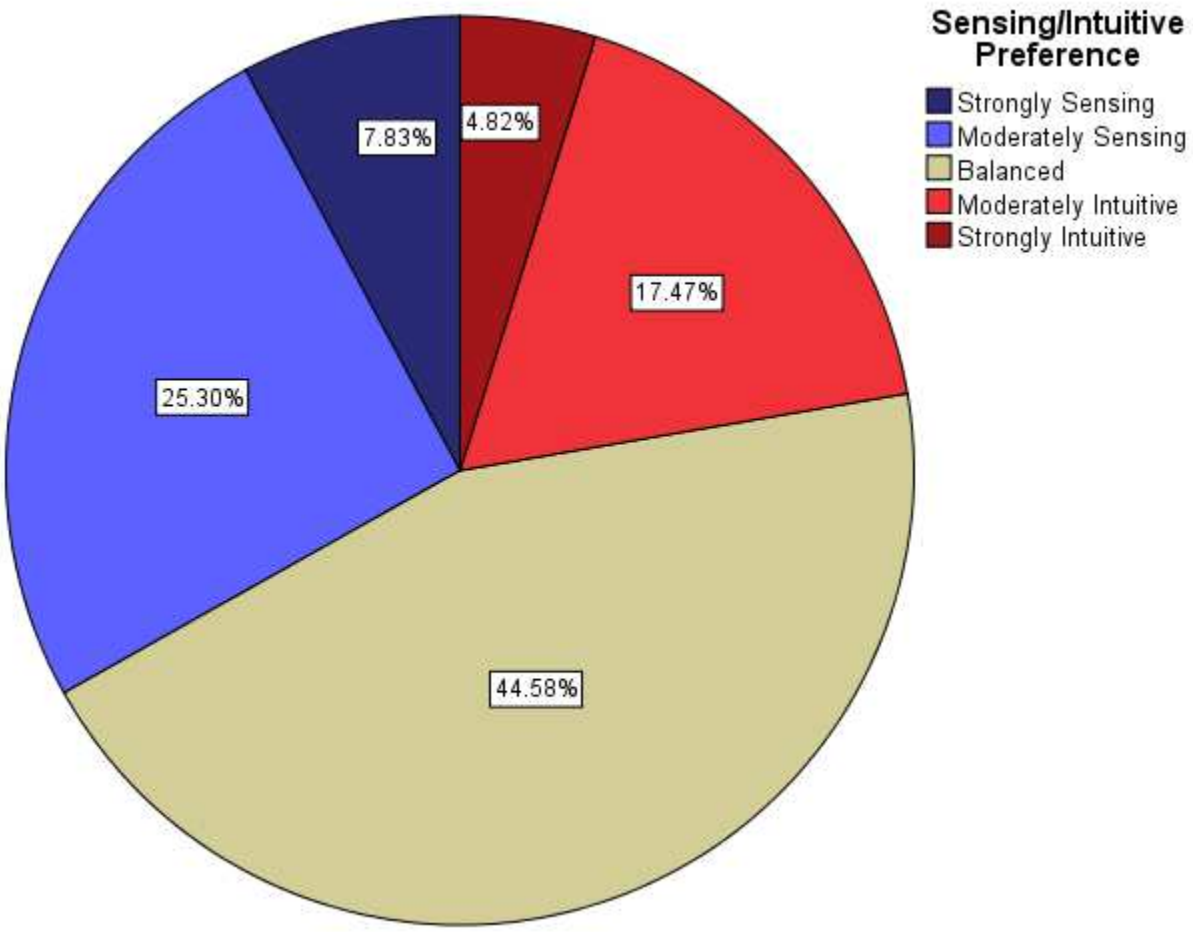
Proportion of scores in each classification on the active/reflective dimension in Study 1. Scores from -10 to -4 are strongly active; scores from -3.5 to -1.5 are moderately active; scores from -1 to 1 are balanced; scores from 1.5 to 3.5 are moderately reflective; scores from 4 to 10 are strongly reflective.

Figure 3. Study 1: Sensing/Intuitive Histogram



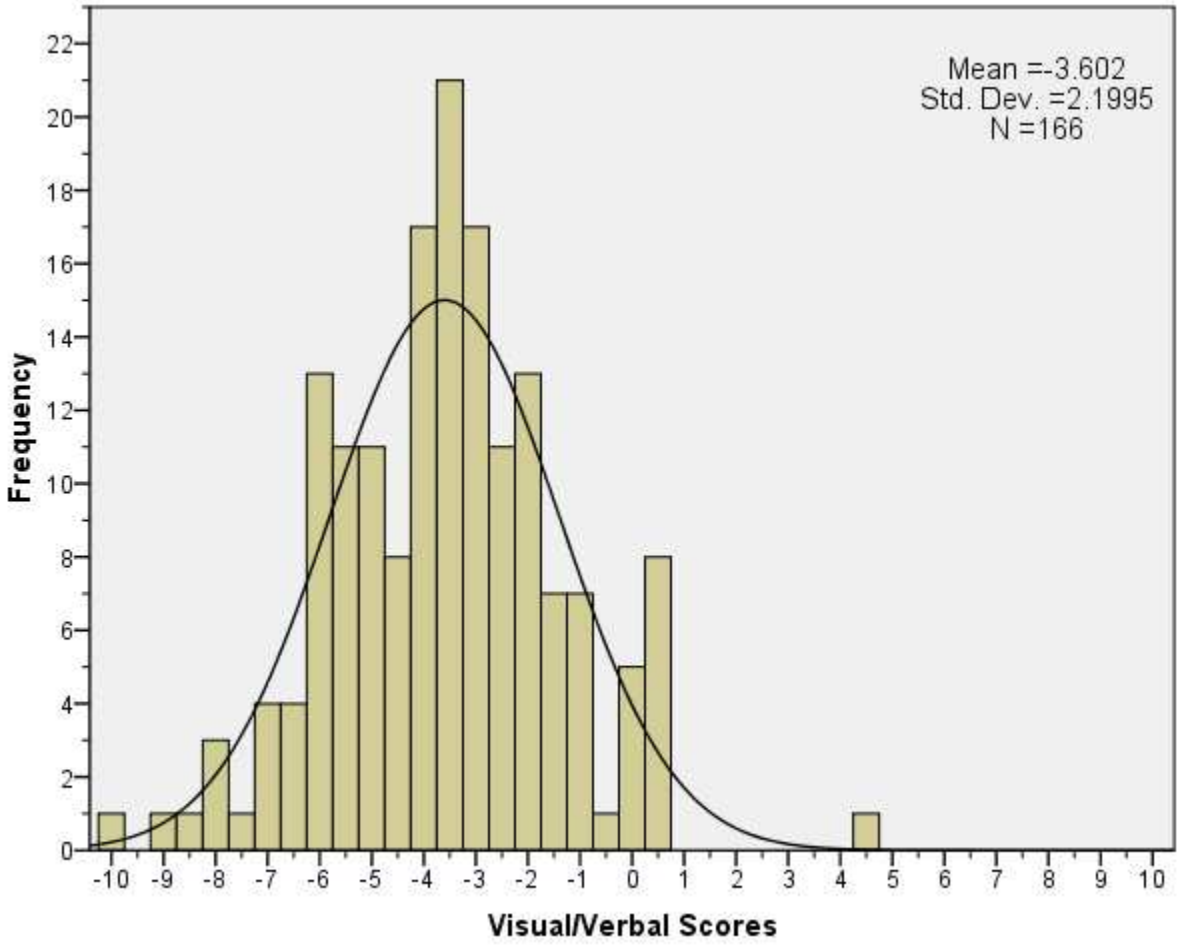
Distribution of scores on the sensing/intuitive dimension among all students in Study 1.

Figure 4. Study 1: Sensing/Intuitive Pie Chart



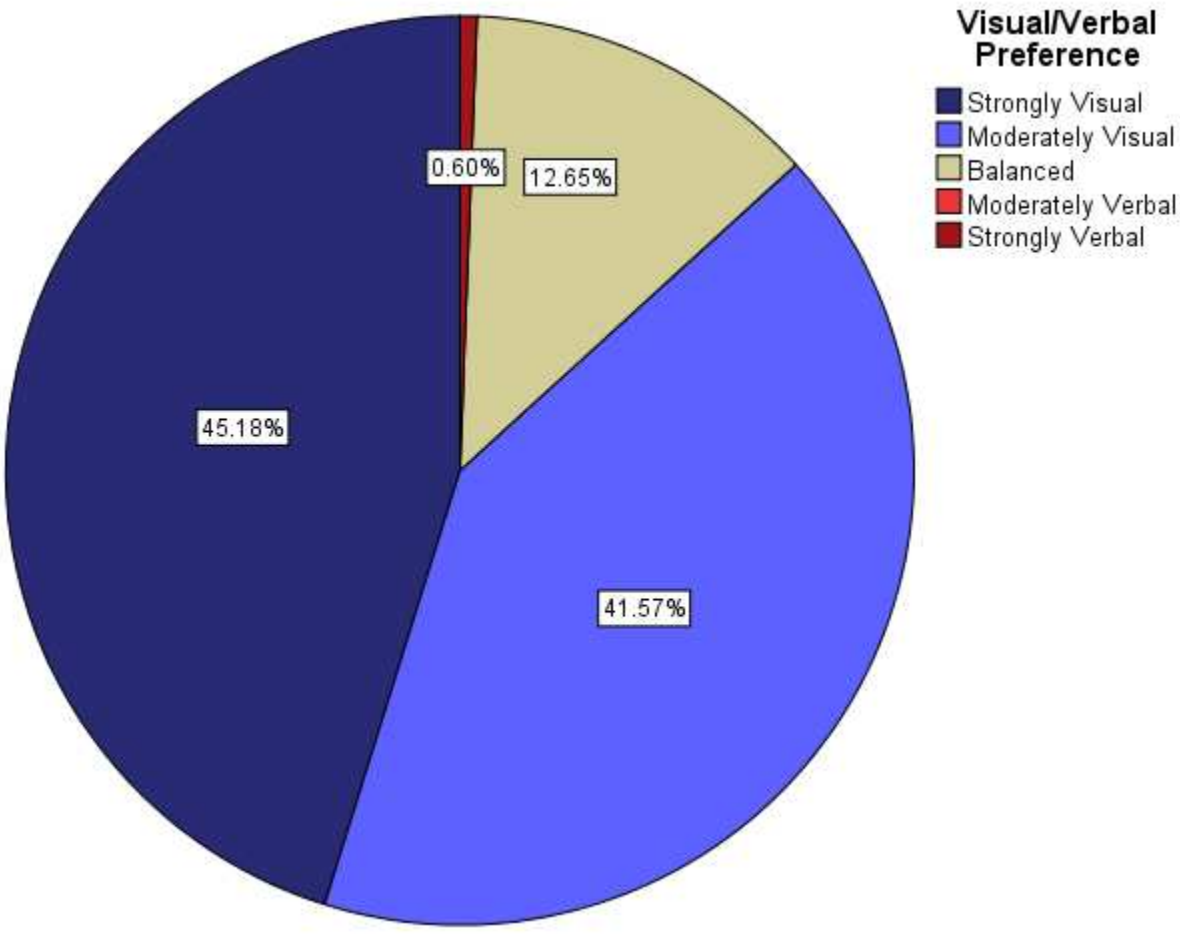
Proportion of scores in each classification on the sensing/intuitive dimension in Study 1. Scores from -10 to -4 are strongly sensing; scores from -3.5 to -1.5 are moderately sensing; scores from -1 to 1 are balanced; scores from 1.5 to 3.5 are moderately intuitive; scores from 4 to 10 are strongly intuitive.

Figure 5. Study 1: Visual/Verbal Histogram



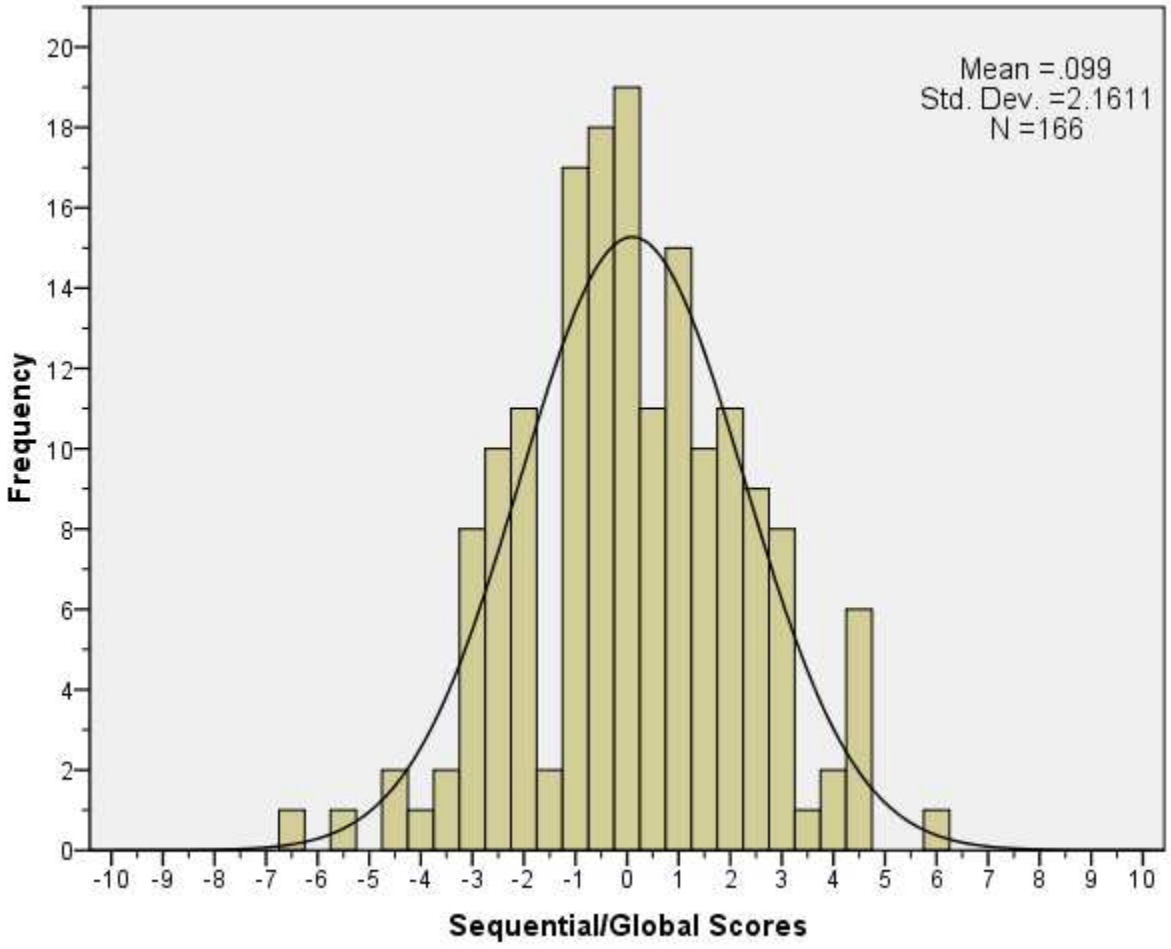
Distribution of scores on the visual/verbal dimension among all students in Study 1.

Figure 6. Study 1: Visual/Verbal Pie Chart



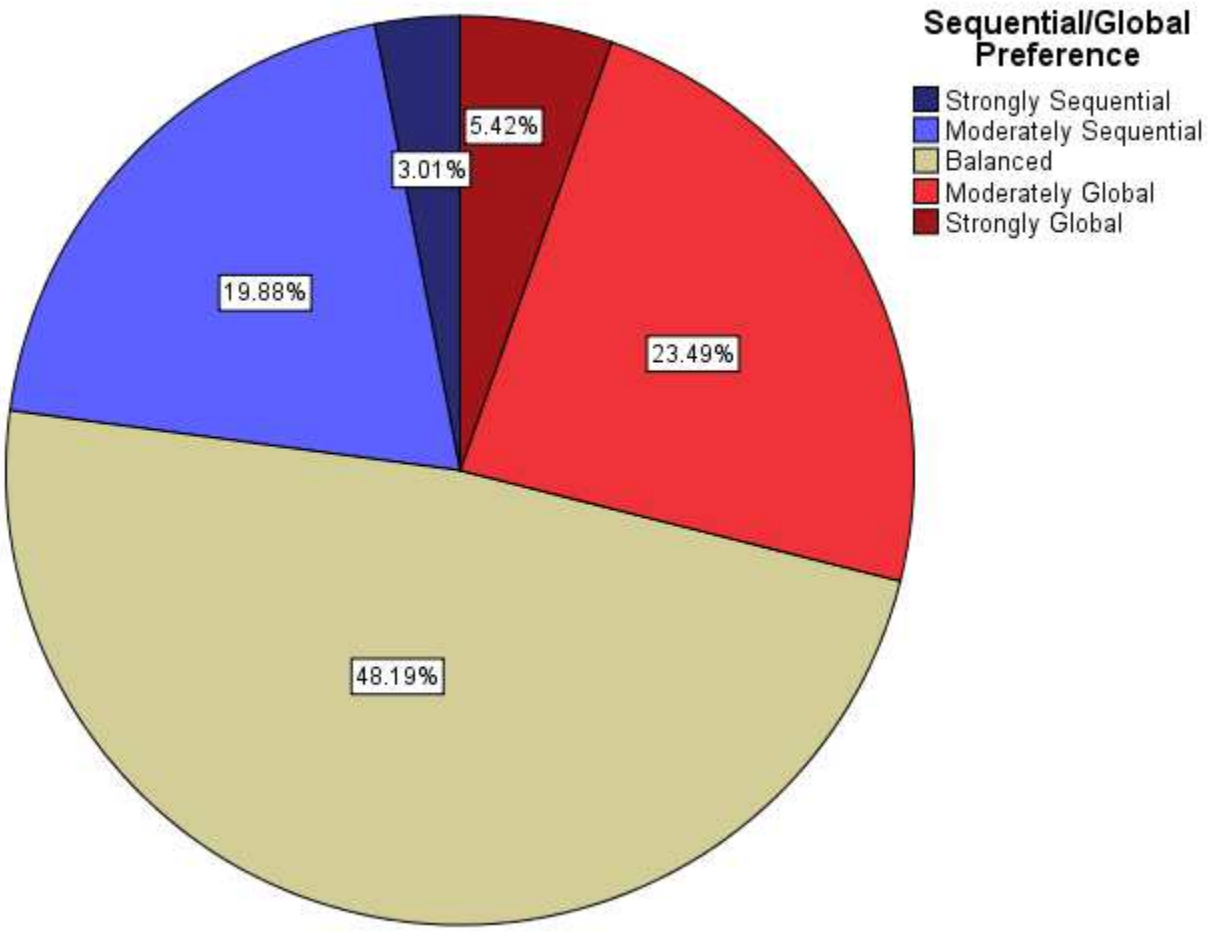
Proportion of scores in each classification on the visual/verbal dimension in Study 1. Scores from -10 to -4 are strongly visual; scores from -3.5 to -1.5 are moderately visual; scores from -1 to 1 are balanced; scores from 1.5 to 3.5 are moderately verbal; scores from 4 to 10 are strongly verbal.

Figure 7. Study 1: Sequential/Global Histogram



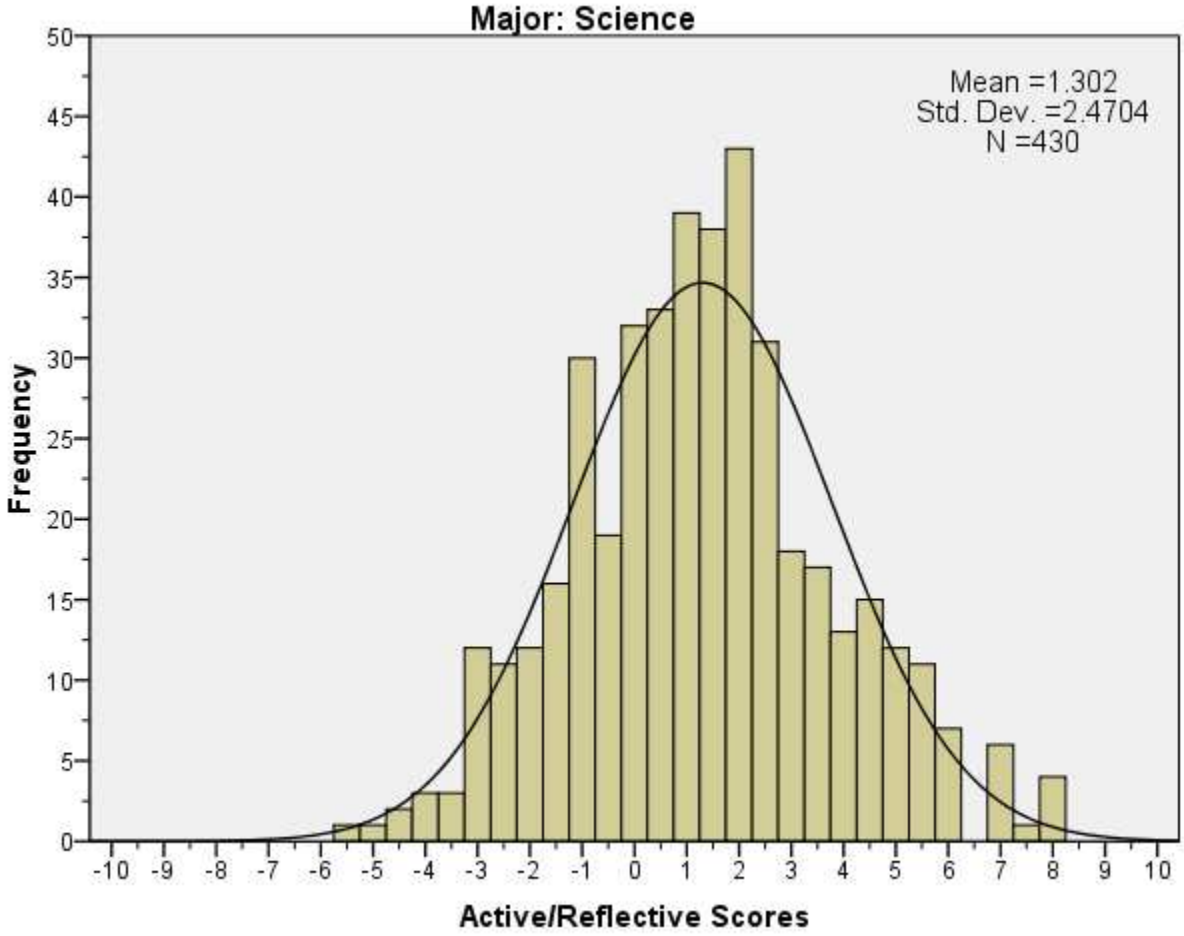
Distribution of scores on the sequential/global dimension among all students in Study 1.

Figure 8. Study 1: Sequential/Global Histogram



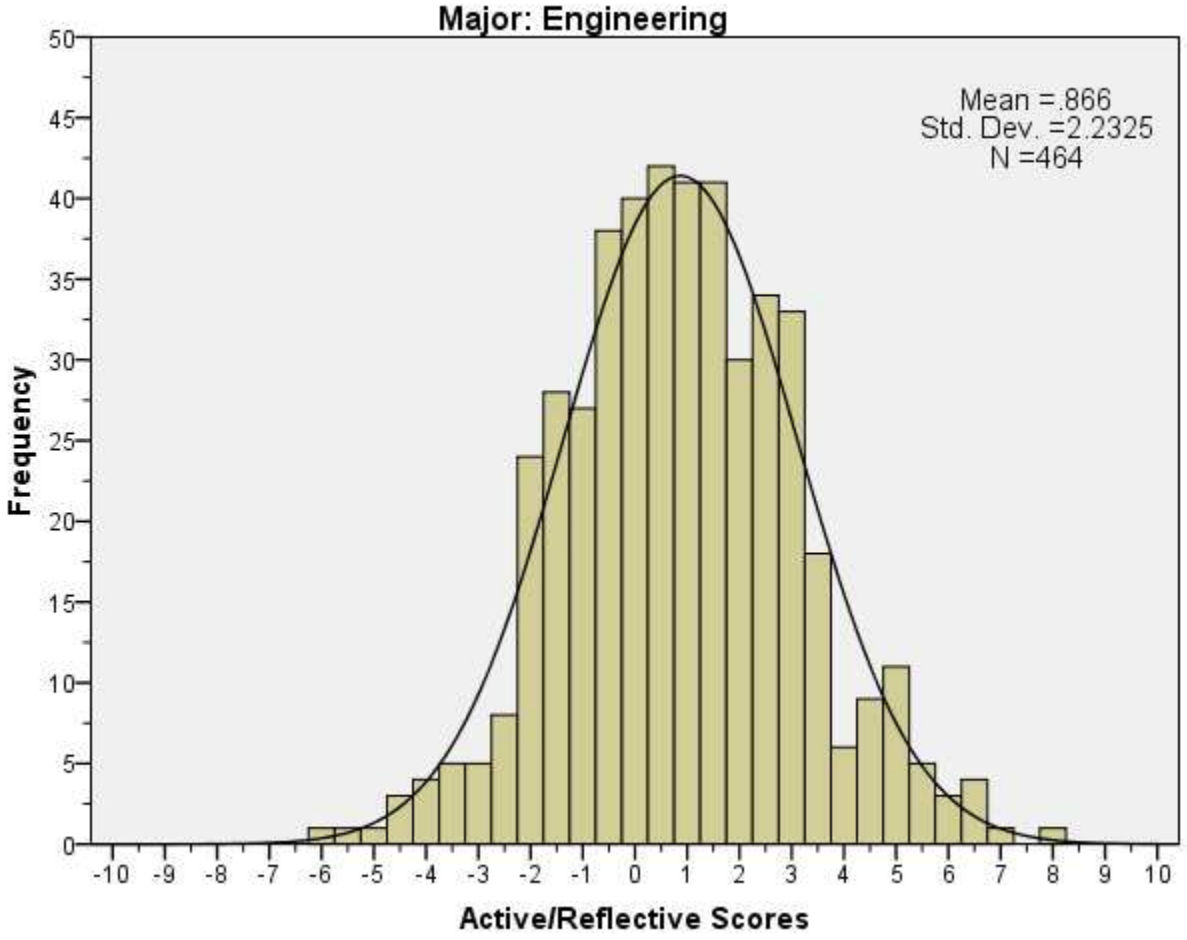
Proportion of scores in each classification on the sequential/global dimension in Study 1. Scores from -10 to -4 are strongly sequential; scores from -3.5 to -1.5 are moderately sequential; scores from -1 to 1 are balanced; scores from 1.5 to 3.5 are moderately global; scores from 4 to 10 are strongly global.

Figure 9. Study 2: Active/Reflective Histogram, Science Students



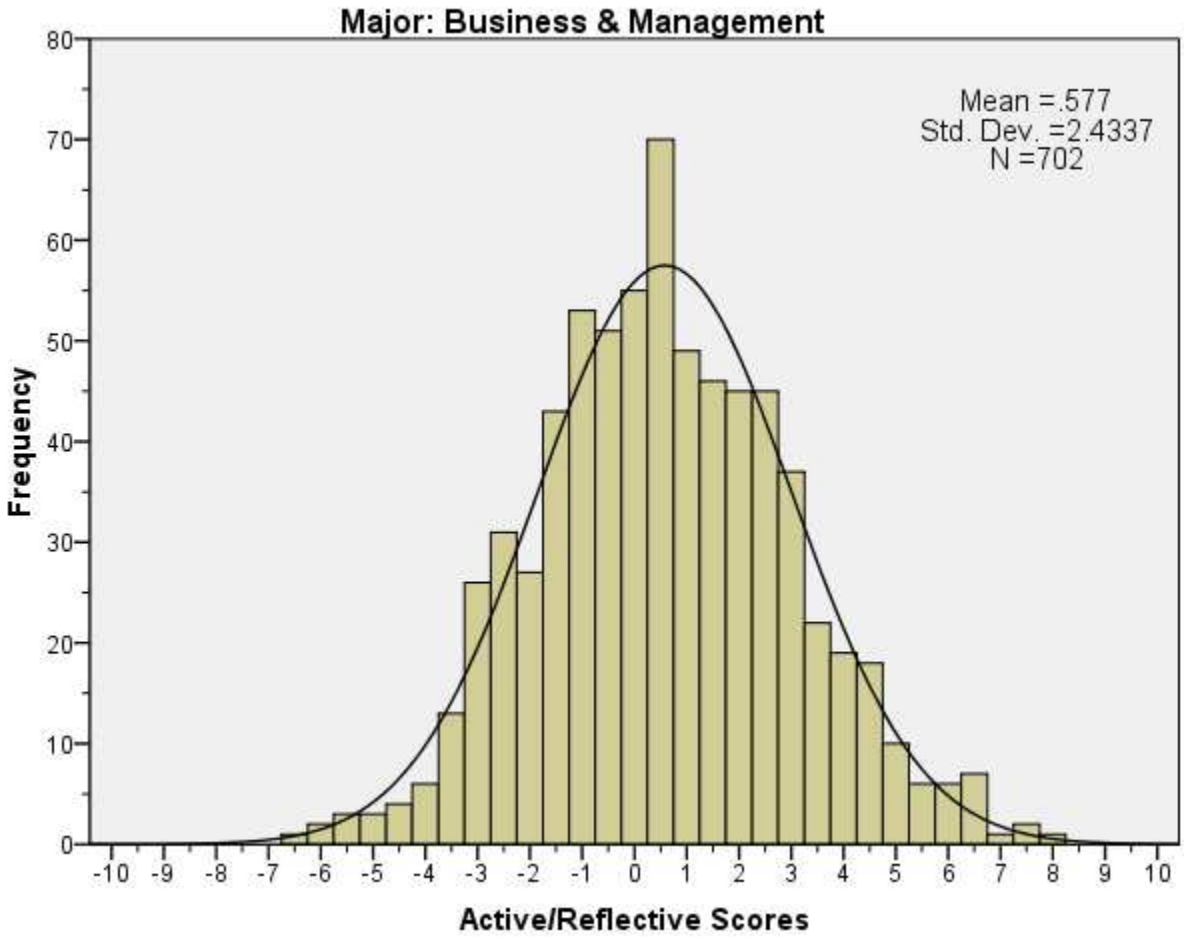
Distribution of scores on the active/reflective dimension among Science students in Study 2.

Figure 10. Study 2: Active/Reflective Histogram, Engineering Students



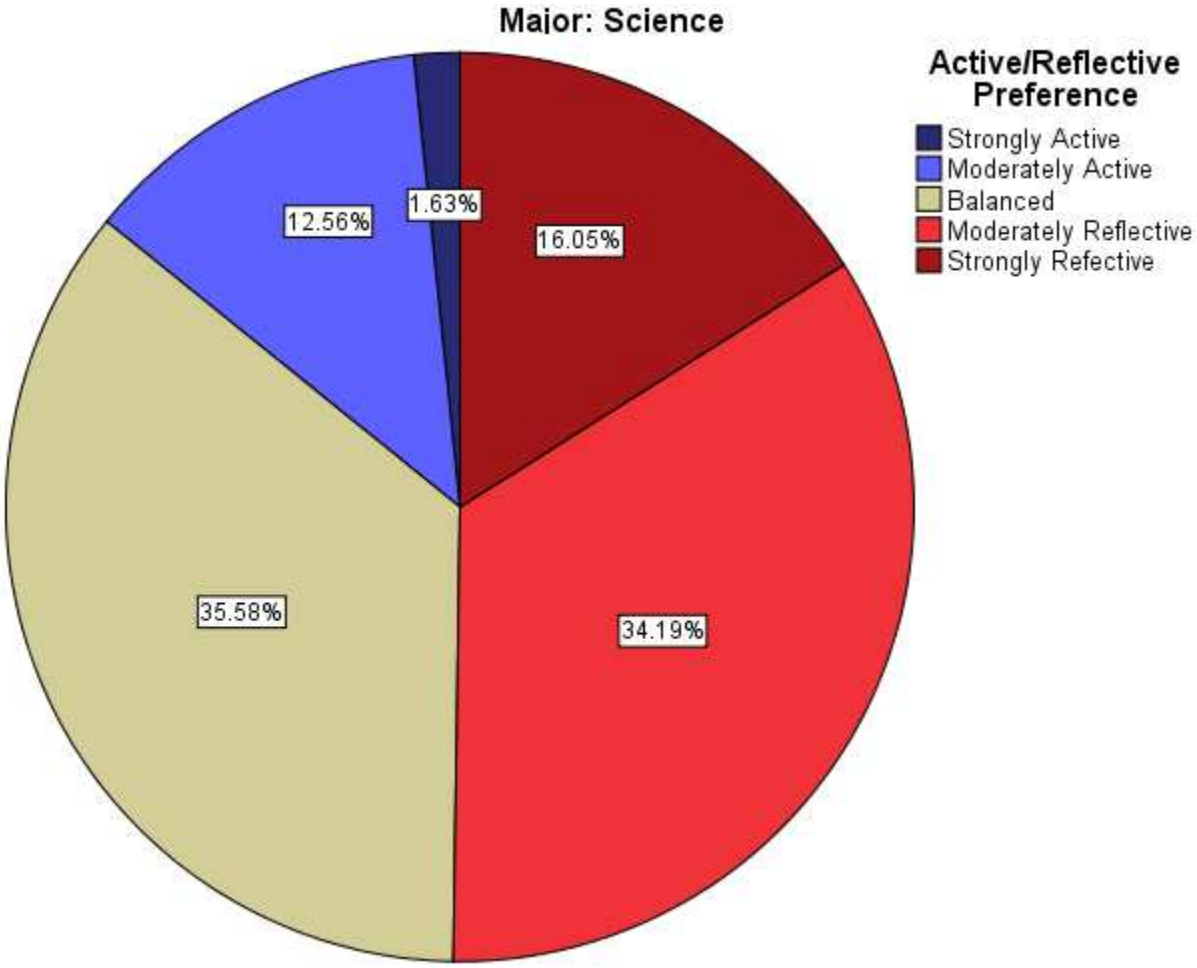
Distribution of scores on the active/reflective dimension among Engineering students in Study 2.

Figure 11. Study 2: Active/Reflective Histogram, Business and Management Students



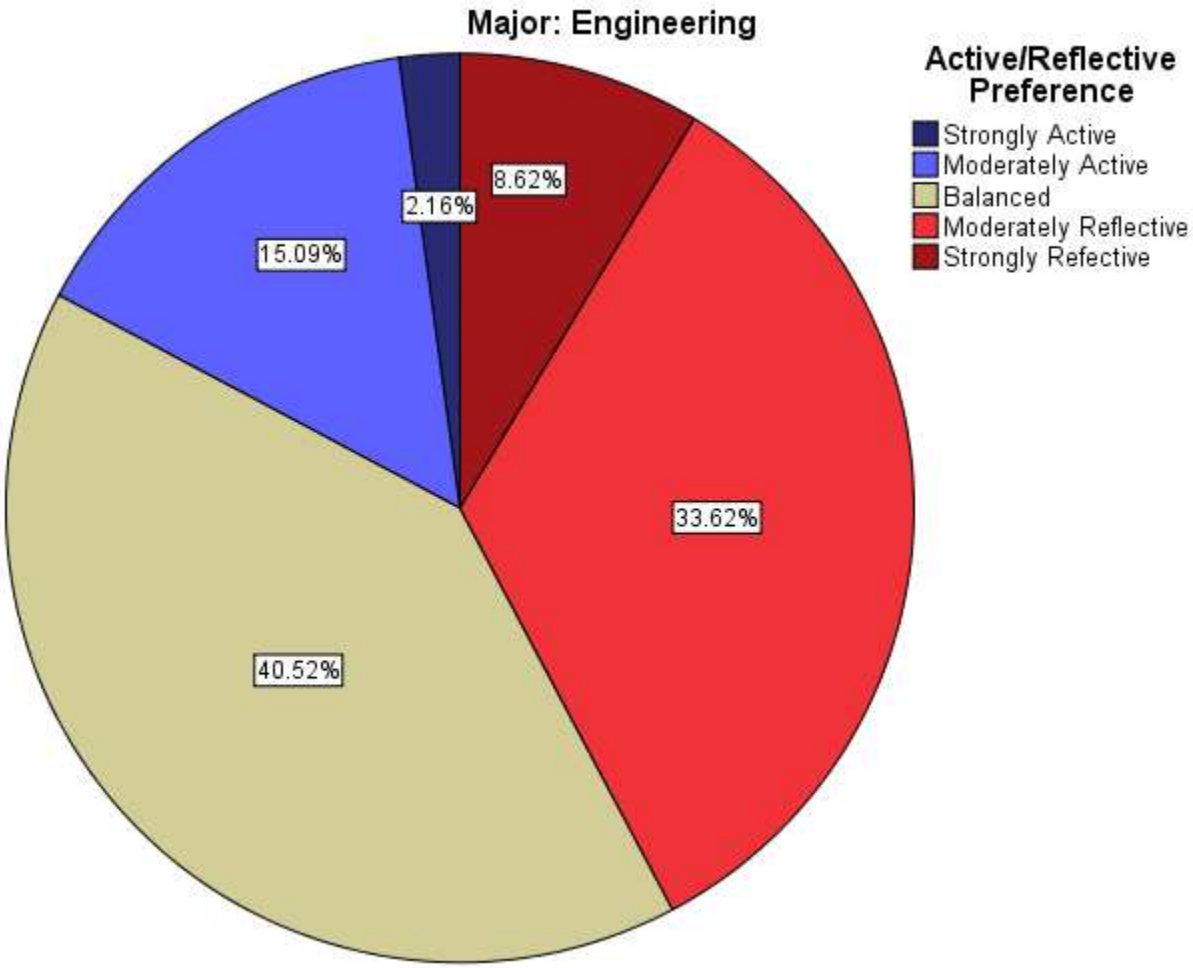
Distribution of scores on the active/reflective dimension among Business and Management students in Study 2.

Figure 12. Study 2: Active/Reflective Pie Chart, Science Students



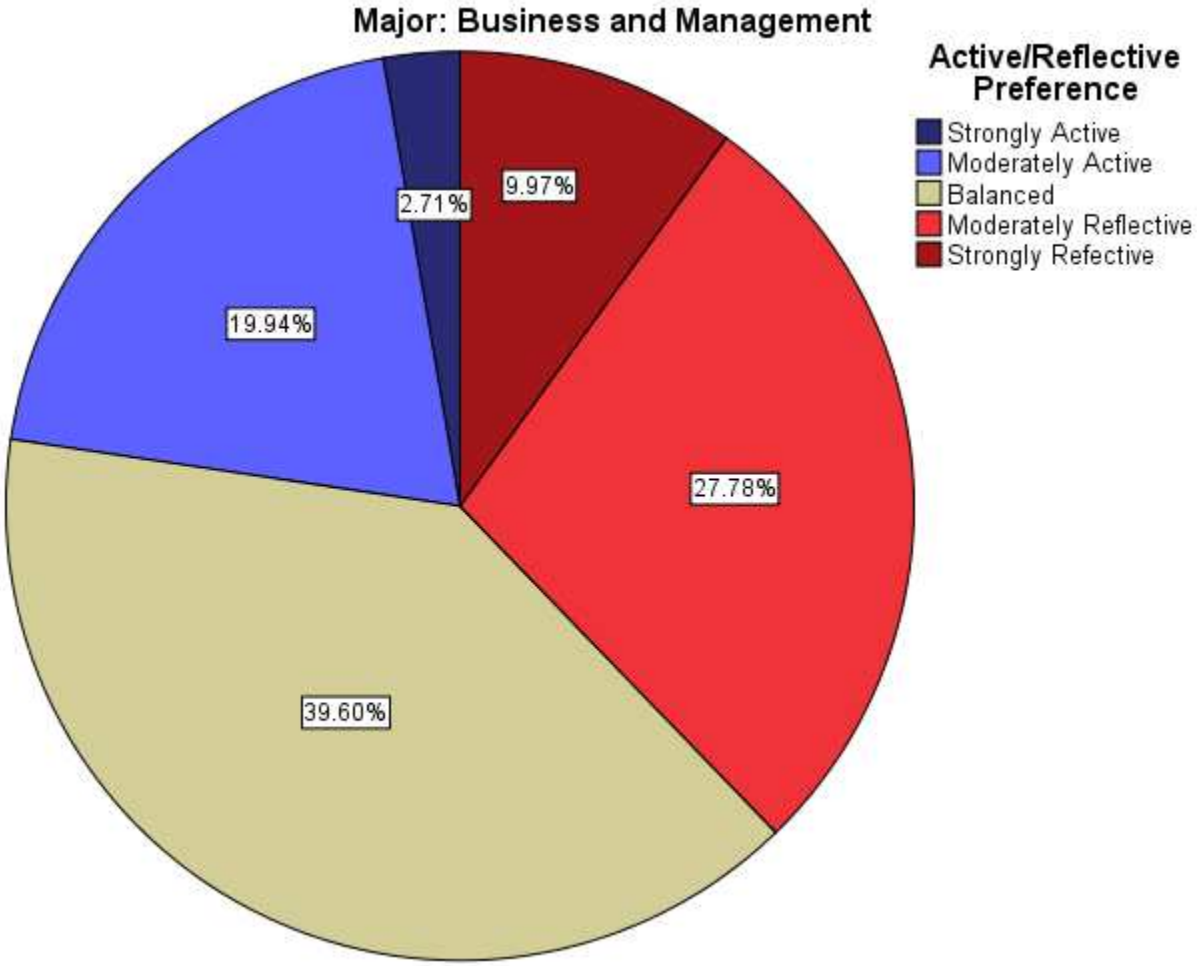
Proportion of scores in each classification on the active/reflective dimension for Science students in Study 2. Scores from -10 to -4 are strongly active; scores from -3.5 to -1.5 are moderately active; scores from -1 to 1 are balanced; scores from 1.5 to 3.5 are moderately reflective; scores from 4 to 10 are strongly reflective.

Figure 13. Study 2: Active/Reflective Pie Chart, Engineering Students



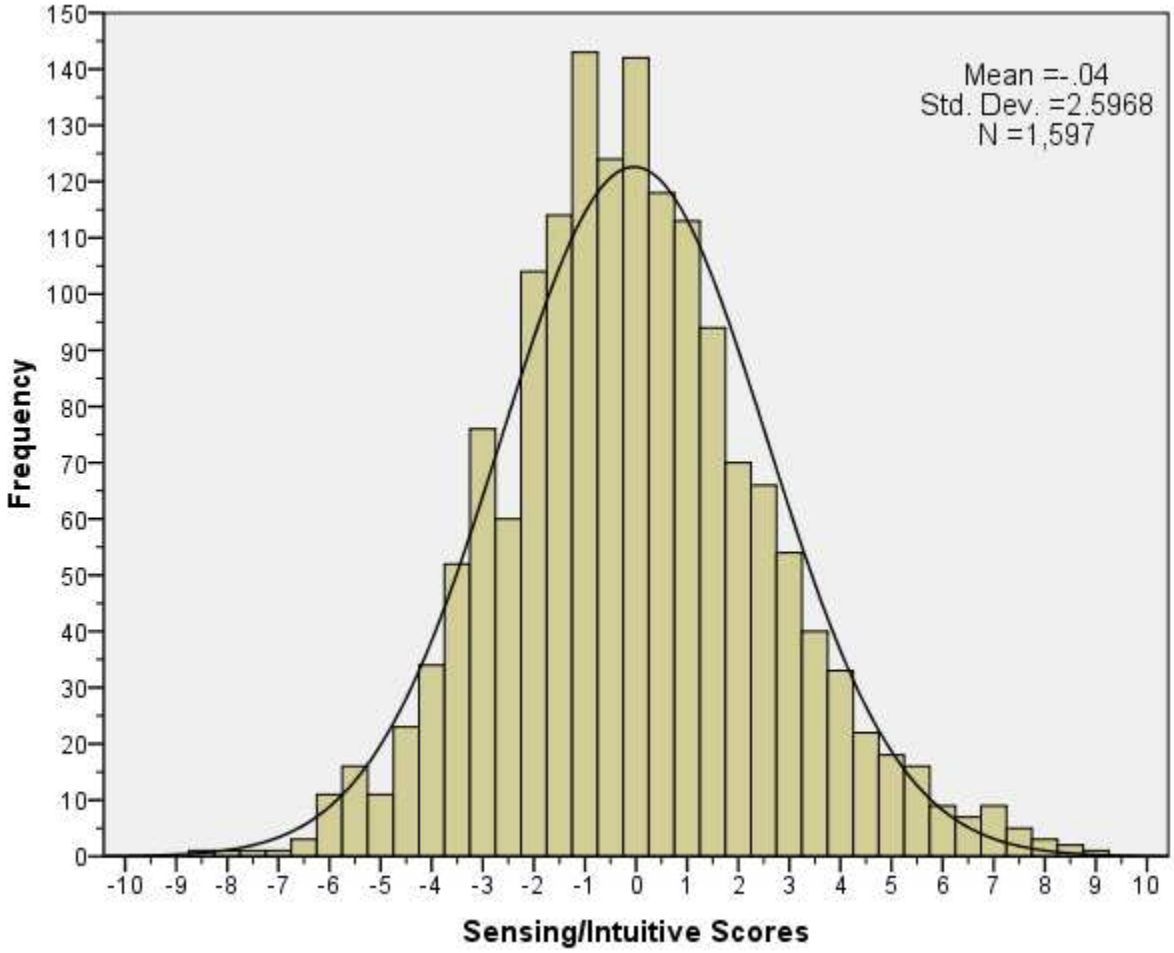
Proportion of scores in each classification on the active/reflective dimension for Engineering students in Study 2. Scores from -10 to -4 are strongly active; scores from -3.5 to -1.5 are moderately active; scores from -1 to 1 are balanced; scores from 1.5 to 3.5 are moderately reflective; scores from 4 to 10 are strongly reflective.

Figure 14. Study 2: Active/Reflective Pie Chart, Business and Management



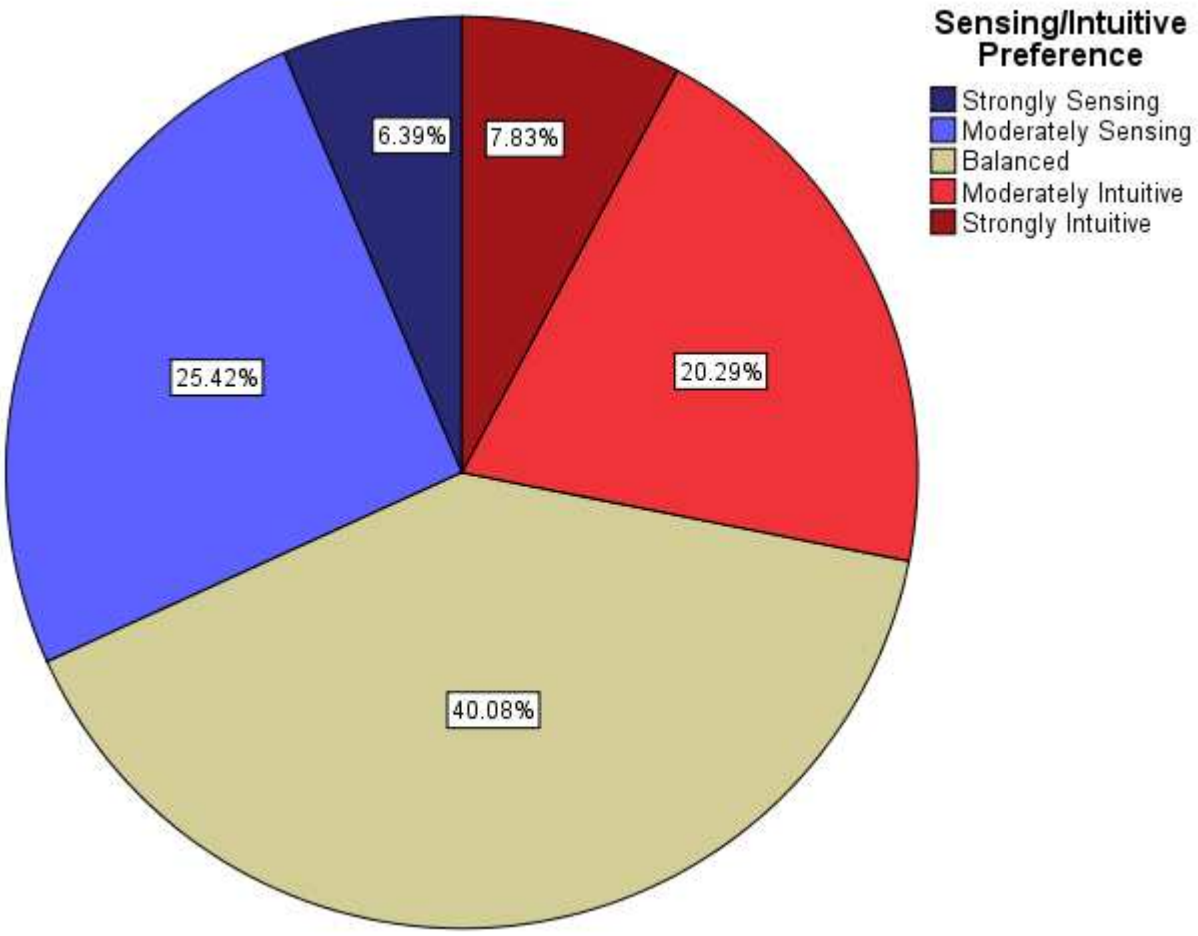
Proportion of scores in each classification on the active/reflective dimension for Business and Management students in Study 2. Scores from -10 to -4 are strongly active; scores from -3.5 to -1.5 are moderately active; scores from -1 to 1 are balanced; scores from 1.5 to 3.5 are moderately reflective; scores from 4 to 10 are strongly reflective.

Figure 15. Study 2: Sensing/Intuitive Histogram, All Majors



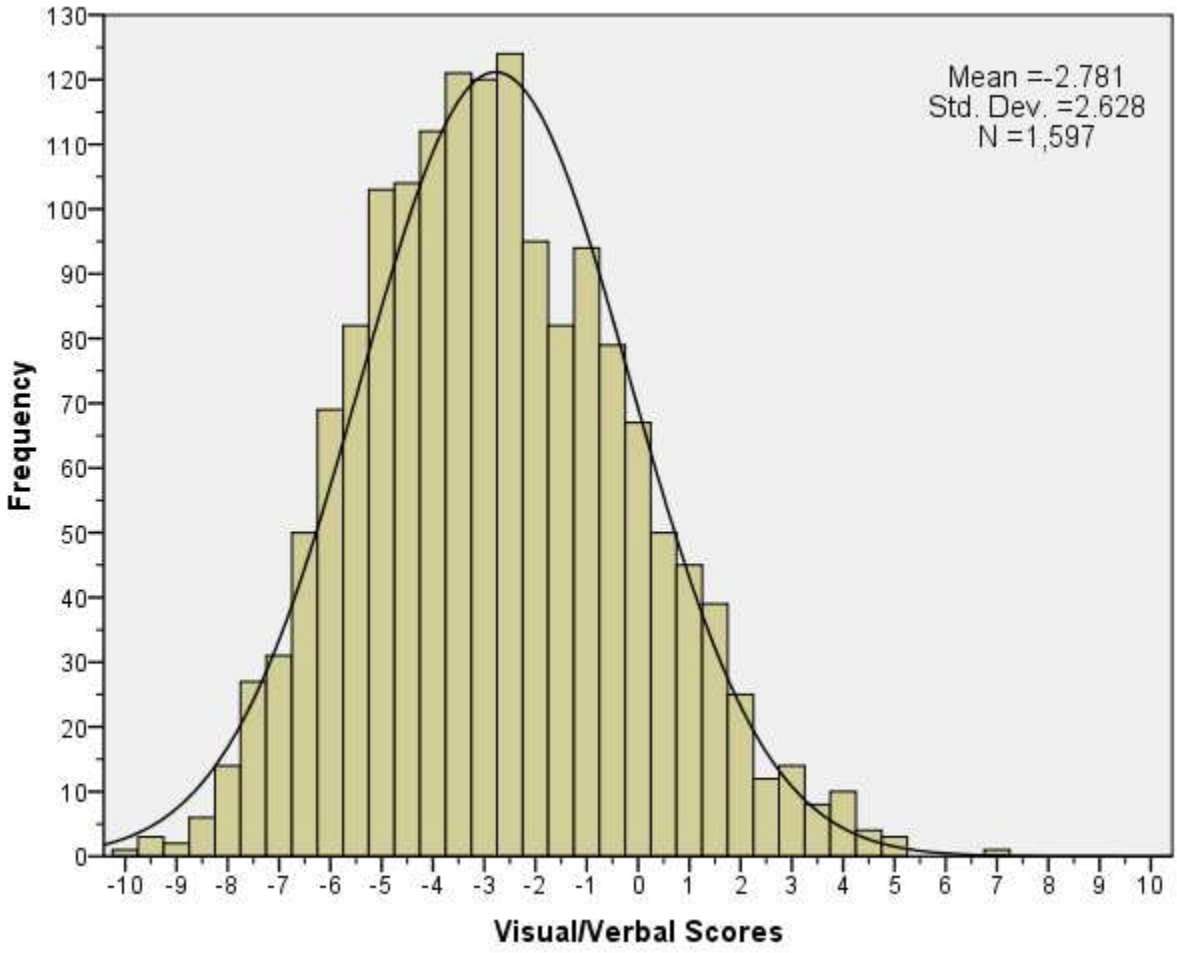
Distribution of scores on the sensing/intuitive dimension among all students in Study 2. No distinction was made between majors since there were no significant differences on this dimension

Figure 16. Study 2: Sensing/Intuitive Pie Chart, All Majors



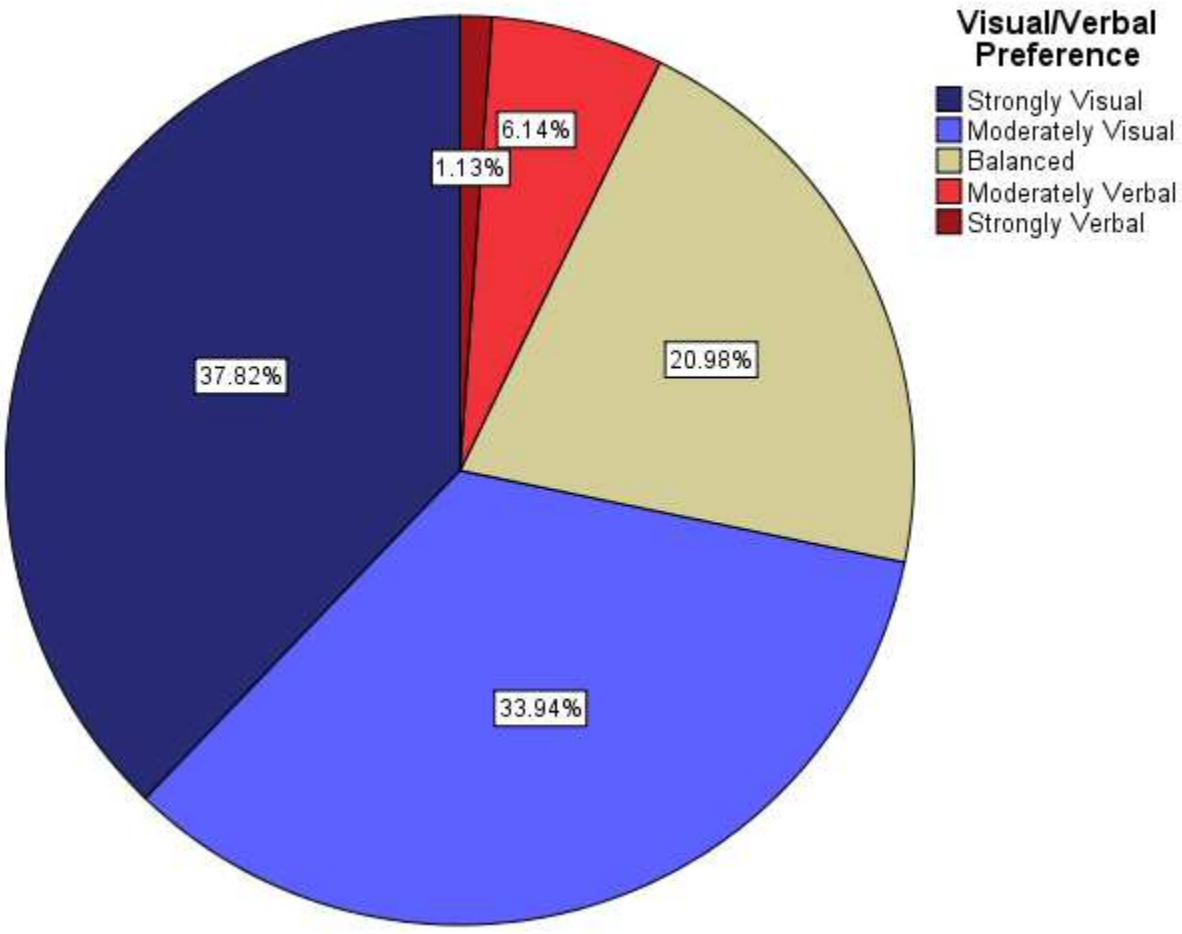
Proportion of scores in each classification on the sensing/intuitive dimension for all majors in Study 2. No distinction was made between majors since there were no significant differences on this dimension. Scores from -10 to -4 are strongly sensing; scores from -3.5 to -1.5 are moderately sensing; scores from -1 to 1 are balanced; scores from 1.5 to 3.5 are moderately intuitive; scores from 4 to 10 are strongly intuitive.

Figure 17. Study 2: Visual/Verbal Histogram, All Majors



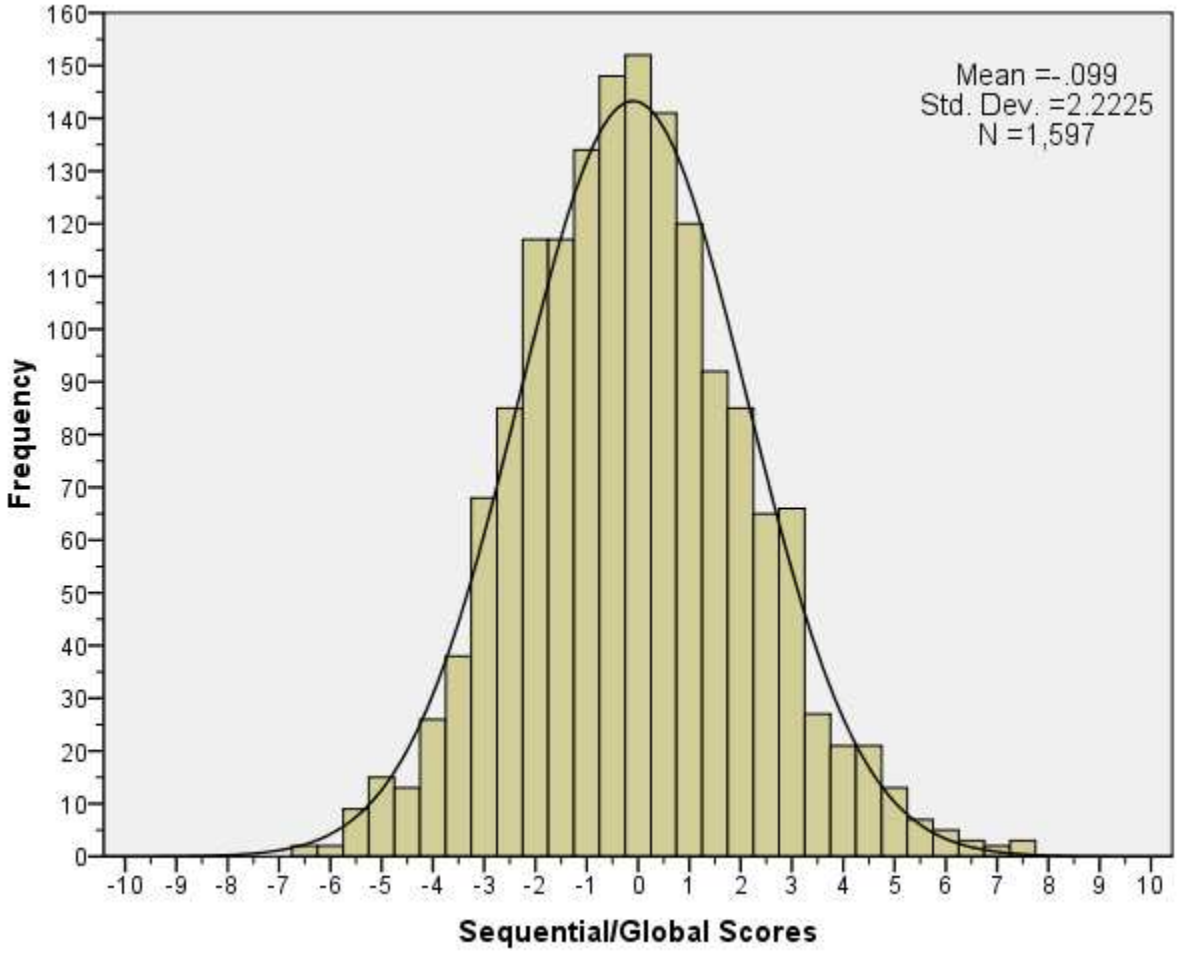
Distribution of scores on the visual/verbal dimension among all students in Study 2. No distinction was made between majors since there were no significant differences on this dimension

Figure 18. Study 2: Visual/Verbal Pie Chart, All Majors



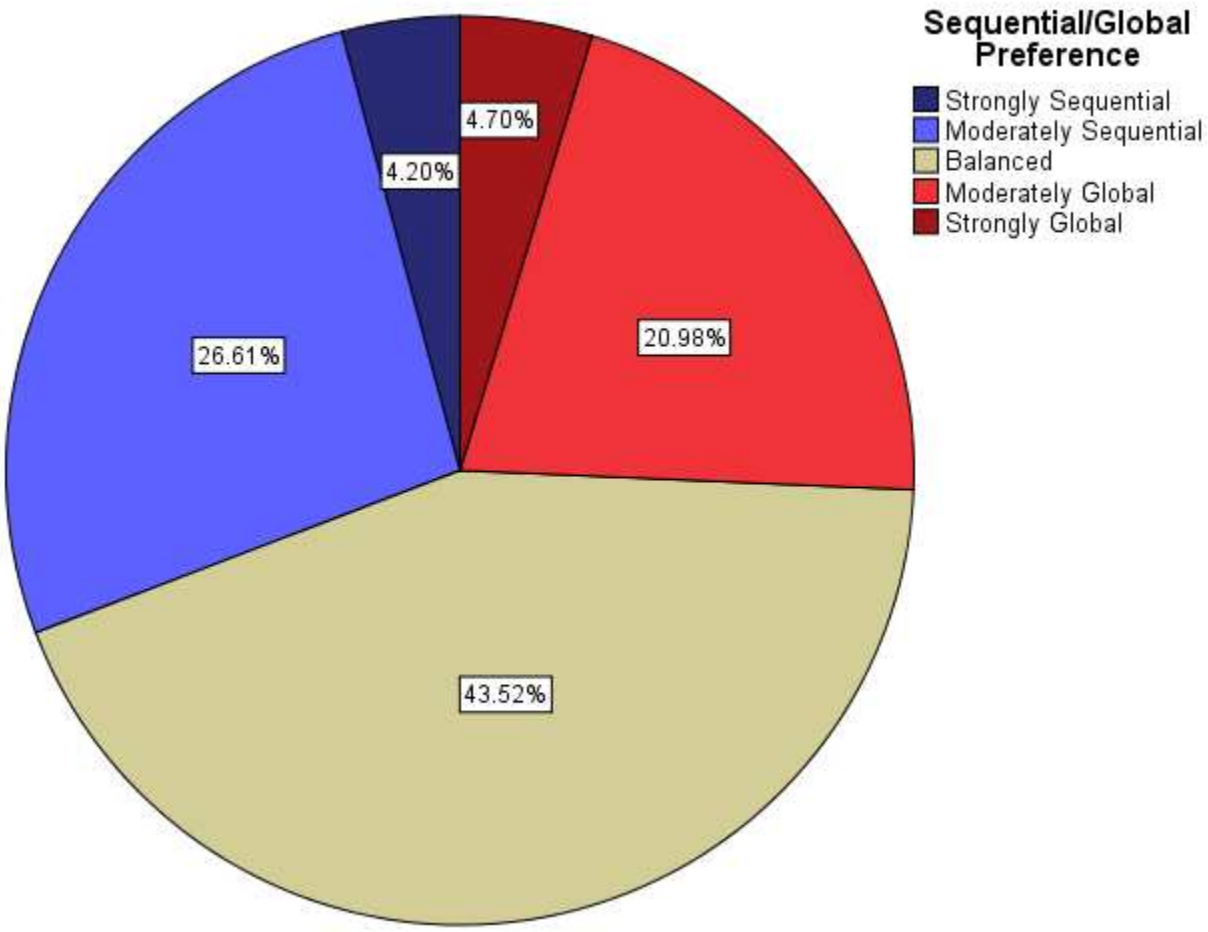
Proportion of scores in each classification on the visual/verbal dimension for all majors in Study 2. No distinction was made between majors since there were no significant differences on this dimension. Scores from -10 to -4 are strongly visual; scores from -3.5 to -1.5 are moderately visual; scores from -1 to 1 are balanced; scores from 1.5 to 3.5 are moderately verbal; scores from 4 to 10 are strongly verbal.

Figure 19. Study 2: Sequential/Global Histogram, All Majors



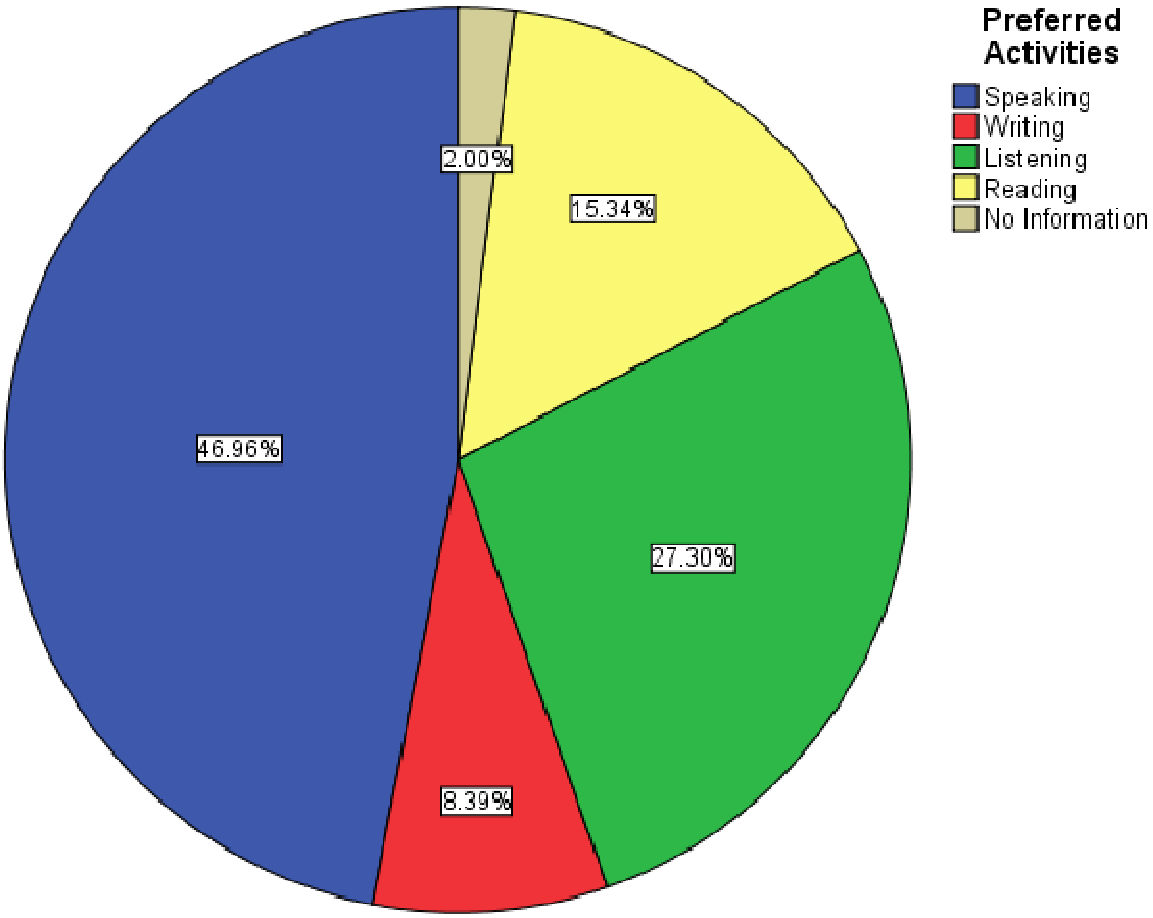
Distribution of scores on the sequential/global dimension among all students in Study 2. No distinction was made between majors since there were no significant differences on this dimension

Figure 20. Study 2: Sequential/Global Pie Chart, All Majors



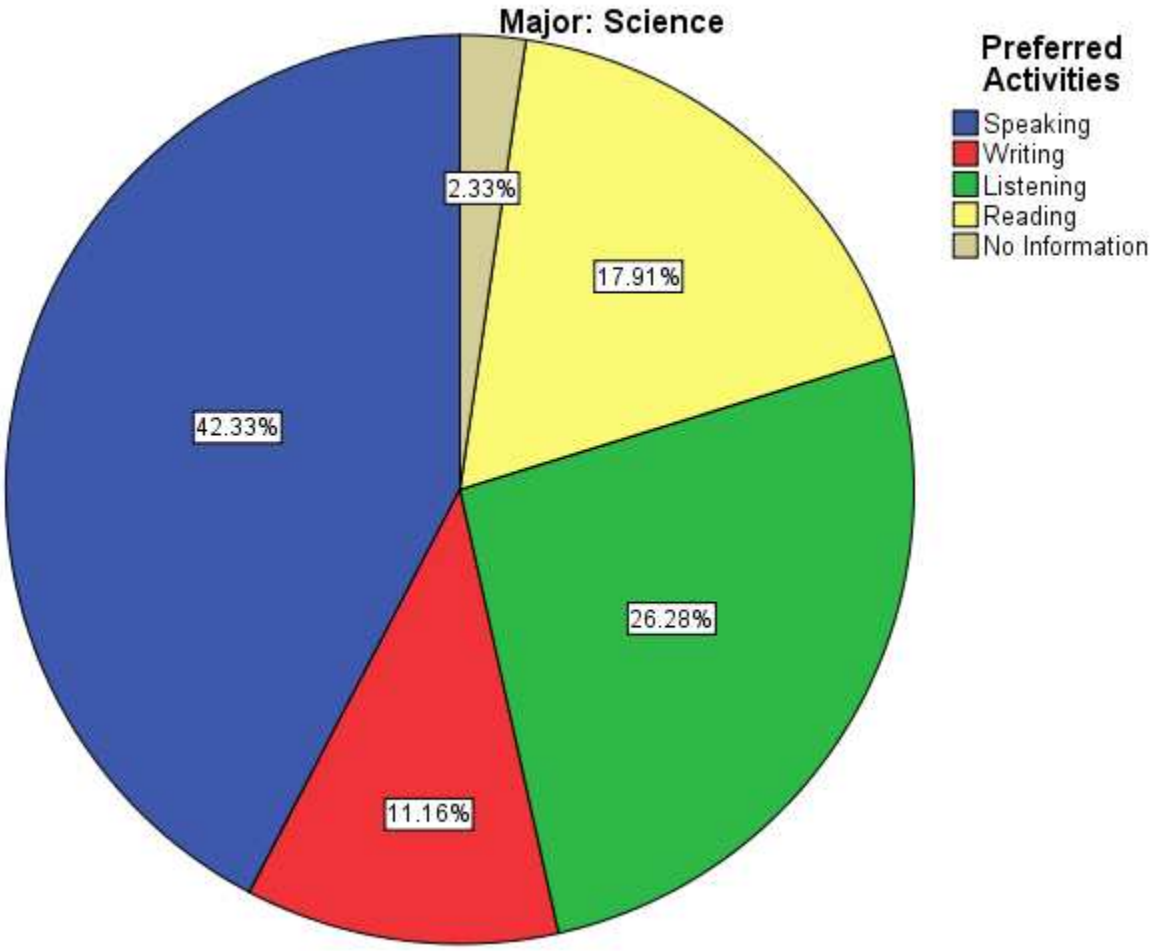
Proportion of scores in each classification on the sequential/global dimension for all majors in Study 2. No distinction was made between majors since there were no significant differences on this dimension. Scores from -10 to -4 are strongly sequential; scores from -3.5 to -1.5 are moderately sequential; scores from -1 to 1 are balanced; scores from 1.5 to 3.5 are moderately global; scores from 4 to 10 are strongly global.

Figure 21. Study 2: Preferred Activities, Entire Sample



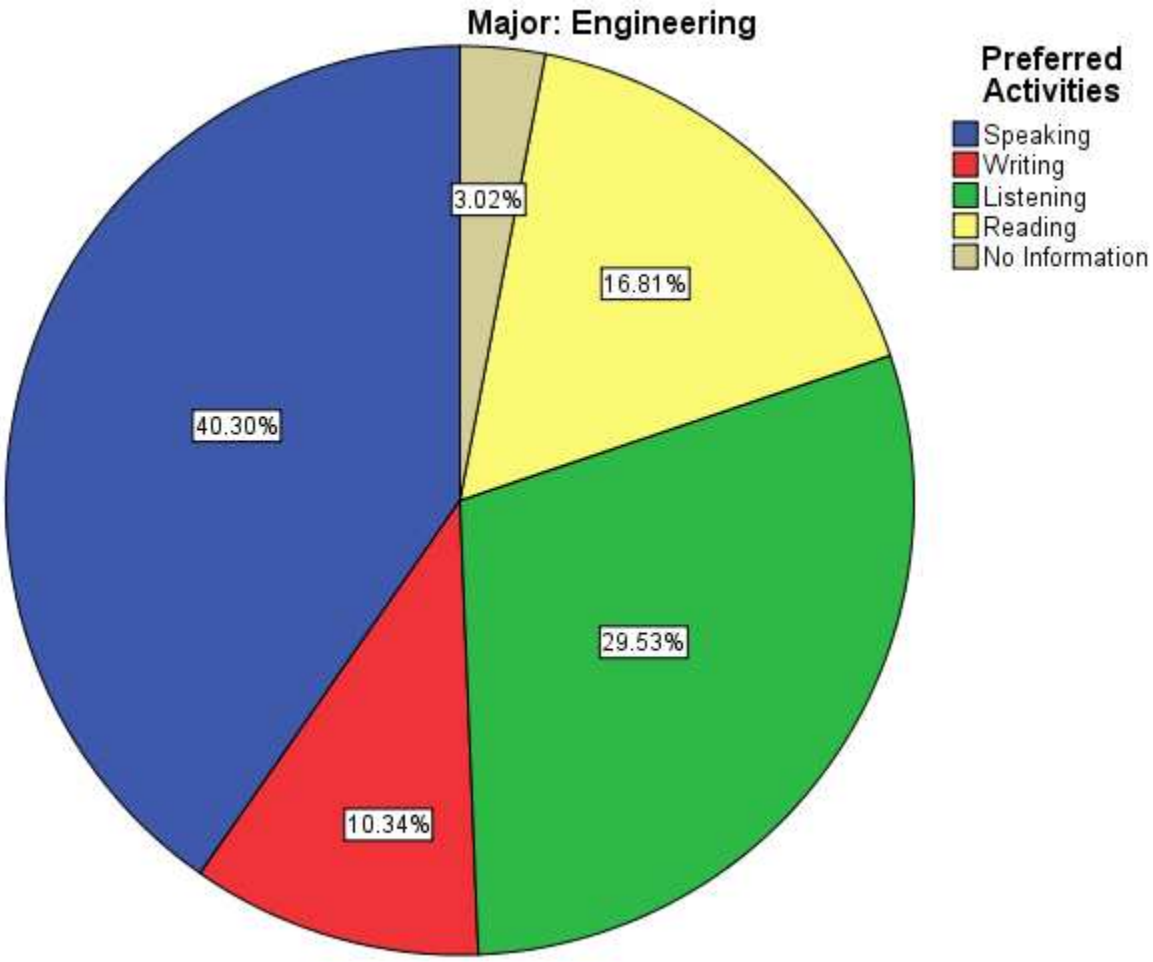
Proportion of survey participants preferring each activity in Study 2. Includes all majors and genders.

Figure 22. Study 2: Preferred Activities, Science Students



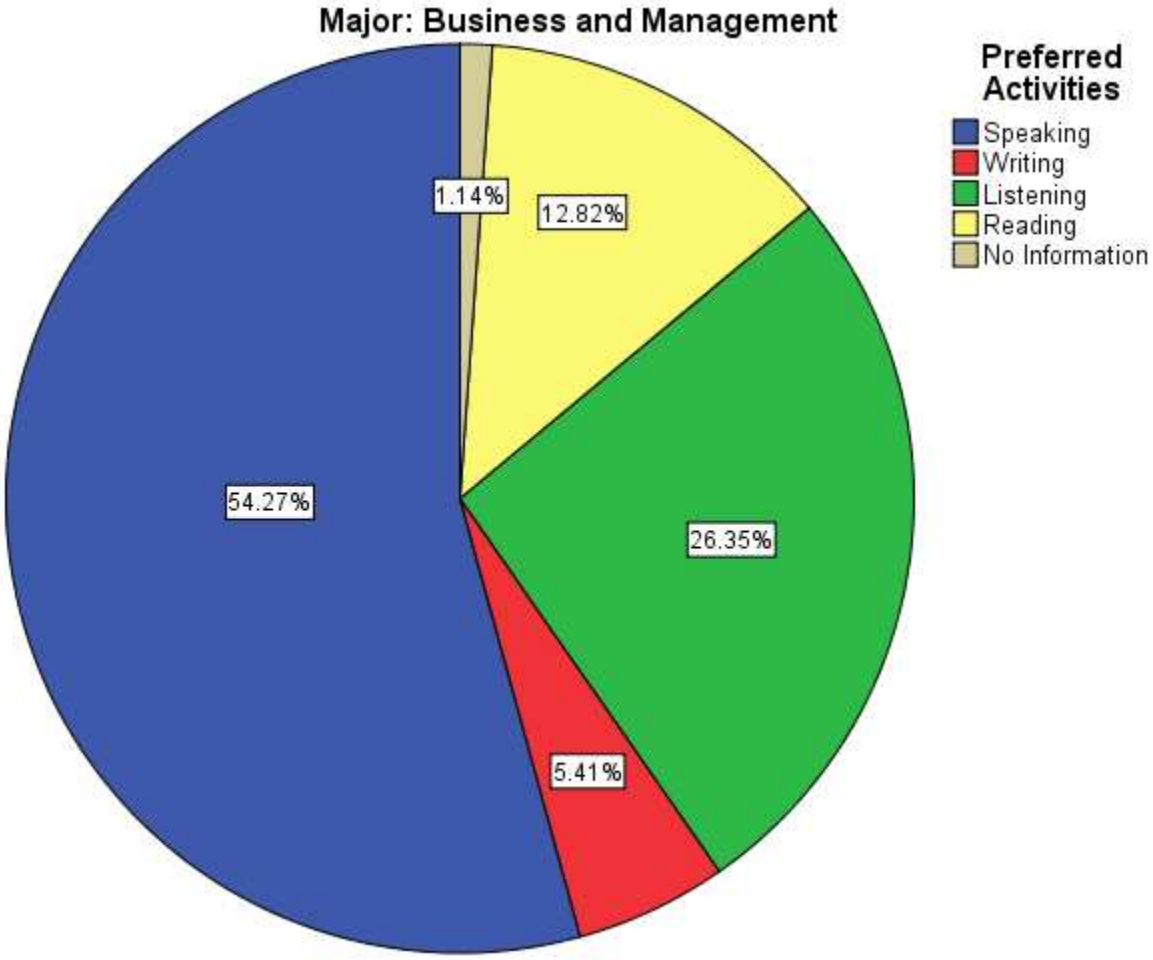
Proportion of survey participants preferring each activity in Study 2. Includes only Science students.

Figure 23. Study 2: Preferred Activities, Engineering Students



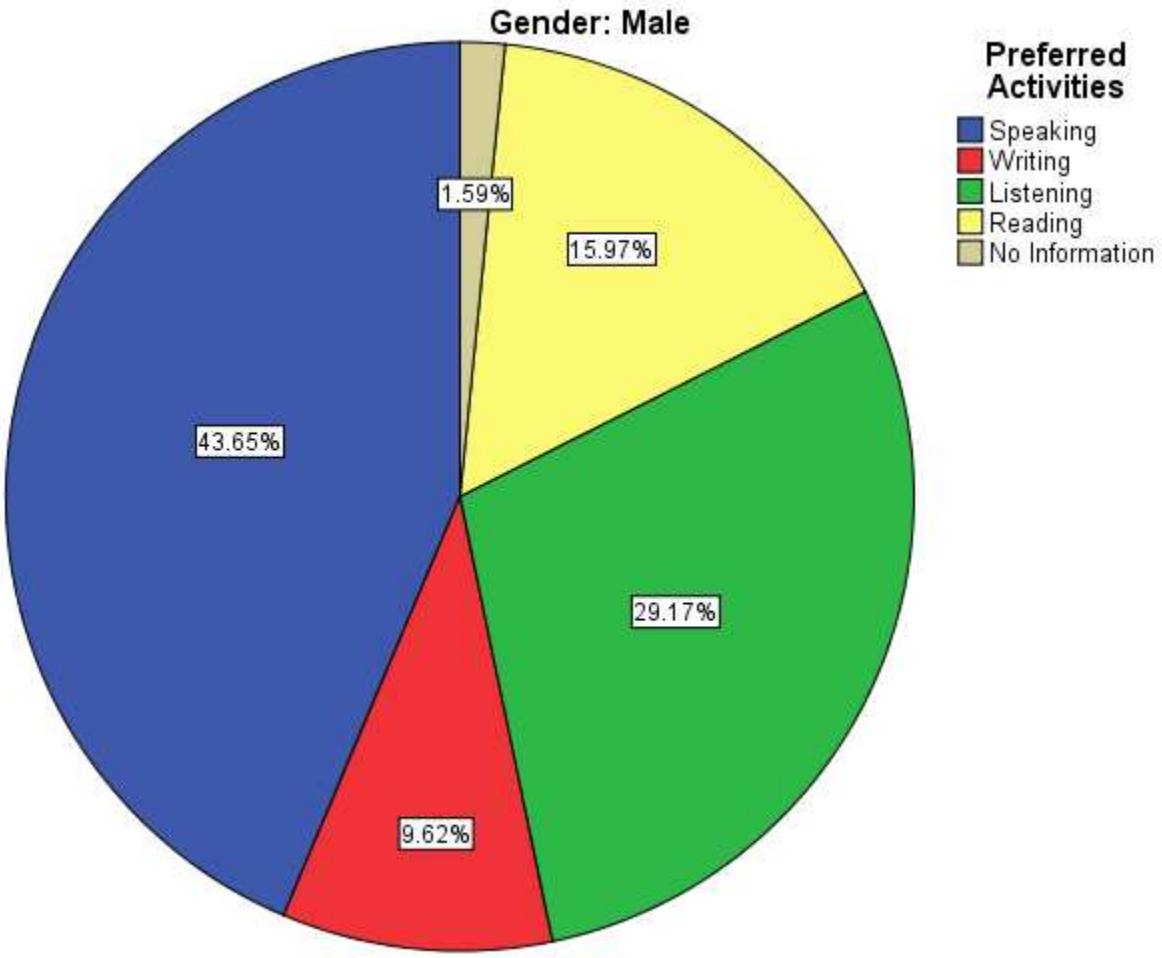
Proportion of survey participants preferring each activity in Study 2. Includes only Engineering students.

Figure 24. Study 2: Preferred Activities, Engineering Students



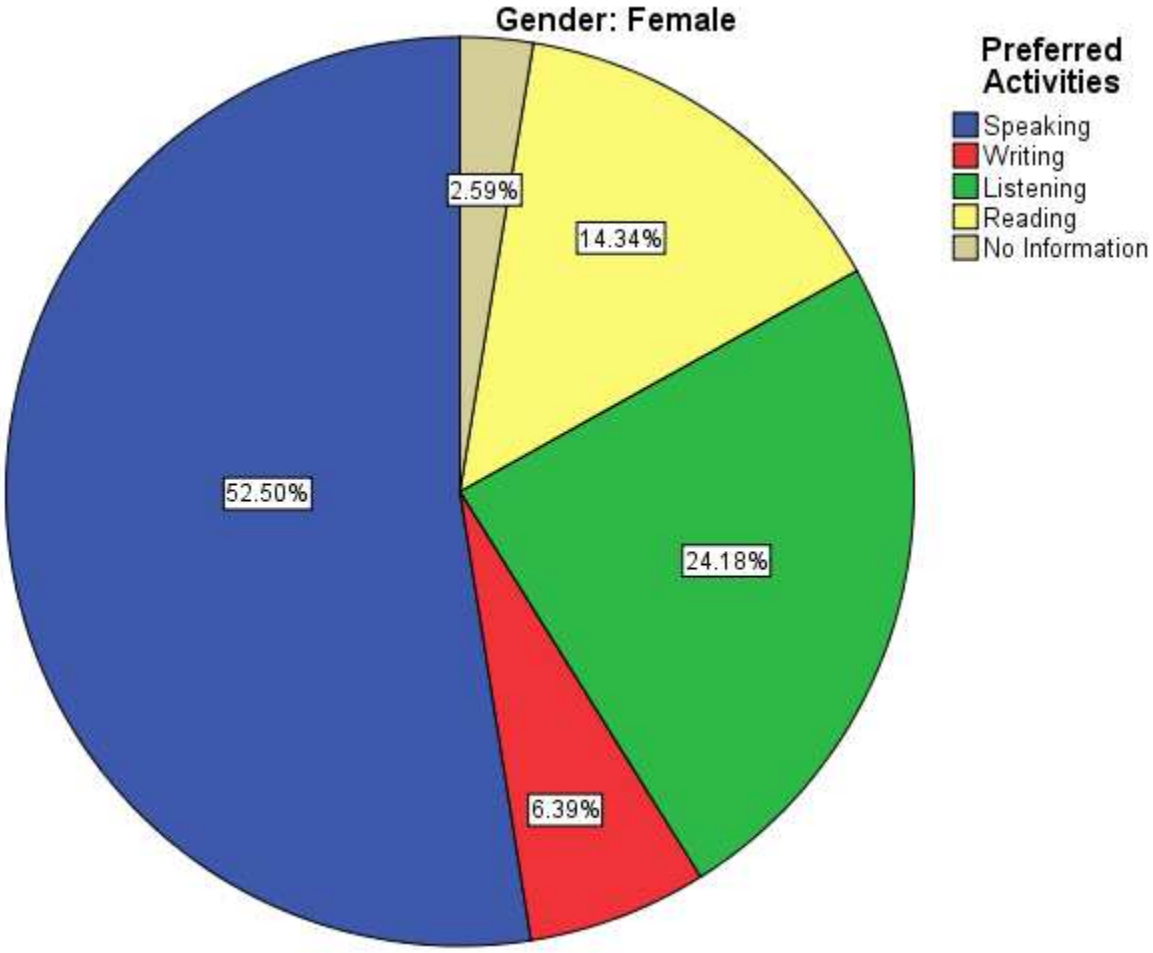
Proportion of survey participants preferring each activity in Study 2. Includes only Business and Management students.

Figure 25. Study 2: Preferred Activities, Males



Proportion of male survey participants preferring each activity in Study 2. Includes all majors.

Figure 26. Study 2: Preferred Activities, Females



Proportion of female survey participants preferring each activity in Study 2. Includes all majors.