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# Exploring Engineering Students' Learning Styles vis-a-vis Students' Demographics

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## ABSTRACT

### CONTEXT

Learning style plays an active role in engineering pedagogy that frame the strategies in which leaners generally get, retain, and retrieve information. It assists students to increase their cognitive capacity and to deal with the learning difficulties which successively improves their academic performance (Mohamad, Mei Hong, & Tze Kiong, 2014). Every learner has different learning style preference depending on their multicultural and pluralistic background.

### PURPOSE OR GOAL

This study aims to identify the learning styles and socio-demographic profile of Engineering students. Specifically, it aims to describe the socio-demographic profile of the participants and establish its relationship to learning styles. Finally, it tests if there is a significant difference on the participants' learning styles when they are grouped according to learning styles and socio-demographic profile.

### APPROACH OR METHODOLOGY/METHODS

This study employs the quantitative research design. Descriptive research will be adopted since the study aims to describe participants' learning styles and socio-demographic profile. Two survey instruments (i.e., standardized and researcher-made instrument) will be used to gather the data.

### ACTUAL OR ANTICIPATED OUTCOMES

Results of the study will provide the following information: participants' socio-demographic profile learning styles. Likewise, it will establish if there is a significant difference on the participants' learning styles when they are grouped according to their socio-demographic profile and learning styles.

### CONCLUSIONS/RECOMMENDATIONS/SUMMARY

Determining learners' preferred learning styles may support to increase the quality of teaching and learning. Engineering educators may need to reform their teaching styles based on students' learning styles so that better academic performance can be achieved. Misalignment learning and teaching styles causes serious concern and can be detrimental to students' achievement.

### REFERENCES (OPTIONAL)

Mohamad, M. M. B., Mei Heong, Y., & Tze Kiong, T. (2014). Conceptions of learning through learning styles and cognitive dimension in vocational education. *Journal of Technical Education and Training, 6*(1).

### KEYWORDS

learning styles, learning challenges, socio-demographic profile

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## 1.Introduction

Individual difference is a universal, timeless and encompassing concept. In education, for instance, learners have different ways of obtaining, processing and transforming information. As a catchall concept to describe such differences among learners, learning styles frame the strategies in which leaners generally get, retain, and retrieve information. It assists students to increase their cognitive capacity and to deal with the learning difficulties which successively improves their academic performance (Mohamad et al., 2014). Sadler-Smith's (1996 in Tulsi et al., 2016) onion model distinguished learning styles from learning preferences and learning strategies. For him, learning styles are relatively more stable compared to the two that are influenced more by the environment.

Scholars (e.g., Cross, 1976; Kolb, 1984; Gregore & Ward, 1977) have provided definitions of learning styles (Tulsi et al., 2016). For Cross (1976), it is how individuals collect, organize and transfer information into useful knowledge. Meanwhile, Gregore and Ward (1977) gave operational definition of the term as characteristic set of individuals' behaviors, which describe how their minds connect to the world and therefore, how they learn. For Kolb (1984), it is the preferred strategy that learners deal with given information and how they construct meaning out of stimuli. He further classified learning styles into convergers, divergers, assimilators and accommodators.

The converger learning style combines abstract conceptualization and active experimentation to test theories into practice. Convergers like to work themselves, solve problems and find practical solution. Diverger refers to a combination of concrete experience and reflective observation, and then considers specific experiences from different perspectives. Divergers see things form multiple perspectives, are open-minded and prefer to work with people. Likewise, they are interested in people and good at generating ideas. Assimilator learning style is characterized by abstract conceptualization and reflective observation. They prefer to think than to act and are good at development of theoretical frameworks. Accommodator learning styles combines concrete experiences and active experimentation and uses the results of individual testing as a basis for new learning. Accommodators learn by actively engaging with the world and actually doing things. They have strong preference for doing, are risk takers and tend to solve problems based on their own information (Kolb, 1984; Tulsi et al., 2016; Too, 2009). Recently, Kolb (2005) mentioned that there is no such thing as constant learning style for it learning happens on a continuum ranging from concrete to abstract or from reflective observation to active experimentation.

More recent scholars (i.e., Honey & Mumford, 2000; Felder & Silverman, 1988) re-classified learning styles: reflectors for divergers, theorist for assimilators, pragmatist for convergers and activitist for accommodators. Reflectors prefer to learn from activities that enable them to watch, ponder, and revisit what has transpired. Theorists prefer to approach problems through step-by-step manner. Pragmatists apply new learning to apply learning to see if they work. Activists prefer challenges of new experiences, involvement with others, assimilation and role playing (Honey & Mumford, 2000). Meanwhile, Felder and Silverman's (1988) reclassification originated in the engineering sciences that includes individual's liking along five bipolar continua: active-reflective, sensing-intuitive, visual-verbal, sequential-global, and intuitive-deductive. Hawk and Shah (2007 in Heenaye, 2012) identified the characteristics of Felder and Silverman's learning styles. Active learners prefer doing thing particularly in groups, while reflective learners work better on their own with time to think about the task before doing it. Sensing learners like facts, data and experimentation and work well with detail, while intuitive learners prefer ideas and theories specifically when they can grasp new ideas and innovation. Verbal learners like to hear their information and engage in discussion specifically when they can speak and hear their own words, while visual learners prefer words, pictures, symbols, flow charts, diagram and reading books. Finally, sequential learners prefer linear reasoning, systematic procedures, and material that came to them in a steady stream, while global learners are strong integrators and synthesizers, making intuitive discoveries and connections to see the whole system or pattern.

Engineering students are typecast as being inquisitive, having strong analytical skills, drawing attention to detail, mathematically oriented with excellent problem-solving abilities as well as strong communication skills and a significant contributor to team effort and competent technical player (Itcenbas & Eryilmaz, 2011). To develop quality engineers, a closer look at engineering education is necessary.

Though there are several studies that looked into the learning styles particularly among engineering students, the present study remains timely and relevant since determining learners' preferred learning styles and learning challenges may support to increase the quality of teaching and learning. As Felder and Brent (2005) emphasized, the more thoroughly educators explore and comprehend the difference, the better chance they have of addressing diverse learning needs of all of their students. Hence, the present study aims to determine the learning styles of engineering students. It also aims to determine if there is significant difference on learning styles when participants are grouped according to their demographic profile. Further, it aims to establish significant relationship between learning styles and selected demographic profile of the participants.

### Research Questions:

The study aims to identify the learning styles of engineering students. Specifically, it aims to answer the following research questions:

1. How can the respondents' learning styles be categorized in terms of active-reflective, sensing-intuitive, visual-verbal, and sequential-global?
2. Is there a significant difference on respondents' learning styles when they are grouped based on gender, civil status, type of student and degree?
3. Is there a significant relationship among respondents' learning styles and their selected demographic profiles?

## 2. METHODOLOGY

### Research Design

The present study is quantitative in nature. The study specifically employed the descriptive, predictive, inferential and non-experimental research design. Descriptive research was used since the study aims to describe the participants' socio-demographic profile and learning styles. Likewise, it involved description, analysis and interpretation of conditions that exist between socio-demographic profile and learning styles. Lastly, the study is non-experimental since no variable manipulation and establishment of neither a control nor experimental group was done (dela Rama et al., 2020; Torres & Alieto, 2019a; Torres & Alieto, 2019b; Robles & Torres, 2020; Cabangcala, 2021; Torres, 2010/2014).

### Setting and Participants

The study was conducted in Southern Institute of Technology in Invercargill, New Zealand. Twenty-two engineering students pursuing Bachelor of Engineering Technology (Civil and Mechanical) and Graduate Diploma in Engineering Technology (Civil and Mechanical) participated in the study.

### Research Instruments

To obtain the data needed for this study, a standardized instrument (i.e., Inventory of Learning Styles by Felder and Soloman, 1993) and researcher-made instrument were used.

Much pedagogical research has underscored the concept of learning styles that resulted in a number of measures use to quantify it. These include Kolb's 4-stage cyclic structure, Learning Style Inventory Instrument (LSI), Learning Style Questionnaire (LSQ), Canfield Learning Style Inventory (CLSI), Learning Style Type Indicator (LSTI) and Cognitive Styles Analysis (CSA) (Romanelli et al., 2009).

The ILS consists of four complementary types (i.e., active-reflective, sensing-intuitive, visual-verbal, sequential-global) to address how information is perceived and processed (Felder & Silverman, 1988; Felder, 1993/1996). It has 44 questions that do not have cultural dependency and are chosen maintaining simplicity for responding in mind. The questionnaire can assess the four aspects of learning (i.e., processing aspect, Active-Reflective; perception aspect, Sensory-Intuitive; input aspect, Visual-Verbal; and understanding aspect, Sequential-Global). Its reliability and reliability has been examined and explained in a number of studies (e.g., Zwanenberg & Wilkinso, 2000; Felder & Spurlin, 2005). The instrument was developed and validated by Richard M. Felder and Barbara A. Soloman. Users answer 44 a-b questions and submit the survey, and their four preferences are reported back to them immediately to be copied or printed out. The results are not stored: when the report window is closed, the results are irretrievably lost. It has been widely used for demonstrating a tendency of a dominant learning style preference within a particular group of learners. Zywno (2003) concurs ILS construct validity by showing no significant difference between consecutive years of ILS scores collected from a consecutive cohort of engineering students and with reference to other studies (e.g., Zwanenberg & Wilkinso, 2000) of engineering learning styles showing similar overall style distribution. In addition, Zywno (2003) contends that ILS discriminant validity is supported by a number of studies (e.g., Montgomery & Groat, 1999; Nulty & Barret, 1996) highlighting significant differences in scores for populations with different characteristics.

### Data Gathering Procedure

Prior to data collection, the researcher first accomplished the needed forms for ethical considerations. After having secured approval from the institute's ethics committee, data gathering commenced.

The first step was to identify study participants. After they have been identified, an orientation was given to them as regards the extent of their participation in the study. They were informed that they were not entitled to any remuneration or reward due to their voluntary participation. The moment they were familiarized on the context and extend of their participation, participants were requested to sign the consent to voluntarily participate in the study. The participants were then instructed to take the online survey of Felder and Soloman's (1993) ILS. After the participants completed the online survey, they received the results of their learning styles and an explanation of what the results mean.

### Data Analysis

For the quantitative part, the study employed descriptive statistics such as frequency, percentage, mean, and standard deviation to analyze data for the participants' socio-demographic profile and learning styles. To establish if there is significant difference on the participants' learning styles when grouped according to their demographic profiles, independent samples t-test was used. In determining the relationship among variables, Chi-square was used.

## 3. RESULTS AND DISCUSSION

#### Respondents' Demographics

Twenty-two (19 males, 3 females) engineering students participated in the study. Their ages range from 16 to 36 years old. Nearly-half (9 or 36.30%) were above 36 years old, more than one-fourth (6 or 27.30%) were 26 to 30 years old and the remaining were 21 to 25 (4 or 18.20%), 31 to 35 (3 or 13.60%) and 16 to 20 (1 or 4.50%) years old. Majority (15 or 68.10%) were single and the remaining (7 or 31.80%) were married. In terms of type of students, almost all (18 or 81.80%) were classified as international students and the rest (4 or 18.20%) were domestic students. As regards the degree programs the students were taking, more than one-fourth (7 or 31.80%) enrolled in Bachelor of Engineering Technology (Mechanical). Likewise, more than one-fourth (7 or 31.80%) enrolled in Graduate Diploma in Engineering Technology (Mechanical, 7 or 31.80%; Civil, 6 or 27.30%) and 2 or 9.10% enrolled in Bachelor of Engineering Technology (Civil). In terms of the participants' perceived level of preparation to pursue degree in engineering, majority (14 or 63.60%) reported that they were prepared, 6 or 27.30% mentioned they were moderately prepared and only 2 or 9.10% perceived themselves highly prepared. For their grades in Engineering Mathematics, more than half had grades of B (6 or 27.20%), A+ (4 or 18.20%) and A (4 or 18.20%). The remaining obtained grades of B+ (3 or 13.60%), C+ (1 or 4.50%), C (1 or 4.50%) and E (1 or 4.50%).

**Respondents' Learning Styles**

Presented in Table 1 is the summary of the respondents' learning styles. Data show that in general, there are more respondents who reported having well-balanced preference in Active-Reflective (13 or 59.10%), Sensing-Intuitive (11 or 50%), Visual-Verbal (8 or 36.40%) and Sequential-Global (15 or 68.20%). This supports the findings of Fang et al. (2017) that students have well-balanced preference for all learning style dimension. It could also be noted that none from among the participants have strong preference for verbal and global.

A closer look at the results reveals that for Active-Reflective, the remaining respondents (9 or 40.8%) reported moderate preference for active (4 or 18.20%) and reflective (3 or 13.60%), and strong preference for active (1 or 4.50%) and reflective (1 or 4.50%). Meanwhile, for Sensing-Intuitive, the rest of the respondents said that they have moderate preference for sensing (7 or 31.80%) and intuitive (2 or 9.10%) and only one for each dimension mentioned having strong preference for sensing and intuitive. For Visual-Verbal, there are more respondents with moderate preference for visual (7 or 31.80%) compared to those with moderate preference for verbal (2 or 9.10%). The same was noted in terms on the strong preference for visual, in which there were more respondents who reported strong preference for visual (5 or 22.70%) and none reported strong preference for verbal. This also concurs with the findings of Fang et al. (2017) that there are more engineering students who prefer visual learning style over verbal learning styles. Finally, for Sequential-Global, the remaining respondents reported having moderate preference for global (2 or 9.10%) and sequential (2 or 9.10%), and with regard to strong preference in both dimensions, none reported having strong preference for global while 2(9.10%) said having strong preference for sequential.

**Table 1: Summary of the Respondents' Learning Styles**

| Learning Styles | f n=22 | % |
|---|---|---|
| **Active-Reflective** | | |
| Strong Preference for Active | 1 | 4.50% |
| Moderate Preference for Active | 4 | 18.20% |
| Well-balanced Preference for Active-Reflective | 13 | 59.10% |
| Moderate Preference for Reflective | 3 | 13.60% |
| Strong Preference for Reflective | 1 | 4.50% |
| **Sensing-Intuitive** | | |
| Strong Preference for Sensing | 1 | 4.50% |

| | | |
|---|---|---|
| Moderate Preference for Sensing | 7 | 31.80% |
| Well-balanced Preference for Sensing-Intuitive | 11 | 50.00% |
| Moderate Preference for Intuitive | 2 | 9.10% |
| Strong Preference for Intuitive | 1 | 4.50% |
| **Visual-Verbal** | | |
| Strong Preference for Visual | 5 | 22.70% |
| Moderate Preference for Visual | 7 | 31.80% |
| Well-balanced Preference for Visual-Verbal | 8 | 36.40% |
| Moderate Preference for Verbal | 2 | 9.10% |
| Strong Preference for Verbal | - | - |
| **Sequential-Global** | | |
| Strong Preference for Sequential | 2 | 9.10% |
| Moderate Preference for Sequential | 2 | 9.10% |
| Well-balanced Preference for Sequential-Global | 15 | 68.20% |
| Moderate Preference for Global | 3 | 13.60% |
| Strong Preference for Global | - | - |

### Difference on Respondents' Learning Styles vis-a-vis Demographic Profiles

Results of independent samples t-test to determine the difference on respondents' learning styles when grouped based on their demographic profiles such as gender, civil status, type and degree are summarized in Table 2. Of all the variables, only the respondents' gender established significant difference on their learning styles specifically on the visual-verbal dimension. In this dimension, female respondents obtained higher mean score than the male respondents. This implies that female respondents were more verbal than their male counterparts, who were more visual.

Meanwhile, there is no significant difference on respondents' learning styles when they are grouped based on civil status, type of students, and degree programs. The foregoing result particularly on the no difference on respondents' learning styles when grouped based on their degree programs does not support the findings of Kuri and Truzzi (2002 in Kamal & Radhakrishnan, 2019) that there is a difference on learning styles preference among the mechanical engineering, civil engineering, electrical engineering, and industrial engineering students. Likewise, it does not concur with the findings of Tulsi et al. (2016) that there exist differences in learning styles of students pursuing master's degree in computer science and engineering, civil engineering, electrical engineering, electronics and communication engineering and mechanical engineering.

**Table 2: Results of Independent Samples T-test for Difference on Respondents' Learning Styles vis-à-vis Demographic Profiles**

| Learning Styles | Socio-Demographic Profiles | N | Mean | Std. Deviation | p-value Sig. (2-tailed) |
|---|---|---|---|---|---|
| | Gender | | | | |
| Active-Reflective | *Male* | 19 | 2.89 | 0.875 | 0.416 |
| | *Female* | 3 | 3.33 | 0.577 | |

| | | | | | |
|---|---|---|---|---|---|
| Sensing-Intuitive | *Male* | 19 | 2.79 | 0.918 | 0.826 |
| | *Female* | 3 | 2.67 | 0.577 | |
| Visual-Verbal | *Male* | 19 | 2.16b | 0.898 | 0.042* |
| | *Female* | 3 | 3.33a | 0.577 | |
| Sequential-Global | *Male* | 19 | 2.95 | 0.705 | 0.209 |
| | *Female* | 3 | 2.33 | 1.155 | |
| | Civil Status | | | | |
| Active-Reflective | *Single* | 14 | 2.79 | 0.579 | 0.222 |
| | *Married* | 7 | 3.29 | 1.254 | |
| Sensing-Intuitive | *Single* | 14 | 2.71 | 0.726 | 0.494 |
| | *Married* | 7 | 3.00 | 1.155 | |
| Visual-Verbal | *Single* | 14 | 2.36 | 0.842 | 0.872 |
| | *Married* | 7 | 2.43 | 1.134 | |
| Sequential-Global | *Single* | 14 | 2.71 | 0.914 | 0.253 |
| | *Married* | 7 | 3.14 | 0.378 | |
| | Type of Student | | | | |
| Active-Reflective | *International* | 18 | 2.94 | 0.802 | 0.909 |
| | *Domestic* | 4 | 3.00 | 1.155 | |
| Sensing-Intuitive | *International* | 18 | 2.72 | 0.895 | 0.576 |
| | *Domestic* | 4 | 3.00 | 0.816 | |
| Visual-Verbal | *International* | 18 | 2.28 | 0.895 | 0.681 |
| | *Domestic* | 4 | 2.50 | 1.291 | |
| Sequential-Global | *International* | 18 | 2.83 | 0.786 | 0.707 |
| | *Domestic* | 4 | 3.00 | 0.816 | |
| | Degree | | | | |
| Active-Reflective | *Civil* | 8 | 3 | 0.926 | 0.854 |
| | *Mechanical* | 14 | 2.93 | 0.829 | |
| Sensing-Intuitive | *Civil* | 8 | 3.13 | 1.246 | 0.155 |
| | *Mechanical* | 14 | 2.57 | 0.514 | |
| Visual-Verbal | *Civil* | 8 | 2.38 | 1.061 | 0.837 |
| | *Mechanical* | 14 | 2.29 | 0.914 | |
| Sequential-Global | *Civil* | 8 | 3.13 | 0.354 | 0.151 |
| | *Mechanical* | 14 | 2.71 | 0.914 | |

*p value significant at 0.05

**Correlation among variables**

To determine if there is significant relationship among variables such as learning styles, grades in engineering mathematics, and the perceived level of preparedness to pursue degree in engineering, Spearman rank correlation was used. The results are presented in Table 3. As reflected in the Table, none from participants' demographics established significant relationship with any of the four dimensions of learning styles. Meanwhile, among the four dimensions, two (i.e. Active-Reflective, Sequential-Global) established significant relationship between each other. This means that the higher their preference to Active-Reflective, the same goes with their level of preference for Sequential-Global. The relationship between the two dimensions may be based on the idea that both dimensions have to do on how a learner approaches a specific learning task. For instance, while active learners tend to retain and understand information best by doing something active with it, and reflective learning prefer to think about it quietly first, the sequential learners tend to gain understanding in linear steps, and the global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections and then suddenly getting it.

**Table 3: Results of Spearman Rank Correlation for relationship among variables**

| Demographic Variables and Learning Styles | Active-Reflective | Sensing-Intuitive | Visual-Verbal | Sequential-Global |
|---|---|---|---|---|
| Grade in Engineering Mathematics | .149 | .688 | .121 | .235 |
| Perceived Level of Preparedness to pursue degree in engineering | .14 | .542 | .098 | .578 |
| Active-Reflective | | .534 | .926 | .029* |
| Sensing-Intuitive | .534 | | .629 | .136 |
| Visual-Verbal | .926 | .629 | | .306 |
| Sequential-Global | .029* | .136 | .306 | |

*Correlation is significant at 0.05 level (2-tailed)

# 4. CONCLUSION

Every learner has different learning style preference depending on their multicultural and pluralistic background. Determining learners' preferred learning styles may support to increase the quality of teaching and learning. Engineering educators may need to reform their teaching styles based on students' learning styles so that better academic performance can be achieved. Misalignment learning and teaching styles causes serious concern and can be detrimental to students' achievement.

Engineering education needs to be more responsive to future needs and more appealing to a wider, more diverse group of students. Hence, as part of their efforts to enhance the teaching and learning in engineering, engineering educators underscore learning style theories in their respective instruction. For instance, institutions of higher learning may consider gender differences in learning styles and challenges into consideration, especially in classrooms which still utilize traditional teaching methods. Engineering educators may also explore the possibility of adopting a multi-disciplinary approach to teaching by incorporating real-life application and practical examples that begin on student interest and hold relevance to the topics being discussed in class.

The recent findings also highlight the recommendation of Fang et al. (2017) that encouraged tutors to tailor their instructional and learning materials based on a balanced approach that cater for both sides of each of the four dimensions, to address for more than one of the learning style preferences. This is to attend to learners who have a balanced preference learning style. However, due to small sampling involved in the current study, it is suggested that the current findings be treated with reservations and precautions until follow-up studies with larger samples are done.

## References:


Cabangcala, R., Alieto, E., Estigoy, E., Delos Santos, M., & Torres, J.M. (2021). When language learning suddenly becomes online: Analyzing English as second language learners' (ELLs) attitude and technological competence. *TESOL International Journal*, *16*(4.3), 115-131.

Cross, K. (1976). *Accent on learning*. Jossey-Bass.

de la Rama, J.M., Sabasales, M., Antonio, A., Ricohermoso, C., Torres, J.M, Devanadera, A., Tulio, C., & Alieto, E. (2020). Virtual Teaching as the 'New Norm': Analyzing Science Teachers' Attitude toward Online Teaching, Technological Competence and Access. *International Journal of Advanced Science and Technology*, 29 (7), 2705-12715.

Fang, N., Daud, M.F., Al Haddad & Mohd-Yusof (2017). A quantitative investigation of learning styles, motivation and learning strategies for undergraduate engineering students. *Global Journal of Engineering Education*, *19*(1), 24-29.

Felder, R. & Brent, R. (2005). Understanding student differences. *Journal of Engineering Education, 94*(1), 57-72.

Felder, R.M. & Spurlin, J. (2005). Application, readability and validity of the Index of Learning Styles. *International Journal of Engineering Education, 21*(1), 103-112.

Felder, R.M. & Silverman, L.K. (1988). Learning and teaching styles in engineering education. *Engineering Education*, *78*(7), 674-681.

Grayson, J. (2014). Negative racial encounters and academic outcomes of international and domestic students in four Canadian universities. Journal of International Students, 4(3), 262-278. https://files.eric.ed.gov/fulltext/EJ1054986.pdf

Gregore, A.F. & Ward, H.B. (1977). A new definition for individual: Implications for learning and teaching. *NASSP Bulletin*, *401*(6), 20-23.

Hawk, T. & Shah, A. (2007). Using learning style instruments to enhance student learning, decision sciences. *Journal of Innovative Education, 5*(1).

Heenaye, M., Gobin, B.A. & Khan, N.A.M. (2012). Analysis of Felder-Solomon Index of Learning Styles of Students from management and engineering at the University of Mauritius. *Journal of Education and Vocational Research, 3*(8), 244-249.

Hofstede, G. (1986). Cultural differences in teaching and learning. *International Journal of Intercultural Relations, 10*, 301-309.

Honey, P. & Mumford, A. (2000). *The learning styles helper's guide*. Peter Honey Publications Ltd.

Hussain, M.T. & de Graaff E. (2012). Learning experiences of engineering students related to cultural differences in group work. In *Engineering Education 2020: Meet the Future: SEFI 40th annual conference SEFI*: European Association for Engineering Education.

Ictenbas, B.D. & Eryilmaz, H. (2011). Determining learning styles of engineering students to improve the design of a service course. *Social and Behavioral Sciences, 28*, 342-346.

Jamieson, L. & Lohmann, J. (2009). *Creating a culture for scholarly and systematic innovation in engineering education: Ensuring US engineering has the right people with the right talent for a global society.* American Society for Engineering Education.

Kelly, J. (2000). Gender and equity in training and teaching behavior. *Journal of Instructional Psychology, 27*(3), 173-178.

Klein, S. (2007). *Achieving gender equity in technical education through education*. Sage Publications.

Kolb, D.A. (1985). *Learning style inventory: Self-scoring inventory and interpretation booklet*. McBer and Co.

Kolb, D.A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.

Kombo, D. (2004). S*ociology of education*. Paulines Publications Africa.

Madara, D.S. & Cherotich, S. (2016). Challenges faced by female-students in engineering education. Journal of Education and Practice, 7(25), 8-22.

Mohamad, M. M. B., Mei Heong, Y. & Tze Kiong, T. (2014). Conceptions of learning through learning styles and cognitive dimension in vocational education. *Journal of Technical Education and Training, 6*(1).

Montgomery, S. & Groat, L.N. (1999). Student learning styles and their implications for teaching. CRLT Occasional Paper. University of Michigan.

Nelavia, N. & Ramesh, S. (2020). An insight into the challenges faced by first year engineering students: Poor foundational knowledge. *Procedia Computer Science*, *172*, 823-830.

Nulty, D. & Barrett, M. (1996). Transitions in students learning styles. *Studies in Higher Education, 21*(3), 333-346.

Pieterse, A. L., & Carter, R. T. (2010). An exploratory examination of the association among racial and ethnic discrimination, racial climate, and trauma-related symptoms in a college student population. *Journal of Counseling Psychology, 57*(3), 255-263.

Richard, W. & Susan, M. (2009). *Gender gaps in technical education*. Wellesley College Press.

Robles, R.M.V., & Torres, J.M. (2020). Filipino ESL teachers' attitudes, practices and challenges in using peer correction strategy in teaching writing. *Ciencia (HEALS), 1*(1), 1-26).

Romanelli, F., Bird, E. & Ryan, M. (2009). Learning styles: A review of theory, application and best practices. *American Journal of Pharmaceutical Education, 73*(1), 1-5.

Sadler-Smith, E. (1996). Learning styles: A holistic approach. *Journal of European Industrial Training, 20*(7), 29-36.

Too, S.W. (2009). Students' learning style and their academic achievement for taxation course – A comparison study. P*roceedings of the 2nd International Conference of Teaching and Learning (ICTL 2009)*. INTI University College, Malaysia.

Torres, J.M., & Santos, M.L. (2021). Language policy, medium of instruction and economic development of countries in Kachru's concentric circles of Asian Englishes. *International Journal of Language and Literary Studies, 3*(1), 87-104.

Torres, J.M. & Alieto, E.O. (2019a). Acceptability of Philippine English grammatical and lexical items among pre-service teachers. *The Asian EFL Journal*, 21(2.3), 158-181.

Torres, J.M. & Alieto, E.O. (2019b). English learning motivation and self-efficacy of Filipino senior high school students. *The Asian EFL Journal*, 22(1), 51-72.

Torres, J.M. (2014). Exposure to broadcast Media and Level of English Proficiency of High School Students. *Education Digest, 15*, 51-64.

Torres, J.M. (2010). Affective Filters and Selected Variables in Second Language Acquisition as Indicators of Language Proficiency. *Education Digest, 11*, 34-45.

Tulsi, P., Poonia, M.P. & Priya, A. (2016). Learning styles of engineering students. *Journal* *of Engineering Education Transformations, 30*(2),

Yang, Y., & Cornelius, L. (2004). Students' perception towards the quality of online education: A qualitative approach. *Association for Educational Communications and Technology*, 861-876.

Zwanenberg, N.V. & Wilkinson, L.J. (2000). Felder and Silverman's Index of Learning Styles and Honey and Mumford's Learning Styles Questionnaire: How do they compare and do they predict academic performance?. *Educational Psychology, 20*(3), 365-381.

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