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A Study on Learning Styles and Academic Performance in Relation with Kinesthetic, Verbal and Visual Intelligences

Salina Budin, Nor Liawati Abu Othman, Shaira Ismail

***Abstract*—**This study attempts to determine kinesthetic, verbal and visual intelligences among mechanical engineering undergraduate students and explores any probable relation with students' learning styles and academic performance. The questionnaire used in this study is based on Howard Gardner's multiple intelligences theory comprising of five elements of learning style; environmental, sociological, emotional, physiological and psychological. Questionnaires are distributed amongst undergraduates in the Faculty of Mechanical Engineering**.** Additional questions on students' perception of learning styles and their academic performance are included in the questionnaire. The results show that one third of the students are strongly dominant in the kinesthetic intelligent (33%), followed by a combination of kinesthetic and visual intelligences (29%) and 21% are strongly dominant in all three types of intelligences. There is a statistically significant correlation between kinesthetic, verbal and visual intelligences and students learning styles and academic performances. The ANOVA analysis supports that there is a significant relationship between academic performances and level of kinesthetic, verbal and visual intelligences. In addition, it has also proven a remarkable relationship between academic performances and kinesthetic, verbal and visual learning styles amongst the male and female students. Thus, it can be concluded that, academic achievements can be enhanced by understanding as well as capitalizing the students' types of intelligences and learning styles.

***Keywords*—**Kinesthetic intelligent, verbal intelligent, visual intelligent, learning style, academic performances.

I. Introduction

EACH student carries different intelligence. Some of them can easily adapt and adopt what have been learned in the classes. Some are moderate learners and some may be a very slow learner. Some loves mathematic and learn effectively with numbers, but some are better in linguistically related courses. The students basically possess a variety of learning styles in the learning process. Some of them may be best in learning by hearing (verbal) while another may be learned successfully by seeing (visual) and doing (kinesthetic). The differences in students' intelligence capability and learning styles become a challenge for the lecturers to adopt progressive teaching styles to accommodate their varied abilities.

One of the theories that can be used to acknowledge the difference of intelligent capabilities of students is the theory of Multiple Intelligence (MI). The theory was first introduced by Howard Gardner. According to this theory, human intelligences can be differentiated into nine categories, which are visual/spatial intelligence, linguistic intelligence, musical/ rhythmic intelligence, logical/mathematical intelligence, bodily/kinesthetic intelligence, interpersonal intelligence, intrapersonal intelligence, naturalistic intelligence and existential intelligence [1]-[8]. The nine intelligences can be defined as:

1. Logical-mathematical intelligence consists of the capacity to analyze problems logically, perform mathematical operation and investigate issues scientifically.
2. Verbal-linguistic intelligence includes the ability to effectively use language to express oneself rhetorically or poetically.
3. Visual-spatial intelligence gives one the ability to manipulate and create mental image in order to solve problems.
4. Musical intelligence involves skill in the performance, composition and appreciation of musical patterns.
5. Bodily-kinesthetic intelligence entails the potential of using one's whole body or parts of the body to solve problems.
6. Interpersonal intelligence is the ability to notice and make distinctions among other individuals and, in particular, among their moods, temperaments, motivations, and intentions. It is concerned with the capacity to understand the intentions, motivations and desires of other people. It allows people to work effectively with others.
7. Intrapersonal intelligence is the ability to distinguish and identify various personal thoughts and feelings and to use them to understand one's own behavior.
8. Naturalist intelligence is the ability to discern similarities and differences and make classifications among the living organisms in one's environment.
9. Existential intelligence is the appreciation of the spirituality and understanding questions about life.

Each individual has different intelligence profiles that consist of a combination of these nine intelligences. The individuals can be highly developed in certain intelligence domains, and less developed in other intelligence domains [9].

Salina Budin is a Senior Lecturer at the Faculty of Mechanical Engineering, Universiti Teknologi Mara, Cawangan Pulau Pinang (phone: 604 3823208, fax: 604 3823212, e-mail: salinabudin@ppinang.uitm.edu.my).

Nor Liawati Abu Othman is a Lecturer at the Faculty of Mechanical Engineering, Universiti Teknologi Mara, Cawangan Pulau Pinang (phone: 604 3823211, fax: 604 3823212, e-mail: norliawati086@ppinang.uitm.edu.my

Shaira Ismail is a Senior Lecturer at the Faculty of Business Management, Universiti Teknologi Mara, Pulau Pinang, Malaysia (e-mail: sheeraz@ppinang.uitm.edu.my).

The intelligence profiles are also noted as dynamic and capable to grow and further develop in an appropriate environment [10]. In other word, each individual can improve their intelligence levels up to a certain level as long as they have a sufficient education.

In the educational field, the Gardner's Theory [24] has emphasized that the differences in the intelligence profile create a different learning style among students. Thus, they must be educated differently. This means that lecturers should teach students in the ways that they can learn and evaluate them in a way that allows them to show what they have understood. With such remarks, it is clarified that effective teaching should be colored with various teaching strategies that will help students to develop their strengths, and strengthen their weakness in each domain of intelligences. Therefore, it is important to identify the students' intelligence profile prior to teaching and learning activities. Such information will guide lecturers to strategize teaching activities with various styles that are compatible with students' intelligences.

II. Literature Review

Many researches in conjunction with the MI in educational field have been reported. Those works highlighted some ideas concerning the differences in intelligences profile among students and its relationship with various factors such as learning styles, learning strategies, personal factor and background and roles of each intelligence toward specific courses, etc. [4], [8], [9], [11]-[16].

Seifoori and Zarei [13] have examined the relationship of MIs domain and learning styles among the Iranian undergraduate students of English Foreign language course. It is remarkable that students with a higher preference for tactile learning style seem to be stronger in their mathematical, spatial, and bodily intelligences. Besides, it is also reported that those with a higher preference in kinesthetic learning style seem to be stronger in mathematical and bodily intelligences. In other work, Narl et al. [17] have conducted a study to determine the MI score and between learning styles. The finding shows a significant relationship between learning styles and MIs.

In another investigation, Kok [18] found that lecturers who consider students' intelligence differences and design the teaching environment according to students' intelligences show better academic performances. Similar results were reported by [3], which pointed out that MI approaches attempt to provoke and produce a deeper understanding. Besides, it also increases the ability of exploring, learning and creativity among the students. In addition, Akkuzu and Akcay [12] reported positive motivation among students and significant test score when teaching and learning activities are accomplished with MI theory. A similar conclusion was stated by [19] and [20] which claimed that the MI based teaching material enhanced the students' motivation and at the same time facilitated the teacher's task. Consequently, better results are attained by the students. However, a reversed finding was reported by [21] which observed that learners with spatial/ visual intelligence do not necessarily perform better by seeing the materials; visual resources such as photographs, slides, films, charts, video, paintings, drawings, cartoons, prints, designs, and three-dimensional art such as sculpture and architecture which can be categorized as fine art or documentary record or any other visual materials per se. These visual learners are also strongly influenced by their cognitive abilities. Similarly, Ozdilek [8] has conducted a survey to observe the influence of MIs profile toward a particle model of matter courses. The result shows that the mean average scores for the course are higher among students who dominant in mathematical/logical, visual/spatial, and bodily/kinesthetic intelligences. Based on the findings, the author suggested various learning styles to overcome the students' intelligence differences. In other work, Savas [22] has investigated the role of MIs in Learning English Foreign Language course. The results pointed that, linguistic intelligence alone is unable to guarantee the successful on Learning English Foreign Language course. All intelligences have to be integrated with one another at varying degrees for the effective foreign language learning. However, contradicted results were reported by [20] which stated that 80.39% of the pupils who got good marks in English examinations had strong Linguistic Intelligence. In other work, Razmjoo [5] has concluded that none of the multiple intelligences contribute directly towards the Iranian's English language proficiency level among the Iranian PhD candidates at Shiraz University, Shiraz, Iran.

Based on the literatures [3], [5], [8], [12], [18]-[21], there is no specific pattern of MIs profiles indicated on the relationship between the learning styles and academic performance. In this work, the relations of kinesthetic, verbal and visual intelligences toward the kinesthetic, verbal and visual learning style are investigated. Theoretically, it is known that those with dominant kinesthetic intelligent will prefer kinesthetic learning style. On the other hand, students who are dominated with verbal intelligence will prefer verbal learning style. Similarly, students with a high influence of visual intelligence will prefer visual learning style. Information about students' intelligences and learning styles can help instructors or lecturers become more sensitive to the differences between students. This might help lecturers in designing suitable teaching and learning methods that match students' intelligences and learning styles. Consequently, it increases the effectiveness of the learning process. It is expected that by having an effective learning process, the students' academic performances will also increase.

III. Objective

The aim of this study is to determine the kinesthetic, verbal and visual intelligent profiles among undergraduate students in the Faculty of Mechanical Engineering (FKM), Universiti Teknologi Mara Pulau Pinang (UiTMPP). It is also to investigate its relations towards students learning styles and academic performances. The significance of this study lies in an increasing awareness of undergraduate students MIs profile and learning styles. Identifying the most strengths and weaknesses of intelligence domains will help students and

lecturers in creating effective teaching and learning activities that match with theirs' intelligence and learning styles. The answers of the following questions are sought as the main purposes of the study.

1. What is the distribution level of kinesthetic, verbal and visual intelligences among the diploma students in the FKM, UiTMPP?
2. What is the distribution level of kinesthetic, verbal and visual learning styles among the diploma students in FKM, UiTMPP?
3. Is there any relationship between kinesthetic, verbal and visual intelligences on the student's learning style?
4. Is there any relationship between kinesthetic, verbal and visual intelligences, and students' learning styles on academic performance?
5. Are there any differences between male and female students on the level of kinesthetic, verbal and visual intelligences and learning styles?

IV. Methodology

A multiple intelligent questionnaire developed by McClellan and Conti [2] was used in this survey. The reliability of the instrument has been verified by the authors using Cronbach's alpha coefficient. The result of each type of MIs was found to be statistically significant to measure the dominant MI for each participant. The instrument consists of 27 items; 3 items for each type of MIs which were ranked by the respondents. The possible scores have ranged from 3 to 15 points.

The score was computed for each participant in each type of MIs by summing scores for each item. The level of each intelligent domain is based on the average scored points indicated by the participants, which is summarized in Table I. [9], [23].

TABLE I
Multiple Intelligent Levels

Scored point for intelligent domain	Level of the intelligent domain
12 - 15	Strongly Dominant
9 - 11	Dominant
6–8	Partially dominant
3 - 5	Poor

In our studies, the kinesthetic, verbal and visual intelligences are analyzed in relation to the respondent's kinesthetic, visual and verbal learning styles.

In order to determine the learning preferences, nine questions have been developed to identify the learning preferences of each participant either kinesthetic, visual or verbal learner. The question items were developed based on VARK learning model. Three items were constructed for each learning preference. The questions were validated and the alpha co-efficient reliability index obtained using Cronbach method was 0.766. The result shows that the alpha coefficient is above 0.7 which indicate that the question in the survey is reliable to measure the learning style.

The score was computed for each learning preference by summing scores of each item. Any score in the range of 12 to 15 is considered highly preferable, 9 – 11; preferable, 6 to 8; moderately preferable and 3 to 5; less preferable. Finally, the academic performances will be based on student's cumulative grade point average (CGPA).

V. Sample

A total of 326 diploma of mechanical engineering students from semester 4 and 5 are participating in this survey. Students from semester 4 and 5 are selected as a participant to obtain an accurate academic performance as the CGPA is calculated based on GPA, an average point from previous semesters. In this program student will have to complete all the courses within five semesters. The final semester is assigned for an industrial training. Over 326 participants, 86% of the students are male and the remaining is female. The big difference between male and female participants is due to student enrollment where 80% of the quota is allocated to male students specifically for this program.

VI. Data Analysis

The data collected were analyzed by descriptive statistics and Pearson correlation analysis using SPSS software at 0.05 significant levels.

VII. Results and Discussion

The distribution of the kinesthetic, visual and verbal intelligence is summarized in Fig. 1 and Table II. The results indicated that 33% of diploma students in the FKM, UiTMPP exhibited a dominant kinesthetic intelligent. In addition, 29% are dominant in dual intelligence which are kinesthetic and visual intelligent whereas 21% is seen to carry triple intelligence domains which are kinesthetic, visual and verbal intelligences.

TABLE II
Summary of Kinesthetic, Verbal and Visual Intelligence Distribution

	%		
	Total	Male	Female
All Poor	7	6	1
Kinesthetic Intelligent	33	30	3
Visual Intelligent	3	2	1
Verbal Intelligent	1	0	0
Kinesthetic + Visual Intelligent	29	25	3
Kinesthetic + Verbal Intelligent	5	3	2
Visual + Verbal Intelligent	2	2	0
All Dominants	21	17	4

The finding sound relevant to the mechanical engineering curriculum. Dominant in kinesthetic intelligent will assist the students to use their body in solving engineering problems and creating innovation in their learning process, especially in the Integrated Product Design course and final year project. In addition, dominant in visual intelligent aids students in recognizing, manipulating and analyzing complex engineering problems.

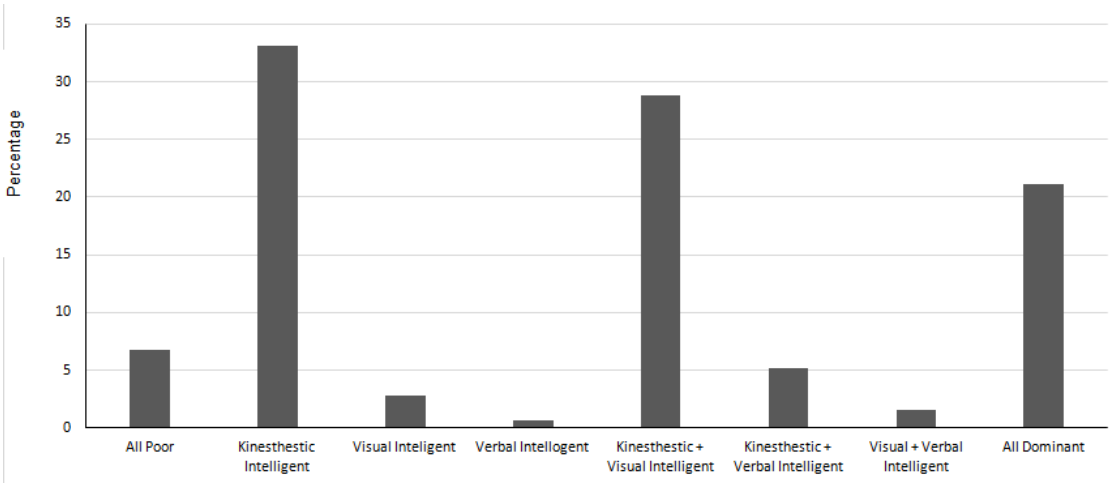

Fig. 1 Histogram plot of kinesthetic, verbal and visual intelligence distribution

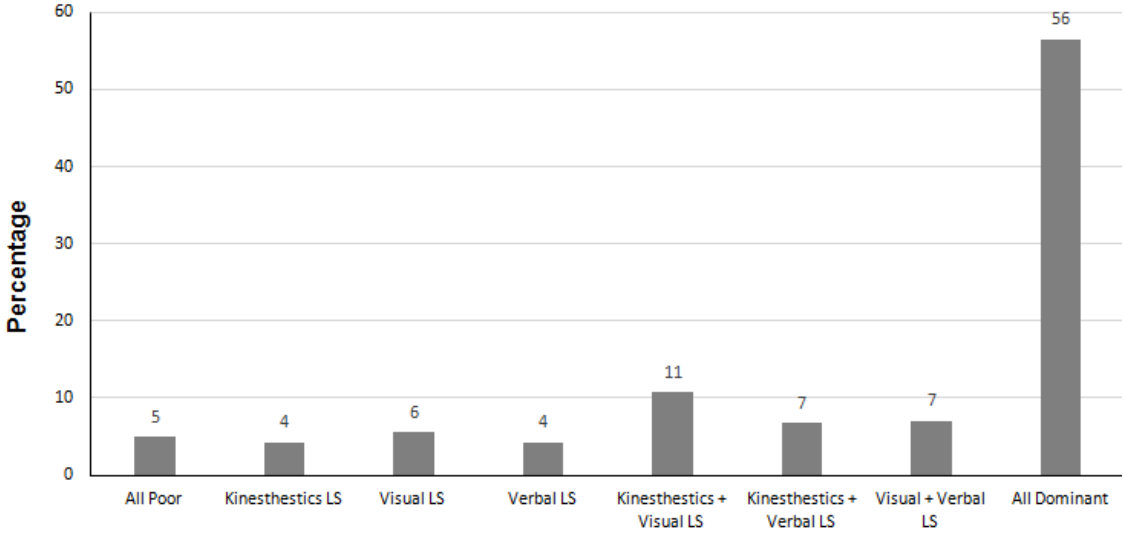

Fig. 2 Histogram plot of kinesthetic, verbal and visual learning styles (LSs) distribution

TABLE III
SUMMARY OF KINESTHETIC, VERBAL AND VISUAL LEARNING STYLES (LSS) DISTRIBUTION

	%		
	Total	Male	Female
All Poor	5	5	0
Kinesthetics LS	4	4	0
Visual LS	6	5	0.3
Verbal LS	4	4	1
Kinesthetics + Visual LS	11	9	2
Kinesthetics + Verbal LS	7	6	1
Visual + Verbal LS	7	5	2
All Dominant	56	47	10

The distribution of participants learning styles is summarized in Table III and Fig. 2. It is obvious that almost 50% of the undergraduate students in the Mechanical Engineering Faculty learn best in various styles of learning which are kinesthetic, verbal and visual learning styles. The result shows that most of the participants are able to learn in unlimited learning environment. The findings indicate positive feedback to the lecturers. This may allow flexibility to the lecturers in selecting diverse teaching strategies. With such findings, lecturers can apply various teaching styles that match well with the subject content, especially when it involves courses with a complex engineering problem. Some of engineering problems may effectively be taught using kinesthetic learning style, but others could be more efficient to use visual and verbal learning styles.

A correlation analysis using Pearson Correlation proved that there is a positive correlation between kinesthetic intelligent and kinesthetic learning style, verbal intelligence and verbal learning style and between visual intelligent and visual learning style. The Kinesthetic learning style and verbal intelligent are moderately correlated at the coefficient value of 0.087. The findings are consistent as reported by Narl et al. [17]. The results sound rationale since theoretically, students

with dominant kinesthetic intelligent will learn best in kinesthetic learning style as reported by Seifoori and Zarei [13]. Students with verbal intelligence dominant will learn best in verbal learning style and students with dominant visual intelligent will learn best in visual learning style. It is also notified that there is a significant inter-correlation between kinesthetic intelligent and, verbal and visual learning styles, verbal intelligent and visual learning style and visual intelligent and, kinesthetic and verbal learning styles.

TABLE IV
CORRELATION ANALYSIS BETWEEN KINESTHETIC, VERBAL AND VISUAL INTELLIGENCES AND KINESTHETIC, VERBAL AND VISUAL LEARNING STYLES

		Kinesthetic Learning Style	Verbal Learning Style	Visual Learning Style
Kinesthetic Intelligence	Pearson Corr.	0.387	0.249	0.356
	Sig (2-tailed)	0.000	0.000	0.000
Verbal Intelligence	Pearson Corr.	0.087	0.281	0.221
	Sig (2-tailed)	0.115	0.000	0.000
Visual Intelligence	Pearson Corr.	0.302	0.242	0.206
	Sig (2-tailed)	0.000	0.000	0.000

As demonstrated in Table V, there is a statistically significant correlation between kinesthetic, verbal and visual intelligences and academic performance (p-value< 0.05). A similar result is also observed on learning style. It is indicated that the p-value between CGPA and kinesthetic, verbal and visual learning styles is less than 0.05 which has proven that there is a significant relation between the two factors.

A correlation analysis also proved that there is a positive correlation between kinesthetic intelligent and kinesthetic learning style, verbal intelligence and verbal learning style and visual intelligent and visual learning style. The kinesthetic learning style and verbal intelligent are moderately correlated at the coefficient value of 0.087

The outcomes revealed that the kinesthetic, verbal and visual intelligences in conjunction with kinesthetic, verbal and visual learning styles are essential factors towards high academic performance of diploma students in the Mechanical Engineering. In other words, the combination of MIs and a variety of learning styles escalates the students to learn more effectively.

TABLE V
CORRELATION ANALYSIS BETWEEN KINESTHETIC, VERBAL, VISUAL INTELLIGENCE AND LEARNING STYLES

CGPA	Kinesthestic, verbal, visual Intelligent	Learning Style
Pearson Corr.	0.206	0.100
Sig (2-tailed)	0.000	0.000

Table VI illustrates the ANOVA results between male and female students toward the academic performances, CGPA, level of kinesthetic, verbal and visual intelligences and learning styles (kinesthetic, verbal and visual). The results affirmed that there is a significant relationship between male and female students for academic performances, level of kinesthetic, verbal and visual intelligences and types of learning style; kinesthetic learning style, verbal learning style and visual learning style.

TABLE VI
COMPARISON BETWEEN MALE AND FEMALE STUDENTS

	df	F	Sig
CGPA	325	7.998	0.005
Kinesthetic, Verbal, Visual Intelligent	325	4.005	0.046
Kinesthetic, Verbal, Visual learning style	325	6.795	0.010

VIII. CONCLUSION

The overall results demonstrated that almost one third of the mechanical engineering undergraduate students carries kinesthetic intelligent dominants. 29% are dominant in dual intelligent which are kinesthetic intelligent and visual intelligent and 21% exhibits dominant intelligent in all three intelligences; kinesthetic intelligent, verbal intelligent and visual intelligent. It is also observed that 50% of student's learn best in all three types of learning style which are kinesthetic learning style, verbal learning style and visual learning style. The results point out that all the learning styles should be taken into consideration during teaching and learning processes involving engineering students.

There is a significant correlation between kinesthetic, verbal and visual intelligences and learning styles involving kinesthetic, verbal and visual learning styles. Correspondingly, it is indicated that there is a significant correlation between academic performances and kinesthetic, verbal and visual intelligences and kinesthetic, verbal and visual learning styles.

The findings of this study suggested that the students carry varies intelligent dominants and learning styles. With such information, it will benefit the lecturers to design learning strategies effectively, which match perfectly with their MIs. Lecturers are also encouraged to work out on a variety of teaching styles as to encounter the diversity of students MIs and learning styles. In other words, a 'one size fits all' approach is no longer practical in the current educational environment. Hence, the university academics should be equipped with teaching skills or techniques adequately prepared for the teaching activities to meet up all discipline needs which should be aligned appropriately with the philosophies and methodologies of teaching.

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Salina Budin (Ir. Dr.) is currently a Senior Lecturer at Faculty of Mechanical Engineering, Universiti Teknologi Mara, Cawangan Pulau Pinang. She completed her undergraduate studies in Material Engineering (Hons) in 1993 at Universiti Sains Malaysia. 10 years later, she continue her post-graduate education at the same university and graduated with MSc (Mechanical Engineering) in 2003 and PhD in Manufacturing Technology in 2010. To further improve her skill in education, she have undergone a series of education training organized by the university.

Before appointed as a lecturer at UiTM last 12 years ago, she has gone through working experiences in three manufacturing industries and has deeply explored in various manufacturing functions such as product quality, product reliability, customer return, quality monitoring system, Lean management system and supply chain management.

Currently, she is a Corporate Member of Institute of Engineering (Malaysia) and Professional Engineer under Board of Engineer (Malaysia). Her current interest research fields including advanced material, powder metallurgy, machining and engineering education.

Nor Liawati Abu Othman was born in Johor, Malaysia, in 1980. She received the B.E. degree in Mechanical Engineering from the Universiti Teknologi Mara (UiTM), Malaysia, in 2004, and the M.Eng. degrees in Industrial Engineering from the Universiti Teknologi Malaysia (UTM), Malaysia, in 2009. In 2010, she joined the Department of Mechanical Engineering, Universiti Teknologi Mara, Cawangan Pulau Pinang, as a Lecturer. Her current research interest includes industrial engineering, engineering education and dynamics.

Shaira Ismail is a Senior Lecturer at the Faculty of Business Management, Universiti Teknologi Mara, Pulau Pinang. She has 15 years of working experience as the HR practitioner in the conglomerate company in Malaysia. She was the prosecuting officer handling employees disciplinary issues; attended Industrial Court Cases and conducted Domestic Inquiry. She is well-versed in the Administrative Law and Malaysian Employment Laws. Her areas of expertise are on Industrial Relations, Collective Bargaining and Trade Union, Employment Act and Labor Law, Performance Management System, Grievance Procedure, Employee Relations, HRM Strategic Planning, Organizational Development and Change Management, High Performance Work Systems (HPWSs), Training Needs Assessment, Operations Management, Education and Curriculum Development and any other business management related field.