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Multimodality in Education 4.0: A Case in an Engineering Context

S. Indra Devi[1], Farah Shahnaz Feroz[2], K. Kasturi[3], Shamsuri Md Saad[4], M.S. Linda Khoo[5]
[1]Pusat Bahasa dan Pembangunan Insan, Universiti Teknikal Malaysia Melaka (UTeM), Malaysia.
(Corresponding author: indradevi@utem.edu.my)
[2]Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer, Universiti Teknikal Malaysia Melaka (UTeM),
Malaysia. shahnaz@utem.edu.my
[3]Fakulti Teknologi Maklumat dan Komunikasi, Universiti Teknikal Malaysia Melaka (UTeM), Malaysia,
kasturi@utem.edu.my
[4]Pusat Bahasa dan Pembangunan Insan, Universiti Teknikal Malaysia Melaka (UTeM), Malaysia.
shamsuri@utem.edu.my
[5]Pusat Bahasa dan Pembangunan Insan, Universiti Teknikal Malaysia Melaka (UTeM), Malaysia.
linda@utem.edu.my

ABSTRACT

The emergence of Education 4.0 has enabled instructors to take advantage of multimedia resources, tools and interfaces in the teaching environment so as to prepare graduates for a global and digitalized work environment. This paper aims to investigate whether instruction based on the application of multimodality is effective in developing the oral communicative proficiency of learners with limited language proficiency in this Education 4.0 era and specifically in an engineering context. In this study, 15 students of limited language proficiency were immersed in multimodal enhanced classroom activities like creating video content, editing audio clips and other activities that facilitated meaning making. Classroom activities were designed and documented using The Learning by Design Model. The oral communicative proficiency levels of the learners were evaluated before and after 29 weeks of instruction using the Foreign Language Oral Skills Evaluation Matrix (FLOSEM). A Wilcoxon Signed-Ranks Test indicates a significant improvement in their proficiency levels despite numerous language inaccuracies. This study hence testifies that multimodality which advocates the affordances of media and modalities or a fusion of technologies to communicate knowledge is a step forward for future engineers to embrace Industry 4.0. Due to its effectiveness, this study calls for a design-oriented multimodal-based instruction in engineering institutions.

Key words : Education 4.0, Engineering context, Industry 4.0, Multimodality

1. INTRODUCTION

The world around us is changing and rapidly developing in the field of technology, specifically in the field of artificial intelligence. This has fueled the concept of Industry 4.0 which is driving intense transformation and sophistication to the nature of the future workforce. Industry 4.0 has been defined as a revolution that empowers the application of leading edge technologies (like IT) at the manufacturing level, hence benefiting customers and organizations in terms of values and services [1]. The relentless speed of development and changes has affected training in higher learning institutions which are mandated to equip undergraduates with new competencies that match the requirements of Industry 4.0. A re-bundling of old mindsets and traditional instructional methods is crucial so that undergraduates could be exposed to state-of-art digital tools and technologies as well as to be empowered with the required competencies and knowledge. Since education is considered to be a foundation of reform in a nation [2], revisiting instructional methods is deemed to be imperative. A reformation in the field of education is needed not only to meet the needs of the industry but also to ensure enrichment of learners' experiences. Thus, Education 4.0 has been recognized as an approach to learning and that aligns itself with the emerging fourth Industrial Revolution. It is against this background that this study investigates on the effectiveness of multimodality in developing the oral communicative proficiency of learners in an engineering context.

2. EDUCATION 4.0

The evolvement of the 3rd Industrial Revolution to the 4th Industrial Revolution has spurred a new trend of education called Education 4.0 which refers to upskilling via the deployment of technology in educational settings [3]. Learning is promoted in a different way whereby students do not only use text books and stationery as in traditional classrooms but instead learning takes place via the essential use of technology-based tools and resources. Basically,

Education 4.0 which reflects the Gen Z students' learning practices aims to prepare them to face future realism so that they would be able to thrive as qualified professionals in a global and digital environment of the 4th Industrial Revolution.

As elucidated by [4], Education 4.0 generally constitutes 9 aspects. Firstly, teaching and learning can be implemented anywhere irrespective of time and place, be it in class as a flipped in-class activity whilst the theoretical parts can be conducted as out-of-class activities. Secondly, learning will be primarily based on students' individual needs while at the same time augmenting their self-confidence via exposure to rich learning experiences. Thirdly, instructors can provide students the onus to select their preferable gadgets or techniques based on the pre-determined learning outcomes of the course. Education 4.0 will also be more project-based, and students will be exposed to more practical experiences. Sixth, curriculum design will be based on the diverse needs of students. Seventh, their subject content knowledge will be gauged during the in-class learning phase whilst their practical knowledge can be assessed while they are involved in field work. Eighth, students will be exposed to utilizing their reasoning skills to make inferences based on given data and finally students will be independent in their own learning while instructors assume new roles as facilitators. In short, with Education 4.0, future learning would become more customized, volatile, intelligent, global and virtual [5].

3. MULTIMODALITY IN EDUCATION 4.0

Multimodality [6] highlights the complex combinations between media, modes and semiotic resources. According to [7], it is recognizable in the texts found in new technologies such as in mobile phones, web pages, CDROM's, video games, computer software programs, digital photography and multimedia.

In short, it refers to the multiple media types used in teaching and learning [8]. Although the multimodal theory was developed in the 1990s, instruction based on multimodality has been proven to provide dynamic learning experiences to students. As stated by [9] in [10], multimodality in instruction helps students to exploit semiotic modes beyond verbal language such as visual, gestural and spatial. Classroom instruction in this study is based on multimodality which includes the utilization of concepts, methods and framework that has combined the linguistic, visual, audio, gestural and spatial modes. This variety of modes as seen in multimedia strategically involves words, sounds, visuals and other components that would enrich learning experiences. For example, infographics, videos, slides, visual worksheets that are used in classrooms involve captions, images, music, narration, animation that would stimulate students' multiple

senses. Hence, it is indubitable that harnessing instruction based on multimodality is prominent in Education 4.0.

4. ENGINEERS OF THE TWENTY FIRST CENTURY

Industrial Revolution 4.0 has resulted in engineering systems that are increasingly complex. According to [11] information and communication technologies (ICT) is now being deployed in every industrial domain. Since the internet of things (IoT), icloud, big data, connectivity and digitalization seem to be characteristics of IR 4.0, instructors in engineering institutions are required to integrate a wide array of these technological developments and sophisticated devices in teaching and learning activities [12]. In this context, multimodal learning which includes the utilization of different semiotic affordances of ICT has the potential to enable students to become active designers of learning due to their exposure to various modes and media. This will provide an avenue for the students to evolve as effective innovators in the rapidly evolving engineering landscape of Industrial Revolution 4.0. [13] postulates that the use of various digital devices has become a necessity in higher learning institutions. The use of a variety of high-tech teaching tools would provide great support as well as motivate students with diverse learning needs and styles besides engaging them with new experiences [14]. New trends like green engineering which are often overlooked are critical to innovation and should be integrated into engineering curriculum so as to expose students as well as assist them to bolster the adoption of Industry 4.0 [15]. Hence, the objective of this study is to identify whether instruction based on the application of multimodality is effective in developing the oral communicative proficiency of learners in an engineering institution.

5. LEARNING BY DESIGN MODEL AND KNOWLEDGE PROCESSES

The concept of design which is based on the multimodal and the Learning by Design (LBD) theory developed by The New London Group [16], [17] is embodied as the theoretical foundation for this study. The multiliteracies theory addresses the notion that both knowledge and meaning are 'designed artefacts' in which learners are inheritors and active designers of the patterns and conventions of meanings. The concept of design as advocated by [18] includes the designing of the learning processes and environments by teachers and learners' knowledge on literacy while they are involved in the process of meaning making.

The meaning making process involves six design elements and modes of expression that include linguistic design such as vocabulary and metaphor, visual design that includes colours and perspectives, audio design comprising music and sound effects. The remaining designs include gestural, spatial and the multimodal that include a combination of all the five modes of meaning.

Design as advocated by [16] is a robust and metamorphic process consisting firstly of 'The Design' which constitutes life-world resources or discourses of meaning in a specific aesthetical context. Second is 'Designing' which comprise the process of framing the emergent meaning besides exemplifying and re-contextualizing it. Finally, the third is 'The Redesigned' meaning the outcomes resulting from the designing. In this process, the meaning-maker is a true designer as new meaning-making resources are created.

Pedagogy based on LBD encompasses 8 processes of knowledge, namely, experiencing the known, experiencing the new, conceptualizing by naming, conceptualizing with theory, analysing function, analysing critically, applying appropriately and applying creatively.

[18] who initially formulated the Learning by Design theory as four main concepts, namely, situated practice, overt instruction, critical framing and transformed practice. The four concepts were then simplified into four main processes of knowledge and every knowledge process signifies a particular way of learning. Instructors could design their pedagogy by including the knowledge processes in any order. During instruction, the instructors could take the necessary measures to identify the learning outcomes that have been achieved based on the selected knowledge processes. These main knowledge processes that include experiencing, conceptualizing, analysing and applying and their sub-divisions are as in Table 1 below.

Table 1: Knowledge processes and Learning by Design Concepts

Knowledge Processes	Learning by Design Concepts
Experiencing the known Experiencing the new	Situated practice
Conceptualizing by naming Conceptualizing with theory	Overt instruction
Analysing function Analysing critically	Critical framing
Applying appropriately Applying creatively	Transformed practice

This study hopes to bridge the gap on the body of knowledge related to the significance of instruction based on multimodality as past studies did not explore on its relevance to learners of limited language proficiency in the Education 4.0 era and in the engineering context in Malaysia.

6. METHOD

This case study was conducted in an engineering institution in Malaysia. The study was conducted on 15 third-year undergraduates with a Band 1 and 2 in the Malaysian University English Test (MUET). According to the MUET band description, a candidate with Band 1 is identified as an extremely limited user with a poor command of the language. A candidate with Band 2 is identified as a limited user with a limited command of the language. Purposive sampling was used in the selection of these undergraduates. Firstly, their oral communicative proficiency was pre-tested when they participated in a two-minute impromptu speech.

The Foreign Language Oral Skills Evaluation Matrix (FLOSEM) was used to evaluate their oral proficiency measures along five dimensions that include content, fluency, vocabulary, pronunciation and grammar. FLOSEM rates the students' oral abilities in each of the five dimensions from Level 1 to Level 6, 1 being the lowest mark and 6 being the highest. The scores based on the five dimensions were added up to obtain the final score which determined the learners' oral communicative proficiency levels. There are six proficiency levels that include Pre-production (Level 1), Early Production (Level 2), Speech Emergence (Level 3), Intermediate Fluency- Low Intermediate (Level 4), Advanced Fluency- High Intermediate (Level 5) and Advanced – Native-like Speaker (Level 6).

Taking into consideration the learners' performance and interest, they were exposed to 17 weeks of the immersion phase in which they were involved in out-of-class activities using the group Facebook for the discussion of social issues posted by the instructor. They were also involved in online threaded discussions in the specially designed website and webpages where sharing of resources and new content took place. Asynchronous Forum discussions were also held in the learning management system. They were required to record and edit audio clips using tools such as Soundcloud and Vocaroo. Besides, they were involved in creating video content based on their presentations using YouTube video editor.

This was followed by 12 weeks of the instructional phase where they were exposed to topics on group discussion, job interview and group presentation. The in-class activities for the teaching of the instructional components were based on the Multimodal Instructional Template (MIT) that was devised by the instructor as a curriculum planning tool and as a guideline for the teaching of group discussions, job interviews and group presentation. Each of the component was taught for four weeks based on the MIT and the learning process was analysed using an observation form.

The MIT was devised based on multimodal activities and the Learning by Design knowledge processes. The template was divided into various columns that include knowledge objective, learning element, knowledge processes, curriculum orientation and multimodal resources. After 29 weeks of in

and out-of-class, project-based activities, a post-test was held following the procedures as in the pre-test. A Wilcoxon Signed-Ranks Test was conducted to identify if a difference was evident in their achievement based on the pre-test and post-test.

7. RESULTS AND DISCUSSION

From the findings, it is evident that the learners had the highest percentage of improvement in the Vocabulary Dimension with 45.7% more marks in the post-test compared to the pre-test. The next highest percentage of improvement was noted in the Fluency Dimension with 41.7% more marks in the post-test compared to the pre-test as presented in table 2.

Table 2: Percentage of improvement in the dimensions

Dimensions % increase (in the total)	Dimensions % increase (in the total)
Content	31.1
Fluency	41.7
Vocabulary	45.7
Pronunciation	23.9

As for vocabulary, the post-test results revealed that 6 out of the 15 participants (40%) are at Level 4 meaning that they clearly demonstrate knowledge on synonyms and alternative ways of expressing simple ideas as well as have enough vocabulary to participate in conversations. Another 9 participants (60%) are at level 3 implying that they have a limited number of alternative ways to express simple ideas. According to [18], this condition could be improved by exposing them to traditional word lists, multiple word meanings, idioms etc. that would enable them to function in a relaxed way without having to translate from their first language.

A Wilcoxon Signed-Ranks Test run on the pre-test and post-test scores indicated a significant difference in the oral communicative proficiency levels of the learners (Z = 3.41, p < .001). This indicates that the implementation of the Learning by Design method had resulted in a statistically significant improvement in the oral communicative proficiency scores at α = .05. Median of Pre and Post test scores are as depicted in Figure 1 that follows.
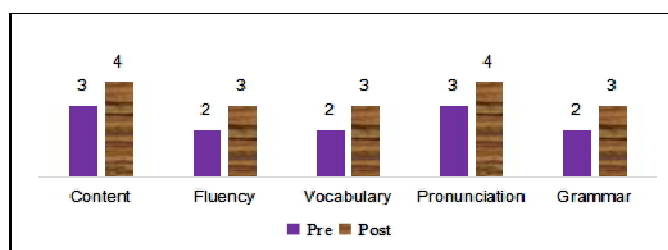
Figure 1: Median of Pre and Post Test Scores

Table 3: Pre and post test scores in the oral communicative proficiency levels

TEST	PAIRED DIFFERENCE		
	Median	N	Range
Pre-test	13	15	6
Post-test	17	15	5

It is important to point out that there was a considerable variation in the post-test results. It was found that all the 12 students who were at the Speech Emergence level during the pre-test had improved and they were at the Intermediate Fluency (Low Intermediate) level. The other three who were at the Intermediate Fluency (Low Intermediate) reached the Advanced Fluency (High Intermediate) level as depicted in Table 3.

It is to be noted that there were three participants with MUET Band 2 and 12 with MUET Band 1. As the sample sizes were drastically different between the groups, a non-parametric Mann-Whitney-U test was conducted to check the effectiveness of the teaching method in terms of the improvement of participants' scores with respect to their MUET band as in Table 4 below.

Table 4: Mann-Whitney-U Test

	Rank Sum Band 1	Rank Sum Band 2	U	Z adjusted	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]
C	102	18	12	2	0.0455	0.4483
F	96	24	18	0.00	1.0000	1.0000
V	97.5	22.5	16.5	0.50	0.6171	0.8396
P	92.	28	14	-0.632	0.5277	0.6330
G	87	33	9	-1.528	0.1266	0.2330

C - Content   F - Fluency   V - Vocabulary
P - Pronunciation G - Grammar

Results show that the test was not significant in all the five dimensions that include content, fluency, vocabulary, pronunciation and grammar. At the 5% level of significance, there was no significant difference between participants with MUET Band 1 and Band 2 in terms of the improvement in their scores in all dimensions.

The instructor as the designer of the classroom activities has given prominence to the application of multimodality as well as establish the design process by allowing the students to experience the knowledge processes. Concurrently, while being engaged in the process of handling Available Designs, Designing and Redesigning, learners were immersed in

activities that enabled them to express their knowledge via the different multimodal semiotic modes. This is in line with [20] who mentions that thoughtfully designed multimodal activities enables learners to develop their language skills and language components.

Despite the numerous deficiencies and inaccuracies in the language, all the participants reflected various levels of fluency and all of them could communicate their message. In the context of this research, emphasis is placed upon achieving fluency as opposed to the traditional form-focus or accuracy.

8. CONCLUSION

The results of this study suggests that multimodal applications are effective in teaching and learning, specifically in developing oral communicative proficiency of learners. Although it was introduced by [18] in the early 21st century, this research has proven that it is still applicable in Education 4.0 of today. It also has the potentials to be further researched in line with the needs of future societies.

The instructor, as the designer and manager of the learning has been able to involve the participants in a range of knowledge processes, foster collaboration among group members and enable them to explore, reflect and comment, hence keeping them involved, motivated and engaged. This has been evidenced in various other research in past literature such as [21] and [22].

The findings highlight the importance and the effectiveness of multimodality as the results confirm that the learning environment that is planned with the inclusion of multimodality and in accordance to the LBD model has been very effective. It goes without saying that the provision of multimodality harnessed with activities designed based on the LBD model makes a strong case for its important contribution to the oral communicative proficiency development of learners with limited language proficiency in engineering institutions. Hence, this study calls for an instructional shift, thus adding to the body of scholarly knowledge on engineering education with special focus on the significance of the multimodality in teaching and learning specifically for limited language learners.

This study calls for an instructional shift for an instructional shift to a design-oriented multimodal-based instruction for learners with limited language proficiencies in engineering institutions. Since engineering institutions play a prime role in transitioning the world towards sustainable development, there is a future need to re-orient their programs. Future research could focus on the assessment methods.

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