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Lessons from a Blended Learning Implementation – What to do and what not to do?

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***Abstract*— Blended learning has taken its importance due to the turbulent ripple in teaching learning process in the past few years. Increase in online teaching expertise among the instructors has paved the way for developing online repositories and thus leading to blended mode offering of courses. But there exists a question "What is the pedagogy for every online repository to be converted to blended learning?" There must be few dos and don'ts in every implementation of any new pedagogical techniques. This research attempts to find a new pedagogical framework for effective implementation of blended learning into the regular curriculum after identifying appropriate learning method. The research is conducted as quantitative research with surveys obtained from students and faculty of the host institution after the first cycle of blended learning implementation in a computer science course. 40 students participated in the learning and recorded their responses through an online survey. Observations from the survey are analyzed in the perspective of different factors of blended learning with statistical analysis and Natural Language Processing (NLP) methods. From the study, it has been inferred that students recognize blended learning as an innovative pedagogical technique provided with factors that motivates and demotivates them. From these observations, suitable recommendations are made in terms of what to do and what not to do and a framework for effective implementation of the blended mode of learning is proposed.**

***Keywords*— Blended learning; Learning framework; New Pedagogy ; Student expectation; Faculty expertise**

***JEET Category*—Research**

I. INTRODUCTION

Education is a slowly growing field in terms of economic, political and market demands, but always tries to cater to the holistic needs of learners. The evolvements in this field include new educational frameworks, different pedagogical

interventions and introduction of technology enabled tools for content delivery and assessments. The intrusion of technology in learning has paved the way for online learning through various Massive Open Online Courses (MOOC) and blended learning that are implemented along with MOOC.
According to Cambridge dictionary, Blended learning is a way of learning that combines traditional classroom lessons with lessons that use computer technology and may be given over the internet. Many instructors have ideas about blended learning as a teaching method incorporating content videos and follow up discussion. It is a mixture of online learning and classroom learning planned meticulously with very clear content designed especially for the purpose and appropriate practice and assessment activities. Hence, the implementation of the blended learning needs some research.

Transforming from a conventional method of teaching to a different form of teaching is a cakewalk only for the persons who have already exercised the relevant tools and techniques (Sun, Strobel & Newby, 2017). And, it is essential that the implementation of any new pedagogical activity should meet the students' expectations. But with little or no experience of blended learning among the teachers, the implementation may be dangerous to the learners (Moskal, Dziuban & Hartman, 2013). Hence the identification of factors that may help teachers to switch to the new mode of teaching is essential. By observing various research studies, there are many factors that have influence on the success of blended learning. There are certain learner factors such as age, preference, study habits, motivation and involvement learners. From the instructors' perspective there are factors such as quality of material, activities, learning support and workload assigned (Lim & Morris, 2009, Chen & Yoa, 2016). As the role of instructors is very much crucial in the implementation of blended learning irrespective of the variabilities found in students, this research study is interested in finding out the influence of instructor's efficacy in content development and pedagogy of blended learning. This study tries to bring the answer for the question *"What are the dos and don'ts of a successful blended learning implementation?"* with appropriate methods and materials.

II. LITERATURE REVIEW

There are two major models in implementing blended learning: Program-flow model which is executed by students and core-and-spoke model executed by the instructors (Hoic-Bozic et al., 2008). A literature survey of 56 blended learning studies has been done and declared that blended learning may have a positive effect on knowledge acquisition (Vallee et al., 2020). For effective implementation of any models of blended learning, the faculty's willingness and expertise is very important in various aspects of development including technical domain knowledge, content creation knowledge and pedagogical knowledge (Smith & Hill, 2018). A study has reported the unsuccessful attempt of blended learning due to the lack of expertise and coordinated efforts among faculty (Tshabalala et al., 2014). The efficiency of blended learning implementations is usually assessed with the feedback responses of the students. The feedback responses usually include common parameters like ease of use, enjoyable, motivating, active participation in Likert scales (Hoic-Bozic et al., 2008, Tshabalala et al.m 2014, Fernandes et al., 2020, Acar & Kayaoglu, 2020). Another research has used a questionnaire survey that focused on the participants' perceptions of their engagement with blended learning, their motivation, learning autonomy and overall satisfaction and found blended learning create an efficient learning environment (Wang et al., 2021). A study has considered students' emotional and cognitive engagement (Halverson & Graham, 2020) in a blended learning environment in the perspective of student.

A research work has analyzed the online component of blended learning and has reported many student-level challenges. Among those, student isolation due to lack of interaction, poor understanding of the learning objectives and the quality of videos are major challenges that includes instructor's efficacy in implementing blended learning (Rasheed et al., 2020). The same study has reported that from the students' point of view, careful structuring of the face-to-face and online components would lessen the challenges. For teachers, the major challenges are technological illiteracy, creation of quality videos and change in belief in using blended learning environment. A team of researchers (Bouilheres et al. 2020) has considered in-depth questions on blended learning including the major aspects of blended learning like student-student, student-instructor interaction, and online access pattern of learning materials. As this proposed work approaches the implementation of blended learning in the perspective of instructors, a detailed survey is needed in observing specific details related to the dos and don'ts of a blended learning implementations considering the student expectations.

III. RESEARCH QUESTIONS

As per the observations derived from the literature study on the research theme, the following research questions have been formulated for the research.

RQ1. What are the factors that motivate and demotivate students in a blended learning environment?

RQ2. What is the design of a blended learning framework expected by a student?

IV. EXPERIMENTAL SETUP

This research is proposed as an experimental implementation of blended learning and following quantitative analysis with survey responses collected from students. The research is conducted with the Post graduate students of Thiagarajar College of Engineering, Madurai, India in a course entitled "Predictive Analytics". 40 students of the course have participated in the experiment. A blended learning dashboard has been created for the course in moodle platform as shown in Fig 1. The course shall be accessed at https://www.tce.edu/tce-mooc/21tocds02 and currently available for the students of the institution.

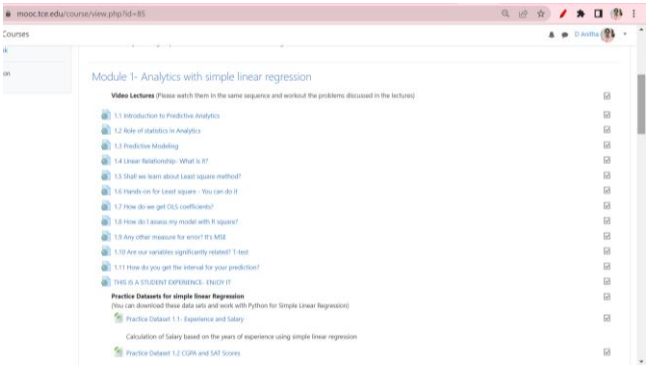

Fig 1. Blended learning environment in Moodle

Table I lists the major topics of the syllabus and mode of addressing. Every week has four sessions for the course in which the students shall be viewing the learning material for 30 minutes and relevant discussion or follow-up activities shall go on for the other 30 minutes in each session. The learning materials are in the form of pre-recorded lectures prepared by the instructor as the student preference is high for this type of content delivery (Attard & Holmes, 2020; Anitha & Kavitha, 2021). The follow up activities are quiz and discussion on the questions raised by the students on the video content and are done in regular face-to-face mode as in the traditional classroom setup. Sample videos of the same shall be accessed at https://drive.google.com/drive/folders/1FIS937T8VHYK8xjzeRaBYpToIvkP3XaW?usp=sharing

TABLE I
SYLLABUS TOPICS

Topics	Mode of learning
Simple Linear Regression	Blended Mode
Multiple Linear Regression	
Logistic regression	
Improving performance measures	
Time series Analysis	Face-to-face mode

A student survey questionnaire has been designed with three important factors that are essentially be addressed in a blended mode of learning (Bouilheres et al. 2020): 1. Organization of blended learning sessions with appropriate goals and sequence of sessions 2. Quality of learning materials with interactive elements in making the concept understandable 3. Student efficacy in managing and gaining knowledge in a blended learning mode. These 3 factors are observed with 5-point Likert Scale (Strongly agree, agree, neutral, disagree, strongly disagree). Additionally, the open responses from the students are recorded about the features that are most appreciated and missed in a blended mode of learning. Also, students give open responses for three other questions: 1. Quality of interaction between students and the instructors 2. Challenges/difficulty faced 3. Suggestions for improving the blended learning. Table II shows the list of parameters in the survey questionnaire with Likert scale responses and open responses. The student survey response is designed considering the earlier works (Lim & Morris, 2009, Chen & Yoa, 2016; Bouilheres et al. 2020). The designed student survey questionnaire is available at https://docs.google.com/forms/d/1xW-rKnq6-XEohZvV4JL23DmN_rxf6IO6CgDra4vSWdk/edit#responses.

TABLE II
LIST OF FEEDBACK PARAMETERS IN SURVEY QUESTIONNAIRE

Factor	Feedback Parameters	Reference Name
Organization of sessions (Likert Scale)	1a. Learning objectives are made clear with appropriate plan and instructions before the start of the sessions (Likert scale)	LO clear
	1b.Organized and well planned sequence of learning (Likert scale)	sequence
	1c. Tasks given after the videos are structured and engaging (Likert scale)	Tasks
	1d. It is easy for me to understand the concepts after watching the videos (Likert scale)	easy
Quality of learning materials and interaction (Likert scale)	2a. The videos are engaging and interesting (Likert scale)	interesting
	2b. The audio and video quality of lecture videos are very good (Likert scale)	Quality
	2c. Instructors' own videos are more effective than any other videos available in web (Likert scale)	Own videos
	2d. The lecture videos are well structured and interactive (Likert scale)	Interactive
Blended learning – Student efficacy in managing and gaining knowledge in blended mode of learning (Likert scale)	3a. Discussion after the videos are very helpful in getting higher knowledge (Likert scale)	Higherknowledge
	3b. Work load of watching and doing is balanced (Likert scale)	workload
	3c. Appropriate guidance and time is provided to use the knowledge acquired to the next level (Likert scale)	Guidance
	3d. Blended learning mode increases the performance in the assessments (Likert scale)	Performance
	3e. It was easy to reach higher knowledge with suitable tasks following the videos (Likert scale)	taskknowledge
4.Appreciable factors in blended learning (open response)		
5. Missing factors in blended learning (open responses)		
6.Personal Interaction among students and instructor (Open response)		Personal interaction
7.Challenges/ difficulty faced (Open response)		Challenges
8.Suggestions to improve user experience (Open response)		Suggestions

To address research question 1, the Likert scale responses of the students are analysed. The feedback parameters are analyzed with spearman rank correlation as the data is not normally distributed (Demaidi et al., 2019). The parameters that are highly correlated and with greater positive responses shall be considered as the factors that motivate the students to take up the blended learning while the other parameters must be taken care during the blended learning implementation as the student's feedback on those parameters is less. Similarly, the responses of the students for the open question "Challenges or difficulty faced" are analysed with NLP tool to get the more frequently occurring bigrams (two continuous words) after removing the common words and repeated words. The words extracted gives the demotivating factors for the blended learning implementation.

To address research question 2, the open feedback responses of the students are analysed for the questions "What are the appreciable factors in blended learning? And what do you miss in blended learning?". Frequencies of common words are found with NLP toolkit in **Python** and a word cloud is formed. By observing the word cloud formed the concerns of the students are identified. Specific comments containing the high frequency words are analysed for getting the expectations of students in a blended learning environment. The other two survey elements "Interaction", and "Suggestions" are analysed in a similar way as the challenge. The identified words are manually analysed to identify their needs of interaction and recommendations in effective implementation of blended learning. The statistical analysis and natural language processing of the observed data has been carried out in **Python**. Figure 2 gives the pictorial representation of the analysis methods described above.

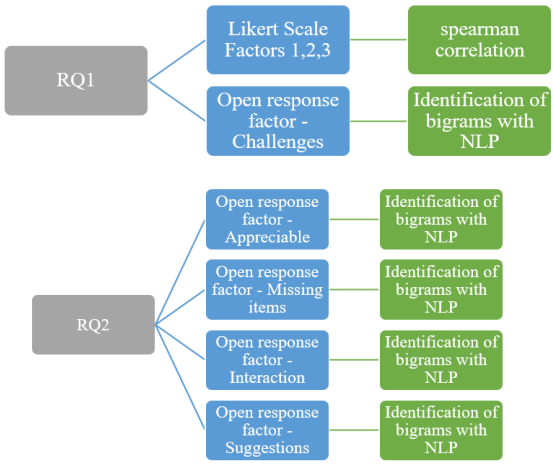

Fig 2. Data analysis methods

V RESULTS

After the experimentation of blended learning, the feedback questionnaire is circulated among 40 students among which 32 have recorded their responses. Table III gives the feedback responses for each parameter in %. Figure 3 gives the correlation heat map of the response parameters after performing spearman correlation. Figures 4 and 5 show the word cloud for the appreciable and missing factors in blended learning mode from NLP tool kit of Python.

TABLE III
STUDENT RESPONSES IN %

Parameters	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
LO clear	46.875	40.625	12.5	0	0
sequence	40.625	46.875	6.25	6.25	0
workload	28.125	12.5	28.125	28.125	3.125
easy	40.625	34.375	12.5	9.375	3.125
interesting	40.625	34.375	18.75	0	6.25
quality	53.125	40.625	6.25	0	0
own videos	46.875	25	15.625	12.5	0
interactive	40.625	31.25	25	3.125	0
Higher knowledge	43.75	34.375	15.625	0	6.25
tasks	34.375	56.25	6.25	3.125	0
guidance	43.75	28.125	21.875	6.25	0
performance	40.625	18.75	28.125	12.5	0
Task knowledge	37.5	37.5	12.5	9.375	3.125

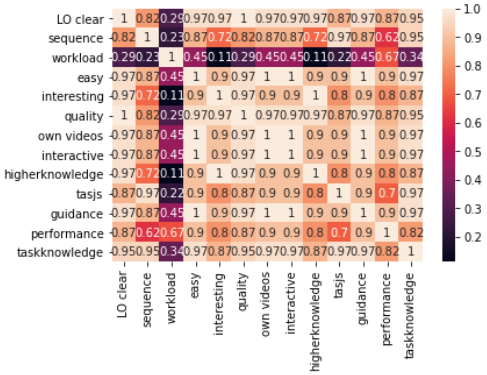

Fig 3. Correlation heat map of parameters

Fig 4. Highly appreciable factors of blended learning

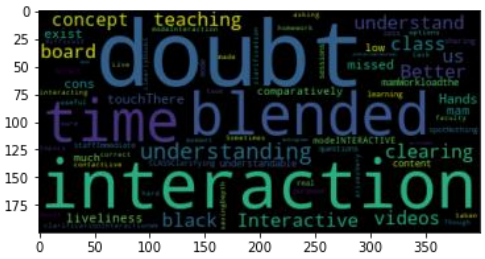

Fig 5. Highly missed factors in blended learning

After processing the open responses of the students for the questions “Interaction”, “Challenges” and “Suggestions” with NLP tool, the bigrams (two continuous words) are identified along with their frequencies. Table IV lists the top 10 bigrams after processing with NLP toolkit after removing common stop words and repeated words for the three parameters.

TABLE IV
IDENTIFIED BIGRAMS

INTERACTION	CHALLENGES	SUGGESTIONS
Interactive session	Take notes	Board teaching
After-video discussion	Time factor	30%online 70%offline
Student perspectives	Sufficient time	Taking notes
Comparatively low	Slightly collapsed	More interactive
Less interaction	Daily workload	Normal teaching
	Less interaction	Unavoidable situations
After-video discussion	Instant clarification	Primitive method
Understand things	Faster pace	Simple topics
Really good	Couldn’t cope	Black board
Comparatively less	ARIMA model	Great initiative

VI DISCUSSION

Analysis of the results obtained is essential in implementing blended learning effectively. From the responses tabulated in Table III, Table V has been formulated with the parameters rated with positive responses (Strongly agree & Agree).

TABLE V
POSITIVE RESPONSES

Positive responses > = 80%	**Positive responses 70% to 80%**	**Positive responses <= 60%**
Quality (93.75)	Higher knowledge (78.13)	Workload (59.4)
Tasks(90.625)	Easy(75)	Performance (40.6)
LO clear (87.5)	Interesting (75)	
Sequence (87.5)	Task knowledge (75)	
	own videos(71.9)	
	Interactive(71.9)	
	Guidance(71.9)	

In Table IV, the four parameters that are rated above 80% are dependent on the instructor's efficacy on preparing the content and the organization of content. The parameters that are rated between 70% and 80% are the ones that represents the quality of materials with appropriate interaction and the student efficacy in understanding the concept. The parameters that are rated under 60% are part of students' efficacy to manage themselves in a blended learning environment. From this observation from Table IV, the greatest concern in a blended learning environment is improving the student efficacy in managing their workload and performance in a blended learning environment. The blended learning environment shall provide opportunities for the students to balance their workload and improve the performance in assessments. To provide these opportunities, the factors that fall in the range of 70% to 80% shall be also improved. These factors include interaction and student efficacy parameters. It is well understood from the responses that though the blended learning is designed exceptionally with good materials and effective organization of sessions, the student efficacy has to be improved with interaction and guidance for balanced workload.

From the heat map presented in Figure 3, let us take the parameters having correlation less than 0.7 (Bujang & Baharum, 2016). Table VI gives the list of parameters for every other parameter for which the correlation is less than 0.7. From the correlation, it can be understood that even with higher level of organization and quality materials in a blended mode of learning, the management of workload and performance of student need not be satisfactory and hence special attention needs to be paid to improve the management of workload and performance assessment activities.

TABLE VI
CORRELATION OBSERVATION

Parameter	**Less correlated parameters**
LO clear	Workload
sequence	Workload, performance
workload	All the other parameters
easy	Workload
interesting	Workload
quality	Workload
own videos	Workload
interactive	Workload
Higher knowledge	Workload
tasks	Workload, performance
guidance	Workload
performance	Sequence, Workload, Tasks
Task knowledge	Workload

Next, the appreciable factors and missed factors in a blended learning mode shall be analysed with the word clouds given in Figures 4 and 5. The most appearing words are given below for both the parameters,

Appreciable: Video, whenever, watch, notes, time, revisit, rewatch, revise, anytime,
Missed: Interaction, doubt, board, liveliness

From the identified words, it can be easily observed that the highly appreciable factor of blended mode of learning is the rewatchable videos that enables taking notes at anytime and anywhere. However, the students miss the liveliness caused by the interaction that an instructor makes for clarifying doubts and explaining on boards.

As table IV presents the bigrams listed for the parameters "Interaction", "Challenges" and "Suggestions", the bigrams are analysed for capturing the student thoughts on these parameters. From the Interaction parameter, it can be observed that though the students understand things and perceive this initiative as a good one, they have a feel of comparatively lesser interaction than regular teaching sessions. They demand a better after-video discussion and interaction. From the challenges parameter, more demotivating factors are observed including lesser time to take notes, increasing daily workload, faster pace of teaching concepts and again, a lesser interaction. They could not cope up with this new mode of learning environment and felt slightly collapsed. So, what do they want? The following suggestions are observed from the bigrams of suggestions parameter.

1. More interactivity (Attard & Holmes, 2020)
2. 30% of topics, especially simple topics, shall be in learning materials while the discussion and interaction from the instructor is expected for higher level problem solving
3. Use of black board in teaching is still highly recommended by students

From the observations made from all the parameters, a consolidated recommendation shall be given as below. Table VII gives a list of Motivating and Demotivating factors for effective implementation of blended learning environment answering to research question 1.

TABLE VII
MOTIVATING AND DEMOTIVATING FACTORS

Motivating factors	**Demotivating factors**
Clear Learning objectives with appropriate instructions	Inability to balance workload in watching and doing due to time factor

Learning materials of good quality audio and video	Missing periodical performance assessments
Engaging and interactive video design	Lesser interaction during the follow up activities after watching videos
Appropriate tasks matching the content of videos	Higher level concepts are not understandable without interaction
Sequential organization of follow up tasks	Lack of timely guidance from the instructor
Learning material of basic concepts is easy to understand	
Discussion after the videos on higher level concepts	

From Table VII we shall arrive at the answer for this research work. What to do and what not to do? This shall be explained in terms of 3 dimensions: Faculty preparation, Content delivery and Assessments.

A. What to do?

1. Initial Preparation
   a. Developing instructor efficacy in creating content
   b. Familiarizing with different ICT tools and pedagogic activities

2. Content delivery
   a. Establishment of clear learning objective
   b. Development of good quality engaging video materials mapping to the given learning objectives
   c. Design of pedagogical activities after watching every video suitable to the outcome to be attained
   d. Basic concepts shall be given as video materials and concepts related to higher cognitive skills shall be dealt with appropriate activities or discussions in class room sessions
   e. Timely guidance and motivation by the teacher

3. Assessment
   a. Periodical ungraded assessments for practice
   b. Periodic feedback and correction

B. What not to do?

1. Initial Preparation
   a. All the courses suddenly getting transformed into blended learning mode
   b. Too much of technical training related to video preparation and editing to faculty
   c. Non interacti

2. Content delivery
   a. Not considering student workload in watching the lecture and writing notes
   b. Lesser interaction after every video
   c. Disinteresting pedagogical interventions
   d. Using videos and materials of others without contextual introduction

3. Assessment
   a. Lack of timely support for assessments
   b. Summative assessments only

With an understanding of what to do and what not to do, a blended learning framework is formulated. Figure 6 presents the framework based on the expectations of a student in two different phases: instructor and instructor-student interaction. For effective implementation of blended learning, an instructor must be a master in content, learning material preparation and in pedagogical organization and hence need to develop oneself in all these. The learning materials and related tasks are to be developed by the instructor in Phase 1. The second phase where instructor meets students must be carefully designed with appropriate introduction to make the students ready. One of the major challenges that the student faced was the time factor and hence appropriate time must be granted for watching the learning material and thereby reducing their workload. Interaction has been recognized as an important demand from the student and hence every learning material needs interaction and discussion, thereby leading to higher knowledge from the basic concepts. At every stage of learning, appropriate guidance and support must be provided by the instructor to apply the knowledge. Finally, performance improvement had been a concern of the students. Periodical performance assessment is necessary for every part of acquired knowledge.

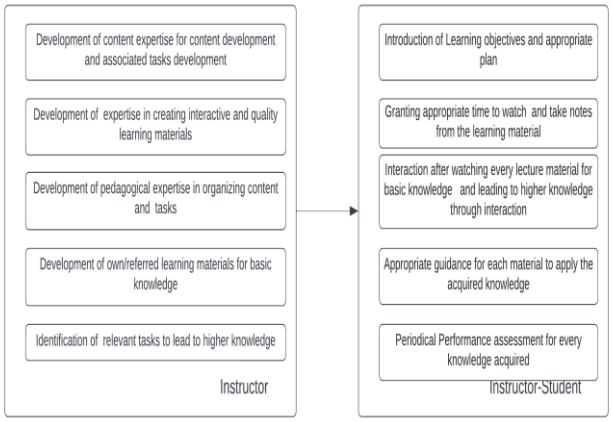

Fig 6. Blended Learning Framework

VII CONCLUSION

This research work has been carried out as a case study in experimenting blended learning in regular curriculum in which a course has been partially designed in blended learning framework. There is a need of identifying the factors that motivates the students to take the blended learning environment. There is also a need of removing the factors that demotivates them. This research work identifies these factors and shall set the pathway for implementing an effective blended learning framework. The needs and challenges of the students are addressed and thus leads to a blended learning framework design. This framework shall be a guideline for every trial of setting up a blended learning environment. The

framework contains only the recommended practice that enhances the experience of the blended learning environment.

This research work has its major limitation in the number of students(n=40) that this study has been experimented. The instructor who conducted this experiment has undergone various pedagogical training programs including training in creating interactive videos and has good technical knowledge in the designed course. Hence, the instructor efficacy is high in this experiment. However, in realization of this blended learning, the major obstacle that may hinder the process of blended learning may be the lack of content expertise, lack of expertise in developing interactive learning materials and the lack of appropriate pedagogical activities in the classroom sessions. Hence, rigorous training must be given to the instructors both in technical domain and pedagogical domain before the implementation of any blended learning framework. The future work pertaining to this research work is the analysis of the performance assessment scores in formative and summative examination which may lead to more insights on the implementation. If a blended learning environment is implemented satisfying all these needs, a new venture opens in education.

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REFERENCES

Acar, A., & Kayaoglu, M. N. (2020). MOODLE as a Potential Tool for Language Education under the Shadow of COVID-19. Eurasian Journal of Educational Research, 90, 67-82.

Al-Busaidi, K. A. (2012). Learners' perspective on critical factors to LMS success in blended learning: An empirical investigation. Communications of the Association for Information Systems, 30(1), 2.

Anitha, D., & Kavitha, D. (2021). Is long-serving teaching experience a barrier of transformation in online teaching?–An exploration. J. Eng. Educ. Transform, 34, 201-205.

Attard, C., & Holmes, K. (2020). An exploration of teacher and student perceptions of blended learning in four secondary mathematics classrooms. Mathematics Education Research Journal, 1-22.

Bouilheres, F., Le, L. T. V. H., McDonald, S., Nkhoma, C., & Jandug-Montera, L. (2020). Defining student learning experience through blended learning. Education and Information Technologies, 25(4), 3049-3069.

Bujang, M. A., & Baharum, N. (2016). Sample size guideline for correlation analysis. World, 3(1), 37-46.

Chen, W. S., & Yao, A. Y. T. (2016). An empirical evaluation of critical factors influencing learner satisfaction in blended learning: A pilot study. Universal Journal of Educational Research, 4(7), 1667-1671.

Demaidi, M. N., Qamhieh, M., & Afeefi, A. (2019). Applying blended learning in programming courses. IEEE Access, 7, 156824-156833.

Fernandes, R. A. M. L., de Oliveira Lima, J. T., da Silva, B. H., Sales, M. J. T., & de Orange, F. A. (2020). Development, implementation and evaluation of a management specialization course in oncology using blended learning. BMC Medical Education, 20(1), 1-10.

Halverson, L. R., & Graham, C. R. (2019). Learner engagement in blended learning environments: A conceptual framework. Online Learning, 23(2), 145-178.

Hoic-Bozic, N., Mornar, V., & Boticki, I. (2008). A blended learning approach to course design and implementation. IEEE transactions on education, 52(1), 19-30.

Moskal, P., Dziuban, C., & Hartman, J. (2013). Blended learning: A dangerous idea?. The Internet and Higher Education, 18, 15-23.

Nortvig, A. M., Petersen, A. K., & Balle, S. H. (2018). A Literature Review of the Factors Influencing E-Learning and Blended Learning in Relation to Learning Outcome, Student Satisfaction and Engagement. Electronic Journal of E-learning, 16(1), pp46-55.

Rasheed, R. A., Kamsin, A., & Abdullah, N. A. (2020). Challenges in the online component of blended learning: A systematic review. Computers & Education, 144, 103701.

Smith, K., & Hill, J. (2019). Defining the nature of blended learning through its depiction in current research. Higher Education Research & Development, 38(2), 383-397.

Sari, F. M., & Wahyudin, A. Y. (2019). Undergraduate Students' Perceptions Toward Blended Learning through Instagram in English for Business Class. International Journal of Language Education, 3(1), 64-73.

Tshabalala, M., Ndeya-Ndereya, C., & van der Merwe, T. (2014). Implementing Blended Learning at a Developing University: Obstacles in the Way. Electronic Journal of E-learning, 12(1), 101-110.

Vallée, A., Blacher, J., Cariou, A., & Sorbets, E. (2020). Blended learning compared to traditional learning in medical education: systematic review and meta-analysis. Journal of medical Internet research, 22(8), e16504.

Wang, N., Chen, J., Tai, M., & Zhang, J. (2021). Blended learning for Chinese university EFL learners: Learning environment and learner perceptions. Computer Assisted Language Learning, 34(3), 297-323.