A Framework to Analyze the Effectiveness of Collaborative e-Learning (CeL) in Sri Lankan University Education

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Abstract

E-learning introduced new ways of learning using computers and the Internet, and is rapidly evolving with the development of technology. Learners can actively participate and collaborate in a learning process using either synchronous or asynchronous e-learning. Collaborative e-Learning (CeL) is an effective pedagogy approach, which also improves the processing skills, communication skills, and cognitive skills of the students.

In this research study, a framework was developed to analyze the effectiveness of CeL in Sri Lankan university education. The study was conducted among lecturers, assistant lecturers, undergraduate students and post-graduate students of 15 Sri Lankan National universities. Interviews were used as the research instrument through different media such as direct interview, telephone interview and Skype interview. Our research findings helped to identify the most effective tools to use in CeL, which improve lecturer-student and student-student interaction. Further, awareness about CeL, perception of the requirement of CeL, and the assessment criteria of the effectiveness of CeL were identified in the context of Sri Lankan university education. In addition, a framework was developed to analyze the effectiveness of CeL in a quantitative manner. Finally, this paper presents recommendations to improve the effectiveness of CeL in Sri Lankan universities and discusses possible areas for future research in this arena.

1. Introduction[1]

Collaborative e-Learning (CeL) is defined as "constructing knowledge or solving problems through mutual engagement of two or more learners in a coordinated effort using Internet and electronic communications for their interactions" [1]. The previous research suggests that, CeL can be used in an effective way to improve students' performance by enhancing their soft skills and cognitive capabilities. The effectiveness of CeL is highly dependent on the learner's behavior, learning styles, learning domain, emotions and the teacher's proper adoption relevant to the course content and learner's capabilities. Currently in the global context, several types of e-learning tools are used to provide CeL facilities. Examples include Moodle, online conferencing tools, online chat tools, messaging tools, wiki, forum posts, community platforms, tablet platforms, etc. Among these, some tools cannot be used in Sri Lanka due to the technical and financial constraints of the universities and students. Therefore, it is required to find out which tools can increase the effectiveness of lecturer-student interaction and student-student interaction in CeL.

Currently in Sri Lankan universities, e-learning approaches are being used. However, it is mostly implemented in an asynchronous way so that the collaboration between students is very low. In some cases, collaborative learning is practiced in a traditional teaching approach without the usage of electronic resources. Both cases result in lack of performance when compared with CeL. Therefore, it

is expected that, by effectively using CeL pedagogy approaches together with traditional teaching approaches, students can gain more knowledge, and can enhance skills such as group based thinking skills, team working skills, group-based problem solving skills, thinking in peer's perspective skills, analytical skills, etc. Further, Sri Lankan university education has a need to identify and develop an effective CeL instructional model since this is the transition period from traditional teaching to blended teaching in most of the universities. Further, to align with the other developed countries, the Sri Lankan education system also should be capable enough to handle the novel technologies.

Therefore, there is a requirement to assess the effectiveness of CeL in Sri Lankan university education. However, to measure it quantitatively, based on the resources available and the relevant constraints in Sri Lankan universities, a framework is required. This research study develops a framework to measure the effectiveness of CeL based on six independent variables as follows: (i) students' academic performance improvement, (ii) students' communication skills improvement, (iii) students' cognitive skills improvement, (iv) participants' social interaction improvement, (v) participants' technical capability improvement, and (vi) participants' satisfaction improvement. Each of these variables is measured using certain measurement indicators

2. Literature Review

2.1 Importance of e-Learning

According to the study done by Clark and Mayer [2], a significant amount of research has been done to consider the what, how and why aspects of e-learning in the past years. In the 'what' aspect, e-learning includes both the content (information) and instructional methods (techniques) which help to learn the content.

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In the 'how' aspect of e-learning, the mode of delivery is considered. For example, e-learning through digital devices such as computers and smart phones, using text and media such as photos, animation or video. In the 'why' aspect, the importance of e-learning compared to the traditional classroom learning is considered. Li et al. [3] specify that e-learning is the delivery of learning programs, training programs or education programs by using an electronic medium. According to Bermejo [4], e-learning is an education which uses computerized communication systems as a tool for the exchange of knowledge and information between students and instructors.

2.2 Importance of CeL

According to Larsen and Hole [5], traditionally e-learning courses are considered as individual and lonely learning processes where they are constructed in a way that does not stimulate interaction and cooperation between students. However, e-learning has undergone a huge development in the recent years with the developments in Internet technology. Multitudes of systems are now available to provide the e-learning facilities and environment so that the number of users is also increasing. Since most of the currently available e-learning systems provide a single user learning environment, the resultant lifelong knowledge gain is limited. As stated by Sing et al., [6] with the emergence of the knowledge-based economy, educationalists are giving more attention to proper skills and attitudes, which are required in addition to knowledge improvement. Successful workers of the 21st century are required to have soft skills regarding group based problem solving and knowledge creation. Therefore, the current trend is to use collaborative learning concepts with e-learning.

According to Sing et al., [6] students who engaged in collaborative learning acquired soft skills such as ways of seeing from their peers' perspectives and, improved communication skills, and also became more aware of their personal strengths and weaknesses. According to Wells [7], the talk pattern that occurs in classrooms is categorized into two, as monologue and dialogic. Monologue talks are one-way transmission of knowledge from the teacher to the students, which expect the students to be passive recipients of knowledge, while dialogic talks are two-way which expects students to be active learners. According to Mehan [8], in classrooms, teachers control the communication and collaboration. As per the study done by Yi [9], when it comes to college-level English teaching in China, CeL is an undoubtedly effective way of learning. It helps to introduce variety to teachers' programs and it meets various student needs, improves students' academic achievement, and provides a relaxed environment to students.

According to the study done by the current paper authors [10], CeL in university education for this research is defined as the learning using any electronic tools or any electronic resources by maintaining lecturer-student and student-student interactions synchronously or asynchronously.

2.3 Tools used in CeL

There are a variety of tools used in CeL. A proper tool is required to facilitate the learning process. According to [11], e-learning tools can be categorized into two major types as follows: (i) Production tools, which are used during the design and development phase of e-learning content, and (ii) Learning tools, which are used during the delivery of the learning process. According to Matas [12], to get e-learning done from initial design to development through implementation, there are specific types of tools required under five different categories. A learning professional can create high quality e-learning from start to finish by using these five categories of tools namely authoring, interactivity, social activity, quizzing and delivery. The success of CeL depends on the proper usage of e-learning tools. Therefore, based on the CeL content, a proper tool should selected. According to the study done by Chourishi et al. [13], effectiveness of learning depends on the level of interaction provided among the students and lecturers by the e-learning system.

2.4 E-learning in Sri Lankan University Education

At present, there are 15 national universities in Sri Lanka including the Open University of Sri Lanka. Even though technology has evolved greatly in recent times, the universities in Sri Lanka still primarily use traditional face-to-face teaching for the delivery of course content. However, the Open University of Sri Lanka is an exception where most of its courses are conducted online [14].

According to the study conducted by Premawardhena [15] among students of the faculties of Humanities and Social Sciences of the University of Kelaniya, by integrating web-based learning and online teaching tools in addition to traditional face-to-face teaching, some valuable findings were obtained. The two major constraints faced by all the universities at present are as follows: (i) lack of academic staff and (ii) difficulty of industry experts to attend the universities physically for the delivery of their lectures. Further, in the study, limitations of the local graduates as pointed out by the industry such as lack of ability to work independently, decision making, teamwork, organizational skills and communication skills were all enhanced by a web presence. The feedback obtained from students revealed that the physical presence of a lecturer is not required since an online communication platform provides them with video facilities to see the lecturers and to participate in the discussions.

The study done by Sandanayake et al. [16] among 100 undergraduate learners of the Faculty of Information Technology, University of Moratuwa revealed that e-learning is the most preferred learning method when compared with face-to-face learning, problem based learning (PBL), project work and discussion groups. The study done by Arachchi et al. [17] revealed that e-learning content and material

should be based on the learning styles of the learners. An experiment carried out among the Sri Lankan university system regarding the learner behavior during teaching and learning [18] showed that emotions play an essential role not only in events such as decision making, managing, perceiving, influencing rational thinking process of humans, etc, but also in teaching and learning.

2.5 CeL in Sri Lankan University Education

Even though collaborative learning has been a well-known concept in Sri Lankan education for a long time, to integrate it together with e-learning to get the maximum learner performance out of it is a new concept. The study done by Gunawardena et al. [19] based on the 'tutor mentor development program', utilized a community-building model to train online tutors and mentors in higher education institutions and professional organizations in Sri Lanka. A blended format of face-to-face and online activities in Moodle was used and it attempted to build a learning community between trainees, both academics and professionals who represented diverse disciplines and organizations. The research findings contradicted the traditional belief that learners do not prefer online presence, since it was found that it is via e-learning that they got satisfaction.

2.6 Assess the Effectiveness of CeL

The researchers quantitatively assess effectiveness of CeL by using several variables and measurement criteria. Some of the researchers [20], [21], [22] used students' academic performance by considering their marks and pass rates to assess the effectiveness of CeL. According to the study done by Zafra et al. [20], students' communication skills and motivation to participate in the learning process had a correlation with active learning. The study done by Sridharan et al. [23] identified that interaction of the students with domain experts and knowledge sharing via electronic tools also contributed in effective learning. The study done by Murthy et al. [24] identified the ease of use of the pedagogy approach as a contributing factor on the effectiveness of the CeL. Students' usage preferences were used to assess the effectiveness of personalization in delivering e-learning lectures in the research done by Zhuhadar et al [25]. The study done by Liu [26] identified that e-learners not only showed a better outcome than traditional learners, but also showed a better satisfaction in learning materials and learning environments.

3. Methodology

The population for this research study was the selected 30 students and 30 lecturers from different faculties and departments of 15 Sri Lankan National universities, where CeL is used in their academic curricula. Based on the availability of the lecturers and students, the interview was carried out through different modes, such as face-to-face interviews, telephone interviews and Skype interviews with twenty lecturers and twenty students. E-mails are also used to get the

answers from an additional ten lecturers and ten students.

The research instrument as used in the interview is given in Table 1. The results of the research were analyzed using statistical methods.

Table 1: Interview questions and the purpose

Question	Purpose of the question
(Q1). Do you practice CeL in your teaching or learning? If yes, to what extent?	(i) To identify the awareness of the participant about CeL
(Q2). Which e-learning tools improve the interaction among students & lecturers?	(ii) To identify the tools which improve collaboration among lecturers and students
(Q3). Which e-learning tools improve the collaboration among students?	(iii) To identify the tools which improve collaboration among students
(Q4). Do you think effectiveness of CeL in university education can be measurable?

(Q5). If so, what are the indicators, which can used to measure the effectiveness of CeL? | (iv) To identify whether effectiveness of CeL is measurable

(v) To identify the factors which can be used to assess the effectiveness of CeL |
| **(Q6)**. "Current Sri Lankan university students are no longer interested in pure traditional face-to-face teaching. They want to include blended teaching approaches such as the hybrid of traditional and CeL approaches in their courses". Do you agree with the above? | (vii) To identify the understanding of the university lecturers about their students

(viii) To identify the expectation of the university students |

4. Results and Discussion

4.1 Effective Tools to Use in CeL

Table2: Effective CeL Tool

CeL Tools	Student-Lecturer interaction	Student-Student interaction
Moodle	**29.76%**	15.52%
Wiki (except from Moodle)	5.95%	8.62%
Online sources	10.71%	10.34%
Weblog (except from Moodle)	7.14%	6.90%
Social media (Facebook, YouTube, etc)	3.57%	3.45%
Online conferencing (Google Hangout, Skype, etc)	14.29%	**31.03%**
Virtual classroom	4.76%	10.34%
Online whiteboard	2.38%	5.17%
Production tools (graphic, simulation, tools, etc)	21.44%	8.63%

CeL tools, which improve the interaction among the students and lecturer, were identified using question

Q2 of the Table 1. Results obtained are given in Table 2 and Table 3.

Table3: Summary of Effective CeL Tool

	Student-Lecturer interaction	Student-Student interaction
CeL Tool	Moodle	Online conferencing

The research done by the author [10] identified the e-learning tools commonly used in the Sri Lankan universities among the broad categories of tools available in production tools and learning tools.

A. CeL tools which Improve the Interaction among Lecturers and Students

The results given in Table 2 indicate that Moodle is considered as the most effective tool (29.76%) to improve interaction among the lecturers and students in CeL practices. The next most effective tools are production tools (21.44%), online conferencing tools (14.29%) and online sources (10.71%). According to an Engineering lecturer, Moodle is an effective tool since it includes some of the collaboration tools such as wiki, forums, and online messaging. Additionally, since it is an open source application, it is accessible even to those university students with less financial resources. The results are consistent with the study done by Chourishi et al. [13], which identified that Moodle is a great tool for tutors and it performs not only as a content management tool but that it also provides the interaction between the tutor and students using its various features such as forums, quiz module, chat, messaging, wiki, etc.

However, Moodle was also criticized by a lecturer of the University of Colombo, who is lecturing for eBIT. He stated that, in the university environment, Moodle is not 100% effective when considering the interaction between students and the lecturer. The reason he gave is that the university education system is trying to infuse undergraduates with skills such as leadership skills, communication skills, processing skills, etc which will benefit the society. Another Engineering lecturer emphasized that an effective CeL tool should have the ability to provide effective feedback. Currently, Moodle needs much improvement in terms of providing feedback, since the ability to give group feedback is minimal in Moodle.

According to another Engineering lecturer, effectiveness of CeL is independent of the tool. He further stated that, instead of sophisticated e-learning software, a forum is enough to keep the collaboration active. However, for collaboration to happen, there are requirements for a proper environment and a problem to solve with an open-ended answer. The lecturer needs to perform as a facilitator to improve the collaboration of the students. Further, a Management lecturer specified that the effective tool for CeL depends on the subject content, since sometimes the content itself can encourage collaboration.

"I think all of these tools serve this purpose, depending on the context in which they are used".
According to one lecturer, for post-graduate students, social media also can be used as an effective tool to interact with the students. Further, he stated that since the younger generation is familiar with Facebook, it could be utilized for education purposes rather than merely for entertainment purposes. The comment of the lecturer is given below.
"For some learning activities, I used Facebook as a tool to encourage students to come out with the idea"

B. CeL Tools Improve the Interaction among Students

The results given in Table 2 indicate that online conferencing is considered to be a very effective tool (31.03%) which improves the interaction among students. The results are consistent with the study done by Hiltz [27], which emphasized that computer conferencing can be used in a way to create learning and teaching environments that are more effective. The next most effective tools are Moodle (15.52%), online sources (10.34%) and virtual classrooms (10.34%). Generally, the students who were interviewed had a slightly different opinion than that of the lecturers. According to a post-graduate student, online conferencing tools like Google Hangouts and Skype improves the collaboration among students when compared to Moodle. Further, he stated that, though Moodle also has its own benefits such as, providing assignment submission mechanism, providing ways to share the learning materials, enabling the lecturer to conduct online exams, etc., unless it is used for such specific tasks using forum posts, online discussions, group-based wiki, etc, it is not improving the interactivity among students.

According to a post-graduate student from the field of engineering, CeL content development can be done offline and separately using the production tools. However, content delivery tools (learning tools) have to be more interactive to persuade the participants to be collaborative. Further, he stated that video conferencing is the next method of communication, as it provides a face-to-face real time communication, which is very important for CeL. Further, some students specified that the forums and group discussions in Moodle also aid in increasing their interaction with peers. A comment from a student, given below, indicates the requirement of a CeL tool which supports student-student interaction.

"The available facilities in a tool should be capable of supporting group assignments which enable collaborative thinking among students."

According to a lecturer of the eBIT course in University of Colombo, the effectiveness of the tool depends on the ability of students. There are different types of students who can learn more by listening, touching, observing, practicing, etc. Since the students have different capabilities, lecturers need to practice different

approaches to cater to their different needs. Some comments from lecturers are given below.

> *"Students are catching things in different manner. Therefore, we need to use different tools to deliver the subject contents".*

> *"Peer evaluation systems can be used if we have lot of students"*

4.2 Perception of Lecturers about the Students' Interest in CeL

By using the open-ended question Q6, in Table 1, the perception of the lecturers about the students' interest in CeL were identified, and the findings have been given in Table 4.

Table 4: Interest in CeL

Agree/ Disagree	Lecturers	Students
Agree	56%	76%
Disagree	44%	24%

The results indicate that though 76% of the students emphasized that they prefer to practice a blended learning rather than solely face-to-face classroom learning, only 56% of the lecturers are having the same opinion. In fact, some of the lecturers have a perception that Sri Lankan university students are not interested in CeL blended with traditional classroom lectures, which contrasts with the general opinion among students. Further, those lecturers who emphasized that Sri Lankan university students are interested in CeL have different reasons from students for their opinion. Some of the comments from lecturers who agreed with the question Q6 are given below.

> *"Now students have good knowledge in computer usage and they do many other external courses. Therefore, they can manage their time using CeL approaches."*

> *"Pure conventional teaching is no longer work alone. Students going for higher studies, especially, to foreign countries need to get exposure to novel technologies."*

> *"By using CeL tools, which have features to participate in the online discussions anonymously, can get more participation from the students in some sensitive discussion topics."*

> *"Today the young generation in Sri Lankan universities are already fans of social networking and technology mediated communication. Therefore, they prefer CeL using those novel technologies.*

> *"Traditional face-to-face teacher-centered education does not attract students and keep them motivated anymore."*

According to some of the lecturers who disagree with the question Q6 in Table 1, dependency on teachers is high in the majority of the university students in the country. Mainly, the student population coming to the university had gone through a learning system, which is heavily supported by schoolteachers and tuition-teachers. In the Sri Lankan school education system, since the teachers teach the entire subject contents as per the syllabus, the amount of self-learning required from students via available online resources is minimal. As a result, students have the same mindset even after they enter the university. Therefore, some of the lecturers have a perception that students still prefer a pure traditional teaching rather than a hybrid approach of traditional teaching blended with CeL. The lecturers' comments which support this opinion are given below.

> *"Majority of students want traditional face-to-face teaching."*

> *"I don't think students are interested in CeL. University students want everything to be formally structured and straight forward where CeL is not like that and it needs lot of efforts."*

> *"If students are allowed to connect from home in an online discussion, some students may not work at all. Gradually it may decrease their interest in the subject"*

However, some of the lecturers emphasized the fact that the necessity of CeL is dependent on several factors such as students' attitude, student's ICT awareness, subject content, etc as identified in the previous research done by the authors [10].

> *"It depends on the subject stream as well. Some subjects need practical sessions, therefore, can't be lecture using online presence."*

> *"Students who had background knowledge in IT prior to university entrance can catch up easily with CeL."*

> *"Students in IT stream prefer CeL blended with traditional teaching. They want to engage via laptop, mobile phone, etc."*

All the above comments reveal that the necessity of CeL depends on many factors, and that lecturers need to adopt the best teaching method based on the student population, subject content and the availability of resources. This is consistent with the study done by Yi, [9], which identified that CeL needs to be selectively used with the student population to be effective.

4.3 Interest of Sri Lankan University Students in CeL

By using the open-ended question Q6 in Table 1, the interest of the students to engage in CeL was identified and the findings provided in Table 4. Though the majority of the students (76%) preferred to have

CeL, some students (24%) still wanted to have traditional face-to-face teaching.

Students preferred to have CeL blended with traditional teaching due to many reasons such as the interesting nature of CeL, suitability of subject content to CeL, desire to learn novel technologies, desire to have a flexi-learning environment, etc. An engineering undergraduate student stated that CeL is required for him due to the subject content and he cannot depend just on the classroom lecturing since a lecturer cannot cover the whole subject in the allocated classroom time. Another engineering undergraduate student specified that when classroom learning is not sufficient, he used related online videos, e-books, websites and web forums to improve his subject knowledge.

"I have shared lot of my doubts in some forums and got answer quickly in many views."

"Once get into the industry students have to find their own solutions to the industrial challenges. Therefore, CeL will train them to face the situation more efficiently."

"Students appreciate freedom in their learning due to busy schedules. Hence, CeL is one of the methods to overcome the barriers like location, time, traveling, etc."

"Traditional methods of teaching become boring and both student and teachers lose their concentration, which results in less productive for both sides."

A few students emphasized that generally, traditional face-to-face teaching takes more time than CeL and some students are hesitant to participate in face-to-face teaching. Other students specified that with the increasing technology advancements and globalization, students now prefer to learn using CeL pedagogy approaches rather than the traditional pedagogy approaches. They realized that they are in the transition period between the traditional learning and e-learning modes; they preferred a blended pedagogy approach. Even though the majority of students prefer CeL, some of the students do not prefer CeL due to unfamiliarity of pedagogy approaches, subject content, lack of resources, lack of ICT awareness, lack of motivation, etc. Some of the comments of the students who disagreed are as below.

"CeL best suits only the IT related fields, but not the other streams like medicine, art, commerce, etc."

"Students are very familiar with traditional teaching."

"Due to the cultural and technological limitations, Sri Lankan students still interested in face-to-face learning."

4.4 Perception about the Assessment of Effectiveness of CeL

From the analysis of the results of the question Q4 in Table 1, the perception of the lecturers and students regarding the assessment of effectiveness of CeL was identified. According to an Engineering faculty lecturer, in the university environment, the lecturers are very comfortable with the summative assessment for the modules, which is of exam type. However, to assess CeL, lecturers need to do formative assessments. Since formative assessment is subjective and it is a continuous assessment, it is complicated when compared to summative assessment. Lecturers are traditionally familiar with summative assessment and if they fail to do formative assessment for CeL pedagogy approaches, the assessment will not be effective. Further, another Engineering faculty lecturer emphasized that, when practicing CeL, they need to practice authentic learning concepts, in which they can provide a real life problem to the students and ask the students to discuss and come up with solutions. Since there is no specific answer to the problem, it helps the students to interact with their peers and lecturer and come up with different solutions.

Comments from some other lecturers explaining how the effectiveness of CeL can be measured have been given below.

"In a collaborative group activity, if we can identify the contribution of each individual student, then we can measure their improvement in contribution"

"Get feedback from students about CeL & traditional teaching. By asking them to rank certain features, can assess their satisfaction"

However, answers of some of the lecturers indicated that they experience difficulties in assessing CeL. Some comments from the lecturers, which reveal their perception of difficulty in assessing CeL are given below.

"I do not think it is an easy task"

"It's not just some quantitative measurement. Therefore, it is not easy as assessing using exam results"

"It is measurable, but it is depends on the stream".

"When it's come to learning, effectiveness may be difficult to measure in short term"

All these reveal that some lecturers do not prefer CeL since they have a perception that it is difficult to analyze the students' performances.

4.5 Assess the Effectiveness of CeL

Based on the literature review and the results of the question Q5 in Table 1, several indicators which used to assess the effectiveness of CeL are identified. They

have been categorized into nine groups as given in Table 5.

Table5: Indicators to Measure the Effectiveness of CeL

Indicators to assess the effectiveness of CeL
I1. Students' academic performance improvement
I2. Students' cognitive skills improvement
I3. Students' communication skills improvement
I4. Students' social interaction improvement
I5. Students' technical capability improvement
I6. Students' satisfaction improvement
I7. Lecturers' social interaction improvement
I8. Lecturers' technical capability improvement
I9. Lecturers' satisfaction improvement

4.6 Framework to Assess the Effectiveness of CeL

The indicators, which can be used to assess the effectiveness of CeL have been grouped into six categories based on the similarities of the indicators. The framework to assess the effectiveness of CeL is modeled by considering the indicators as independent variables and the effectiveness of CeL as the dependent variable as given in Figure 1. All the indicators have a positive or negative impact on the effectiveness of CeL. They can be analyzed by using the measurement criteria for each independent variable.
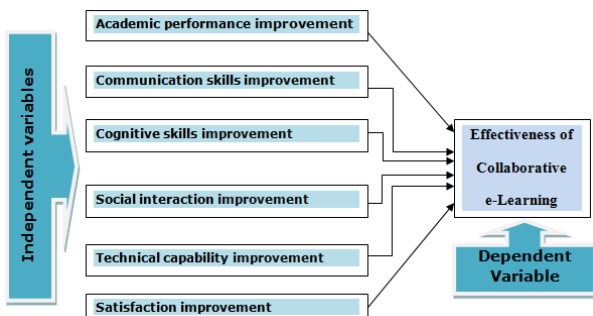

Figure 1: Framework to assess the effectiveness of CeL

As given in Figure 1, the dependent variable is the effectiveness of CeL and the independent variables are the six variables. Improvement in social interaction, technical capability and satisfaction can be considered for both lectures and students. The measurement criteria for each of the variables have been given in Table 6.

Therefore, the framework with the measurement criteria can be used to analyze the effectiveness of CeL in Sri Lankan university education. The framework is different from the framework used by Sridharan et al. [23], which analyzed the perception of learners on the effectiveness of e-learning in higher education. That model identified whether the selected six dimensions of learning such as preferred pedagogies, technologies, learning resources, management of learning resources, metadata ontology and management effectiveness are positively influencing the effectiveness of e-learning.

Table 6: Measurement Criteria of the Indicators

Independent Variables	Measurement criteria
Students' academic performance	Results
	Time spend on CeL
	Self-study via online resources
Students' communication skills	Writing skills
	Reading skills
	Speaking skills
	Listening skills
Students' cognitive skills	Creative thinking skills
	Analysis skills
	Problem solving skills
	Quantitative reasoning skills
Social interaction of the participants	Interaction among the peer students
	Interaction with the lecturers
	Formation of new contacts with lecturers & professionals
Technical capability of the participants	Awareness about e-learning tools
	E-learning tools usage for knowledge & learning material sharing
	Usage of social media for academic matters
Satisfaction of the participants	Motivation for studying or lecturing
	Convenience (accessibility, usability) of the learning environment

5. Conclusions

The findings reveal that the effectiveness of CeL and the necessity of CeL depend on many factors. Lecturers should analyze the student population's different characteristics and they have to identify the interest of the students rather than rely on their traditional perception that students are not interested in CeL. Further, an effective tool should be utilized with CeL, which improves the lecturer-student and student-student interactions. Lecturers can practice a blended pedagogy approach, which is a combination of different learning methods such as face-to-face interactions, self-paced and individualized learning and online interactions based on the subject content. The findings further suggested that the effectiveness of CeL in Sri Lankan university education can be assessed quantitatively via the framework identified in Figure 1. The independent variables can be measured using the criteria given in Table 6.

6. Recommendations

The findings revealed that there is a perception misunderstanding of lecturers about students' interest in CeL. While a majority of students stated they prefer to have a blended teaching together with CeL, a certain percentage of lecturers still think that the majority of

students do not prefer CeL since they come from a traditional school experience where the teacher knows everything and transfers the knowledge to students. The perception of lecturers needs to change to have effective CeL pedagogy approaches in the university curriculum. Lecturers need to motivate the students to engage in CeL by providing them with the required facilities and by reducing their fear of technology. Students who still think that they need the help of the lecturers for every form of knowledge gathering need to change their attitude towards CeL to get the maximum benefit out of it.

Further, the lecturers should identify effective tools, which enhance the collaboration among the students, and use them in their teaching. If the students are reluctant to practice CeL, then lecturers need to motivate them. Further, the government should facilitate the introduction of CeL practices from the school level onwards in the future to make the younger generation ready for CeL when they enter the university. The proposed framework can be used by the lecturers in all the Sri Lankan universities to identify the effectiveness of CeL and to identify whether CeL is effective in their course module for the particular set of students. Based on the results, they can improve their teaching to cater to students' needs. They can also improve the framework model with some additional independent variables which are unique for their subject content. Further, the university administration and the government need to provide their support to facilitate the lecturers and students with necessary resources to practice the CeL pedagogy approaches.

7. Future Research

Analyzing the effectiveness of CeL in Sri Lankan university education is an area where it is essential to conduct research. Further, identifying the effective instructional models for the students based on the subject stream and available resources should also be analyzed well to improve the university education in Sri Lanka.

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