ISSN 2278-3091
Volume 9, No.4, July – August 2020
International Journal of Advanced Trends in Computer Science and Engineering
Available Online at http://www.warse.org/IJATCSE/static/pdf/file/ijatcse133942020.pdf
https://doi.org/10.30534/ijatcse/2020/133942020

Crowdsourcing Technology for Classroom Learning

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ABSTRACT

Crowdsourcing technology is a revolution that connects collective intelligence of users and has transformed learning process among teachers and students to a new form of engagement and collaboration in the classroom. It enables learners to make personal learning networks to gain ideas and use the crowd to find solutions to problems. This study employed experimental, sharable content object reference model (SCORM), and descriptive research methods and conducted at the University of La Salette, Inc. (ULSI) with students, teachers, subject matter experts, personnel and IT experts as participants. Data were gathered through sets of questionnaires and interview and were analyzed through frequency and percentage, mean, and t-test for significant difference. Results revealed that the university has the readiness and sustainability for implementation of Crowdsourcing Technology for Classroom Learning (CTCL) platform indicated by the presence of ICT infrastructure, administrative and resource support. Students and teachers have the readiness to adopt the platform supported by their technological tools, confidence, attitudes and training towards a successful online learner or teacher. CTCL was designed through SCORM of Moodle platform. Considering the significance of utilizing the platform, learning becomes more effective, engaging and enhancing in the students' performance in their course. Moreover, satisfaction and usability acceptance of users on the platform met the requirements of software quality standards of ISO 25010. Therefore, adoption of CTCL in the university and its sister schools in the province of Isabela is recommended as a crowdsourced learning management system. In the future, this study can be enhanced further and work on integration of other emerging technologies such as widespread use of mobile computing which would change the instructor and learner learning systems. Researchers working on similar topic would consider integration of virtual and augmented reality technologies and offline mode of learning using mobile learning platforms for enhancement of this study

Key words : crowdsourcing, crowdsourced learning, learning management system, SCORM

1. INTRODUCTION

Technology has become an important tool in transforming learning. It has helped strengthen and develop the association among teachers and students, and has changed learning and communication approaches. These transformation in learning has introduced crowdsourcing technology in classroom. The growth of crowdsourcing technologies has offered a innovative way of student's engagement in the classroom. It is a modern revolution conveyed by the digital technologies of computing and communication and a revolution that brings users together and connects their collective intelligence. It is a significant part of scientific, methodological and educational phenomenon. A shifting approach in obtaining information, transfer, storage and processing in classroom learning. In action, crowdsourcing forms a secure connection between the crowds' wisdom phenomenon and the content created by the user [1].

Howe describes the creation of virtual crowd from the internet that allows sharing of interests and passions [2]. This wisdom of crowdsourcing enables learners to do personal learning networks to gain a variety of ideas, find experts and use the crowd to find answers and ask better questions. The idea of crowdsourced learning is based on the information generated within a community where participants actively exchange experiences and engage with asymmetric roles. The method is student-centered rather than teacher-centered and learning is observed as a social paradigm, facilitated by peer collaboration, evaluation and cooperation. To adapt this structure of collaborative learning, technology should be supported by a management style that encourages learning in a crowd [3].

Crowdsourcing composed of people join together to solve a common problem with similar interests to cooperate, provide opportunities to help others, learn more, and gain recognition [4]. Via crowdsourcing, teachers can exchange learning plans and discover new and discover ways to share content with students. Crowdsourcing is based on the idea that knowledge can be found in a variety of locations, not just within a closed organization [5]. Online crowds can facilitate learning in the classroom and how collaborative, inclusive, immediate online crowd input affects student learning and project-based design

work motivation [6]. The fundamental concepts of educational crowdsourcing pointed out that when they have the most skilled teacher, the students have a greater chance of success and results. With higher student outcomes, teachers will point to what works, improve what can be accepted, and compile, share, and replicate success elsewhere [7]. Experienced online educators describe themes relevant to the successful online course layout and facilitation that foster student success; provide clarification and relevance through content structure and presentation; create presence to foster a positive learning community; and enhance student success readiness [8].

While crowdsourcing is Internet-dependent [9], it should consider Internet speed, anonymity, incentives for collaborative participation in ventures and different types of media lead to the realization of the definition of crowdsourcing. Smart classrooms allow teachers to see how students really want to know and the knowledge they want [10]. Crowdsourcing may generate a range of learning tools from a large number of teachers, who exhibit considerable diversity along the crowdsourcing dimensions [11]. With crowdsourcing, learners have more tailor-made learning opportunities and better incentives, they can enjoy learning more with their chosen courses. [12]. Gamified crowdsourcing systems addressed developments in ICT that spawned into two growing trends, crowdsourcing and gamification [13]. The main aim of learning focussed on students is to position the awareness and commitment of each student at the center of the lesson. Crowdsourcing approaches include a description of images; gathering questions; representing prior knowledge; stock of interest; analysis of text; learning understanding; analysis of images; formulating arguments; Q&A; making slides; and interactive maps and timelines [14]. Classroom crowdsourcing as an online platform for higher learning dealt with ways of bridging the distance between suitable research activities and actual student work [15]. Development of educational content through crowdsourcing promotes student engagement. A model of micro-learning that combines cooperative learning and processes with the aim of adopting learner-centered approach through generating crowdsourced content and enhancing the learning process [16].

In the Philippines, Filipino culture places a high value on education. The rapid progression of ICT has brought significant challenges in the educational system from empowering people in new ways to learn how to develop systems of teaching and learning, and work together. This processes enhances the academic achievements of Filipino higher education students by incorporating e-learning technologies into the educational system [17].

The Revised Curriculum for General Education Courses (GEC) of the Commission on Higher Education (CHED) has been laid out in conjunction with the K-12 curricular program of DepEd. It summarizes the outcomes of the GEC which include higher levels of comprehension; communication competently and efficiently; application of computing and information technology to assist and facilitate research; capacity to deal professionally with the technology world and problem solving [18]. Despite ongoing improvements in the curriculum of education teachers need to update themselves to incorporate these changes properly. The integration of crowdsourcing for classroom learning can be adopted to optimize the benefits derived from technologies.

The ULSI., an institution of higher education in the City of Santiago carrying its core values of achieving excellence and upholds the highest standard of quality assured education and professionalism in the areas of instruction, research and extension, including ICT integrated learning as a reference source and teaching technique. The institution assumes that applying ICT changes the teaching and learning processes from strongly teacher-dominated to student-centric. This transition resulted in increased learning gains among learners, providing and encouraging incentives to develop higher-order thinking skills of learners.

This research aims to suggest incorporation in the ULSI of crowdsourced training technologies for classroom learning in support to the institution's vision, mission, objectives and core competencies in achieving excellence and outcomes-based education in the 21st century learning. The work offers an approach to integrating crowdsourced learning resources for teachers and students as one of the methodologies for the delivery of instruction in the classroom. Even this research aims to contribute to the educational approaches of the institution in enhancing, engaging and extending teacher's teaching competencies and enhancing students' active learning competencies. Within this analysis is included the design of crowdsourcing technology for classroom learning (CTCL) application based on sharable content object reference model (SCORM); a student level comparison of traditional classroom learning and implementation CTCL platform; and the extent of satisfaction and acceptability of users on the developed platform based on ISO 25010 [19].

The conceptual structure of this research was focused on certain crowdsourcing principles, SCORM-compliant e-learning platform architecture [20] and learning opportunities model [21]. Crowdsourcing concept focuses on digital learning environments that provide important learning opportunities for interactivity; adaptability to the actions, awareness, and user features; success reviews, choices allowing learners to monitor their own learning, nonlinear access, linked representations, open-ended learner

input, and interaction with others. The SCORM is used to build a learning environment using learning resources such as crowdsourced sharable content objects that use SCORM to communicate with the learning management system (LMS); content organization which represents the intended use of the content through uniform instruction units; and metadata which clearly identify the elements.

Figure 1 shows the architectural design of CTCL platform used in this study [20]. The management component consists of administrator responsible for system management and configuration; manager responsible for creation of courses and organization of content; and teacher responsible for creating course content which were sourced out from various materials and the sharable content object from the crowd.

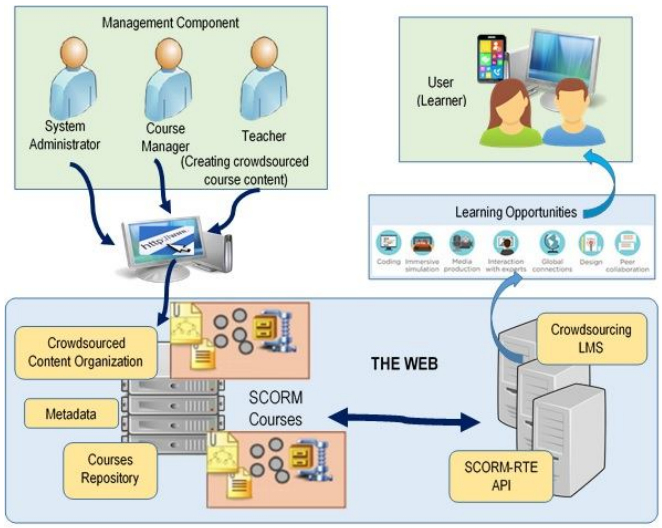

Figure 1: Architectural Design of Crowdsourcing Technology
for Classroom Learning (CTCL) Platform

The course content were organized as SCORM and stored in a cloud server environment. The crowdsourced learning management system (CLMS) retrieves stored course content through SCORM runtime environment that implements application programming interface. The CLMS interface provides the learner with various learning experiences depending on the type of tools and activities developed by the instructor for the course material. With implementation of CLMS, learning promotes enhancement, engagement, and extend learning goals among learners.

Within the context of this study, it seeks answers to the following developmental and adoption Crowdsourcing Technology for Classroom Learning (CTCL) in the ULSI:

1. What is the present institutional readiness and sustainability for a successful online learning implementation in terms of: ICT infrastructure, administrative support, and resource support?
2. What is the assessment of students' readiness in terms of: technology access; technological confidence, support and training; and attitudes towards a successful online/ crowdsourced learner?
3. What is the assessment of teachers' readiness in terms of: technology access; technological confidence and training; and attitudes towards a successful online/crowdsourced teacher?
4. What CTCL platform can be developed to enhance student learning?
5. What is the level of assessment on the components of CTCL course content?
6. What is the performance rating of learners in the pre-test and post-test questionnaire of the course before and after using the CTCL?
7. Is there a significant difference between the performance of the control group and the experimental group in terms of: pre-test scores and post-test scores?
8. What is the level of potential effectiveness of using CTCL application in terms of: enhancing learning, engaging learning, and extending learning?
9. What is the evaluation of the participants in the developed application according to ISO 25010 software quality standards in terms of: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability?
10. What is the usability acceptance level of the developed application to ISO 25010 software quality standards as assessed by the IT Experts end Users?.
11. What enhancement could be done to expand the developed system?

2. METHODOLOGY

2.1 Research Design

The research used experimental design to test the CTCL course content among two (2) groups of participants; the SCORM model for the design of CTCL platform; and the descriptive research design to describe observable situations and study and analysis of data obtained by various instruments. Some of the concepts used by papers [22], [23], [24] in shaping the methodology of this research.

2.2 Participants of the Study

A total of sixty-five (65) participants included in this study composed of five (5) groups. Among these were forty (40) students divided equally into two (2) groups, control group and experimental group. To avoid biases in the selection of groups, the classification process was based on their enrolment on the course during enrolment period where first twenty (20) enrollees belonged to the experimental group and the 21st to 40th enrollees were part of the control group. Other participants include six (6) IT teachers from ULSI College of Information Technology, four (4) administrative personnel

coming from the offices of Educational Management Information Systems, the Laboratory Services and the Human Resource Office of the university, and ten (10) IT experts composed of IT practitioners and teachers of HEI's in the region.

2.3 Instrumentation

The researcher utilized different sets of instruments to assess use of crowdsourcing technology for classroom learning as an online learning platform for the university. Moreover, the researcher included some items that was deemed necessary in sourcing reliable answers from the participants. The instruments adopted and used by the researcher is as follows:

The E-Learning Readiness Assessment Tool for Philippine Higher Education Institutions developed by Doculan which composed of three sections: (a) assessment on the status of the university for a successful e-learning/ online learning implementation; (b) assessment of students' readiness on their technology access, technological confidence, support and training and attitudes towards a successful online learner; and (c) assessment of teachers' readiness on technology access, technological confidence and training, and attitudes towards a successful online teacher [25]. The Course Content Evaluation Rubric by University of Dakota for assessing the components of CTCL course content in the area of learners' information; structure, content, and ease of navigation; interactions and assessments; and technology, support, and accessibility. The Pre-test/Post-test Questionnaire developed by the researcher to assess and measure students' performance before using the CTCL and the CTCL's effectiveness on student's performance after using it. The Triple E Framework (enhancing, engaging and extending learning) questionnaire was used to assess the course technologies and to support students in achieving learning objectives [26]. CTCL evaluation using ISO 25010 Software Quality Standards has been used to determine the level of user satisfaction with the use of the built application platform in terms of: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. Assessment on the extent of usability acceptance of the developed CTCL application system according to users and IT experts.

2.4 Data Gathering Procedure

The preliminary conduct of this study was initiated through a letter of permission to the President of the University of La Salette, Inc. Different participants have been disseminated an informed consent form which states the intent of the forgoing research and contains agreement on their risk, benefits as well as confidentiality of their responses to participate in this research work. When accepted, the distribution of the various survey questionnaire was conducted to assess the readiness of the school, teachers and students to adopt the established application successfully. An assessment of two (2) groups of participants was also carried out by means of a pre-test and post-test questionnaire to assess students ' success before and after using the platform.

Using the triple-E framework questionnaire was also floated to assess teachers' enhancement, engagement and extend of learning goals. Other sets of survey questionnaires were also floated to users and IT experts to assess their extent of satisfaction and test of acceptability to the developed platform based on ISO 25010.

2.5 Data Analysis

The interpretation of the data has helped the researcher understand the findings from different data sources. The data analysis was used to keep the bias away from the study findings with the help of appropriate statistical treatment. The researcher extracted qualitative and quantitative data, using data analysis tools.

Feedback from different participants was used to improve validity of qualitative research. The input from the participants and the observations and findings of the researchers in this study helped to provide valuable evidence, perspectives and challenges. The data obtained from using the various survey instruments and were subjected for analysis with the aid of software tools. Frequency and percentage were used to show the participants' distribution of this research that includes students, IT teachers, subject matter experts, administrative staff and IT experts. T-test was used to evaluate the substantial difference in the results of the participants' two (2) groups, namely: the control and the experimental groups. The CTCL course content was measured with a rubric scale along learners' information; structure, content, and ease of navigation; interactions and assessments; and technology, support, and accessibility. Triple E evaluation rubric was used for evaluating the potential effectiveness of the developed application along enhancing learning, engaging learning, and extending learning. Weighted mean was also used to analyze the ratings of users and IT experts to the extent of satisfaction and usability acceptance of the developed application in relation to ISO/IEC 25010 software quality standards.

3. RESULTS AND DISCUSSIONS

3.1 Present Institutional Readiness and Sustainability for a Successful Online Learning Implementation

The institution has sufficient ICT hardware and stable internet connectivity with wireless access points were made available on campus. License, open source and freeware software were also used for instructional purposes. The university also maintain backups of data servers as it's precautionary in case of server failures. The university

administrators definitely support the adoption of online/crowdsourced learning as can be seen in the institution's vision statement and in the light of its core competencies and outcomes that demonstrates skills in using modern technologies. The university is financially equipped in terms of resource support, has skilled and sufficient human capital to explore and to promote online learning. However, it is discovered that there is no specific courseware or online platform which provides communication and collaboration tools for teacher and learner.

3.2 Assessment of Students' Readiness Towards a Successful Online/Crowdsourced Learner

Majority of the participants have laptop or mobile devices with internet access at home. Their devices are fitted with applications, search engines and virus protection. They also do internet access at nearby internet cafes. This suggests that in terms of technology access, students are ready to become an online/crowdsourced learner.

In terms of technological confidence, support and training, students are technically assured that they are ready to become an online/crowdsourced learner when it comes to basic computer information and skills, internet, online operation, and application software skills. In addition, students received social support from their parents, peers, and teachers. However, training on the use of online learning suggests that there is a need for more workshops, activities, and sessions where students can learn more about using a clear framework for handling online learning.

In terms of attitudes, students sometime take into account study habits, motivation, abilities, time management and usefulness while engaging in an online learning. Findings indicates that students' attitudes significantly affect their readiness for a successful online/crowdsourced learner.

3.3 Assessment of Teachers' Readiness Towards a Successful Online/Crowdsourced Teacher

All teachers under surveyed owned a personal computer system with appropriate software and virus protection installed and have in-house internet connectivity. However, some has limited access to internet at home. The presence of technological tools among teachers indicates that they have the readiness towards a successful online/crowdsourced teacher.

In terms of technological confidence and training teachers, have the skills and expertise in computer operations, internet and being online, software productivity, prior knowledge and training in the use of online learning management system. These indicators suggest that they have the capacity and readiness to become a successful online/crowdsourced teacher.

In terms of attitudes, teachers' have a positive attitude at a very great extent regarding their teaching styles and techniques, abilities, motivation, time management, and use of online teaching and learning. This implies that teachers' attitudes would be necessary to prepare them for a successful online/crowdsourced teacher.

3.4 Development of CTCL Platform to Enhance Student Learning

The CTCL platform has been designed to improve student learning and the development involves stages of requirement analysis, building specification, design, writing content, testing, and maintenance and updating.

Requirement Analysis. The requirements considers technical specification for designing and access of CTCL application such as PC hardware with internet connectivity, internet browser and support plug-ins, PHP server, MySQL database, and cloud-based platform with secure socket layer (SSL) to host the application.

Building Specification. The CTCL was built and executed as an online or crowdsourced learning management system for the University of La Salette, Inc. A learning environment for teachers and learners wanting for appropriate, accessible, self-paced, and personalized content. The web-based application is accessible to various search engines and browsers of any type of pc's and mobile devices.

Design. The design was conceived through the idea of sharable content object reference model (SCORM) of Modular Object-Oriented Dynamic Learning Environment (Moodle) platform. The sharable content objects (SCO) were the building blocks of online learning material and digital instruction which the CTCL delivers to learners. The designed platform utilizes the Moodle data manipulation API to access the database function.

Writing Content. The platform is primarily used as an additional strategy in classroom learning to deliver the course content written by teachers. The writing content of the course includes: course information, course guide, learning resources, and activities. Learning resources may take the form of files uploaded or links to various web pages while activities may be done through forum, assignments, quizzes, examinations, etc.

Testing was performed to ensure that the developed CTCL provides what it is meant to deliver a learning management system, without causing new problems. Integration testing involves testing systems packages or content objects, and interfaces with the Internet. Load testing was used to determine the maximum amount of work the platform should be able to manage without major performance degradation.

Cross-browser testing a consistent behavior and experience across all browsers, devices, and OS platforms.

Maintenance and Updating. Technical maintenance performed through database and platform file backups; install updates on themes and plugins of Moodle; check CTCL website for broken links; ensure that all SCO's, course modules, and fields on the website are working effectively; and maintaining annual renewal of web hosting of the CTCL platform domain name.

3.5 Level of Assessment on the Components of CTCL Course Content

The overall mean of 2.51 on the level of assessment on the components of CTCL course content exceeds requirements on learner information; structure, content, and navigational ease; interactions and assessments; and technology, support, and accessibility. These requirements were given priority to the design of components of CTCL platform. The paper of Koschmider, et al. affirms that requirements in designing course content should be given priority [27]. The process of designing content takes challenges to be addressed such as generating activities, examinations, and effort for quality assurance.

3.6 Performance Rating of Students in the Pretest and Posttest Questionnaire of the Course Before and After Using the CTCL

For both the control and experimental groups, the pre-test was administered to 20 participants per group in Programming 1 course. The results show that mean performance of two groups were 50.80 and 58.75 respectively for the control and experimental groups. Both groups are not significantly different since they are both classified as "good." Fifty-five (55) percent of control group participants and 40 percent of experimental group participants have a pre-test performance score of between 41 and 60 and none of the two groups have a score of 81 to 100.

Along with post-test administered to two classes, the findings show that the mean output is 56.50 and 72.15 for both control and experimental groups after the experimental group used the established platform for programming 1 course. The findings are substantially different since the control group was classified as "good" while the experimental group was classified as "very good." Forty-five (45) per cent of the participants in the control group have a success score ranging from 41 to 60, while the experimental group has score ranges from 81 to 10. The findings show that the performance of two groups in the pretest for programming 1 course is the same and in the post-test the success rating of two groups, the experimental group fared significantly better than the control group.

3.7 Significant difference test on the performance of control and experimental group

The control and the experimental groups are similar in terms of their previous course experience covered prior to the procedure. The experimental group's pre-test mean score is 58.75, while the post-test mean score is 72.15 with the measured t-value of -2.56 and the likelihood value of 0.00729 which is less than the significance level of 0.01 recommend statistically relevant mean difference. This shows that the mean mean score of the experimental group after test is significantly higher than that of the mean score of the pre-test. This further means that the use of the CTCL platform in Programming 1 course is successful in improving student's performance. In addition, the experimental group's performance score in the pre-test is classified as "good" had improved to be "very good" in the post-test. Zengin, et al. also affirm that students when exposed to learning resources anywhere, and in various formats, enhances their ability to learn deeply and enabling them to develop their own knowledge [28].

3.8 Level of Potential Effectiveness of Using CTCL application

The results shows an "Exceptional Potential" as the potential effectiveness of using the CTCL platform to engage, enhance and extend the learning goals with a total of 14.17 points based on the Triple E Evaluation Rubric for Educational Applications (2019). The result shows a remarkable link between the technology platform, the instructional choices around the platform, the students' attention, and the learning goals. Students engaged as active time-on-work social learners through platform. Students' understanding of learning goals were improved by technology in ways that traditional approaches can't easily do, and the comprehension of learning goals has transcend the classroom and connect what they were studying to their everyday lives

Glover's study validates the potential effectiveness of using CTCL, which realizes that technology enhances learning by focusing on the opportunity within the institution to advance the pedagogical use of technology, creating a vibrant, engaging learning experience for students, and varied, active teaching experience for teachers.

3.9 Assessment of participants in the developed application to ISO 25010 Software Quality Standards

Table 1: Mean Assessment of Participants' Satisfaction on the Developed Application to ISO 25010 Software Quality Standards

Indicators	Students		Teachers		IT Experts		Overall	
	Mean	DI	Mean	DI	Mean	DI	Mean	DI
Functional Suitability	4.73	VGE	3.94	GE	3.97	GE	4.21	VGE
Performance Efficiency	4.58	VGE	4.22	VGE	4.07	GE	4.29	VGE

Compatibility	4.68	VGE	4.25	VGE	4.00	GE	4.31	VGE
Usability	4.65	VGE	4.39	VGE	3.97	GE	4.34	VGE
Reliability	4.64	VGE	4.17	GE	4.00	GE	4.27	VGE
Security	4.59	VGE	4.43	VGE	4.04	GE	4.35	VGE
Maintainability	4.62	VGE	4.43	VGE	4.16	GE	4.40	VGE
Portability	4.72	VGE	4.50	VGE	4.00	GE	4.41	VGE
Overall Mean	4.65	VGE	4.29	VGE	4.03	GE	4.32	VGE

Table 1 shows the mean assessment of participants' satisfaction in the developed application to ISO 25010 characteristics for software quality standards such as functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability is of very great extent according to students and teachers level of satisfaction While IT experts with level of satisfaction is of great extent. However, the overall findings shows that users satisfaction with a mean of 4.32 level is of very great extent on the application of CTCL system and meet requirements of ISO standards for software development.

3.10 Usability Acceptance Level of the Developed Application to ISO 25010 Software Quality Standards as Assessed by IT Experts and Users

The usability acceptance level of the developed application according to students is of very great extent. While teachers and IT experts sees the need for little improvement or enhancement on the developed application along its usability. However, the 4.11 overall mean or descriptively interpreted as "great extent" level of acceptance of users to the developed application met all the requirements and quality standards which also satisfies the defined characteristics of usability of ISO standards

3.11 Enhancement of the Developed System

Enhancement of the developed CTCL application system considers new and emerging technology requirements such as hardware with higher capabilities, new software releases including browsers, and other technical requirements to support the enhancement of the system. While the system has been designed through the current version of Moodle platform, this can be enhanced using new releases of the platforms to address the limitations of the developed system. Other technologies and tools are also considered to enhance the features and capability of the system.

4. CONCLUSION AND FUTURE WORK

The University of La Salette, Inc. has the readiness and sustainability for a successful implementation of crowdsourcing technology for classroom learning (CTCL) indicated by the presence of ICT infrastructure, administrative support, and resource support. The students and teachers have the readiness to adopt CTCL supported by the presence of their technological tools, high level of confidence, and attitudes towards a successful online learning and teaching. In terms of training, teachers have prior knowledge and training that will support their readiness to use the CTCL platform while students need more orientation on this platform.

The CTCL platform was designed and developed with the aid of SCORM of Moodle platform. The developed product is in the form of an online learning management system. Considering the significance of utilizing the platform, learning becomes more effective, engaging and enhancing in the performance of students in their course. Moreover, satisfaction and usability acceptance of users on the use of platform met the characteristics and requirements of software quality standards defined in ISO/IEC 25010.

Future development work that would enhance the capability of the current developed application system may consider new and emerging technology requirements such as hardware with higher speed and disk space capabilities, new software releases including browsers, and other technical requirements to support the enhancement of the developed platform.

For the enhancement of the existing method, future researchers working on a similar topic with the incorporation of virtual and augmented reality technology and offline learning mode utilizing the advent of mobile learning platforms may also be considered. The widespread use of mobile computing would change learning processes for teachers and learners. However, enhancement challenges such as screen size, connectivity, limited memory capacity and file formats learner accessibility options, and frequent upgrade of device can affect the learning process.

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