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THE EFFECTIVENESS OF A CUSTOMIZED ONLINE COLLABORATION TOOL FOR TEACHING AND LEARNING

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ABSTRACT

Aim/Purpose: There is a huge array of educational technology tools that are now in use today. These tools have changed the way teachers teach and the way students learn. Among the many educational technology tools that are gaining popularity are the online collaboration tools. Online collaboration tools are web-based tools that allow individuals to do things together online like messaging, file sharing, and assessment. However, when new educational technology is integrated in the classroom, its effects must be determined as this is an essential component for evaluation. Having the tool is not enough, there has to be an evaluation of its quality to make it more effective. It is on this premise that the customized online collaboration tool of one university in the Philippines was assessed. The study specifically aimed to identify the perceived effectiveness of the customized online collaboration tool; and identify the effectiveness of using Usability Metrics for Effectiveness.

Background: Most studies provide evaluation of newly developed software using a set of quality standards such as functionality and usability. However, there is limited evidence where online collaboration tools are evaluated on their effectiveness using user's perception as well as assessing their usability using a set of effectiveness metrics.

Methodology: The study employed questionnaire-based (n=127) and metrics-based (n=81) approaches. Data gathered were analyzed using simple and relative frequencies, weighted mean, ANOVA, and Tukey HSD (Honestly Significant Difference).

Contribution: This study supplements the literature regarding the effectiveness of online collaboration tools that are used for teaching and learning particularly those that are custom-made for an institution. It provides additional information on other ways to evaluate the effectiveness of customized online collaboration tools. It likewise provides information on the difference between what the users report about the tool's effectiveness and what the metrics show.

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Findings	The customized online collaboration tool was perceived to be very effective for collaboration, teaching and learning. But there is a significant difference on the students' perception based from their courses and year levels. The customized online collaboration tool's effectiveness as regards its application performance is poor because of design interface faults. However, the customized online collaboration tool has good completion rate.
Recommendations for Practitioners	Findings suggest that the customized online collaboration tool can be an alternative tool to open-source learning platforms which faculty members may use for teaching and learning as students find it very effective not only for collaboration but for teaching and learning as well. However, errors caused by interface design problems must be addressed to yield a higher application performance rating and higher completion rate.
Recommendation for Researchers	Further assessment on the tool's effectiveness using an empirical study is recommended to provide additional definitive evidence which may support the benefits of using online collaboration tools in the classroom.
Keywords	online collaboration tool, software effectiveness, educational technology, usability metrics

INTRODUCTION

The use of Information and Communications Technology (ICT) is an integral part of education. Many educational institutions provide students access to the Internet, equip classrooms with technology tools, and use ICT for relevant purposes such as communication, presentations, teaching and learning, assessment, research and office administrations. It has increasingly become a powerful tool for educational change and reform (Fu, 2013). Recognizing the benefits of integrating ICTs in education, the Department of Education of the Philippines introduced the National Strategic Planning Initiative for ICTs in Basic Education which comprises the six years primary education and four years secondary education in 2005. One of the highlights of the integration of ICT in the Philippines' educational system is the application of computer skills to the other learning areas. This means that in the teaching-learning process, it should not only be confined with the use of textbooks or other paper-based learning resources. The educational processes should also include the application of ICT in teaching and learning, where appropriate. The need to integrate ICT in education was also underscored in one of the Senate hearings in the Philippines in 2012 urging the Commission on Higher Education to adopt an ICT strategic framework for universities and colleges in the country to inform them of how they can incorporate ICT in the curriculum and in teaching methods. Hence, it is important that faculty members work towards introducing ICT in the classroom for them to keep up with the radically changing developments in technology.

One of the ways to support this shift in the teaching-learning process is the use of online collaboration tools. Online collaboration tools (OCT) are web-based tools that allow individuals to do things together online like messaging, file sharing and assessment. Since students are becoming increasingly digital users (Coldwell-Neilson, 2018), the integration of Web 2.0 computer technologies into the classroom setting enables them to have new authentic and meaningful learning experiences (Boundless, 2015).

There are a lot of online collaboration tools available in the market. However, these tools have inadequate feature sets. An inadequate feature set not only means that the software has some features that are lacking but could also mean it has too many features (Stoy, n.d.). In the latter case, this makes it confusing for users. Further, available OCTs, which are considered off-the-shelf software lack customization which may lead to inefficiency and scalability (Cohn, 2014).

It is on this premise that a research project was initiated which integrated OCT for teaching and learning in a tertiary education. In this project, two studies were conducted in Isabela State University (ISU) at Cabagan, Isabela, Philippines to determine the students' and teachers' perception on the use of OCTs to help leverage the student's learning and teacher's instruction (Buraga, 2017; Cabauatan, 2018). The insights of these two studies served as the basis for the conduct of the third study which involved the development and customization of the OCT to address the specific needs of both the students and faculty members of ISU.

The Customized Online Collaborative Tool (COCT) was designed and developed to provide a platform for collaboration, file storing and sharing, online quizzes, polling, discussion forums, and calendar planning which can be used by faculty members in their classes. The features of the COCT were tailored from the needs of the students and faculty of the university to make it more reliable and scalable. After the development of the COCT a study was conducted, including students and faculty members, to evaluate the COCT according to a set of quality standards, including functionality and usability.

However, the effects of a new educational intervention on the learning process and outcomes must also be determined as this is considered an essential component of any evaluation (Schleyer & Johnson, 2003). Hence, evaluation of the COCT's effectiveness is deemed necessary and this has led to the conduct of the present research.

The effectiveness of the tool was evaluated by determining the perceptions of the students and their experiences in the use of the COCT. This is likewise believed to be integral in the evaluation of the COCT's effectiveness since there are some pertinent immediate effects that are not usually possible to measure using an experimental approach (Arsenault, 2017).

Implementing the COCT into the classroom is an essential prerequisite to achieving the objective of the present research – evaluating how effective the tool is in enhancing student learning experience and measuring the extent to which functional requirements are being met.

In this study, the effectiveness of the COCT was assessed by addressing the following questions: 1) how do students perceive COCT as a tool for collaboration, learning, and teaching; and 2) how effective is the COCT in terms of Application Performance Index and Completion Rate? Application Performance Index and Completion Rate are defined in the Methods section of this paper.

Results of this study may provide evidences on how students perceive the effectiveness of a customized online collaboration tool for teaching and learning, and whether this tool is an asset or a barrier to education. Likewise, it can provide useful insights to software developers on methods to assess custom-made software according to its effectiveness.

REVIEW OF LITERATURE

Two elements of literature are related to this study. First is the importance of Online Collaboration Tools in teaching and learning and second is the need for evaluating software effectiveness.

The first element of the literature presents that Online Collaboration Tools are indeed very important in education. Online Collaboration Tools is a technology tool that can be used to help people work together and share knowledge online to achieve a common goal (Whitsett, 2018). Some tools solely focus on file sharing, while others provide complete features such as document management, document collaboration, shared calendars, task management, and surveys (Sethi, 2018).

The majority of the literature and studies that were reviewed reveal that online collaboration tools enable the learning community to become more engaged with activities without place or time boundaries resulting in an increased productivity (The ABCs of Classroom Accessibility, n.d.; Crockett, 2017; Dorsey, 2014; Kai-Wai Chu & Kennedy, 2011; Powell, 2016). While researchers suggested that online collaboration tools are suitable for teaching and learning, the OCT that is custom-made for a

specific university should still be evaluated on its effectiveness to find out if this will work the best for the concerned students. In the context of this study, the perceived effectiveness of COCT was determined to be the student's belief that the tool is generally useful and valuable in enhancing their learning experiences particularly for collaboration, learning and teaching.

The second element of the literature stressed the need for educational software to be evaluated according to how effectively it meets its purpose as it constantly plays a major role in delivering high quality software (Huda, Arya, & Khan, 2014; Virvou, Katsionis, & Manos, 2005). Hence, many studies were found that investigate the effects of technology on students. Most researchers concluded that the use of technology in education enhances student's academic achievement, increases student's interest and generally transforms learning (Al-Hariri & Al-Hattami, 2017; Flanagan, 2008; Francis, 2017; Lynch, 2006; McCoy, 2018; Lei & Zhao, 2005; Ricks, n.d.). While the majority of the literature has shown through empirical studies that educational software plays an important role in improving the academic achievement of the student, evidence is lacking of the effectiveness of the custom-made educational software assessed by means other than the use of empirical methods. Mifsud (2015) said that effectiveness of software among other criteria is very often left at the discretion of the evaluator. Hence, this study provides substantiations on how customized online collaboration tool is assessed on its effectiveness using the individual insights as well as software usability metrics for effectiveness.

Typically, software is evaluated using the Technology Acceptance Model (TAM) such as Unified Theory of Acceptance Use of Technology (UTAUT) that focuses on the level of acceptance and use of the software. It consists of four main concepts, Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions (Ayman, 2015). Hence, the focus is on the decisions an individual has to make whether to accept and use a technology. While this model gives an insight on an individual's decision to accept and use the technology, the TAM does not measure the effectiveness of the software such as how functional the technology is. It merely emphasizes the social factors and not the characteristics of the technology. Bubinas (2013) stated that "*defining and evaluating the tangible functional outcomes of a program can give a more comprehensive view of how the software works*". Hence, in this study, metrics on effectiveness were considered in conjunction with the survey of individual's perceptions.

METHODS

As Salters-Pedneault (2018) stated, "*most experts in psychological research and diagnosis suggest that self-report data should not be used alone as it tends to be biased*". Hence, to completely describe the whole range of evaluation for COCT, two distinct approaches were used – the questionnaire-based and metrics-based approaches.

Questionnaire-based approach is a measurement of the COCT's effectiveness based on the evaluation of responses to a questionnaire. This was employed to address the first research question. On the other hand, a metrics-based approach was used to measure the COCT's effectiveness in terms of select metrics such as application performance index and completion rate. This was employed to address the second research question.

QUESTIONNAIRE-BASED APPROACH

In this approach, a questionnaire was developed using a four-point scale namely Highly Effective (4), Effective (3), Least Effective (2) and Not Effective (1). It consists of three categories, Collaboration, Teaching and Learning with six to eight questions per category. Three open-ended questions were also included in the survey instrument to gather more insights about the COCT's effectiveness. The questionnaire was submitted for evaluation by experts to ensure that items in the questionnaire effectively capture the effectiveness of the tool under survey.

Table 1 shows the breakdown of the study population per program of the College of Computing Studies, Information and Communication Technology (CCSICT) of Isabela State University Cabagan campus who were exposed to the use of the COCT. The study population consisted of 90 Bachelor of Science in Information Technology (BSIT), 46 Bachelor of Science in Computer Science (BSCS), and 45 Bachelor of Science in Computer Engineering (BSCpE), for a total of 181 students.

Students from the different classes were requested to use and explore the COCT as a platform for collaboration and learning. Specifically, they were requested to register in the COCT and use their accounts for discussion, communication, downloading of instructional materials, taking assessments and other activities as required by their teachers.

Table 1: Breakdown of Study Population

PROGRAM	NUMBER OF CLASSES	NUMBER OF PARTICIPANTS
BSIT	3	90
BSCS	2	46
BSCpE	2	45

N=181

Faculty handling these classes were likewise requested to use and explore the same platform for teaching. Specifically, they were requested to register, create a timeline for each class, communicate and discuss with their students, post announcements, upload learning resources, create quizzes and other activities provided by the COCT.

Figure 1 shows the relative frequency of the study sample. It was comprised of 127 students which represented 70.17% of the study population.

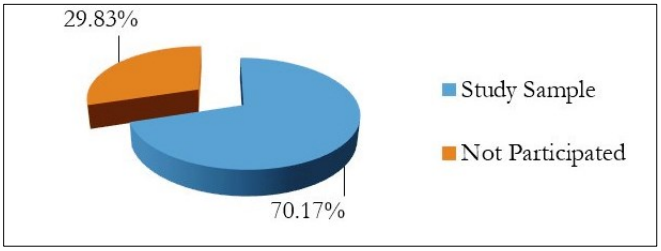
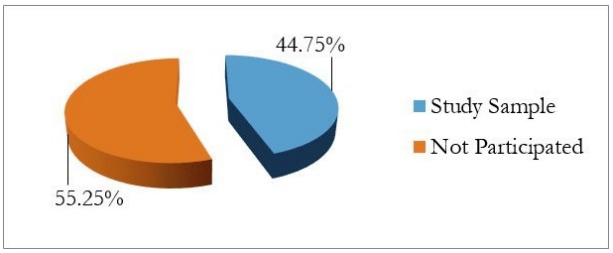


Figure 1: Relative Frequency of Study Sample in Questionnaire-Based Evaluation

Data collection was performed per class at times scheduled by the students and the subject teacher. Responses from the open-ended questions were analyzed by grouping similar responses together and response count was performed. Data gathered from the survey instrument were analyzed using simple (n) and relative (%) frequencies for the respondents' profile, weighted mean for the perception on the effectiveness of the COCT, analysis of variance (ANOVA) and Tukey HSD for the test of difference on the perceived effectiveness of COCT by the students from the different demographics.

METRICS-BASED APPROACH

From the study population, only 55.25% (n=81) of students successfully participated during the evaluation for the metrics-based approach. Figure 2 shows the Relative Frequency of the study sample who participated in this evaluation.



n=81

Figure 2: Relative Frequency of Study Sample in Metrics-Based Evaluation

In the metrics-based approach, Application Performance Index (Apdex) and Completion Rate were used. Data collection was performed by group for easier tracking of the application's response time, and completion count. For these two metrics, each of the students in the group was required to perform common transactions using the COCT where timestamps were recorded. These transactions were account registration, signing-in and viewing of classes in their account. Viewing of classes includes selecting a class and doing one of the following: posting a message, checking the calendar, viewing an announcement, and viewing an uploaded learning material.

Apdex "*numerically scores the level of satisfaction of an end user based on application responsiveness by calculating the degree to which user expectations compare to performance in a fractional 0 (no users satisfied) to 1 (all users satisfied) scale*" (Rouse, 2017). This metric was selected because a relationship does exist between satisfaction and effectiveness. It was in fact stated by Borbelly (2011) in his findings that "*effectiveness has the greatest influence on user satisfaction*". This implies that user satisfaction is a measure of software effectiveness. The formula for Apdex is given below:

$$\boldsymbol{Apdex_t} = \frac{Satisfying\ Count + \frac{Tolerating\ Count}{2}}{Total\ Samples}$$

where:

$\boldsymbol{t}$ = set threshold, and the tolerable time is assumed to be 4 times the target time

$\boldsymbol{Satisfying\ Count}$ = number of users with satisfying responses from the application

$\boldsymbol{Tolerating\ Count}$ = number of users with tolerating/ slower responses from the application

$\boldsymbol{Total\ Samples}$ = total number of users

According to Apdex Technical Specification (2007) of the Apdex Alliance, "*the threshold is a positive decimal value in seconds, having no more than two significant digits of granularity*". In this study, the set threshold (t) was assumed to be 80 seconds which was based on a reasonable approximation of response time measurements that was performed by a user given all the common transactions. From this, the *satisfying* time is less than or equal to 80 seconds, the *tolerating* time is between 80 and 320 seconds while the *frustrating* time is greater than 320 seconds. Apdex ratings are based on three levels of responsiveness, through the perception of the end user: satisfying, tolerating and frustrating. Table 2 shows the intervals and descriptions that were adopted from Rouse (2017) based from the reporting rules set by the Apdex Alliance to interpret the Apdex score.

Table 2: Interval and Description for Apdex

RANGE	DESCRIPTION
1.00 – 0.94	Excellent
0.93 – 0.85	Good
0.84 – 0.70	Fair
0.69 – 0.49	Poor
Below 0.49	Unacceptable

On the other hand, Completion Rate was used for tracking successful completion of tasks. The average number of tasks successfully completed compared to total number of tasks is the completion rate as shown below.

$$Effectiveness = \frac{Number\ of\ tasks\ completed\ successfully}{Total\ number\ of\ tasks\ undertaken}\ x\ 100\%$$

Completion rate was selected as it is part of the Usability Metrics for Effectiveness of Software (ISO/IEC 9126-4 Metrics). A binary classification rule was applied for the completion rate where completed tasks were coded as 1 when a user manages to complete a task or 0 when a user does not.

As to the interpretation of data, the completion rate is highly dependent on the context of the task given to the user (Sauro, 2012), and therefore there is no exact arbitrary rating for it. Hence, for the purpose of this study, the interval and description for the completion rate is presented in Table 3.

Table 3: Interval and Description for Completion Rate

Range	Description
100% – 96%	Excellent
95% – 91%	Good
90% – 86%	Fair
85% – 81%	Poor
Below 81%	Unacceptable

RESULTS

RESPONDENTS' PROFILE

The different programs of the CCSICT were represented in the survey as shown in Figure 2. At the time of data collection, there were no students enrolled in BSIT 2nd year level, BSCS 2nd and 3rd year levels, and BSCpE 2nd and 3rd year levels because of the K+12 transition phase in the educational system in the Philippines wherein Kindergarten was already required and two years were added to the Basic Education. Out of the 127 students, 45.67% are BSIT, 33.86% are BSCS and 20.47% are BSCpE students. The largest proportion of student-respondents in terms of year level is 4th year which represented 51.18% of the total sample.

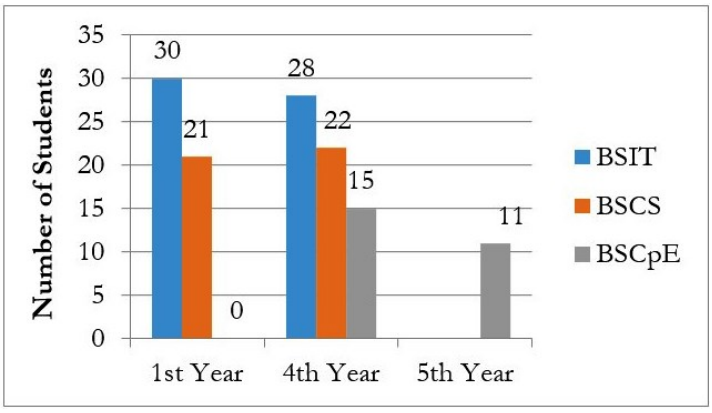


Figure 2: Student-Respondents According to Program and Year Level

There was approximately the same number of female respondents (64) as male respondents (63). The mean age of the sample is approximately 20, and the maximum age is 27. Figure 3 shows that

the largest proportion of the survey sample is in the age ranging from 19-21, having the greatest number of students for both gender (36.22% for female and 33.86% for male).

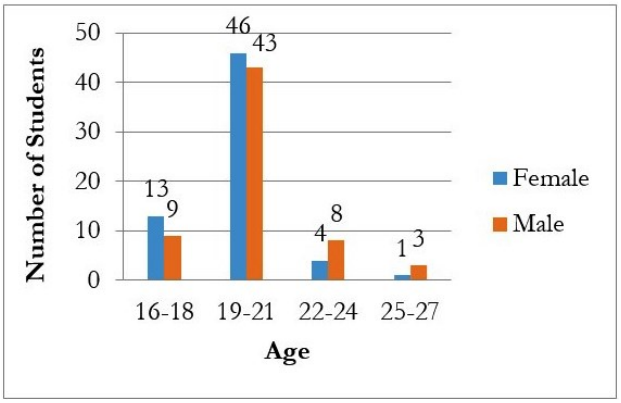


Figure 3: Student-Respondents According to Age and Gender

Figure 4 shows the distribution of students grouped accordingly (with smartphone, with personal computer, and with Internet access at home). It could be gleaned from the figure that a high proportion of students (84.25%) owns a smartphone. However, the majority of them (66.14%) do not have personal computers of their own and only 22.83% of the students have Internet access at home.

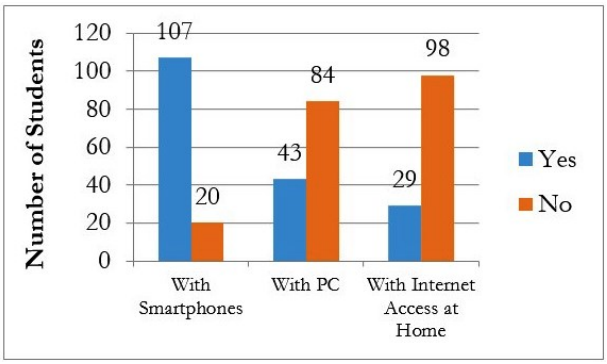


Figure 4: Student-Respondents According to Group

Nonetheless, over half (52%), as shown in Figure 5, have already experienced using online collaboration tool.

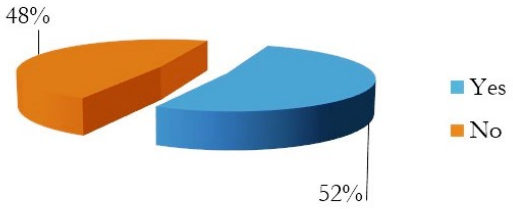


Figure 5: Student-Respondents with Experience in Using Online Collaboration Tool

Perceived Effectiveness of the COCT

Effectiveness of COCT as a tool for collaboration

Concerning the perceived effectiveness of the COCT as a tool for collaboration, Table 4 shows that students were quite assured that the COCT was very effective when used for student-teacher interaction at a weighted mean of 3.74. Interestingly, all the means were relatively close and generally can be interpreted as being very effective (3.59). It is also worth mentioning that the lowest rating is the use of the tool for information dissemination, though it is still very effective.

Table 4: Students' Perceived Level of Effectiveness of COCT for Collaboration

	WEIGHTED MEAN	DESCRIPTION
1. Communication or Discussion among team members	3.65	Very Effective
2. Sharing of Learning Materials	3.66	Very Effective
3. Teamwork	3.63	Very Effective
4. Student-Teacher Interaction	3.74	Very Effective
5. Peer-to-peer Involvement	3.53	Very Effective
6. Student Engagement	3.57	Very Effective
7. Information Acquisition	3.54	Very Effective
8. Information Dissemination	3.44	Very Effective
Overall Weighted Mean	**3.59**	**Very Effective**

Effectiveness of COCT as a tool for learning

Students were also asked to evaluate the COCT's effectiveness as a tool for learning. Table 5 shows that there is a relatively small difference on the weighted means in all items. Mean scores revealed that students generally have the same perception that the COCT is very effective as a tool for learning. Although still very effective for learning, students gave the smallest rating to development of writing skills.

Table 5: Students' Perceived Level of Effectiveness of COCT for Learning

	WEIGHTED MEAN	DESCRIPTION
1. Self-Learning	3.62	Very Effective
2. Learning from Others	3.54	Very Effective
3. Participation in the Discussion	3.57	Very Effective
4. Self-Assessment	3.60	Very Effective
5. Acquisition of Learning Materials	3.56	Very Effective
6. Development of Writing Skills	3.48	Very Effective
7. Demonstration of Ability	3.62	Very Effective
8. Awareness of Learning Needs	3.61	Very Effective
Overall Weighted Mean	**3.57**	**Very Effective**

Effectiveness of COCT as a tool for teaching

COCT's perceived effectiveness as a tool for teaching was also examined. It could be gleaned from Table 6 that students themselves generally perceived COCT as a very effective tool for teaching. Students highlighted that COCT is very effective as a tool for assessment and information dissemination as substantiated by a higher mean of 3.74 and 3.73 respectively.

Table 6: Students' Perceived Level of Effectiveness of COCT for Teaching

	WEIGHTED MEAN	DESCRIPTION
1. As an Assessment tool	3.74	Very Effective
2. As a motivation tool for student engagement	3.66	Very Effective
3. Sharing of Learning Materials	3.61	Very Effective

	WEIGHTED MEAN	DESCRIPTION
4. Information Dissemination	3.73	Very Effective
5. Achievement of Learning Outcomes	3.61	Very Effective
6. Transfer of Knowledge	3.67	Very Effective
Overall Weighted Mean	**3.67**	**Very Effective**

Variations in the Perception of COCT Effectiveness

Analysis of Variance (ANOVA) and Tukey HSD were used to examine the potential variations in the perception of the students on the effectiveness of the COCT by the different demographics.

By gender

Variation in perceptions on effectiveness was tested by gender. Table 7 shows that the p-value (0.769) is greater than 0.05 level of significance. Therefore, the null hypothesis which states that the means are the same is accepted. This implies that the perceptions of the female and male students are statistically the same.

Table 7: ANOVA by Gender

SOURCE OF VARIATION	SS	df	MS	F	P-value
Between Groups	0.0079	1	0.0079	0.0866	0.769
Within Groups	11.4765	125	0.0918		
Total	11.4844	126			

By age group

Concerning the variation in perceptions on effectiveness by age group, Table 8 shows that students exhibited statistically no significant differences in perception on effectiveness for the four different age groups at $p>0.05$ level.

Table 8: ANOVA by Age Group

SOURCE OF VARIATION	SS	df	MS	F	P-value
Between Groups	0.550	3	0.183	2.063	0.109
Within Groups	10.934	123	0.089		
Total	11.484	126			

By year level

Variations in perceptions on effectiveness were likewise tested by year levels (1st, 4th and 5th). Table 9 shows that students exhibited statistically significant differences in perception on effectiveness for the three different year levels at $p<0.05$ level.

Table 9: ANOVA by Year Level

SOURCE OF VARIATION	SS	df	MS	F	P-value
Between Groups	1.765	2	0.882	11.255	3.22E-05
Within Groups	9.72	124	0.078		
Total	11.485	126			

Post-hoc analysis using Tukey HSD (Honestly Significant Difference) was conducted to determine which group is significantly different. Table 10 shows the difference of means per year level. The data suggest that the difference of means between 1st year and 4th year is statistically significant as the q-value (6.683007) is greater than the q-critical value (3.36).

Table 10: Difference of Means per Year Level

GROUP 1	GROUP 2	MEAN DIFFERENCE	n 1	n2	STANDARDIZE ERROR	Q-VALUE
1st	4th	0.247495	51	65	0.037033427	6.683007
4th	5th	0.071456	65	11	0.06454468	1.107075
5th	1st	0.176039	11	51	0.065814425	2.674776

By program

Variations in perceptions on effectiveness were likewise tested by program (BSIT, BSCS, BSCpE). Table 11 shows that students exhibited statistically significant differences in perception on effectiveness for the three programs at $p<0.05$ level.

Table 11: ANOVA by Program

SOURCE OF VARIATION	SS	df	MS	F	P-value
Between Groups	0.709	2	0.354	4.077	0.0193
Within Groups	10.776	124	0.087		
Total	11.484	126			

Further analysis using Tukey HSD was conducted to determine which programs are significantly different. Table 12 shows the differences of means per program. The data reveals that means between BSCS and BSCpE as well as BSCpE and BSIT have significant differences where q-critical=3.36.

Table 12: Difference of Means per Program

GROUP 1	**GROUP 2**	**MEAN DIFFERENCE**	**n 1**	**n 2**	**STANDARDIZE ERROR**	**Q-VALUE**
BSIT	BSCS	0.059817	58	43	0.041948	1.425986
BSCS	BSCpE	0.207554	43	26	0.051785	4.008006
BSCpE	BSIT	3.702797	26	58	0.049197	75.26477

By group

Results from ANOVA as shown in Table 13 indicated that the means of the three different groups (with smartphone, with personal computer, with Internet access at home) were unequal, $F(2,175) = 0.807$, $p = 0.448$. This indicates that the perception on effectiveness by the students on three different groups has no significant difference.

Table 13: ANOVA by Group

SOURCE OF VARIATION	SS	df	MS	F	P-value
Between Groups	0.118	2	0.059	0.807	0.448
Within Groups	12.844	175	0.073		
Total	12.962	177			

Effectiveness of COCT in Terms of Usability Metrics

Application performance index

For the measurement of Apdex, Table 14 presents the response counts for each of the level of responsiveness based from the timestamp from transaction request to completion. It could be gleaned from the table that frustrating response counts are few compared to the satisfying and tolerating response counts. Most of the response counts (46.91%) are in the level of tolerating with a mean response time of 159.13 seconds. With the given data, Apdex was computed to be 0.65. This implies that the COCT's effectiveness in meeting application's requirements is poor as far as Application Performance Index is concerned.

Table 14: Response Counts

LEVEL OF RESPONSIVENESS	MEAN RESPONSE TIME (SEC)	RESPONSE COUNT	RELATIVE FREQUENCY (%)
Satisfied	67.03	34	41.98
Tolerating	159.13	38	46.91
Frustrating	497.5	9	11.11

Completion rate

The same set of samples and the same tasks were used in recording the completion count. Figure 6 shows the successful completion rate per task. There were very few students who were not able to successfully complete the registration of accounts (3.7%) and sign-in (11.11%) tasks. It is notable to state that all the students were able to successfully view their classes in their respective accounts in COCT. Generally, the COCT achieved a good completion rate which was computed as 95.06%.

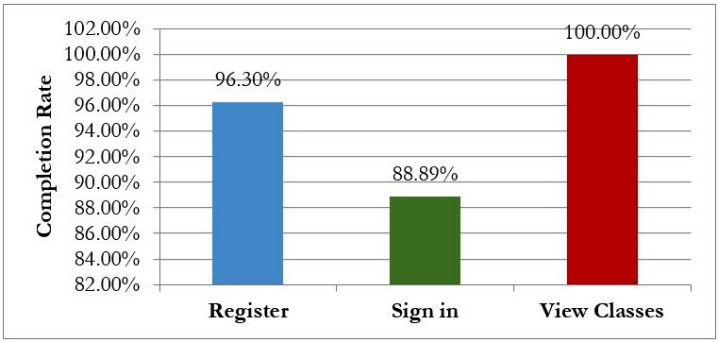


Figure 6: Successful Completion Rate

DISCUSSION

The respondents are mostly in the BSIT program, the majority of the students are in the 4th year level, and the majority of the students are 19-21 across all programs. The majority of students own a smartphone but do not have personal computers of their own or Internet access at home. Nonetheless, most of them have already experienced using online collaboration tools. This could be attributed to their age and use of smartphones as the younger generation tends to be more accustomed with using technology. According to Mitchell (2016), "Millennials have more exposure to technology (in some cases) and may be more likely to use technology for everything".

The students were asked to assess their perception of the effectiveness of the COCT. Students believed that the COCT was very effective when used for collaboration. This confirms the statement of Crockett (2017) that technology is effective in engaging students for collaboration. It is worth mentioning that the lowest rating is the use of the tool for information dissemination, though it is still very effective. This could be attributed to the Internet access as the majority of the students do not have Internet access at home and in most areas of the school. Studies show that the provision of Internet in schools will maximize the use of online platforms (Muuro, Wagacha, Oboko, & Kihoro, 2014) and will result to effective information dissemination (Karanja, 2018). Hence, when online collaboration tools are utilized, institutions must provide free Internet access in the school premises to improve its effectiveness. The free Internet access may be used to disseminate information between and among the faculty members and students. When there is unlimited access to this kind of resources, educators get motivated to use these resources differently (Wifi in Schools, n.d.). On the other hand, mean scores revealed that students generally have the same perception that the COCT is very effective as a tool for learning. Although still very effective for learning, students gave the smallest rating to development of writing skills. This could be ascribed to the language used by the students when communicating with other students and faculty members as they are not restricted to

writing styles or language use. Students either use English or Filipino language, and sometimes they use their mother-tongue language such as Ibanag or Ilocano when communicating. Students likewise perceived COCT as a very effective tool for teaching. It was highlighted that COCT is particularly very effective as a tool for assessment. This is due to the provision of immediate feedback by the COCT on the performance of the students to quizzes. Thalheimer (2016) stated that "If your goal is learning, you probably should provide feedback".

Results on the perceived effectiveness of COCT suggest that students are open to the use of a new educational intervention. Having a positive perception indicates the possibility that COCT can be a valuable tool for collaboration, learning and teaching.

Variation in perceptions on effectiveness was tested by gender, age group, year level, program, and group. It was noted that the perceptions of female and male students are statistically the same. This opposes that of Yau and Cheng's (2012) statement that "Males tend to have more positive attitudes about the use of technology for learning than do females." Concerning the variation in perceptions on effectiveness by age group, students exhibited statistically no significant differences in perception as the age range was quite narrow (16-27). As Morrison (2015) said "millennials are happy to embrace technology". Using Tukey HSD, it was found out that the difference of means between 1st year and 4th year is statistically significant. This could be attributed to the exposure of the students with technology as 4th year students are understandably have more exposure than the 1st year students. Similarly, there is significant difference on the students' perceptions of effectiveness among the three programs (BSIT, BSCS, BSCpE). Perceptions between BSCS and BSCpE as well as BSCpE and BSIT have significant differences. Variation on their perceptions could be attributed to their field of specialization as BSIT and BSCS students are more likely to have greater experience in the use of software applications than that of the BSCpE students. On the other hand, the perception of COCT effectiveness by the three different groups of students (with smartphone, with personal computer, with Internet access at home) has no significant difference. This implies that whether or not students have smartphones, personal computers or Internet access at home, they generally have the same perception that the COCT is very effective.

The COCT was likewise assessed on its effectiveness using the Apdex and Completion rate as usability metrics. Data shows that COCT's effectiveness in meeting application's requirements is poor as far as the Apdex is concerned. However, frustrating response counts are few compared to the satisfying and tolerating response counts. Most of the response counts are in the level of tolerating. The resulting Apdex score suggests that the COCT may be enhanced and that user satisfaction should be considered when reviewing its effectiveness. Using the same set of tasks, there were very few students who were not able to successfully complete the registration of accounts and sign-in tasks because of sign-up errors and mistyping of passwords and username. These errors were caused by design interface faults of COCT. Plego (n.d.) suggests that software developers ought to pay attention to interface design as "*it creates fewer problems, increases user involvement, and perfects functionality*". On the other hand, all the students were able to successfully view their classes in their respective accounts in COCT. Generally, the COCT achieved a good completion rate.

CONCLUSION

The students under study are predominantly in the BSIT program with almost the same number of females as males. Likewise, the majority of the students are characterized into minor adult having a mean age of 20, own a smartphone, have no personal computer and Internet access at home, and with experience in using online collaboration tools. These students generally perceived that the COCT is very effective for collaboration, teaching and learning. This implies that faculty members may continue using educational technology tools such as online collaboration tools and explore other ways of integrating this in the classroom. Findings likewise suggest that customized online collaboration tool can be an alternative tool to open-source learning platforms which faculty members may use for teaching and learning as students find it very effective not only for collaboration but for

teaching and learning as well. Students may likewise maximize their use of such tools to gain a significant learning experience. For the educational technology developers, they may continue to acknowledge the benefits of such tools and create more opportunities to make teaching and learning more effective.

A very effective tool based on student perceptions does not necessarily mean a high performance rating as far as application performance index is concerned. COCT may turn out to be poor in performance though very effective in the perception of the students. Hence, to improve performance, COCT design should ensure that user transaction response times are within the satisfying category by paying attention to user interface design to avoid interface faults.

For future research, further assessment on the tool's effectiveness using an empirical study is recommended to provide additional definitive evidence which may support the benefits of using online collaboration tools in the classroom.

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APPENDIX: SURVEY QUESTIONNAIRE ON THE EFFECTIVENESS OF THE CUSTOMIZED ONLINE COLLABORATION TOOL

Name (optional): _____
Course/Year: _____
Age: _____
Gender: O Male O Female

Do you own a personal computer?	O Yes	O No
Do you own a smartphone?	O Yes	O No
Do you have internet access at home?	O Yes	O No
Have you ever experienced using an online collaboration tool?	O Yes	O No

Please take a few minutes to evaluate in your own perception the effectiveness of customized Online Collaboration Tool called ***ISUC Flipboard*** using the criteria below.

VE – Very Effective E – Effective LE – Least Effective NE – Not Effective

1. How effective is ISUC Flipboard in terms of collaboration?

	VE	E	LE	NE
1. Communication or Discussion among team members				
2. Sharing of Learning Materials				
3. Teamwork				
4. Student-Teacher Interaction				
5. Peer-to-peer Involvement				
6. Student Engagement				
7. Information Acquisition				
8. Information Dissemination				

2. How effective is ISUC Flipboard in learning?

	VE	E	LE	NE
1. Self-Learning				
2. Learning from Others				
3. Participation in the Discussion				
4. Self-Assessment				
5. Acquisition of Learning Materials				
6. Development of Writing Skills				
7. Demonstration of Ability				
8. Awareness of Learning Needs				

3. How effective is ISUC Flipboard in teaching?

	VE	E	LE	NE
1. As an Assessment tool				
2. As a motivation tool for student engagement				
3. Sharing of Learning Materials				
4. Information Dissemination				
5. Achievement of Learning Outcomes				
6. Transfer of Knowledge				

4. Are there any problems that you have encountered in the use of the Flipboard?

_____
_____
_____
_____

5. Do you have any thoughts of improving the software?

_____
_____
_____
_____

6. Is the Flipboard generally effective in meeting its functional requirements? Why or Why not?

_____
_____
_____
_____

BIOGRAPHY

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