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A STUDY OF THE IMPACT OF A CROWD WISDOM ONLINE LEARNING COMMUNITY PLATFORM ON STUDENT LEARNING

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Abstract

The use of collective intelligence applications in educational settings has been reported in the literature for almost two decades. These collective intelligence applications aggregate individual knowledge via different synchronous and asynchronous mode of communications and Web 2.0 applications which support learning, communication and collaboration activities, and create “Wisdom of the Crowds”. Crowdsourcing further extends these collective intelligence processes in a distributed and cross-organizational way. This paper evaluates the effects and impacts of crowd wisdom applications on a peer assisted learning support service titled Peer-Assisted Learning scheme using Supplemental Instruction (PALSI) in a higher education institution in Hong Kong. Adopting the Design Science approach, an Online Learning Community (OLC) platform was developed tap on the Wisdom of Crowds and its effectiveness on student learning was evaluated. The OLC platform is not designed to replace existing face-to-face PALSI learning sessions and activities. Rather it helps to provide an additional online platform for supplementing and facilitating interaction between student mentors and mentees and among student mentees as well. The OLC platform is designed in a way that supports indexed and search functions who join the PALSI scheme, and it can also be archived as a repository for future reference by similar courses. Empirical analysis was carried out to evaluate the relationship between user participation and assessment results. Statistics show that students who made use of the OLC platform obtained better grades.

Keywords: Collective Intelligence, Crowd Wisdom, Online Learning Community, Peer-Assisted Learning.

1 INTRODUCTION

During the past two decades, there have been numerous educational collective intelligence applications reported in the literature. These applications are specially designed web-based applications that facilitate teacher-teacher or teacher-student communications. With regard to teacher-teacher communications, Gregg (2009) chronicles the development of a collective intelligence educational application in the special education domain, that is, developmentally disabled children. The objective of Gregg's project was to facilitate teacher-teacher communication in order to "*collect data and share insights related to student performance during educational tasks*" (p. 455). The users of Gregg's system were educators (teachers), clinicians, families, parents and related professional staff. Regarding the teacher-student communications side, Salter (2013) presents the use of Web 2.0 applications in a standard Blackboard Learning Management System to support crowdsourcing learning activities. The objective of this approach was to *"empower students to choose their own course materials"* (p. 365) so that students could become more engaged with the course materials and their peers. These online crowdsourcing activities depended heavily on the clear feedback from both peers and the teachers, and the Blackboard Discussion Forum played an important role to support crowdsourcing activities amongst students and teachers.

E-learning applications have been valued for their ability to support asynchronous and synchronous interactions in both in-class and out-of-classroom learning activities and such interactions can allow equal student participation, which are particularly good for passive students in large classroom settings. In a typical year-one undergraduate core course, it is not rare to see large enrolment courses with class sizes of up to 500 or more, though they may be split into smaller class sessions or groups. Hrastinski et al. (2010) postulate that synchronous e-learning applications are useful in strengthening group-wide relations and helpful in building up better relationships between learners and teachers, as well as enhancing group and social support within a class. Strengthening group-wide relations is more challenging in a large-class setting, as large classes decrease, students' involvement in the learning process due to fewer interactions within the classroom. It has been documented that interaction between learners has a direct relationship with academic performance (Cuseo 2007). To improve student interaction in large class settings, peer assisted learning (peer instruction) is an effective pedagogy to improve academic skills. Gok (2012) asserts that students' conceptual understanding and problem solving skills can be improved after taking part in peer assisted learning. Gregg (2009) acknowledges that the special education application only provided service to a total of 48 users, and Salter (2013) reports that the pilot crowdsourcing activities for undergraduate students only included 200-300 student users. Discussion on a large-scale peer crowd wisdom system, primarily on student-student interaction, is still rare in the literature.

The purpose of this research is to address the practical issues of utilizing collective intelligence applications to support crowdsourcing learning activities in a large class of over 500 students. For example, the enrolment of a core business course, such as MIS and Accounting, usually exceeds 700 students. The development of a crowd wisdom Online Learning Community platform (OLC) helps support online collaborative learning activities under a peer assisted learning support service titled Peer-Assisted Learning scheme using Supplemental Instruction (PALSI). Evans and Moore (2013) conducted a research study on an online discussion platform with a ticketing system in the United States, and found dynamic roles between tutor and tutee relationship. Similar examples in other Western countries can be found in the work of Smet et al. (2008) and Beaumont et al. (2012). To assess the effectiveness of OLC in student learning, an empirical analysis was conducted to investigate the relationship of OLC participation and the achievement of learning outcomes in terms of academic grades and results. The results from this research indicate a significant relationship between OLC participation and higher achievement of learning outcomes. To address the issues that have arisen on improving student academic performance in a large class size setting through peer assisted learning, this study attempts to answer the following research questions:

1. Can online collective intelligence systems for crowdsourcing activities improve students' academic performance in an extremely large class of over 500?
2. How can an OLC be designed to effectively support a peer learning model within an extremely large class?
3. Compared with the experience in the Western countries, is online peer assisted learning equally effective in Asian context?

The contribution of this paper is two-fold. Theoretically, the existing literature on IS is enriched through the presentation of a case and a model on the adoption of collective intelligence applications in a peer learning setting with quantitative evidence on its effectiveness. Pragmatically, recommendations have been made on effective OLC design for teachers and educational technologists to facilitate active online peer learning through the optimisation of functionalities and user experience.

2 LITERATURE REVIEW

The use of web-based collective intelligence systems in the literature primarily targets on business users, for example, supporting decision making in an organizational context. There is not much work to address issues related to large-scale applications of collective intelligence systems in the higher education context for crowd wisdom activities. In this section, literature will be presented on peer assisted learning, including its effectiveness and some applications of web-based collective intelligence systems adopted in peer assisted learning. Drawing on the literature on peer assisted learning and web-based educational collective intelligence systems, will finally discuss the potentials of adopting online collective intelligence systems to further enhance peer assisted learning services and initiatives.

2.1 Effectiveness of Peer Assisted Learning

Evidence shows that peer assisted learning on campus help students establish social networks which can have a positive influence on their learning achievements (Ning and Downing 2010). As both mentors and mentees participate voluntarily and meet regularly, a sense of community is developed among the participants (Huijser et al. 2008; Omar et al. 2012; Tsuei 2011). Peer assisted learning (PAL) or supplemental instruction (SI) is a well adopted strategy to support student learning in a wide range of course subjects, levels of study and educational settings (Foot and Howe 1998; D. Fuchs et al. 1997; L. S. Fuchs et al. 1999; Ginsburg-Block et al. 2006). The major benefits or outcomes for participating can be observed in academics, social relationships and self-concepts in which higher level reasoning and thinking, more constructive relationships, positive attitudes and better motivation are encouraged (Maheady 1998). Such kind of online community can create more learning opportunities for students and improve motivation, concentration and interaction of students (Tsuei 2011). However creating these types of effective strategies requires a large amount of resources such as training, time, ongoing consultations and support, venue and space resources, logistic support on scheduling and student recruitment and grouping. Thus student coverage for this type of initiative is limited. In addition, the online learning community enables dynamic and improved student peer interactions as a consequence of the availability of virtual space, feasibility of both synchronous and asynchronous learning activities, as well as flexibility in role changes that each student may play, that is, as a mentee or mentor, on a subject matter, course, or even discussion topic, and customizable mechanisms for feedback and rating on information and knowledge shared. This form of online learning community allows participants to enhance their performance in high-level knowledge constructions when compared to a face-to-face setting. With real-time feedback received from the online learning community, a positive relationship between learners' attitude and "e-mentoring" is found (Lan et al. 2007; Omar et al. 2012). Also interrelationships between individual Internet self-efficacy, perceived learning and e-learning satisfaction are all found to be positive at various levels of analysis (Chu and Chu 2010). This kind of autonomy environment encourages learners to be more involved and have frequent contact with the e-mentor. Since e-mentees may use nicknames as a kind of avatar online, peer pressure does not exist and they can purely focus on information exchange and the discussion of the subject matter. It reduces not only the pressure experienced by students but also facilitates student collaboration (Lan et al. 2007), increases learning flexibility (Omar et al. 2012) and enhances students' satisfaction of learning (Hui et al. 2008). Moreover, online peer-assisted activities allow the learners to be less anxious but more confident (Tseng and Tsai 2010). Thus, better learning performance is more likely to be achieved. However, studies also found that additional learning support, known as scaffolding, is needed when student grouping heterogeneously with various levels of critical thinking skills among the students (Lan et al. 2007). In an online environment, the mentors can learn more as they provide additional feedback. However, the more mentees would learn when receiving feedback less structured that requires them more effort and attention on further exploration and investigation of the interested topics afterwards (Topping et al. 2013).

2.2 Web-Based Collective Intelligence Systems in the Educational Context

Pedagogically, web-based online peer learning bring many advantages. Razak and See (2010) highlight that online peer learning is successful in motivating and engaging young students. Keppell et al. (2006) further point out that transferrable skills, for example, cooperation, communication and the providing and receiving peer feedback, can be developed through online peer learning. In order to benefit from online peer learning, web-based collective intelligence systems should be deployed in order to support these online peer learning activities. In the educational settings, collective intelligence systems have been adopted both formally and informally by students and teachers. Brady et al. (2010) postulate that the most significant benefit perceived by students on using web-based collective intelligence systems is the improved online communication links between students. This is reflected in the early design of collective intelligence systems. For instance, Gregg (2010) presents a framework on educational web-based collective intelligence systems for special education professionals. The framework suggests that communication and information sharing components, that is, documentation, wiki and blogs, constitute two major components in the systems. To further support crowdsourcing activities, social and behaviour data are maintained in the system, with extensive functions on data analysis, including individual students' achievement on "social interaction" targets: tracking social behaviours that are encouraged during social interactions with teachers, therapists, or other students that do not have specific instructional tasks associated with its completion (Gregg 2009). Based on his research, Gregg (2009) proposes six good practices in designing web-based collective intelligence systems: (1) task specific representations of situations and goals; (2) sharing of different types of data; (3) exchange of ideas among team members; (4) using multiple means to retrieve and analyse data; (5) incorporating user feedback regarding the system; and (6) ensuring universal usability. Table 1 presents these six good practices with examples of practical implementations.

Good Practices	Examples of Practical Implementations
(1) Task specific representations of situations and goals	• Familiarity with the terminology and the domain in the discipline • Interface intuitive and easy to use
(2) Sharing of different types of data	• Capturing all the information necessary to understand and evaluate the specific problem • Capability of manipulating quantitative and qualitative data
(3) Exchange of ideas among team members	• Supporting the seamless sharing and commenting on ideas and experiences shared by others. • Facilitating group members to learn from each other between meetings or without meetings. • Ability of other team members to comment on narrative observations of others
(4) Multiple means of retrieving and	• Provision of a variety of charts and reports to allow practitioners to analyse data in a variety of different ways

analysing data	• Ability to understand and remix data in innovative ways
(5) Incorporating user feedback regarding the system	• Iterative process of incorporating changes in the application as suggested by the users enabled the resulting application to better meet the needs of the target population • Using the web as the primary delivery unit allows new pages to be added and the system to grow as new needs were identified – without impacting other parts of the system
(6) Universal usability	• Online availability of the system anywhere and the usability of the system on different devices

Table 1: A Summary of six good practices in designing web-based collective intelligence systems

2.3 Adoption of Web-Based Collective Intelligence Systems for Peer Learning

Different web-based collective intelligence systems have been applied in peer learning and reported (Beaumont et al. 2012; Cole and Watson 2013; Evans and Moore 2013; Hrastinski et al. 2010; Hrastinski and Stenbom 2013; Smet et al. 2008). The literature represents different models of web-based peer learning systems application: (1) fixed tutor and tutee relationship (Beaumont et al. 2012; Cole and Watson 2013; Hrastinski et al. 2010; Hrastinski and Stenbom 2013; Smet et al. 2008); (2) dynamic tutor and tutee relationship (Evans and Moore 2013); (3) one-to-many tutor-tutee relationship (Beaumont et al. 2012; Evans and Moore 2013; Hrastinski et al. 2010; Hrastinski and Stenbom 2013; Smet et al. 2008); and (4) one-to-one tutor-tutee relationship (Cole and Watson 2013).

Table 2 is a summary of these applications, including major online functions, the number of student users, student levels and the respective geographical regions.

Literature	Major Online Functions	No. of Student users	Student Level	Geographical Region
Smet et al. (2008)	Online discussion groups	257 junior students, 39 online tutors	Tutee: Year one undergraduate students Tutor: Fourth year undergraduate students	Belgium
Beaumont et al. (2012)	Break-out rooms, video, voice and chat functions together with whiteboards and the ability to upload documents via Adobe Connect	87 undergraduate students	Tutee: First and second year engineering undergraduate students Tutor: First and second year engineering undergraduate students	Australia
Cole and Watson (2013)	Virtual academic writing classroom: quiz, discussion, essay submission and feedback	14 in-service teachers, working in 7 pairs.	Tutee: less experienced in-service teachers Tutor: more experienced in-service teachers	Caribbean
Evans and Moore (2013)	Online assessment, online discussion and ticketing system for tutor qualification assessment	181 undergraduate students	Tutee and Tutor: Same group of undergraduate students, roles are dynamic based on the familiarity of the topic	USA
Hrastinski and Stenbom (2013)	Instant messaging via Windows Live Massager (now Skype)	Only mentioned as a large-scale internationally recognized project	Tutee: Elementary school (K-12) students Tutor: Master's degree students	Sweden

Table 2: A summary of literature on web-based collective intelligence systems in peer learning

2.4 Limitations of Current Literature

The literature shows that applications of online collective intelligence systems have been widely adopted in different geographical regions, primarily focusing on facilitating collaboration between different peer users. The benefits of adopting collective intelligence systems in peer learning have also been asserted. However, there are a few areas that are under-explored:

1. The effectiveness of online collective intelligence systems for crowdsourcing activities in an extremely large class of over 500 students;
2. The design principles that enable effective support to a peer learning model for a highly dynamic teaching group in each semester.
3. The effectiveness of online peer assisted learning in Asian context.

3 RESEARCH APPROACH

Our approach attempts to design a crowd wisdom OLC to support PALSI activities at the College of Business in a university in Hong Kong. The majority of students, over 90%, were ethnic Chinese from Hong Kong or the mainland China, which provided a large pool of Asian population for this study. The compulsory course “CB2500: Information Management” provides a large pool of available data source that fit well within the context of this case study. Adopting the Design Science approach (Hevner and Chatterjee 2010; Hevner et al. 2004), a prototype crowd wisdom OLC, that is, the IT artefact, was developed to support PALSI activities as described in Sections 2.1 and 4.1. Section 4 presents the design and development of the crowd wisdom OLC.

An empirical analysis was conducted to ascertain the effectiveness of our crowd wisdom OLC on student learning. The relationship between student participation in our OLC and academic achievement was further investigated at the end of the semester. Section 4 presents the quantitative analysis of the OLC effectiveness and achieved learning outcomes.

4 DESIGN AND DEVELOPMENT OF THE CROWD WISDOM ONLINE LEARNING COMMUNITY

The crowd wisdom OLC platform developed in this study is based on the Design Science approach and the six good practices proposed by Gregg (2009).

Guideline	Description	Alignment with Gregg’s (2009) good practices	Alignment of Guidelines in OLC
Guideline 1: Design as an Artefact	Design-science research can produce a viable artefact in the form of a construct, a model, a method, or an instantiation.	(3) The artefact (OLC) allows the exchange of ideas among team members	The artefact produced is the OLC, a web IT platform for crowd wisdom peer assisted learning.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions for important and relevant business problems.	(1) The OLC is a task specific representation of situations and goals, that is, supporting peer instruction in extremely large class settings	The OLC is a technology-based solution, a web-based platform that addresses issues arising from peer instruction in extremely large class settings and allows fair participation by both active and passive online members.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artefact can be rigorously	(5) During testing, user feedback is incorporated into the system.	Functional testing can be achieved by executing the OLC interfaces to discover failures and identify defects. Prototype was built to demonstrate feasibility of our

	demonstrated via well-executed evaluation methods.		approach and observational methods of evaluation is also used by means of field study in multiple courses.
Guideline 4: Research Contributions	Effective design-science research should provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.	N/A	The design artefact is the crowd wisdom OLC which integrates peer teaching and learning activities and ultimately helps improve academic performance. A creative foundation of traffic-light indication of question-and-answer shows the status of each question mentees asked and improve the existing foundation of forum-like platform (see Section 4.1). This contribution is well evaluated by methodologies of design evaluation in Guideline 3.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.	(2) Sharing of different types of data, and (4) multiple means of retrieving and analysing data is supported in the OLC	The construction and evaluation of the designed OLC has undergone rigorous methods and the effectiveness of the OLC is evaluated, for example, functionality, performance, reliability, usability and fit, through analysing the correlation between students' access patterns and academic performance.
Guideline 6: Design as a Search Process	The search for an effective artefact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.	N/A	The OLC is developed with decomposing into various modules and implemented following Gregg's six good practices. In particular, incorporating user feedback into and about the system can be achieved when the observational methods is used by field study in multiple course in the early stage of development, as stated in Guideline 3.
Guideline 7: Communication of Research	Design-science research should be presented effectively both to technology-oriented, as well as, management-oriented audiences.	(6) Universal usability can be achieved by communicating with educational audiences in future publications.	Currently the OLC platform can serve multiple courses every semester. The research is communicated to different IS and educational audiences via the present and future publications.

Table 3: The crowd wisdom OLC is developed with reference to the Design Science approach and incorporating Gregg's (2009) six good practices

4.1 Traffic-light Indication IT Artefact and Piloting the OLC with PALSI Scheme

With reference to Guideline 3, the crowd wisdom OLC platform was first evaluated by means of field study in some courses. One of the courses, "CB2500: Information Management", was selected for the pilot study. The teaching team trained senior students who joined the PALSI scheme to become PALSI mentors and learnt to teach, share information and assist junior/peer students online. The design of our crowd wisdom OLC platform is based on the idea of collective intelligence obtained from the peers through asking themselves questions and their responses. The PALSI mentors met the teaching team every week before the lecture and tutorial classes and exchanged ideas on teaching and learning. The PALSI mentees were grouped and assigned to one PALSI mentor. Each group would meet face-to-face regularly once or twice a week. Both mentors and mentees registered and gained access to the OLC platform on a voluntary basis. Besides, students from the same course who did not join the PALSI scheme were also invited to join OLC on a voluntary basis. To avoid exhausting PALSI mentors and participants' efforts, a traffic-light indication with 3 colours (red, yellow and green) was used, selectively "turned on" and placed next to each question (Lan et al. 2007; Topping et al. 2013). By default, a newly posted question is indicated red. If a question is viewed, responded and accepted by the questioner, the colour will turn into yellow, as shown in Figure 1. If the questioner is satisfied with any one of the answers, the status will turn green which stops further response. Questions in the green status can also attract more participants to view, as depicted at the end of Figure 1, where we allow the autonomy platform to use different medium for communication and

PALSI mentors also have the right to moderate posts and hide inappropriate posts, however, this is not the focus of this research study.

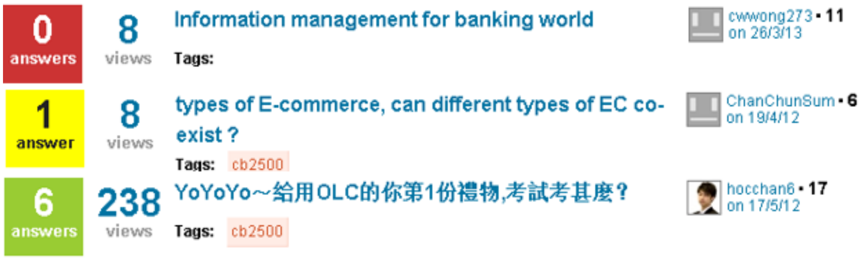

Figure 1: (a) Traffic-light status starts with red, (b) status turns yellow once receiving a response, (c) "closed" question attracts more viewers upon satisfactory acceptance by questioner.

Currently, the OLC allows students to ask questions at any time even without the assigned PALSI mentors. This blurs the border of PALSI grouping. In addition, it is also an indexed and searchable repository of knowledge for respective course, subject or discipline. OLC participants do not need to have any explicit mentor or mentee roles, therefore, when students look for solutions for their questions, they could help answer questions raised by other classmates if they are competent enough. Both the targets of learning to teach and learning to learn could therefore be achieved through this "reciprocal peer-questioning" process (Alrushiedat and Olfman 2013; King 1990). In addition, both mentors and mentees can leverage the OLC for better understanding about the course and achieve better higher academic performance than those who only use the offline face-to-face peer assisted learning services. Section 5 gives a detailed analysis of our research work.

5 AN EMPIRICAL ANALYSIS OF THE PALSI ONLINE LEARNING COMMUNITY PLATFORM

PALSI, an offline face-to-face consultation scheme, has been running for many years at the university to improve students' academic performance. The effectiveness was clearly indicated by the positive feedback from students over the years. The OLC is a platform newly developed in 2012. The following studies were conducted to investigate its values on students' academic performance in class based on statistics.

Study One: To examine whether joining the OLC can help improve the academic performance by comparing the grade distributions of four groups of students.

Study Two: To investigate the relationship between academic performance and participation in either PALSI or OLC.

5.1 Data Description

The data includes the records of 831 students who had completed the course "CB2500 Information Management" in Semester B, 2012. We divided them into four different groups as shown in Table 3. From the distribution, 79 out of 831 students registered as OLC members whereas162 students joined the PALSI scheme. All of them were encouraged to join PALSI or OLC on a voluntary basis and view the questions posted on OLC if they wanted. Non-registered OLC members could only view the questions but not participate in the peer-assisted activities.

Group	Number of users	Percentage
(1) Non-PALSI Students & Non-OLC Members	639	76.9%
(2) Non-PALSI Students & OLC Members	30	3.6%
(3) PALSI Students & Non-OLC Members	113	13.6%
(4) PALSI Students & OLC Members	49	5.9%
Total	831	100%

Table 3. Four different student groups

5.2 Study One: Deduction based on grade distribution of the four different groups

Table 4 presents the grade ranges (e.g. grade A represents A+, A or A-) obtained by the first two groups. In group (1), 28.5% students got A and 43.5% got B. Around 5% of group (1) failed the course. In group (2), 60% of the non-PALSI students who participated in OLC secured their grades in A's range. None of them got grade D or fail the course.

Group	A	B	C	D	F
(1) Non-PALSI Students & Non-OLC Members	28.5%	43.5%	20.7%	2.5%	4.9%
(2) Non-PALSI Students & OLC Members	**60.0%**	26.7%	13.3%	**0.0%**	**0.0%**

Table 4. A comparison of grade distribution between OLC and non-OLC members who did not join the PALSI scheme

Group	A	B	C	D	F
(3) PALSI Students & Non-OLC Members	32.7%	49.6%	13.3%	0.0%	4.4%
(4) PALSI Students & OLC Members	**36.7%**	57.1%	6.1%	0.0%	**0.0%**

Table 5. A comparison of grade distribution between OLC and non-OLC members who joined the PALSI scheme

Table 5 tabulates the grade ranges of the other two groups of students who joined the PALSI scheme. With the support of the face-to-face PALSI peer-tutoring scheme, more than 30% of students in group (3) and (4) obtained grade A and about 50% grade B. However, it was found that students in group (4) who regularly attended PALSI meeting, registered and participated in the OLC environment obtained better grades and none failed the course. To conclude, the results suggest that using the OLC platform could improve academic performance, that is, OLC members who were also PALSI students received more help.

5.3 Study Two: Investigation of the relationship between academic performance and participating in PALSI or OLC

Table 6 classifies the grades into 3 main performance categories: Excellent Performance (A+, A and A-), Average Performance (B+, B and B-) and Poor Performance (C+, C, C-, D+, D, D- and F). In order to investigate the effect of PALSI and OLC on academic performance, the *Multinomial Logit Model* was used in which students' performance (from level 1 (excellent) to 3 (poor)) was regarded as dependent variables and PALSI_Student and OLC_Member as two independent variables (Table 7). A summary of the data for ANOVA testing is listed in Table 8. To check whether the explanatory variables have any effects on the outcome variable, a Wald test was conducted at a 0.05 level of significance and summarized in the ANOVA table in Table 9.

Performance	Counts
1 – Excellent	255
2 – Average	370
3 – Poor	206

Table 6. Dependent variable 'Performance' and its total count

PALSI_Student	1 = PALSI student, 0 = Non-PALSI student
OLC_Member	1 = OLC member, 0 = Non-OLC member

Table 7. Independent variables

Data Summary			
Response	Performance	Response Level	3

Weight Variable		None		Population	4
Data Set		CB2500		Total Frequency	831
Frequency Missing		0		Observation	831
Population Profile				**Response Profile**	
Sample	PALSI_Student	OLC_Member	Sample Size	Response	Performance
1	0	0	639	1	1
2	0	1	30	2	2
3	1	0	113	3	3
4	1	1	49		

Table 8. Data for investigating the effect of PALSI_Student and OLC Member on outcome dependent variable 'Performance'

Maximum Likelihood Analysis			
Maximum likelihood computations *converged*			
Maximum likelihood analysis of variance			
Source	DF	Chi-Square	Pr > ChiSq
Intercept	2	26.28	<.0001
PALSI_Student	2	7.18	0.0276
OLC_Member	2	10.22	0.0060

Table 9. ANOVA testing

Since both p-values (0.0276 for PALSI_Student at chi-square statistics 7.18 and 0.0060 for OLC_Member at chi-square 10.22) are less than 0.05 level of significance. Hence, the *PALSI_Student* and *OLC_Member* have significant effect on the academic performance. These two variables can well explain the outcome variable Performance. Therefore, it is legitimate to include them in the model. Conventionally, the *highest level 3 (poor performance)* is used as the *benchmark,* i.e. the first function (**1**) is the model for *level 1 (excellent performance)* versus *level 3*, and the second function (**2**) is the model for *level 2 (average performance*) versus *level 3.*

Analysis of Maximum Likelihood Estimates					
Parameter	**Function No.**	**Estimate**	**Standard Error**	**Chi-Square**	**Pr > ChiSq**
Intercept	**1**	0.0355	0.1037	0.12	0.7320
	2	0.4223	0.0954	19.56	<.0001
PALSI_Student	**1**	0.4892	0.2831	2.99	0.0840
	2	0.7026	0.2628	7.14	0.0075
OLC_Member	**1**	1.3337	0.4403	9.17	0.0025
	2	0.8118	0.4378	3.44	0.0637

Table 10. Comparison of students joining PALSI/OLC scheme to those who didn't join

PALSI_Student Coefficient	exp(0.4892) = 1.63	The odds for a PALSI student to have excellent performance rather than poor performance are ***1.63 times*** of the odds for a non-PALSI student.
	exp(0.7026) = 2.02	The odds for a PALSI student to have average performance rather than poor performance are ***2.02 times*** of the odds for a non-PALSI student.
OLC_Member Coefficient	exp(1.3337) = 3.80	The odds for an OLC member to have excellent performance rather than poor performance are ***3.80 times*** of the odds for a non-OLC member.
	exp(0.8118) = 2.25	The odds for an OLC member to have average performance rather than poor performance are ***2.25 times*** of the odds for a non-OLC member.

Table 11. Interpretation of the odds on academic performance

PALSI_Student Coefficient	exp(0.4892 – 0.7026) = 0.807833	The odds for a PALSI student to have excellent performance rather than average performance are ***0.81 times*** (< 1) of the odds for a non-PALSI student, i.e. PALSI students were not necessarily better than Non-PALSI students in this case.

OLC_Member Coefficient	exp(1.3337 – 0.8118) = 1.685227	The odds for an OLC student to have excellent performance rather than average performance are ***1.69 times*** of the odds for a non-OLC student, i.e. OLC students seemed to be better than Non-OLC students in this case.

Table 12. Interpretation of odds at level 1 versus level 2

Table 10 shows that all the estimated coefficients are positive numbers, which means it is more likely for the PALSI_Students and/or the OLC_Members to perform better in the course. In other words, for those who did neither join PALSI nor OLC, their performance would be less competitive accordingly. An interpretation of the odds based on the coefficients of PALSI_Students and OLC_Members are explained in Table 11. Also the interpretation of the odds at level 1 versus level 2 is also explained in Table 12. Below is a summary of how the PALSI scheme, OLC platform or both of them could enhance better academic performance.

a. *Intercept > 0 means even without any help from PALSI or OLC, students could still obtain A and B grades rather than C or below, an observation in line with Study One.*

b. *All coefficients of explanatory variables > 0 means that joining PALSI and OLC would give more opportunities for students to achieve a higher grade.*

c. *Therefore, the best performing students tend to be those joining the PALSI and OLC.*

d. *Coefficients of OLC > Coefficients of PALSI implies the positive effects of OLC would be greater than those of PALSI.*

6 DISCUSSION, LIMITATION, AND FUTURE WORKS

Apart from the ordinary peer assisted learning support services, the proposed crowd wisdom OLC platform was designed to provide 24/7 assistance to student learning. Statistics show that students who were active in this blended learning environment, combined with online and offline teaching and learning activities (e.g. offline: lectures, tutorials, PALSI regular meetings; online: OLC participation), would probably attain better academic performance. Every participant may respond slower in the OLC as compared to the conventional face-to-face PALSI consultation, in which conversation and discussion take place in the designated time slots, space and real-time between mentor and mentee. This is our first stage in exploring the effectiveness of the use of the proposed OLC platform in an extremely large class size in the Asian context. However, we acknowledge that there are several limitations in this study.

1. Data collection for comparison between individuals: In comparing the four different groups of students using OLC and PALSI, different academic achievements attained by the 4 groups can be observed. However, the effect of OLC on improving individual academic performance should be further studied in the next phase.

2. Definition of “active” learners: Currently we do not have a precise figure on the time spent on OLC by individual users in order to qualify them as active users. Further studies can be done to analyse the amount of time spent on OLC and to trace users’ activities, and how students’ active participation in OLC could lead to other levels of understandings and aspects of academic achievement.

3. Effect of academic disciplines: The present study only focuses on students majoring in business. Students from other undergraduate courses of different Major studies can be compared in the future.

4. Benchmarking: As the purpose of this study is to evaluate the usefulness of our proposed crowd wisdom OLC systems in real classroom settings from a practitioner’s perspective, it was impractical to set up a control group (i.e. OLC group versus non-OLC group) with the same cohort of students with identical characteristics. We could, however, only compare the effectiveness of OLC with the previous cohort of students.

In addition, future work can focus on promoting the use of OLC and extending OLC to the mobile environment. It is recommended that duty roster can be assigned to PALSI mentors, anonymously or non-anonymously, to give response and feedback to any query so as to encourage more voluntary usage, especially some “celebrities” who performs outstanding in e-mentoring. We can also investigate the relationship between active participation in our OLC and academic achievements at the end of the semester through analysing the correlations between OLC access logs, with definition of “activeness”, and student grades.

7 CONCLUSIONS

To acknowledge the effectiveness of peer learning in improving students’ academic performance, we have investigated the effects of a crowd wisdom online learning community platform on student learning. This study has attempted to address the research gap by evaluating the impact of crowd wisdom OLC on extremely large class settings in the Asian context. The three research questions includes: (1) Can online collective intelligence systems for crowdsourcing activities improve academic performance in an extremely large class of over 500 students? (2) How can an OLC be designed to effectively support a peer learning model within an extremely large class? and (3) Compared with the experience in the Western countries, is online peer assisted learning equally effective in Asian context?

Our crowd wisdom OLC platform has enabled students to ask questions at any time without the constraints of the availability of the assigned PALSI mentors through an indexed and searchable knowledge repository for a course. Results from our empirical study have indicated that online collective intelligence systems for crowdsourcing activities can enhance students’ academic performance in an extremely large class and affirmed the effectiveness of peer assisted learning using the proposed OLC in the Hong Kong educational context characterised by predominantly Chinese learners and a large class size. In the next phase, we will study the effect of OLC on improving academic achievement through a longitudinal study of system usage, in which comparisons across students with different academic interests will be made. It is also suggested that future research direction can focus on OLC user experience and the extension of the use to mobile environment.

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