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Is SRS (Student Response System) Icing on The Cake? Comparing Efficacy of Different Modalities of SRS Engagement Incorporated into Collaborative Reading in an EFL Classroom

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ABSTRACT

Student response systems (SRSs) have been applied in a wide array of educational contexts to promote engaging learning. There exists scant empirical evidence about comparing web-based SRS with other modalities of response methods. In the present study, a quasi-experimental research design was undertaken to compare three learning conditions on EFL learners' learning outcomes in terms of reading comprehension and incidental vocabulary learning: (1) collaborative reading plus high-tech SRS (Nearpod application) (2) collaborative reading plus low-tech SRS (mini-whiteboards) as the two experimental groups and, (3) collaborative reading (non-SRS group) as the control group. The results revealed that there was no significant difference in the vocabulary tests among groups, and that, however, both experimental groups using SRS, whether in digital or non-digital forms, significantly outperformed the non-SRS group, whereas there was no significant difference in the reading scores of high-tech SRS group versus low-tech SRS group. Furthermore, the questionnaire tapping into students' perceptions indicated that students generally hold more positive attitudes towards the use of Nearpod than towards mini whiteboards as a response method. Participants' open-ended responses indicated that the outcome might be associated with limitations inherent from using mini whiteboards as a response method.

INTRODUCTION

Empirical evidence has shown that students' engagement, whether emotional or behavioural, can be a significant predictor of students' academic performance (Lee, 2014). The existing literature has documented a wide array of instructional approaches to involve students in meaningful academic experiences, one of which has received increasing attention and popularity by teachers and educators recently is to integrate mobile technology in class (Hwang & Fu, 2019; Stockwell & Liu, 2015). That is to say, the widespread use of the internet and mobile devices have contributed to the movement of Bring Your Own Device (BYOD) in educational settings, a practice allowing students to bring their own devices to classes for learning opportunities. It certainly changes how a new generation of digital natives learn, especially in the era of the Internet where there is a high level of mobile device ownership and usage. (Hung, 2017). Moreover, there has been a growing prevalence of free-downloaded smartphone applications designed for promoting engaging learning experiences, one of the which that has been widely applied in

classroom settings is web-based student response systems (SRS), which also termed as clickers, audience response system, student response system or class response system. It is note that the term SRS is used in the paper for consistency. The so-called system helps create interactive environments where teachers pose questions on the big screen, and students can give responses and feedbacks using their own mobile devices in real time. As Randolph (2007; p.113) pointed out, the underlying elements of active student response contributing to learning are "an instructional antecedent (e.g., a question posed by the teacher), a student response (e.g., the answer to the question), and teacher feedback."

In literature, there are four forms of SRS techniques commonly applied in classrooms for question-answer activities: (1) non-digital tools such as hand-raising, flashcards or mini whiteboards;(2) hard-wired equipment with triggering devices of numeric keypads; (3) wireless radio frequency or infrared transmitters resembling TV remote by which students can respond to questions asked by teachers, and (4) network-based systems and BYOD (Liu et al., 2017). As Aljaloud et al.(2015) pointed out, classical SRSs, such as the second and third types, have now been rendered obsolete for not only their practical drawbacks such as high cost of purchase and maintenance, wasted time on SRS training and delivery of devices, and technical malfunctions but also by the rise of the mobile phone.

The current paper adopts collaborative reading as a pedagogical framework while integrating with the two remaining SRS modalities, web-based and non-digital, namely Nearpod and mini-whiteboards respectively, to provide productive lenses for the investigation on how learning environments with different levels of technological SRS engagement affect students' peer-meditated learning outcomes, specifically reading comprehension and incidental vocabulary acquisition. Despite a growing interest in the application of web-based SRS in classrooms, several aspects still need to be addressed to contribute to a better understanding of their influence on student learning. There has been little attention in the literature paid to the comparison of a web-based SRS to other modalities. This study aims to further explore whether the use of the web-based SRS or non-digital response methods could facilitate learners' learning outcomes and to what extent students' learning performance would differ. Furthermore, most past studies applied SRS to lectures or individual learning. This study attempts to adopt collaborative learning in conjunction with SRS-integrated instruction. As suggested by previous studies (Chien et al., 2016; Hunsu et al., 2016; Liu et al., 2017), SRS-driven learning should be incorporated with other instructional strategies so as to achieve better academic performance. Peer-aided learning, as a suggested approach, is anticipated to serve as a vehicle for meaning construction, and it is aimed to explore whether the combination of both would possibly lead to a multiplying effect.

Therefore, this study aims to add to the current research on investigating how learning environments with different modalities of SRS engagement affect students' learning in a junior college EFL classroom. The following research questions were posed to guide the study:

(1) Does the use of web-based SRS (Nearpod) mediate the outcomes of peer discussion?
(2) Does the use of non-digital SRS (mini-whiteboards) mediate the outcomes of peer discussion?
(3) Would high-tech SRS engagement in an instructional environment lead to better learning outcomes compared to low-tech SRS, specifically reading comprehension and incidental vocabulary acquisition?
(4) What are students' perceptions toward the use of different SRS modalities?

LITERATURE REVIEW

Previous studies have reported widely recognized benefits of the use of SRS for various contexts and domains(Aljaloud et al., 2015; Castillo-Manzano et al., 2016; Fallon & Forrest, 2011; Kay & LeSage, 2009). In a systematic review of 67 papers from 2000 to 2007 conducted by Kay & LeSage (2009), three categories of benefits using SRS identified include classroom environment benefits, learning benefits, and evaluation benefits. A more recent metanalysis (Hunsu et al., 2016) reported that SRS-based technologies comparing to conventional lectures were not only associated with affective outcomes but also with a small effect on cognitive outcomes, however, with almost non-existent effect on recall or retention of course materials. Castillo-Manzano et al.(2016) further specified that the effect of SRS on academic performance might be moderated by specific features such as educational levels and the category of disciplines.

Some studies have compared the effects of using different forms of SRS modalities. In general, students had a more positive view of digital SRS compared to non-digital response methods, particularly for the provision of anonymity. Nonetheless, the empirical evidence appeared equivocal in terms of the impact of different techniques of SRS on examination results. Shaffer & Collura's (2009) and Morling et al. (2008) indicated that the clicker group outperformed the other non-clickers group who responded by raising hands on performance of exam questions. Brady et al.(2013) compared the effect of clickers and paddles as a low-technological response method on metacognition, and the results showed that metacognitive processes were influenced more by paddles than by clickers but clickers produced significantly higher performance outcomes. However, other studies state that the effect of SRS use is not more sufficiently significant in terms of learners' examination scores than of other conventional alternative student response techniques. Schulz et al. (2020) investigated whether high-tech (clickers) and low-tech (response cards and hand-raising) SRS modalities had an impact on disruptive behaviour and academic responding for young learners. The findings indicated that both clickers and response cards were more effective in increasing student academic responding and decreasing disruptive behaviour compared to hand raising but did not result in increased academic accuracy. Stowell & Nelson (2007), Elicker & McConnell (2011) and Patterson et al.(2010) also reported similar findings with their study conducted in university settings, revealing no significant effects were reported on academic performance when the use of clickers comparing to the other group either using a raised hand response or hand-held flashcards. In Anthis's (2011) study, it was even reported that there existed a negative association between clicker use and exam scores. Some studies have been conducted to compare web-based SRS to classical clickers. Wang et al.(2016) reported that the use of different formative assessments-paper quiz, clickers and web-based SRS Kahoot didn't result in a difference in learning outcome but students using Kahoot had better motivation, enjoyment, engagement, and concertation compared to ones using the other two quiz methods. Another study comparing clickers and Kahoot (Jones et al., 2018) indicated that Kahoot quizzes, notwithstanding bringing more enjoyment, might not be as effective as clickers in terms of promoting deeper understanding.

METHODOLOGY

Participants

Participants in this study were 17-18-year-old nursing majors enrolled General English as a required two-credited course at a junior college in northern Taiwan. Three intact classes taught by the researcher were recruited for the quasi-experimental design employed study and randomly assigned as the non-SRS group (collaborative reading) (N=52), the high-tech SRS group (collaborative reading plus web-based SRS) (N=55), and the low-tech SRS group (collaborative reading plus mini whiteboards)(N=54).

To ensure three groups were comparable in terms of their English proficiency, specifically in reading, an analysis of variance (ANOVA) was conducted to compare reading proficiency tests administered by the school at the beginning of school year for the purpose of measuring students' English proficiency progress annually. The reading proficiency tests were a sample reading test from TOEIC Bridge composed of 50 multiple choice questions in two sections, choosing words/phrases for incomplete sentences and choosing the best answers for short reading passages. The results indicated that the score average for the non-SRS group was 53.42 (SD = 14.32), for the low-tech SRS group 54.18 (SD = 13.836), and for the high-tech SRS group 52.67 (SD = 16.368), with no significant differences among three groups ($F(2,158) = .141$, $p = .868$)

Materials and learning activities

Students from three intact classes used the same textbook prescribed by the school: National Geographic Learning Impact level 2 labelled as B1 level on the CEFR scale. For general intervention procedures, collaborative reading was applied to all three classes which aimed to engage participants as active readers with an emphasis on group mediation. To facilitate group discussions using team heterogeneity of English levels as an advantage, the researcher first sorted the whole class into 4 levelled groups based on student's English proficiency scores and then allowed students to choose their partners from each level to form their homegroup. A worksheet designed for each unit composed of glosses and open-ended guiding questions specific to the learning content was provided to each student and also served as a reading prompt to facilitate students' understanding of the text and guide group discussions.

Students would normally proceed to read a portion of the text silently for comprehension with reading support of L1 glosses provided on the worksheet and stopped to discuss what they had read. During the reading process, they were encouraged to discuss with their group members to clarify the meaning of parts of the passage that didn't make sense to them.

All three classes used the same teaching materials and collaborative learning as a pedagogical approach whereby students discussed possible answers to comprehension questions ranged from looking for the answer from the text to analysing for the deeper meaning of passages. The only difference lied in the use of different mediums for reviewing answers to comprehension questions through which students demonstrated their understanding of the text by elaborating and justifying their answers after group discussions.

Students in the non-SRS class were asked to write down their answers on the worksheets after peer discussion. During the whole class discussion, students either volunteered by raising hands or were randomly called upon to answer questions. In the low-tech SRS class, each group was provided with a small whiteboard as a SRS tool. Each group responded to reading

comprehension questions prompted by the teacher by writing their answers on a small whiteboard and holding it up to display their answers to peers and the teacher. In the high-tech SRS group, the participants used the web-based application Nearpod as a SRS tool for that it doesn't limit responses to multiple-choice or true or false questions and allows for polling, drawing, simple short-closed and open-ended questions. Participants in a group of four shared one mobile device and submitted their responses after group discussion. It is noted that to encourage students to participate actively in responding, points were awarded for correct responses in all three groups, which were accumulated as a part of their course grades. As pointed out by Chien et al.(2016), we can only justify the association between SRS-integrated instruction and its benefits when grades are attached to SRS performance so as to avoid students mindlessly submitting responses.

Instrument

The instruments applied to the present study to investigate the research questions include the following items: (1) a post-lesson comprehension test (2)a post-lesson vocabulary test (3) a perception questionnaire. Participants were not informed about the post-tests.

The post-lesson comprehension tests required participants to recall information they have read in the texts and aimed to measure their comprehension and content acquisition of designated texts. The comprehension test was composed of 10-item multiple-choice questions. Likewise, the post-vocabulary test was designed to measure students' incidental vocabulary learning, and, thus, required passive knowledge since words were not taught as the focus of attention in the research context. The vocabulary test contained 10-item multiple-choice questions (choosing the best fit for the incomplete sentence), 5-item meaning production questions (providing equivalent Chinese translation), and 5-item definition match questions (matching the given definitions with the target words). The instruments were field-tested among 10 pilot participants from another nursing class of the same year whose class mean score for the English reading proficiency test was close to the three recruited intact classes'. The vocabulary test was modified twice before used for the present study.

The perception questionnaires were developed to ascertain participants' learning experience using high-tech and low-tech SRSs, namely Nearpod and mini-whiteboards, consisting of 10 items that were rated on a 5 point Likert scale from strongly disagree to strongly agree and open-ended questions: What are the advantages/disadvantages of using high-tech SRS (Nearpod)/low-tech SRS(mini whiteboards)? The reliability (Cronbach α) of the 10-item questionnaire questions is .96 which indicates an excellent internal consistency.

RESULTS

Learning outcome

The scores of the posttests were first calculated for descriptive statistics and then analyzed using a one-way MANOVA with different levels of technological SRS engagement as the independent variable and the two test scores as dependent variables (i.e., reading comprehension, vocabulary). Students who didn't complete post-tests were eliminated.The mean scores and standard deviations of both vocabulary and reading comprehension test scores are shown in Table

1, for the vocabulary test, there was very little difference across groups whereas for the reading comprehension test, the high-tech SRS group scored the highest (M=65.29, SD=22.12), closely followed by the low-tech SRS group (M=62.86, SD=21.72), and lastly the non-SRS group (M=43.02, SD=24.31). The MANOVA analysis confirmed there was significant multivariate effect: Wilks' Lambda = .766, F(4,312) = 11.108, p < .001, partial eta squared = .125. Following the multivariate tests, ANOVA tests were conducted on the two dependent variables. Prior to performing follow-up ANOVA tests, the homogeneity of variance assumption for two dependent variables at posttests was tested and the results showed that both of the Levene's tests were not statistically significant ($p > .05$); therefore, the homogeneity of variance assumption was satisfied. Results of the univariate tests presented revealed a significantly large effect on reading comprehension test (F(2, 157) = 15.277, p < .001, partial η2 = .163) ; however, no significant difference was found on vocabulary test (F(2, 157) = .098, p = .907, partial η2 = .001).

Further, Post hoc Tukey's HSD analyses to the univariate ANOVA for the reading comprehension scores (Table 2) revealed that both groups using SRS, whether in digital or non-digital forms, significantly outperformed the non-SRS group (p <.01), whereas there was no significant difference in the reading scores of high-tech SRS group versus low-tech SRS group (p=.845).

Table 1. Descriptive Statistics for vocabulary and reading comprehension post-tests

	SRS engagement	Mean	SD	N
vocabulary	non-SRS	53.96	19.743	53
	non-digital SRS	55.27	23.806	56
	digital SRS	53.43	22.814	51
	Total	54.25	22.086	160
reading comprehension post	non-SRS	43.02	24.305	53
	non-digital SRS	62.86	21.718	56
	digital SRS	65.29	22.123	51
	Total	57.06	24.689	160

Table 2. Post hoc analysis of the groups on reading comprehension scores

					95% Confidence Interval	
		Mean Difference	Std. Error	Sig.	Lower Bound	Upper Bound
non-SRS	low- tech SRS	-19.84*	4.356	.000	-30.15	-9.53
	high-tech SRS	-22.28*	4.459	.000	-32.83	-11.72
low-tech SRS	non-SRS	19.84*	4.356	.000	9.53	30.15
	high-tech SRS	-2.44	4.400	.845	-12.85	7.97
high-tech SRS	non-SRS	22.28*	4.459	.000	11.72	32.83
	low-tech SRS	2.44	4.400	.845	-7.97	12.85

Questionnaire

Table 3 summarizes the quantitative results (means and SDs) of students' perception questionnaires for both high-tech and low-tech SRS groups. To examine and compare two groups' feedback on how they perceived their learning experience, an independent samples t-test was conducted for data analysis. Of note, students using Nearpod as a response method rated higher on all 10 items of questions than those using mini-whiteboards. The scores reached a significant difference on question 1, 4, 5, 6, 7, which taped into how leaners perceived likeness and interest (Q1&Q5), self-engagement (Q4), group participation (Q7) and fairness of using SRS tool as a group grading system (Q6). More information was also elicited from participants' responses to two open-ended questions. Both groups didn't differ much on their positive opinions toward the use of high- versus low-tech SRS, with similar comments including better engagement and attainment, more interaction between the teacher and the students, learning within groups and from other groups, earning rewarded points as an incentive, more group communication and positive group dynamics, quickly getting the gist of the text, and a greater impression of the learning content. Nevertheless, the statistical difference seems to indicate that students using Nearpod might have a higher level of perceived engagement and participation in terms of individual and group learning than students using mini-whiteboards. Interestingly, some common words such as "fun", "interesting" and "enjoyable" that were used to describe as advantages of their learning experience mainly come from students using the technology-based response method, which coincides with the indicated statistical difference favoring the high-tech group on perceived likeness and interests toward their learning condition where Nearpod was introduced in the classroom. Another widely acknowledged advantage of the use of SRS in the existing literature is also mentioned by participants from both groups, indicating that they could refer to their fellow classmates' answers to monitor their learning from the peers' display of responses to questions before the correct answers were discussed (Kay & LeSage, 2009).

In terms of hindrances when different modalities of SRS are concerned, it was found that both groups have different perceived disadvantages, with the high-tech group mentioning technical problems occurring during the sessions and a waste of time while waiting for all groups to join the session whereas the low-tech group extensively noted the unfairness of using mini-whiteboards for SRS activity to receive group points. Their comments on the lack of equality are as follows: " We sit in the far back of the classroom, so the teacher sometimes didn't see our answers because of the distance.", " It is not fair because everyone has different writing speed.", "The teacher chose groups that showed answers first but some groups were not seen due to teacher's limited vision span.", "We need more time to react to the questions so we were slower to write down answers." These open-ended comments to some extent revealed why both groups significantly differed in their perceptions of whether it is fair to have their participation graded using SRS tools.

Table 3. The Independent Samples T-Test on learners' perceptions of the use of High-tech vs Low-tech SRS

Questions		Mean (SD)	t	p
1. I like using Nearpod/mini whiteboards for SRS activities.	High-Tech SRS	3.89(0.91)	2.285	**.025**
	Low-Tech SRS	3.46(0.95)		

2. I concentrated more in class because of the use of Nearpod/mini whiteboards for SRS activities.	High-Tech SRS	3.98(0.94)	1.398	.165
	Low-Tech SRS	3.70(1.01)		
3. I could quickly get the gist of the text because of the use of Nearpod/mini whiteboards for SRS activities.	High-Tech SRS	4.07(0.95)	1.942	.055
	Low-Tech SRS	3.66(1.08)		
4. SRS activities using Nearpod/mini-whiteboards enhanced my engagement and participation.	High-Tech SRS	4.21(0.83)	2.974	**.004**
	Low-Tech SRS	3.64(1.04)		
5. SRS activities using Nearpod/mini-whiteboards arouse my interest in learning English.	High-Tech SRS	3.87(0.99)	2.058	**.042**
	Low-Tech SRS	3.44(1.07)		
6. It was fair to use Nearpod/ mini whiteboards as a group grading system.	High-Tech SRS	3.72(1.05)	2.687	**.009**
	Low-Tech SRS	3.10(1.21)		
7. The SRS activities and rewarded points for correct responses promoted group discussion among my group members.	High-Tech SRS	4.09(0.95)	1.999	**.048**
	Low-Tech SRS	3.68(1.03)		
8. Group discussion enhanced by SRS activities helped me clarify parts of the text that I didn't understand.	High-Tech SRS	3.98(0.94)	1.690	.094
	Low-Tech SRS	3.64(1.02)		
9. Group discussion enhanced by SRS activities left me a greater impression of the learning content.	High-Tech SRS	4.15(0.88)	1.872	.064
	Low-Tech SRS	3.80(0.94)		
10. I was more certain regarding the answers to SRS questions after the group discussion.	High-Tech SRS	4.09(0.95)	1.772	.080
	Low-Tech SRS	3.72(1.07)		

Note. Rating scale: 1 = strongly disagree; 2 = somewhat disagree; 3 = neutral; 4 = somewhat agree; 5 = strongly agree.

DISCUSSION

The results of the present study lend support to the facilitative role of SRS on reading comprehension but not on incidental vocabulary acquisition. The result showing different levels of technological SRS engagement didn't produce a statistical effect on incidental vocabulary learning might be due to the fact that vocabulary was learned as a by-product of collaborative reading activities and SRS questions in the context where students focused on comprehending the messages delivered in the text, rather than on learning new words deliberately. Previous studies also suggested that vocabulary acquisition might not take place from reading-only

instruction(Sonbul & Schmitt, 2010). Despite several researchers suggested that the provision of L1 glosses to a certain extent might enhance learners' retention of unknown words learned incidentally from reading (Hulstijn et al., 1996; Teng, 2020), the current study, however, didn't employ the provision of L1 glosses as a between-subject factor so this might also explain why the results didn't yield a significant effect on vocabulary tests across groups.

Students in two forms of SRS-facilitated learning conditions, be it high-tech (Nearpod) or low-tech (mini-whiteboards), had similar learning outcomes and excelled students in the non-SRS integration group in the reading comprehension. Overall, the superiority of both the SRS-integrated groups (digital and non-digital) over the non-SRS group in the comprehension scores further corroborate Chien et al.'s(2016) metanalytic review on SRS-integrated instruction, indicating that SRS-integrated instruction yielded better general outcomes than those of non-SRS groups, and also Randolph's (2007) meta-analysis on response cards, also showing that the use of response cards regardless of types led to better academic performance than did hand-raising. An observation from classes where mini-whiteboards and Nearpod were used as SRSs is that students were more actively engaged in peer discussion whereas students in the non-SRS group tended to work on an individual basis with some students being distracted during the reading process where they were supposed to clarify the meaning of the text with peers and initiate discussion so as to answer the guided questions on the worksheet. This is consistent with widely-reported behavioral outcomes related to SRS-based pedagogy from previous studies that SRS techniques promote wider participation and deeper engagement as opposed to conventional lectures where only a few dominant students respond to in-class questions. (Aljaloud et al., 2015; Castillo-Manzano et al., 2016; Chien et al., 2016; Elicker & McConnell, 2011; Kay & LeSage, 2009; Shaffer & Collura, 2009; Stowell & Nelson, 2007; Wang & Lieberoth, 2016). This also echoes Blasco-Arcas et al.'s (2013) claim that interactivity, active collaborative learning, and engagement are the mechanisms underlying the effect of SRS use on learning performance. It should be noted that in the non-SRS group collaborative learning was also introduced as a pedagogical practice notwithstanding, students were more reluctant to discuss questions with or seek help from their group members. This tendency might be attributed to "individualistic views towards education"(Saito et al., 2020, p.3) in South East Asian countries where individual learning and teacher-led lectures might be the norm in classrooms. How culture plays a role in SRS-integrated learning was also discussed in Fan et al.'s (2017) study, which compared the impact of SRS on the learning experience and learning behaviour of Chinese and Canadian students with their different learning styles rooted from the cultural differences examined. Chinese students hail from Collectivistic cultures where they adopt passive learning and are reticent to answer or ask questions from instructors in public to avoid seeking attention and being boastful whereas Canadian students feel comfortable initiating discussions and tend to be active class participants. Being aligned with the authors' hypothesis that the use of SRS system might benefit Chinese students more in terms of encouraging class participation, the findings indicated that Chinese students viewed their SRS learning experience more positively than their Canadian counterparts, which was linked to the aspects of interaction and engagement. With that said, it also strengthens that the use of question-answer activities facilitated with SRS served as a motivation-enhancement tool for passive and quiet learners to stimulate group dialogue so as to promote a higher level of individual engagement and group collaboration.

Another plausible reason for SRS groups had significantly higher scores in their reading comprehension might be teachers' provision of corrective feedback after SRS questions. As Gauci et al.(2009) pointed out, not only did the increased engagement but also the immediate feedbacks

during lectures attribute to better examination outcomes. The feedback from the instructor could serve as a review of the text and efficiently clarify widespread misunderstandings. Additionally, the qualitative data derived from questionnaires in the present study also revealed that not only does the use of a response system, whether in high-tech or low low-tech form, enable students to learn from the teacher's provision of corrective feedback but also from watching others. Based on a study looking into reluctant participators' perceptions of the SRS conducted by Graham et al. (2007), immediate assessment of their own knowledge and performance and increased awareness of peer's opinions were perceived to have the greatest value when pedagogical practice integrated with SRS was implemented.

Regarding the comparison of effectiveness between low and high technological SRS, the finding of the current study is in line with the previous studies indicating that modalities of SRSs, in general, didn't result in a difference in learners' academic scores (Elicker & McConnell, 2011; Schulz et al., 2020; Stowell & Nelson, 2007). However, the collected data from the questionnaire tapping into students' perceptions indicated that students generally hold more positive attitudes towards the use of Nearpod than towards mini whiteboards as a response method. Specifically, compared to the use of mini-whiteboards as a response method, technology-based SRS activities were perceived as more interesting and more effective in terms of increasing engagement and level of collaboration. A complementary account for the significant difference between the high-tech group favouring the low-tech group on perceptions might be associated with the limitation inherent from using mini whiteboards as a response method. Similar concerns have also been raised in the literature about the use of write-on response cards, including excessive time required for writing and erasing and causing strain on the teacher's eye due to size and legibility of students' handwriting (Heward, 1994; Randolph, 2007). The issue could be further complicated, as seen in the open-ended responses from the low-tech group where the pedagogical strategy was using write-on responses for group grading.

CONCLUSION

A number of previous studies have compared the instructional effectiveness across different response modalities. In general, the results indicate that the use of SRS positively reinforces affective outcomes (i.e., attention, motivation and engagement) and behavioral outcomes (i.e., decrease of off-task and disruptive behaviour, increase of responding rate). However, there remained a conflict in previous research as to whether the use of SRS improves students' examination performance. Notwithstanding that some past studies documented the achievement gap favouring SRS-integrated instruction over control conditions, some researchers (Anthis, 2011; Chien et al., 2016) argued that the greater academic performance might be the function of review questions or a specific instructional method (i.e., collaborative learning) and is falsely attributed to the use of SRS. The present study adds another layer of knowledge on the use of SRS. The results flowing from the study show that comprehension scores were significantly higher for both groups utilizing SRS in collaborative learning when compared to the non-SRS group where students received the same comprehension questions and instructional approach as students of the other two groups. These results strongly suggest that the use of SRS, whether Nearpod or mini whiteboards, indeed has some advantages over collaborative learning as a stand-alone intervention. The key elements to the success of SRS-integrated intervention might be that

SRS promotes more active collaborative reading and increased individual engagement. Consequently, emotional and behavioural engagement boosts learning performance.

Interestingly, consistently with previous studies (Aljaloud et al., 2015; Fallon & Forrest, 2011; Shaffer & Collura, 2009; Stowell & Nelson, 2007) comparing at least two response modalities, the questionnaire revealed that learners viewed high-tech web-based SRS in a more positive light than low-tech write-on response method despite the fact that there exists a nonsignificant difference in reading scores between two groups. However, the reason accounted for the clear preference of high-tech modality in the study might be different from that of previous studies mostly associated with anonymity offered by high-tech SRS. Students' negative opinions on the write-on response method impeding a fair judgment of awarded points might offer a plausible explanation for a significant difference in students' overall perception between two modalities. That said, if SRS responses are to be used as a part of grading, web-based SRS might serve as a better tool because a more immediate graphic display of response results can be shown onto the big screen with students simply typing their answers through their mobile devices. Thus, the whole class responses could be displayed in real time for the instructor to easily and quickly scan so as to award points, monitor students' learning and clarify misconceptions.

Based on some empirical evidence, grades being attached to students' SRS responses might have some incentive factors. Trees & Jackson(2007) found that clicker-awarded points were associated with increased attendance and students' positive perceptions of learning processes and involvement, and that, in consequence, the extrinsic rewards could also lead to intrinsic motivation derived from the desire for being a part of interesting and engaging activities. Noted by the authors that, nonetheless, performance contingent awards might also possibly diminish students' autonomy and undermine the role of intrinsic motivation. A study also reported that students expressed negative views regarding the primary use of SRS for grading purposes (Graham et al., 2007). It is therefore advised that educators who plan to implement incentive-based SRS use, either for testing or participation, should be cautious about the practice by avoiding potential pitfalls and ensure that the award system can be used to affirm students' competence and positively reinforce their constructivist learning experience.

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