PAPERSCRIBBLES VERSUS GROUPSCRIBBLES: ARE THEY THE SAME?

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Abstract: PaperScribbles (PS) consisting of markers, vanguard sheets and 3M Post-It® notes, is a widely used pedagogical tool to harness collective intelligence of groups for collaborative learning in the classroom. Borrowing the key features of PS and yet avoiding some of their physical limitations, a computer-based tool called GroupScribbles (GS) was designed to enable high performance synchronous, face-to-face collaborative experiences in the classroom. In our exploratory study, we discuss and compare the different properties of PS and GS technologies in two elementary grade 5 classes. The findings reveal that there are not only physical and technical differences but more importantly, pedagogical differences between the two technologies that impacts the learning of the students.

Keywords: Information Technology and Education, Primary Schools

1. INTRODUCTION

Traditional patterns of classroom talk have evolved over a significant period of time, and are continuously reproduced as part of institutionalized schooling. Analysis of classroom discourse has been the subject of extensive educational research (e.g., Cazden, 1988; Edwards & Westgate, 1994; Mercer, 1995). The most typical or default pattern of classroom interaction is the IRE (initiation-response-evaluation) pattern which has been shown to account for a possible 70% of teacher-student classroom interactions (Nassaji & Wells, 2000). In the IRE, a teacher initiation (I) is followed by a student reply (R), followed by an evaluation of this reply (E) by the teacher. In this pattern, the teacher initiates discussion, usually with a question, students respond and the teacher provides feedback in the form of evaluation. IRE has been criticized for
leading to unrewarding and boring classroom discussions. Changing such deep-seated traditional patterns of classroom discourse poses a considerable degree of challenge for classroom reform. Moreover, there is an ever-increasing need to provide students with learning experiences that reflect the challenges and opportunities they will experience in the workforce of the 21st century. One key class of workforce skills relates to rapid collaborative knowledge building (RCKB). RCKB techniques include problem identification, brainstorming, prioritizing, concept mapping, and action planning (DiGiano, Tatar, & Kireyev, 2006). By harnessing these techniques in the classroom, it is possible for students both to learn existing subject matter more deeply and also to become participants in 21st century knowledge building practices. These techniques can be enacted with light-weight technology such as sticky paper notes (a.k.a. “PaperScribbles (PS)” or “Post-It” notes or “scribble sheets”), or with digital technologies such as Student Response Systems (SRS). In PS, easy-to-use sticky notes were adopted to facilitate the students’ use in contributing ideas to an activity posed by the teacher. For example, they used sticky notes to guess animals based on the characteristics given by each other, post the name of the organs in the human digestive system, post different living organisms in a particular habitat, and classify fruits according to different characteristics, etc. In addition, they used sticky notes to comment on each others’ posting as well. An example of PS is shown in Figure 1 below. A more sophisticated solution is Group Scribbles (GS), developed by SRI international, which enables collaborative generation, collection and aggregation of ideas through a shared space based upon individual effort and social sharing of notes in graphical and textual form.
2. GROUPSCRIBBLES AS A TECHNOLOGY SUPPORT FOR RKCB

The GS user interface presents each user with a two-paneled window. The lower pane is the user's personal work area, or "private board", with a virtual pad of fresh "scribble sheets" on which the user can draw or type (see Figure 2). The essential feature of the GS client is the combination of the private board where students can work individually and group boards or public boards where students can post the work and position it relative to others’, view others’ work, and take items back to the private board for further elaboration. Figure 1 shows a lesson activity in class in which each student posts answers to the question “When does the heart beat faster/slower?” in the private board, and then moves their answers to the public board for sharing. The students’ Scribble notes showed a multiplicity of ideas they generated which enabled the teacher to initiate discussions on the interesting postings. For example, one student posted “just before examination” in the state of “faster heartbeat”, a contribution which surprised the teacher and the class, and which prompted the teacher to initiate a discussion on why this might be the case.
In collaborative classrooms, groups of learners and their teachers routinely work in more complex configurations than lecture-based classes. They take roles, contribute ideas, critique each other’s work, and together solve aspects of larger problems, all to good effect (Hake, 1998). Managed flow of information and control is essential to the structure of many of these successful educational activities (Guribye, Andreassen, & Wasson, 2003).

However, there remains a common question by users of both technologies: Besides differences in physical and technological characteristics, do they essentially cater to the same pedagogy and produces the same learning outcomes for students? In our exploratory study, we investigate the physical, technological and pedagogical similarities and differences between both technologies in a systematic way. At the end of our study, we make preliminary comparisons between the two technologies.
3. RESEARCH CONTEXT

3.1 Research and intervention context

In Singapore, the school year starts in January and ends in November. We started our study in July 2007 working with two teachers in a primary (elementary) school in Singapore. Both teachers teach different classes in elementary grade 4. One class consists of high ability students while the other consists of average ability students. We started with 6 weeks of Paper Scribbles (PS), which are activities using sticky paper notes, in the classrooms as an initiation phase. This was intentional as a means to begin enculturating the teachers and the students into the practice of rapid collaborative brain-storming and critiquing, and to the relevant protocols and social etiquettes. In the initiation activities, students worked in group of four. They first posted sticky notes on an A4 size magnetic boards (“group boards”) and then put them on the class whiteboard for other groups to see. Sometimes teachers put the group boards under the visualiser in order to let all students see the board at the same time. The groups were pre-formed by the teachers. This worked well as members in groups interacted with one another face-to-face.

Subsequently, the class switched to the use of the GS technology for 10 weeks. The students and teachers were provided training for 2 sessions of an hour each. They then used GS for science lessons for another 10 weeks. Each week they had one hour GS Science lesson in the computer laboratory. In our instructional design, we tried to incorporate the following 10 principles, of which the latter five were adapted from Scardamalia (2002):

- distributed cognition – designing for thinking to be distributed across people, tools and artefacts,
• volunteerism – letting learners choose what piece of the activity they want to participate in,
• spontaneous participation – designing for quick, lightweight interaction driven by students themselves,
• multimodal expression – accommodating different modes of expression for different students,
• higher-order thinking – encouraging analysis, synthesis, evaluation, sorting, categorizing, etc.,
• improvable ideas – providing a conducive environment where ideas can be critiqued and made better,
• idea diversity – exploring ideas and related/contrasting ideas, encouraging different ideas,
• epistemic agency – encouraging students to take responsibility for their own and one another’s learning,
• democratized knowledge – everybody participates and is a legitimate contributor to knowledge,
• symmetric knowledge advancement – expertise is distributed, and advanced via mutual exchanges.

From Jan to Oct 2008, we continue our involvement with the teachers; the students are now in elementary grade 5. Every week for 10 weeks, two lesson periods (totaling an hour and 10 mins) for the subjects of science (for 2 semesters) and mathematics (for 1 semester) adopted GS lessons which were conducted in a computer lab. In this class of 40 students, each pupil has an individual Tablet-PC (TPC) with a GS client software installed.
3.2 Technology comparison experimental design

In our study, we wanted to investigate the physical, technological and pedagogical similarities and differences between both technologies in a systematic way. Hence, we have designed two quasi-experiments for two science lessons in both classes. In these lessons, the topics taught in both classes were of a similar nature i.e. forces and levers. For each lesson, the class is divided equally into two sections. One section will use PS technology while the other will use GS technology for their group work activity. Hence, teachers have to design similar group activities within the same lesson that could be undertaken by both technologies e.g. gallery walk (PS) vs. inter-groups boards swapping (GS), posting of individuals’ ideas using “Post-It” notes (PS) vs. electronic scribbles pads (GS), peer commenting using smaller ‘Post-It’ notes (PS) vs. electronic label pads (GS) etc. It is worthwhile to note here that, in groups that use PS technology, there were no TPCs present on the group table as shown in Figure 3. In the following week, there was a swap of technologies between the two sections. In this way, we can observe the behavior of each student using each technology. In this design, the confounding effects arising from different teachers, topics, classroom environment and students’ emotional states were minimized to ensure quality comparison between PS and GS technologies.

(a)                                                                 (b)

Figure 3: Students in groups of four using a) PS technology and b) GS technology within the same class lesson.
3.3 Data collection

In our collection of data, 2 or more researchers observed each class and took down detailed field observation notes. One video camera was set behind the classroom to record the classroom session, while two other video cameras were focused on two target groups of students. Screen capturing software Morae 2.0 was installed on the TPCs to record the interaction of the pupils using GS. We tried to analyze these videos from different perspectives including uptake analysis (Looi, Chen, Tan, Wen & Wee, 2008), as well as analyze data from surveys, interviews and performance tests (Chen & Looi, 2008). We have also employed semi-structured interview with the teachers and selected students as the method to gain access to the subjective understanding of the teacher. This includes an hour long interview conducted at the end of the semester and weekly post lesson conference sessions. In post lesson conference sessions, both researchers and teacher will discuss about the lesson that has been implemented. In this conference session, researchers will prompt the teacher to reflect on the lesson that has transpired and articulate in the verbal discussion. The immediacy of the conference session after the lesson, ensures that the teacher do not forget the teaching episodes that they have taught and thus, able to provide good feedback and discussion. In the end of semester interview session, the teacher is interviewed by two researchers with a list of prepared interview questions in a private location. The interview session is audio and video recorded. After the interview session, the interview session is transcribed to create written protocols for analysis.

4. RESULTS AND DISCUSSION

This section discusses some of the salient physical, technological and pedagogical similarities and differences between PS and GS that we have observed and analyzed from our
study. It is worthwhile to note here that some of the pedagogical similarities and differences results from the inherent physical and technological similarities and differences between the two technologies. Hence, the three categories may not necessary be distinct from one another but the interplay of the physical and technological properties of each technology produces different pedagogical effects.

4.1 Physical and technological differences

Essentially, PS consumes much more physical resources compared to GS. In every PS lessons that we have conducted, much logistical preparation is needed. Mahjong papers, vanguard sheets, “Post-It” sticky pads of various sizes and colors, markers etc have to be prepared before each lesson. In order to distract the students, materials for PS are only distributed during the relevant group activities in each lesson. This generated a lot of manual busy work i.e. handing out materials in an orderly fashion, collecting, moving from place to place etc for teachers and student alike and precious lesson time is lost during this process. We have recorded an approximate timing of 3 to 5 minutes for such manual work to be completed in each PS activity. In addition, there were constraints from the school placed in limiting the supply of PS materials. In other words, teachers and students have limited supply of “Post-it” sticky pads that they can post their ideas and commenting on each other ideas. In conjunction with the school’s “Clean and Green” initiative (an initiative to educate students about environmental conservation) , students were told not to “waste” these sticky pads and were encouraged to write as much content as possible on one sticky pad. Below is an excerpt of a teacher-student conversation during class:

Student A: Teacher, how much can we write on one sticky pad?
Teacher: Write as much as possible. I have limited supply of sticky pads in class. Also, remember our “Clean and Green” initiative? We must do our part in saving the earth and try not to waste any sticky pads.
In comparison, students take a lesser time of about 1 to 2 minutes to log into the GS user panel. There were little movement in this section of the class and thus, classroom management by teacher was reduced. In addition, GS utilizes unlimited virtual resources for students to post and comment. There were no concerns with environment conservation and students can freely post as many ideas as possible. More often than not, we see students posting one idea per scribbles pad in GS as shown in Figure 4.

![Figure 4: One idea per GS scribble pad](image)

Another physical limitation of PS is, sticky pads do not stick for long. After some time, sticky pads dropped off from their original positions. This serves as an irritation to both the teachers and students as they spend time and efforts to guess the positions of the sticky pads and stick them back. In our study, we found that this happens rather frequently, despite the fact that reasonably good quality sticky pads were used. However, this limitation is overcome by GS technology. Virtual learning artefacts in GS generally remain persistent and permanent. Teachers can digitally store these artefacts and reproduce them individually (either digitally or hardcopy printouts) among the students either for after class purposes e.g. continue any unfinished work after class, individual students can revisit of any learning artefacts done either
own group or other groups etc or for the purpose of continuing where students left off the next lesson. However, work done by PS cannot be reproduced individually to all students. Much effort would have to be put in to photocopy every learning artefact for the whole class. These laborious efforts usually deter most teachers to do that. In our study, teachers usually will hang every group boards in a particular classroom for common viewing. Lastly, GS enables a teacher to project any group board conveniently on the Interactive White Board (IWB) for class teaching and students’ presentation in Figure 5 below. This feature is also very useful for any group presentation to be done. In comparison, we found that projection of a particular PS board from the visualizer often cannot encompass the whole group board. Moreover, the moving of the PS board beneath the visualizer often causes some “Post-It” sticky pads to drop off. This causes unnecessary hassle both for the teachers and students.

![Figure 5: Student using the IWB to project his group board for oral presentation during a GS lesson](image)

However, implementing GS technology in schools does possess certain limitations and tradeoffs. In the setup of GS technology, one needs to invest money, effort and time to purchase necessary computer hardware and software to setup the network. As with most ICT technology, there exists a risk of occasional technical glitches during lessons. In our research work, technical glitches ranging from minor to major problems do occur from time to time, during our lesson observations and data collection. Therefore, it is necessary to provide students, teachers and
school technical assistants with the necessary support especially during the initial phase. This is described in detail in another paper (Chen and Looi, 2009). With PS technology, these issues are of no concern.

Despite the numerous physical and technological differences, PS and GS provide a common platform for individual students to post their ideas. This platform enable publication of students’ ideas to other people i.e. classmates, teachers etc for viewing, peer commenting, ideas organizing and presentation purposes.

4.2 Pedagogical differences and similarities

One of the common pedagogy in group work is Gallery Walk. Gallery Work allows students to view other group boards and hence, enabled them to learn from one another by commenting, questioning and viewing each other ideas. This can be done with or without stationing a presenter at the respective group boards. PS and GS technologies provide different ways in conducting Gallery Work in class that result in different pedagogical effects. In PS, it is difficult for everyone in the class to view a sticky note immediately, simultaneously, and remotely when someone publishes it. This is evident when students need to view group boards from other groups. Students are required to get up from their seats and move around physically in the class (Figure 6) to do Gallery Walk. Although this may benefit kinesthetic learners, the may pose to be additional classroom management issues for the teacher. In our research study, we observed that, in the midst of all the physical movements, students abuse this opportunity to engage in casual chit chatting and misbehavior that disrupts learning in the class.
Hence, strict time and behavioral management must be imposed on the class, in order for students to benefit from this activity. Some teachers attempt to reduce such misbehavior in class by implementing systematic exchange of group boards. In other words, either the PS group boards are interchanged among adjacent groups without any physical walking or the appointed group leader of each group is allowed to swap the group boards. Although this does decrease the occurrences of misbehavior, volunteerism and epistemic agency are compromised as each student is constraint to peer comment on one group board at a time. This may result in less ideas contribution and diversity especially if “groupthink” is prevalent in a group. Hence, there are two ways that Gallery Walk can be conducted in PS shown in Table 1, each with different advantages and disadvantages.
<table>
<thead>
<tr>
<th>Types of Gallery Walk</th>
<th>Description</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Free random movement of any student</td>
<td>Every student is given free choice to choose any group boards to go to</td>
<td>Epistemic agency, volunteerism and idea diversity is preserved</td>
<td>In our research study, this has the highest occurrences of misbehavior.</td>
</tr>
<tr>
<td>2) Systematic swapping of group boards</td>
<td>The PS group boards are interchanged among adjacent groups without any physical walking or the appointed group leader of each group is allowed to swap the group board</td>
<td>Reduction in misbehaviors.</td>
<td>Epistemic agency, volunteerism and idea diversity is compromised</td>
</tr>
</tbody>
</table>

Table 1: Types of Gallery Walk in PS

GS technology overcomes these constraints by allowing students to choose any group boards that they wished to view and comment by a mere clicking on the drop down menu bar. Physical movement is minimized and therefore, occurrences in misbehavior are reduced without compromising students’ volunteerism and epistemic agency. In this way, idea diversity and peer to peer learning remain unbounded as each group board have equal probabilities of being chosen to be viewed and commented upon by each student. In our research study, we notice that the GS groups tend to be quieter, more engaged individually and more on task, as compared to the PS groups shown in Figure 7. In short, GS technology favors individual commenting, questioning and learning during swapping of group boards because individual choice is preserve, as compared to PS.
Another phenomenon that we observed in PS is, there tends to be more verbal communications among the group members as compared to GS technology. As mentioned above, we observe that the PS groups always exhibit higher noise levels, as compared to the GS groups during any group activity. Our anecdotal evidences (shown in Figure 8) indicate the presence of tablet PCs has posed a physical barrier in face to face verbal communication. In contrast, there are no physical barriers in communicating verbally in PS.

Figure 8: (a) No physical barrier in face to face communication in PS groups (b) Tablet PCs posed a physical barrier in face to face communication in GS groups.
Another reason could be the different natures of the group boards inherent in both technologies. In GS technology, every group member has access to their own individual virtual group boards, displayed on the tablet PCs as compared to one common physical group board that is visually and physically accessible to all group members in PS technology as shown in Figure 9 below.

![Figure 9: Group referent artefact in PS](image)

Hence, the referencing to the shared common group artefact, termed as “group referent artefact” by all group members has encouraged more face to face talk as miscommunications is reduced. For example, in our study, we observed the following excerpt in a GS group:

Student A: hey, what do you think of this comment on the yellow scribbles pad?
Student B: Which yellow scribble pad?
Student A: The one that is next to the black scribble pad.
(There was a time of silence as student B figures which pad that student A is talking about)
Student B: I cannot find (slightly frustrated)
(Student A then turns the tablet PCs around to face student B)
Student A: This is the scribble pad I was talking about! (Using a finger to point to the yellow scribble pad)

Evidently, it is more difficult to describe the physical location of a particular GS scribble pad verbally by a student to another student. This is especially so, if language is a problem. GS technology does not allow a student to point physically to a referent material as conveniently as a PS technology. In addition, GS technology enables easier copying and replications of virtual...
posts as compared to PS physical posts. Through the “clone” and “backspace” features in GS technology, students are given opportunities to correct any mistakes, modify and replicate any ideas conveniently without the hassle of changing “Post-It” slips or untidy cancellation of any mistakes in the written ideas in PS technology. These latent features in these technologies have encouraged students to discuss and express their ideas in different sequences. Thus, students tend to articulate their preliminaries thoughts through typing or writing on GS scribble pads. In contrast, students only write their “final product” on the “Post-It” slips in PS to save the hassle of correcting mistakes, changing “Post-It” slips and using too many “Post-It” slips. Intermediary ideas are processed in the minds of the individual students or verbal discussions among the group members. Coupled with the “group referent artefact” as mentioned above, one can deduce verbal face to face communication is highly preferred in PS technology. This is coherent with what we observed in our study. In a free random student movement Gallery Walk shown in Figure 10, students in PS groups tends to congregate and move in their groups though every student are free to choose which group board to go to.

Figure 10: Group movements in the PS groups
The preference for face to face talk in PS ensures that students have their preferred talking partners around them (usually their own group members) when they move around. Hence, we observe a predominant “group movements” pattern instead of random individual students’ movements in a PS enabled group activity. This also partially explains the noisier environment in a PS group activity. Therefore, PS and GS enable different group collaboration mechanisms. In PS, students brainstorm and verbally discuss their individual ideas together before putting down their final group ideas in writing. However, in GS, students apportioned some their individual thoughts in writing and some in verbal talk. Verbal talk is an articulation mode employed when ideas could not be adequately expressed in writing or typing. In addition, GS provides more ways (both writing and typing) to express their thought in words which then encourage students to employ language symbols or pictures as their primary mode of communication. In Figure 11, a schematic diagram is drawn to illustrate the different mechanisms:

![Figure 11: Different group collaboration mechanisms in PS and GS technologies](image-url)

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What then are the implications? The written and typed manifestations of students’ thought processes in their GS private and group boards would assess individual students’ thoughts processes better as compared to PS technology. In this way, GS technology possesses the potential to assess individual’s contributions in a group work. In our work, we are in the process of developing analytical tools that would help us identify and analyze individual students’ postings. Moreover, anecdotal evidences have indicated that the quality of individual students’ ideas is higher in GS as they need to articulate their ideas in a clear fashion in writing or typing. This helps produce better group artefacts especially in problem based learning. In our future work, different individual postings and group artefacts produced by PS and GS technologies will be analyzed to ascertain the qualitative and quantitative differences.

Lastly, GS technology enables anonymity as compared to PS technology. This is helpful in encouraging shy students to contribute more ideas, reducing pressure to post ideas and enables flexibility in signing off if recognition is desired. Below shows an excerpt from an interview with a student:

Interviewer: What do you think are the advantages of GS?
Student X: GS provides anonymity. I do not feel pressure to post as no one knows who has posted. Also, shy students like Student Y would not be afraid to post.
Interviewer: Okay. But if you want some recognition of your contribution, what would you do?
Student X: I would just sign my name on my posts if I want my friends and teachers to know that it is my post.

The multimodal feature (Chen and Looi, 2008) of GS would also encourage students of different learning styles to express their ideas in different ways, producing a rich variety of ideas. PS technology enables much less anonymity. Apart from the fact that the act of writing and pasting one’s ideas on the group board is highly visible to the surrounding students, the handwritings of each student may also reveal one’s identity to another student. This discourages
shy students to post especially if they are not confident about their ideas. Below is another excerpt from another interview with another student:

Interviewer: Why are you still afraid to post though it is anonymous?
Student Z: Oh, my friends can recognize my handwritings!
Interviewer laughs.
Student Z: Yeah! It is true. I can recognize Student Q and P handwritings, you know.

4.3 Comparing PS and GS technologies

From the preceding sections, we see that the different properties and characteristics of each PS and GS technology manifest different classroom phenomena. In Table 2, a consolidated list (albeit not exhaustive) of the various dominant behaviors that are observed by the usage each technologies as discussed in the preceding sections as well as the various features and properties is shown.

<table>
<thead>
<tr>
<th>Aspects</th>
<th>PS technology</th>
<th>GS technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group collaboration</td>
<td>Verbal talk as the primary mode of communication</td>
<td>Writing, typing and drawing as primary modes of communication</td>
</tr>
<tr>
<td>Individual processing of ideas</td>
<td>Individual mental processing of ideas</td>
<td>Articulation of individual ideas via writing, typing and drawing</td>
</tr>
<tr>
<td>Ideas expressions</td>
<td>write and draw</td>
<td>Typing, writing and drawing</td>
</tr>
<tr>
<td>Assessment of individual contribution in group</td>
<td>------------------------------</td>
<td>Potential to assess articulated idea contributions from each student</td>
</tr>
<tr>
<td>Anonymity</td>
<td>Non anonymity</td>
<td>Anonymity</td>
</tr>
</tbody>
</table>

Table 2: Comparison between PS and GS technologies

From table 2, we can infer that PS and GS result in different uses and outcomes. This is not question of which technologies are “better” but it depend the lesson objectives, assessment criteria and the class profile. The lesson objectives and the class profile will determine the
suitability of each technology. For example, in a Tamil language class that emphasized more on writing and speaking, PS may be a better technology to use to achieve such lesson objective. For example, learning new vocabulary without assistance of a language tool in the computer, points to the PS technology as a better technology to leverage upon. In a class where students are predominantly shy and afraid to speak up, GS technology may provide a better platform for students to express their ideas. If a teacher wants to assess student’s collaboration in a group work, GS may provide a better capability to capture this data.

5. CONCLUSION

In this paper, we have discussed the salient differences between PS and GS technologies. The different properties of each technology are a result of inherent physical and technological properties of each technology. One cannot assume that the pedagogical outcomes for both technologies are similar. The suitability of each technology depends on the lesson objectives, assessment criteria and class profile. In order to leverage technology fully, the teacher should gauge the alignment of the properties of each technology with the lesson objectives, assessment criteria and class profile in order that learning can be maximized for each student. As Mehan (1989) states, “it is what people do with machines, not the machine itself that makes a difference.”

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REFERENCES


