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Using Wordle as a Supplementary Research Tool

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A word cloud is a special visualization of text in which the more frequently used words are effectively highlighted by occupying more prominence in the representation. We have used Wordle to produce word-cloud analyses of the spoken and written responses of informants in two research projects. The product demonstrates a fast and visually rich way to enable researchers to have some basic understanding of the data at hand. Word clouds can be a useful tool for preliminary analysis and for validation of previous findings. However, Wordle is an adjunct tool and we do not recommend that this method be used as a stand-alone research tool comparable to traditional content analysis methods. Key Words: Wordle, Research Tool, Word Clouds, and Qualitative Research

Introduction

The potential of word clouds as a research tool

In recent years, a number of social bookmarking tools have been developed. These tools are "public link management applications on the Web" (Hammond, Hannay, Lund, & Scott, 2005) that enable users to "tag" sites and cluster similar sites together. In essence, users can build personal libraries on the Web. These libraries are represented as word clouds. A word cloud is a special visualization of text in which the more frequently used words are effectively highlighted by occupying more prominence in the representation. Grammatical words and non-frequent words are hidden so that the resultant representation cleanly shows the most frequently occurring words of importance.

The early social bookmarking tools were designed to manage and organize URLs. This study focuses on word clouds developed to analyze discrete pieces of text. A number of programs are available for generating these word clouds: TagCrowd (Steinbock, 2008; Sinclair & Cardew-Hall, 2008), MakeCloud (MakeCloud, 2008), ToCloud (ToCloud, 2007) and Wordle (Feinberg, 2009). These programs are quick and automatic. Among them, Wordle may be the most versatile software to use. Users employ a user-friendly web-based interface to change the font, colour, and direction of words in a Wordle word cloud. Wordle outputs are regarded as "more personal and visual than the others" (Ramsden & Bate, 2008, p. 6) when compared to similar tools such as TagCrowd, MakeCloud and ToCloud. Wordle is described by its developer, Jonathan Feinberg, as a "toy" (Feinberg, 2009). We were intrigued by this comment and decided to see if the tool could be a scholarly *toy* of worth to the academic community.

Word clouds reveal the frequencies of the different words that appear in a piece of text. To a certain extent, an understanding of the general composition of the frequently used words allows viewers to have an overview of the main topics and the main themes in a text, and may illustrate the main standpoints held by the writer of the text. Comparison of the word clouds generated from different texts should quickly reveal the

differences between the ideas contained in these texts. In this sense, we wanted to see if the word-cloud strategy could be a potentially useful method for qualitative analysis of text.

There are some examples of word clouds being used analytically. Clement, Plaisant, and Vuillemot (2008), for example, used Wordle to generate word clouds in a literary study to compare and contrast the styles of writing in *The Making of Americans* (Stein, 1995, originally written between 1906 and 1911) to those in a set of 19th century novels written by Jane Austen, Charles Dickens, George Eliot, and George Meredith. The word clouds clearly demonstrated that the use of "one" (mostly as a pronoun) is very prominent in *The Making of Americans*. They observed that the frequent use of this word, "accomplished by the word's schizophrenic nature" (p. 1), contributed to the sense of "confusion" being developed in the work.

Apart from literary work, word clouds have also been used to study public speeches. Dann (2008) used TagCrowd to analyze the 2008 Federal Budget speech of Australia. Dann remarked that the word cloud served well as a preliminary analysis. The representation allowed the researcher to see "the level of self reference to the incumbent government and the presence of relationship marketing keywords" (p. 14) which then led the researcher to carry out further explorations.

Word clouds can also be useful in education. Ramsden and Bate (2008) suggested that word clouds can assist in analyzing the survey responses as teachers can "have a visual depiction of the responses within a minute" (p. 2).

In this paper, we would like to elaborate on the possible uses of word clouds in educational research by demonstrating the use of Wordle in two of our research projects. Wordle seems to be particularly useful for studies that involve qualitative/thematic analyses of written or transcribed spoken text. Specifically, we would like to demonstrate that Wordle can be used as:

- A tool for preliminary analysis, quickly highlighting main differences and possible points of interest, thus providing a direction for detailed analyses in following stages; and
- A validation tool to further confirm findings and interpretations of findings. The word clouds thus provide an additional support for other analytic tools.

Methodology

Using Wordle to carry out preliminary analyses

We looked at the use of Wordle as a research tool for preliminary analysis of focus-group transcripts. It was the beginning of a research project which was conducted to study the dynamics in focus-group meetings and to identify human factors (especially the interactions between the facilitators and the participants) that might affect the comments made by participants. Because of the known limitations of Wordle, which will be elaborated in the final section of the paper, the analysis was intended to be a simple strategy for us to obtain a quick but brief overview of the data. In this sense, it was a supplementary but not a main analytic tool.

We analyzed the transcriptions of six focus-group meetings. Each meeting was about one hour long and involved one or two facilitators talking with a group. Student numbers in each group ranged between six and 14. The meetings involved two quite distinct projects. In both projects, students were interviewed about their educational experiences; the focus-group meetings were included in the project proposals which were vetted for ethical approval by The Chinese University of Hong Kong. All students were volunteers.

The first three meetings were evaluations of a project called "Science Enrichment Programme for Secondary three to four (K9 – K10) Students." It was a two-year enrichment programme for secondary school students gifted in science who attended workshops and completed projects at The Chinese University of Hong Kong. The goal of the project was to offer young gifted students greater opportunities to explore and develop their higher-order thinking skills, creativity, and personal–social competencies with a view to heightening their potential. The project employed a number of evaluation strategies to support reflection on the achievement of the objectives at various stages of the project. Apart from administration of surveys, we also met the students in focus-group settings at various stages in the programme. There were three focus-group meetings held at the end of the whole programme (2008), in which three groups of students (the Mathematics, Physics, and Biology streams) discussed their perceptions of various aspects of the programme. Transcripts were made of the three meeting tapes.

The second set of focus-group meetings came from a study in which the research team met with groups of Year one and Year two students in the Faculty of Law at The Chinese University of Hong Kong. In 2006–07, the Faculty wished to find out students' opinions on the *soft-skill* courses (e.g., legal research, writing, and information literacy) that had been newly introduced to the programme. The students were asked to fill in a questionnaire to comment on how much they could understand and apply the legal knowledge and skills they learnt from the courses. As it was thought that students could elaborate on the points they wanted to make in face-to-face discussions, students were also invited to attend focus-group meetings in April 2008. Transcriptions were made of three of these meetings. Two of the meetings involved Year one students and one involved Year two students. Below is a short extract from one of the transcripts. The Wordle diagram from this complete interview is shown in Figure 4. The bolded words below can be seen in Figure 4.

Facilitator:	Well, would it be possible to cut out these **contents**?
S3:	I believe the **professors** would strongly oppose this idea.
S5:	I don't think it is possible to cut out all these.
S2:	The **content** was not bad. I just think that it would be better to add in some local elements. Then we can see these are also applicable to the **cases** in **Hong Kong**. We will be happier if that can be done.
S5:	These can't be cut out completely. It is because they are about the origin or **tradition** of the **law** system. It is fine to tell us about the case in UK, but it is good to mention the situation in Hong Kong as well. Then we can see how such system has been implemented in Hong Kong. Better integration of the course contents can then be achieved.

A study of the transcriptions in full would include time-consuming and detailed coding of the types of interactions and comments voiced in the six meetings. Before starting a long analytic process, we, the researchers, thought that Wordle might be used to provide a quick outline of the data. Each of the six transcriptions was fed into the Wordle system, resulting in six word clouds as output. We wanted to see whether the preliminary Wordle analysis could better inform the follow-up analysis.

Methodology: Using Wordle to validate existing findings

We also used Wordle as a research tool to validate our previous analysis in a study of students' opinions about the use of eBooks also at The Chinese University of Hong Kong. The project carried out a series of investigations into the usability and acceptability of eBooks. The entire project had a number of phases. In an earlier phase, we investigated students' first impressions of the technology after they had had a brief introduction to eBooks.

In the third phase of the project, the study focused on acceptability (or the actual likelihood of future use). We wanted to answer questions such as "In what ways do students actually use eBooks? (when, where, and with what devices?)" and "What are the factors that influence whether users will continue to use eBooks?"

To answer these questions, the project contained a range of user-feedback sessions, reading sessions, and extended reading periods in which students read the eBooks in naturalistic settings for 12 weeks. Instruments used included questionnaires, interviews, focus-group meetings, video recordings of user actions, and online blogs where students commented on their eBook reading habits. Our contacts with the students (reported in Lam, Lam, Lam, & McNaught, 2009) generally affirmed that the technology has potential to enhance teaching and learning in a university setting. However, the experiences (especially of the long-term users) highlighted a number of challenges that need to be addressed.

Six students participated in the extended reading study. Regularly throughout the extended reading period, each of the students kept an individual online diary in which they freely commented on what they liked and disliked about the eBook reading so far. Each of the students wrote about 1,000 to 2,000 words of online journal entries by the end of the period. Below is a sample extract of the blogs.

> I was reading a **difficult chapter** which I had to review back the pages that I read before to understand the chapter. Since it is not possible to read two different pages at the same time for **ebook**, it was **difficult** for me to refer back to the previous **content** while I am reading on the current page. At this point, book of **hardcopy** is definitely better than ebook. Besides, by rotating the **screen** for 90 degree, more words can be showed in each line, as the length of each line is wider. I found it is more **comfortable** to read in this way.

We used Wordle to analyze the blog entries of five of the six students (one student wrote in Chinese and Wordle cannot handle Chinese characters). The text of their journals was fed into Wordle individually and five word clouds resulted. The extract above was part of the text used for Figure 11. The bolded words can be seen in the figure.

Findings

Using Wordle to carry out preliminary analyses

Figures 1 to 3 are the word clouds of the three focus-group transcripts for the science enrichment project. The word clouds of the Faculty of Law study are presented in Figures 4 to 6. To comply with the notion that Wordle is used for fast analysis, minimal touchups were done to these word clouds. They are largely the first output of the raw text we submitted to the online Wordle system.

Figure 1. Word cloud of the students discussing Physics enrichment activities.

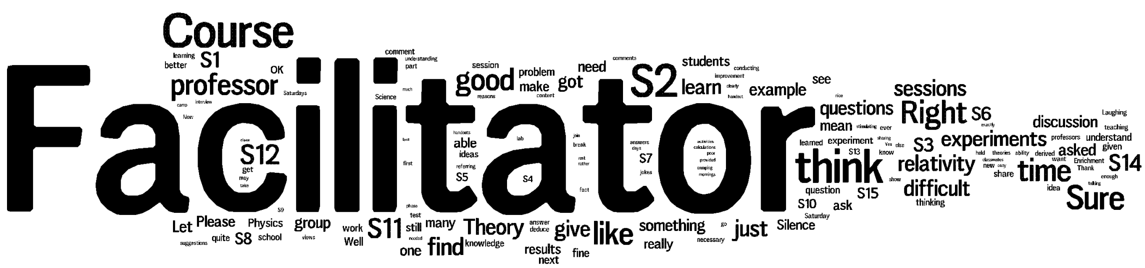


Figure 2. Word cloud of the students discussing Mathematics enrichment activities.

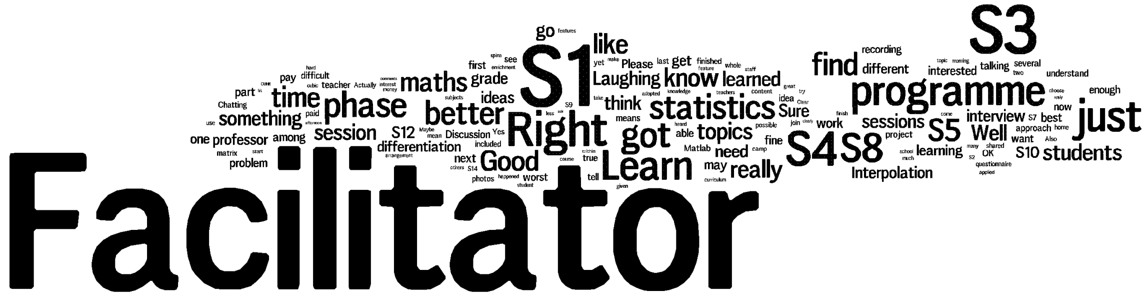


Figure 3. Word cloud of the students discussing Biology enrichment activities.

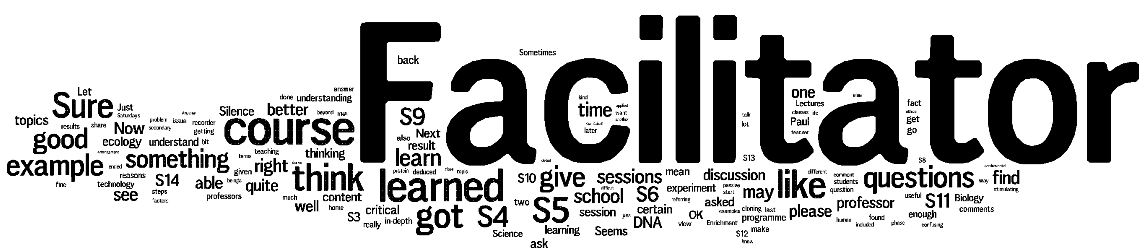


Figure 4. Word cloud of Law Year one, group one, students discussing "soft skills" courses.

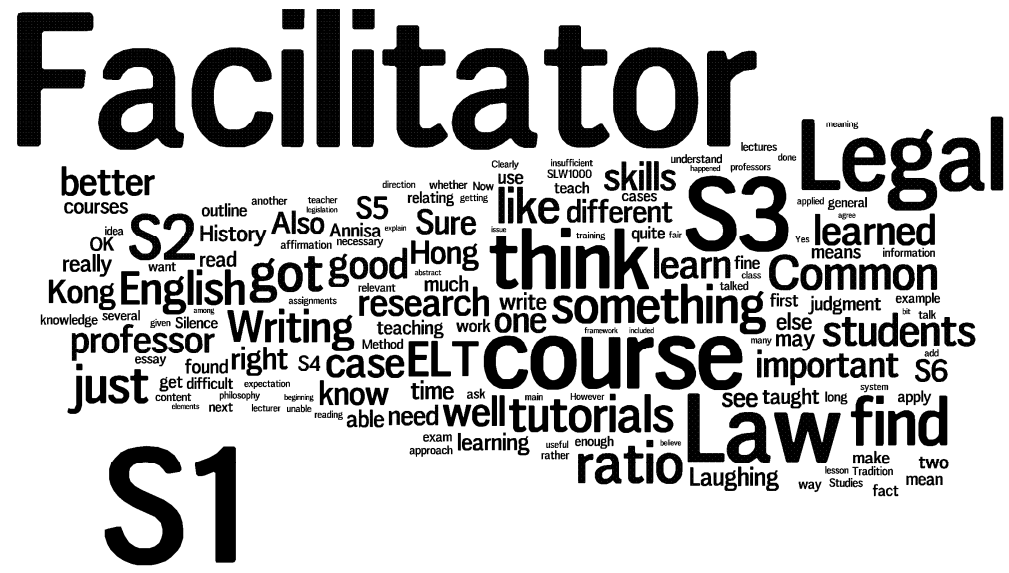
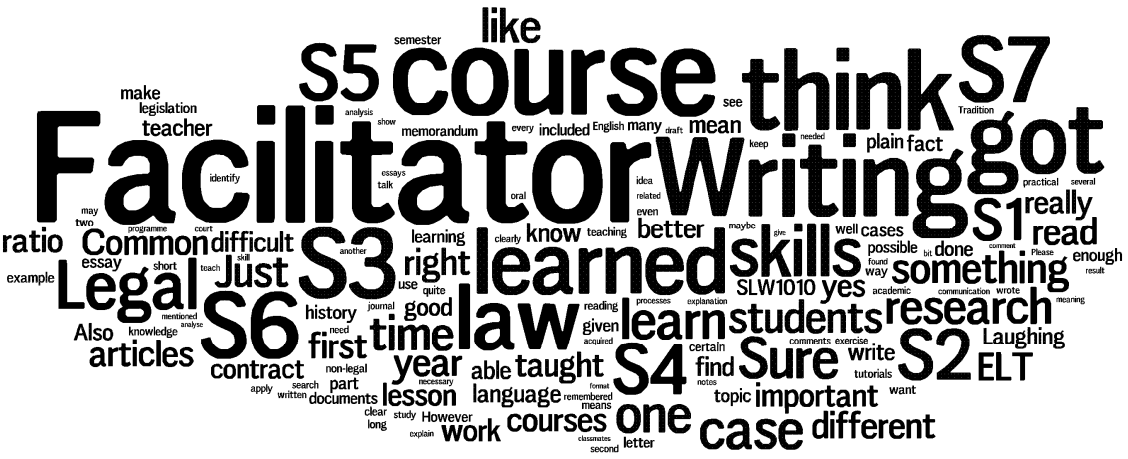


Figure 5. Word cloud of Law Year one students, group two, discussing "soft skills" courses.

Figure 6. Word cloud of Law Year two students discussing "soft skills" courses.



With even a cursory look at the six figures one can tell that the science meetings ran very differently from the law meetings. Apart from the fact that the two sets of focus-group meetings were about very different topics and hence the key words shown in the word clouds are largely different, the two set of word clouds have the following differences that indicate that the dynamics of the discussions in the two sets of meetings also varied a great deal:

- The facilitators had a much more prominent role in the science enrichment meetings.
- The student participation in the science meetings was low. Many students did not appear to have participated.
- Fewer actual comments were received in the science meetings compared with the law meetings. From the Wordle analysis, we see that the number of words that appear to refer to actual discussions and comments is considerably less in Figures 1 to 3 compared with Figures 4 to 6.

The word clouds suggest that the focus-group meetings for the science enrichment programme ran less successfully than those in the Faculty of Law. These observations were confirmed by the reflections of the facilitators in the meetings. Much of the time was occupied by the facilitators in the science meetings and the students were largely unwilling to talk. Even when they talked, they gave simple replies rather than elaborated answers. In contrast, the dynamics in the Faculty of Law meetings were much better. Facilitators still took up a great deal of time but many students were willing and able to participate as well. For example, Figure 6 shows that, in the Year two group, nearly all the students talked, sharing approximately the same amount of time as the facilitator. The richness of the content words in these three figures generally indicates that many ideas were brought up and discussed in the meetings.

In this study, the word clouds effectively gave the research team a fast and preliminary understanding of what was happening in each of the six meetings. In so doing,

they directed the researchers' attention to differences in group dynamics in these meetings. Follow-up investigation will be done to look at the many factors that might have affected the focus-group performance. Factors include both the composition of the groups and the strategies used by both the facilitators and the participants. For example, we will question whether younger participants (those in the science meetings were around 15 years old while students in the law school were 19 or older) are less likely willing to speak up. We will consider whether science students are, on the whole, less expressive than law students. We will also look at the questions and follow-up questions/statements used by the facilitators to see whether some strategies are more likely to lead to student involvement.

Using Wordle to validate existing findings

Figures 7 to 11 are the word clouds of the student blogs recorded in the eBook project. As in the first study, these word clouds are rapid output generated by putting the text of the blogs into the online Wordle system. Since the actual themes and points mentioned in the discussions were of interest in this study, one additional step was taken to clarify some of the ambiguity of the Wordle graphics. As the units of representation in these word clouds are words, instances of use such as "not convenient" will add to the frequency count of the word "convenient", a sense that is opposite to the original meaning in text. Thus an additional step was done in this study to each of the five blogs to delete the space after all "not" words so that "not convenient" becomes a one-word "notconvenient". In this way, the word cloud output would count the frequency of "notconvenient" instead of treating it as "convenient" and the negative sense could be preserved. The changes to text were done relatively quickly using the automatic replace function in the word processor. The general goal to use Wordle as a quick research strategy was still maintained.

Figure 7. Word cloud of the blog written by Student one in the eBooks project.

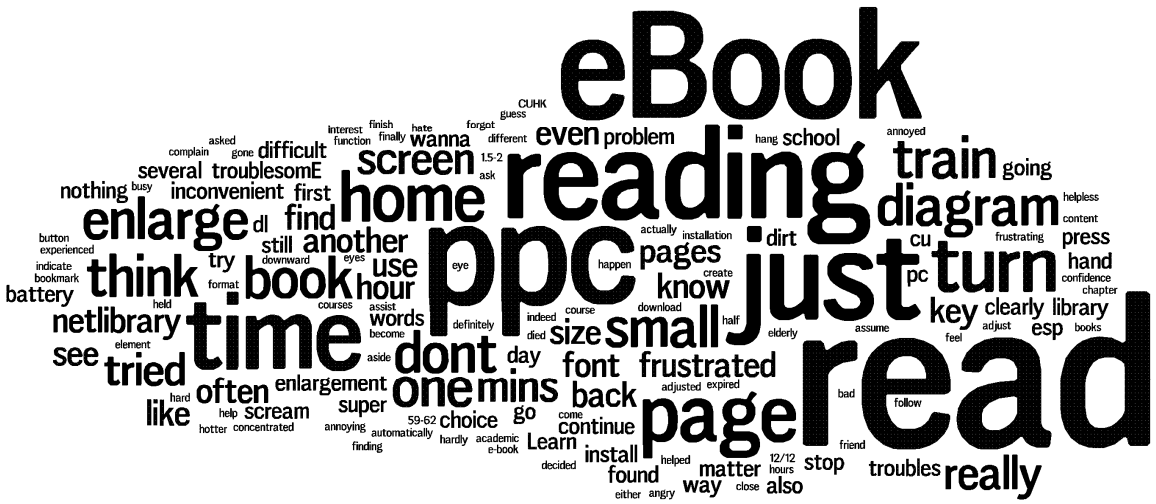


Figure 8. Word cloud of the blog written by Student two in the eBooks project.

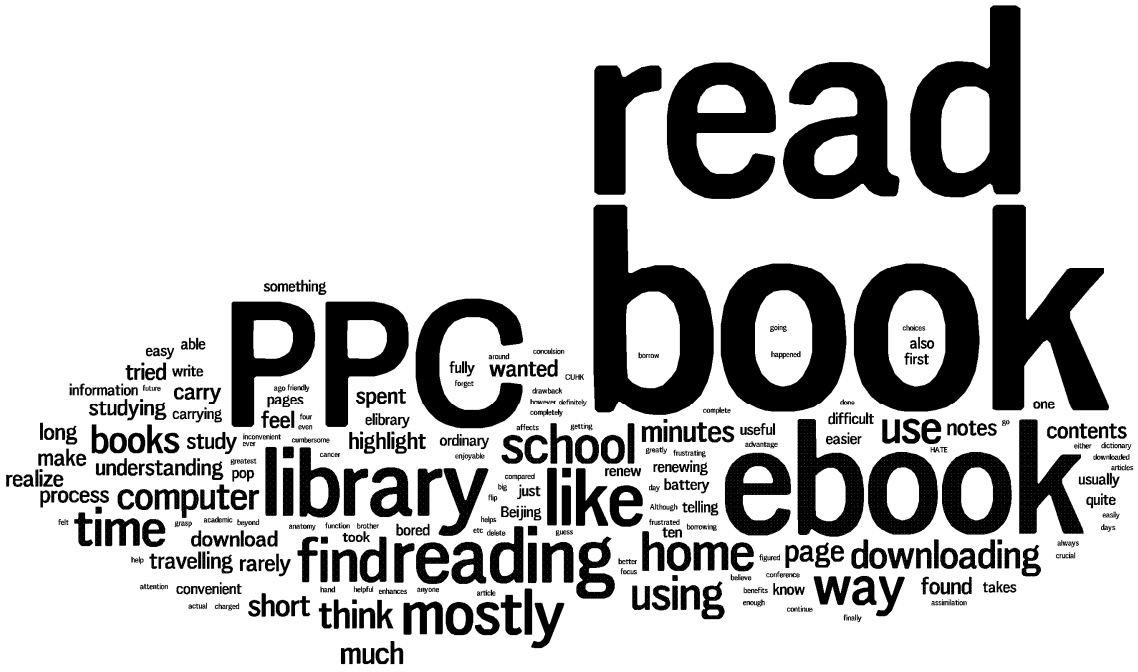


Figure 9. Word cloud of the blog written by Student three in the eBooks project.

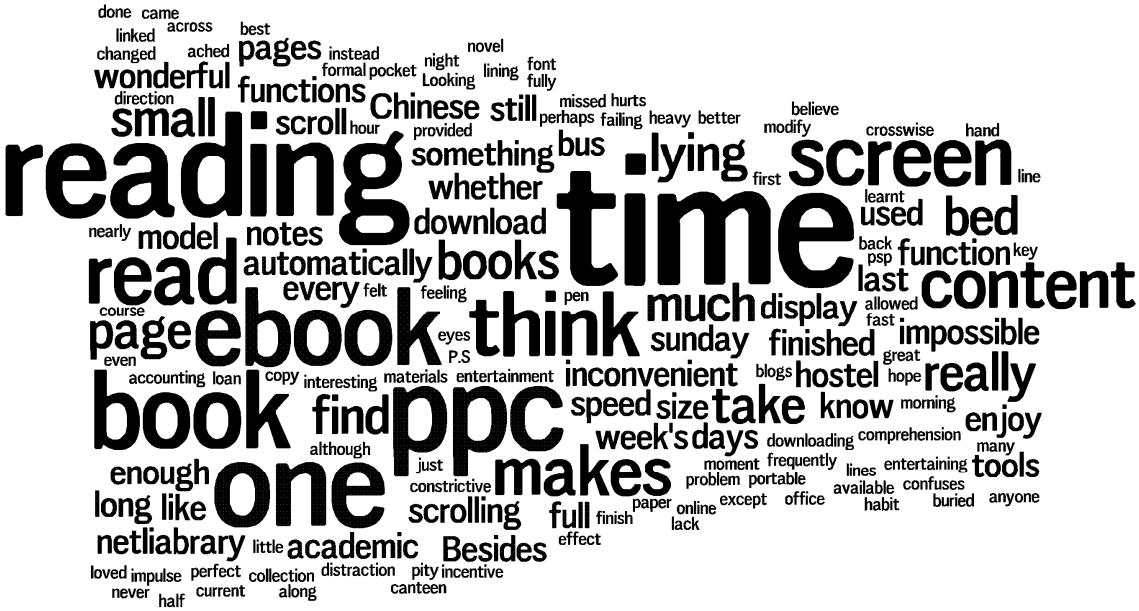


Figure 10. Word cloud of the blog written by Student four in the eBooks project.

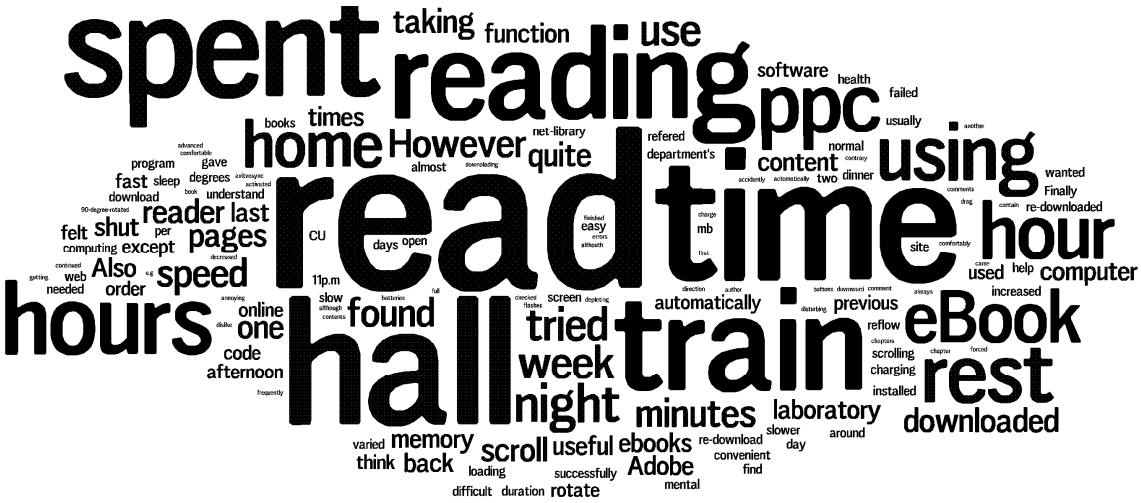
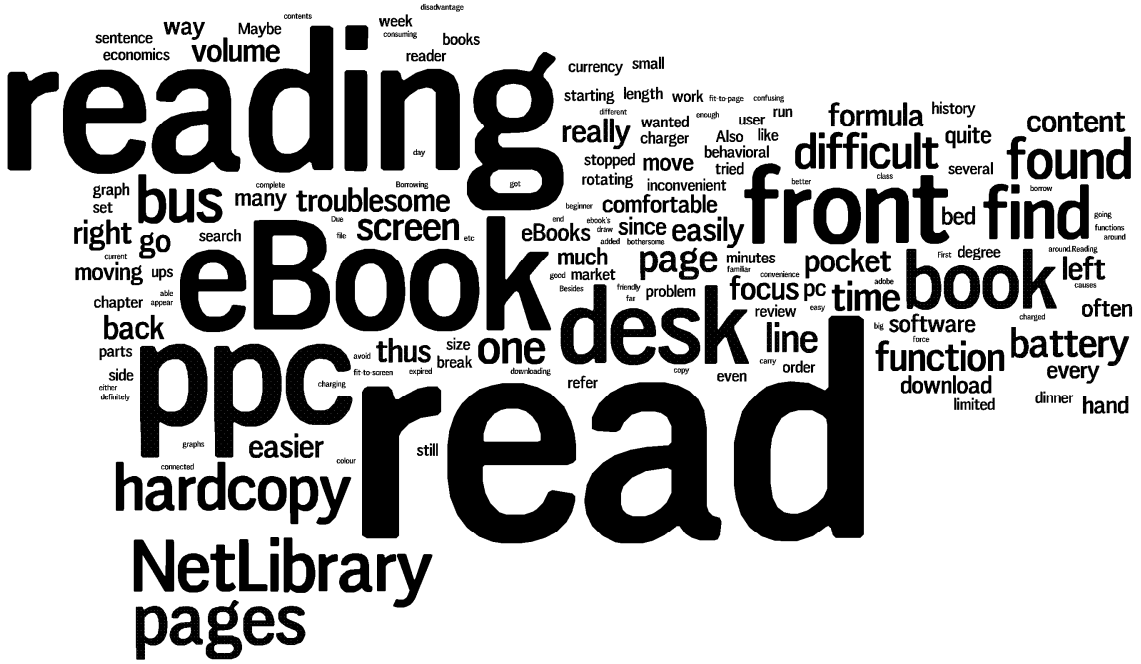
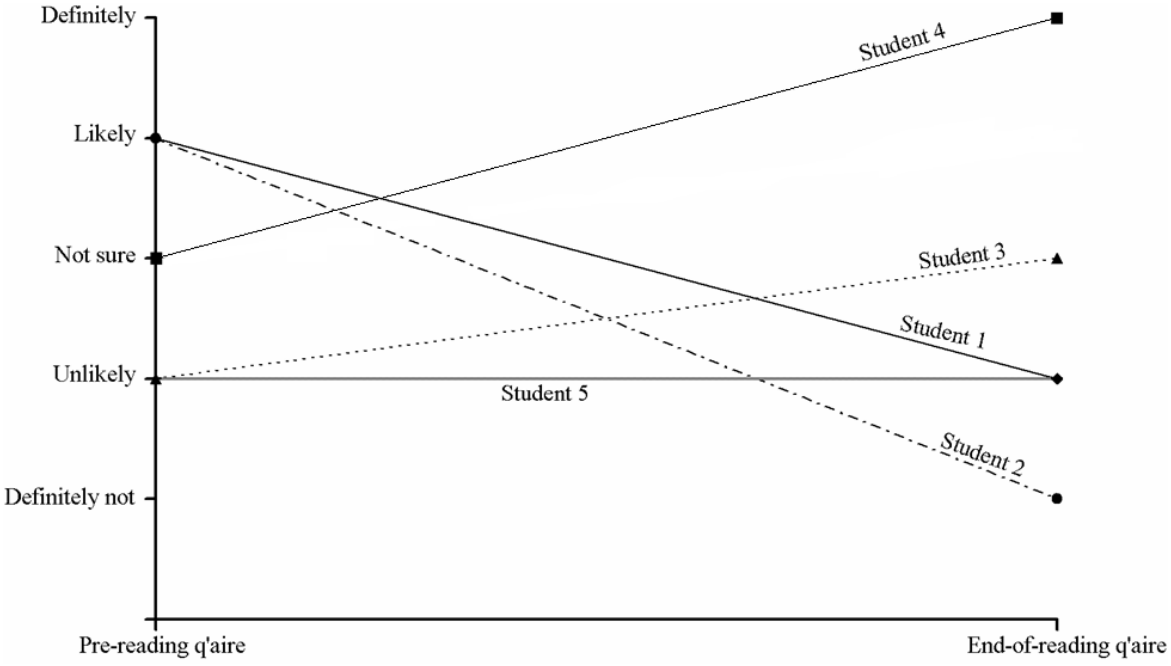


Figure 11. Word cloud of the blog written by Student five in the eBooks project.



As reported in Lam et al. (2009), the students who participated in the extended reading activity answered a simple question about whether they would use eBooks for learning in the future on two occasions. They first gave the researcher their opinions right after they were introduced to the technology and had had some hands-on experience with reading and using eBooks. Also, at the end of the 12-week reading period, in which they were asked to roughly spend about four hours a week using eBooks to learn, they were asked the same question again. The results of their replies are in Figure 12.

Figure 12. Changes in students' perception about the value of eBooks (Lam et al., 2009, p. 41)



We would argue that the word clouds and the students' replies shown in Figure 12 represent similar findings.

Student one (Figure 7) used quite a number of words loaded with negative meanings in her blog such as "inconvenient," "troublesome," "troubles," "difficult," and "frustrated". We were able to see that eBook reading did not seem to be a very enjoyable experience for the student. Student 1 told the researchers at the end of the extended reading period that it is "unlikely" that she would use eBooks by choice.

Student two (Figure 8) was also relatively negative about the experience. The words "boring," "difficult," "renewing," and "battery" are seen in the word clouds. It appears that the student found the battery life short and had to renew (recharge) the battery more frequently than desired. Student two told the researchers that he would "definitely not" use eBooks as a real learning tool.

Student three (Figure 9) had both positive and negative feelings towards eBooks. On the word cloud we see words such as "inconvenient" and "impossible". However, he also wrote quite a number of times about "wonderful", "enjoy" and "interesting." In the survey, Student three remarked that he was neutral about whether he would continue to read eBooks for study.

Student four (Figure 10) had few negative feelings, judged by few words with negative loadings in the word cloud: a limited use of "difficult" and "failed" was all we could find. In fact the reading activity did not seem to arouse much emotion in this student at all. This student spent his time writing rather objectively about the functions used and the time spent on the reading tasks. At the end of the reading, the student said that he would "definitely" use the technology again.

Student five (Figure 10) wrote quite negatively on the blog. There were frequent mentions of words like "troublesome," "inconvenient," "difficult," and "battery" in the word cloud. In contrast, few words are found that can be regarded as clearly positive ("comfortable" may be the only one). Student five remarked that it was "unlikely" for him to use the eBook strategy for studying at both times before and after the extended reading period.

We see that the word clouds not only roughly validated the findings we obtained from another source (survey), they also quickly revealed to us some underlying reasons for students' like or dislike of this eLearning strategy. For example, the Wordle analysis suggested to us that if the students found the technology difficult and inconvenient to use, it is not likely that they would use it in their study. Also, a long battery life may be also of great importance when we are talking about mobile learning strategies.

Conclusion

Our two experiences in using Wordle to inform research have led us to suggest that word clouds can be a useful research tool to aid educational research. We have demonstrated that they can allow researchers to quickly visualize some general patterns in text. In the research setting, these texts are likely to be informants' spoken (transcribed) and written responses. The visualization allow researchers to grasp the common themes in the text, and sometimes even to find out main differences between sets of responses.

As research tools, however, word clouds have certain limitations and we need to be well aware of them. First of all, as frequency is an important aspect of the tool, we would argue that the strategy works best for analyzing text in which the full text of each informant's speech is preserved. In other words, it is less meaningful to input researchers' minutes or summaries of a focus-group meeting into the system as the frequencies of the words used will be changed. Rather, transcription of the actual discussions should be used. Similarly, in the written format, it is best to analyze the raw written responses provided by informants rather than the second-level summaries or reports compiled by the researchers.

Another limitation of word clouds is that the words are retrieved out of context. It is also not possible for users to trace the codes back to the original text. The frequent mention of words such as "screen" and "battery" in our second study is insufficient information for researchers to know the exact opinions concerning the screen and battery.

Word clouds treat each word as the unit of analysis. This mechanical manipulation of text is fast but at the same time it can be misleading because it neglects the semantics of the words and also the phrases and even sentences the words are composed of. As noted above, the treatment will fail to treat "not convenient" as a meaningful phrase in itself. Even if we do what we did in the second study and combine meaningful phrases into joint-words (e.g., "notconvenient"), ambiguity cannot be completely avoided. For example, the system will not be able to reflect the negative sense of a saying like "I wish the software could be more convenient." Because of this simplistic treatment of word forms rather than the actual meanings they carry, the strategy outlined in this paper is not recommended as a stand-alone research tool comparable to traditional content analysis methods.

However, overall, as shown in the two studies reported in this paper, word clouds can be a useful tool for preliminary analysis and for validation of previous findings.

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