GRACE: An Online Reading and Annotation Recommendation Platform

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Abstract. This paper is an extended version of a conference paper submitted to International Conference on Smart Learning Environments 2018. In a course, no matter a traditional classroom learning, distance learning, or e-learning course, there will be some reading activities for students. With those widely used and well-known e-readers, students nowadays can read and make annotations on the screen with their computer, tablet, and smartphone. Making annotations are very important for students as they always focus on the annotations they or their classmates made when they prepare for exams. Students are often borrowing the annotated texts from their classmates to check out whether or not they have overlooked any important content in the textbook. However, most of e-readers in the market don't provide annotation sharing function for users. Even the e-readers want to provide such kind of functions, it may look a mess for students if they see dozen of other students' annotations overlapped on the text. This article is talking about a platform called GRACE (General Rapid Annotation Clustering Enhancement). Teachers can create online reading activities for their students on GRACE and students can do various annotations on the text freely. Moreover, with the help of a bio-inspired innovative clustering method students can see annotation recommendations whenever they make an annotation. The recommendations are found based on the similarity that the students' annotations have from other students made on the same text earlier. The GRACE platform is not only able to help students double check their annotations against with others' and make their annotations more complete and better for exam preparation later, but also can help teachers to figure out what potential learning issue(s) a group of students may have through examining their annotation behaviours.

Keywords: annotation, bio-inspired approach, clustering, e-text, recommendation

1 Introduction

Liu (2005) did a research and found that eighty-three percent of participants indicated that they increased read electronically. Similarly, Chrzastowski and Wiley (2015) found that students prefer the digital ones when they were offered options of having hard copies and digital ones. Bounie and colleagues (2013) also found that Amazon sells more digital books than printed books, especially in higher education according to the research had done by Lopatovska and colleagues (2014).

Almost in every courses teachers will give reading assignments for students to read pieces of articles on papers or in a text. When students read, they usually make annotations on the reading materials. There are different annotations like sidebar notes, words or sentences highlighting, underlining and so on (Tashman & Edwards, 2011). Every students have preferred ways of making annotations; some of them may want to double-underlining the words they thought important but others may choose to simply highlighting the words.

As we all know that no one's annotations are perfect and good for exam preparation, we also know that annotations may represent a person's perception of the importance and familiar degree toward the content. Under such circumstance, if three students' annotations are similar to each other and they have not overlooked or overrate their understandings for the content, then we might be able to say that they have similar degree of understanding and perceptions toward the content. However, we all know that no one is perfect and overlooking and self-overrating do happen. In such case, they might benefit from each other's annotations – which help them re-examine and double check why they didn't make annotation on certain words but others did. They may, of course, confirm that the missing annotation is on purpose because they are already too familiar with the content to annotate. Or perhaps in some cases, the missing annotation may ring the bell for them to make their annotation more complete.

For this reason, the research team developed GRACE (General Rapid Annotation Clustering Enhancement) platform that is composed of a frontend online annotation system and a backend bio-inspired clustering service (Chang, Kuo, Chang, Kinshuk, Kung, 2015). The frontend system allows teachers to create online reading activities and students to make annotations with a variety of ways – highlight, underline, bold, italic, and the use of sidebar notes and different colours. The backend service automatically group students according to their annotations from time to time.

With the backend service's help, the frontend system can prompt annotation recommendations for a student to double check in real time and provide grouping results for teachers to review so they may be able to identify potential learn-

ing problems their students may have. For instance, if a group of students' annotations show that they always annotate those irrelevant or not so important words and sentence, then the teachers can do a mini lecture in the class (in traditional settings) or post important notice on discussion board (in e-learning environments) to remind those students and make them be aware of their problems.

This paper is an extended version of a conference paper submitted to International Conference on Smart Learning Environments 2018. The paper is organized in the following way. Sections 2 and 3 use cases and screenshots to explain how teachers and students use GRACE platform for creating online reading activities and making annotations on the material in a course. Section 4 shows how teachers can use GRACE platform to see their students' annotations, compare a group of students' annotations, and identify the potential learning problems a group of students may have. At the end Section 5 makes conclusion and talks about next steps.

2 How Teachers Use the Online Annotation System

GRACE platform can be free accessed online1. Both of teachers and students can see similar page and self-register an account to use the platform as Fig. 1 shows. After teachers register and sign in, they can see and manage their courses freely as Fig. 2 shows. If they want to create a course to include reading activities for their students, they will need to enter correspondent course information, including course year, season/semester/term, number, and name.

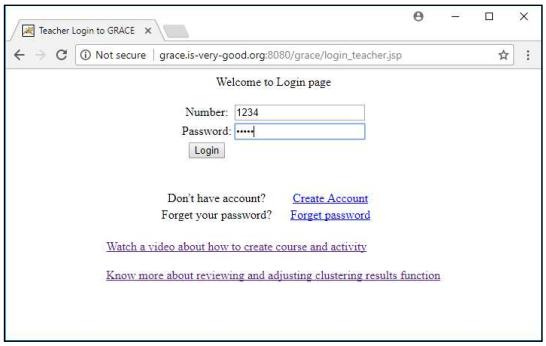


Fig. 1 Login page that users can sign-in or self-register an account.

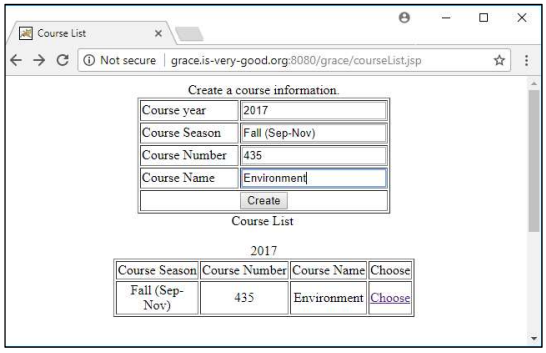
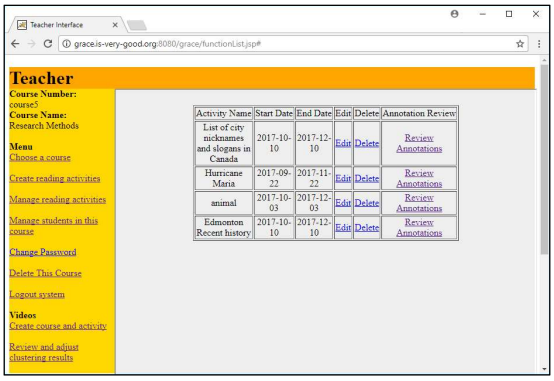
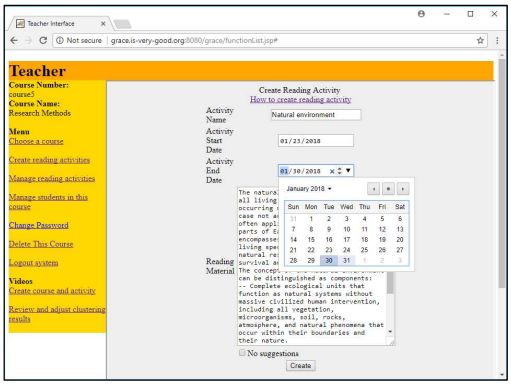


Fig. 2 Course creation and management.

They may directly go to a course that they created earlier, by click "Choose" link, to manage reading activities for their students as well as to review their students' annotations. They can always exit from a course and enter to another one by clicking "Choose a course" link at left-hand side menu shown in Fig. 3. A course can have many reading activities and teachers may create one themselves easily by clicking "Create reading activities" link at left-hand side menu. They will be able to see the user interface like Fig. 4 shows. They need to, first of all, decide the start and end dates for the activity. Students will not be allowed to read before the start date and can still read the material but cannot make any annotation further after the end date. Teachers then need to fill in the form with the reading activity's name and the reading material. At bottom of the page, there is a check box named "No suggestion". If teachers just want to use GRACE platform for their students to read and make annotation but don't want their students to receive any annotation recommendations while reading, then they can check this box. If the box is unchecked, students will be prompted annotation recommendation every time when they make an annotation on the material. Of course, students can also disable the feature themselves at any time while reading and making annotations.





[1] http://grace.game-server.cc

Fig. 3 Reading activities that a course has.

Fig. 4 Teachers can create an online reading activity.

When anytime teachers want to check out all the reading activities they created for the course or edit particular reading activity, they can click "Manage reading activities" link at left-hand side menu to get back to Fig. 3. From there, they can click "Edit" or "Delete" link for specific reading activity to update its information includes reading material or remove it permanently from the course.

3 How Students Make Annotations and See Recommendations

After students register an account and sign in, they can see all courses and enroll any courses they want as Fig. 5 shows. Having this flexibility is to reduce the workload that teachers have. With automatic enrollment feature, teachers can simply tell their students which course they should enroll after sign-in the platform. Of course, in some cases, if teachers want to self-add a particular student to their course, they can simply enter the student's account name by clicking "Manage students in this course" link at left-hand side menu as Fig. 6 shows.

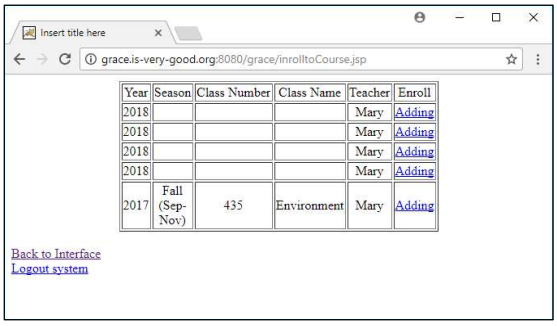


Fig. 5 Students can self-enroll any course they want.

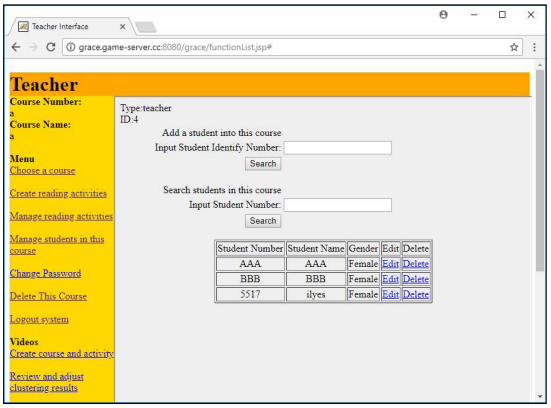


Fig. 6 Teachers can manage students who enroll their course.

When students sign in the platform, they can click "Reading Activities" link on the menu as Fig. 7 shows to check what reading activities they have. As Fig. 8 shows, they can find all reading activities from all courses they have enrolled. They may start working on any reading activity by clicking "Reading" link as long as it is in the time period between the start and end dates.

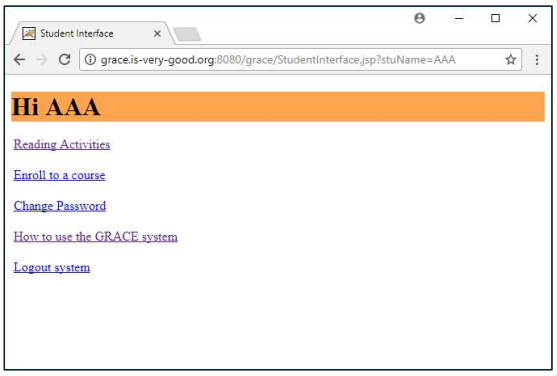


Fig. 7 The menu students can use to switch among courses.

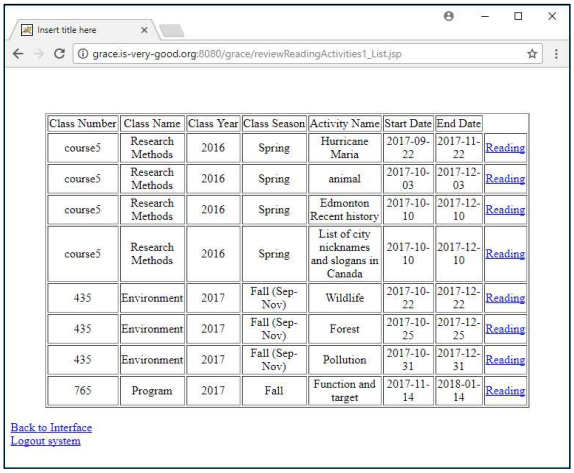


Fig. 8 Students can see all reading activities that different courses have.

When students click an eligible reading activity, they will see the reading material as well as the annotation options on the screen as Fig. 9 shows. At the top panel on the screen, they can find that they can use four different color to highlight words in the reading material. They are also allowed to make selected words be underline, **bold** or *italic*. If they want, they can increase the selected words' font size or even attach a written note to the words. In the panel, there are two options for the students to set for their annotations: single choice and multiple choice. It is because students only annotate content with one kind of annotations, e.g., highlight or underline, in most of time. However, in any case the

students want to highlight the selected words and also underline them, they can choose "Multiple choice" instead. On the other hand, if they don't want to make any annotation but read the material, they can check "Reading Mode" checkbox to disable annotation feature.

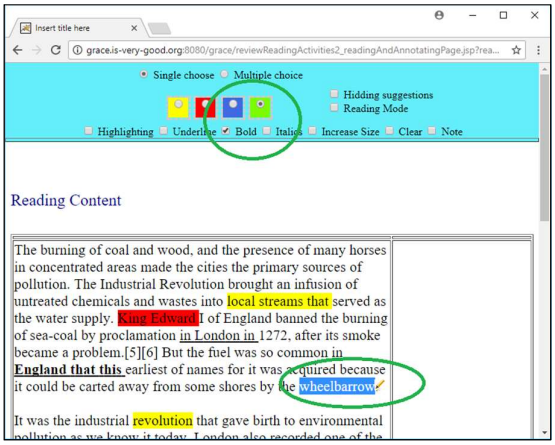


Fig. 9 Annotations that a student can make on the material.

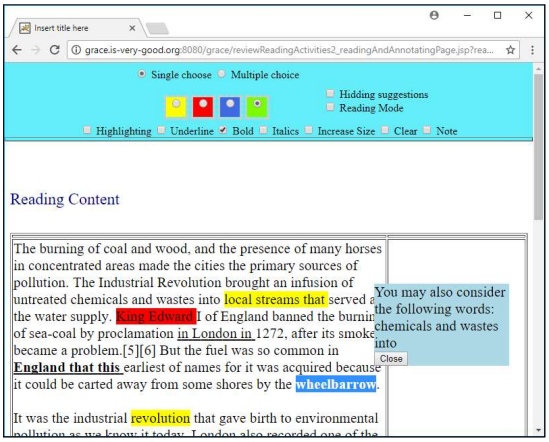


Fig. 10 Students will receive annotation suggestion made by the platform whenever they make an annotation.

Unless the teachers chose to make a reading activity "Reading Mode Only" by checked "No suggestions" checkbox (see Fig. 4), the platform will prompt an annotation suggestion for students every time when they make an annotation on the reading material. As soon as the students annotate the word "wheelbarrow", Fig. 10 shows that the platform tries to remind the students to review the importance of the words "chemicals and wastes into" that other students whose annotation behaviours similar to the students have. If the students think those words they were not annotating are not important, then they can click "Close" button to dismiss the reminder. On the other hand, if they suddenly find that "oh I missed that", then they can make any necessary annotations they want and the platform may prompt another reminder for them if there is any. Last but not the least the students can always free to disable/enable the annotation suggestion feature by checking/unchecking "Hiding suggestions" so they won't be disturbed while reading.

4 How Teachers Review Students' Annotations

At any time teachers can click "Review Annotations" link (see Fig. 3) to check their students' annotations for a specific reading activity. Since the platform uses the bio-inspired clustering method "GRACE" behind the scene and continuously grouping students according to the similarity of their annotations, the teachers can see the grouping results when they enter the annotation review page as Fig. 11 shows. When GRACE groups students, it tries to find different ways to do that. In the case of Fig. 11 teachers can tell that GRACE is capable of grouping students into a single large group as well as two to four smaller groups. Teachers can choose 3-group result and click "Show ALL" button to see what student annotations look like how students are grouped; for instance, Student #66 is in Group 1 when GRACE divides students into three groups. Similarly, teachers can click to check out students and their annotations in particular group; for example, Fig. 12 shows all students in Group 2 when GRACE divides everyone into three groups and Student #61 is one of them.

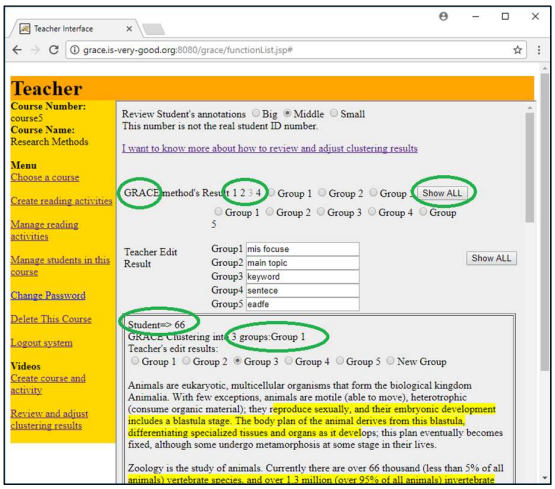


Fig. 11 Student annotations and the grouping results.

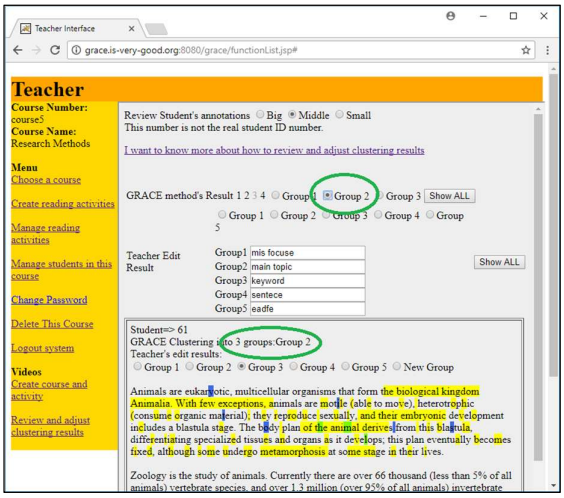
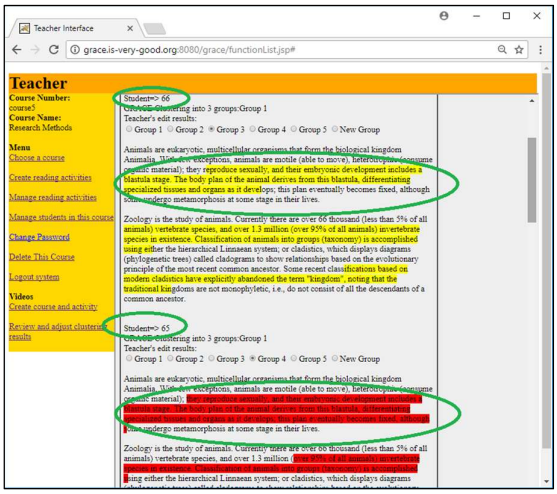
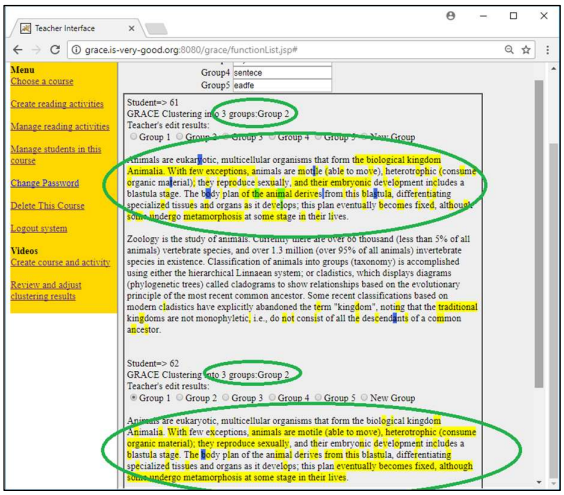


Fig. 12 Teacher can choose to see students of particular group.

With the platform, teachers can easily check out everyone's annotations and they might be able to identify the similarity and difference between the annotations made by students clustered into different groups, by GRACE. As Fig. 13 shows, the annotations obviously are different from Group 1 students to Group 2.



(a) annotations that students in Group 1 have



(b) annotations that students in Group 2 have

Fig. 13 Teachers may easily to find the annotation difference that different groups' students have.

When teachers are not satisfy with the grouping results made by GRACE, they can always override it by clicking any existing group or even choosing to put a student into a new group. Fig.14 shows the teacher believes Student #66 doesn't belong to Group 1 in the 3-group clustering results made by GRACE and think the student's annotation is more similar to other students in Group 3. No matter whether or not teachers override the grouping results, they can label groups according to their perceptions toward the annotations that same group students have.

Sometimes teachers may find that all students in a group have similar learning problems like overlooking fundamental concepts the reading material describes or ignoring the connections between key person and his or her invention, from student annotations. On the other hand, teachers may also be capable of identify common characteristics that a group of students have; for instance, students in a particular group can always catch the most important events and relationships mentioned in the material. In both of the cases, teachers can label a group with their findings as Fig. 15 shows. With the labels, teachers can effectively and put more efforts and energy on those groups of students to help them recognize their problems and make them learn better.

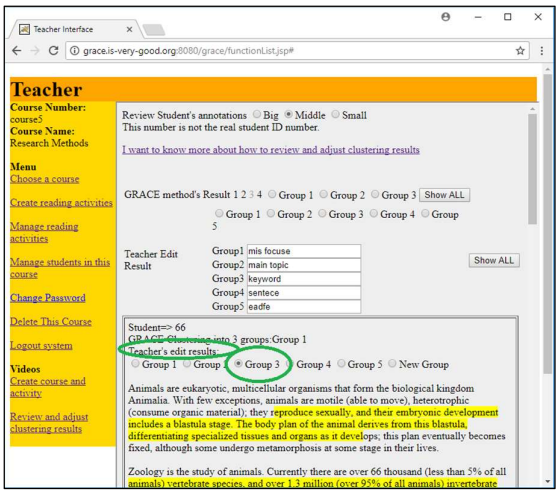


Fig. 14 Teacher can override grouping results.

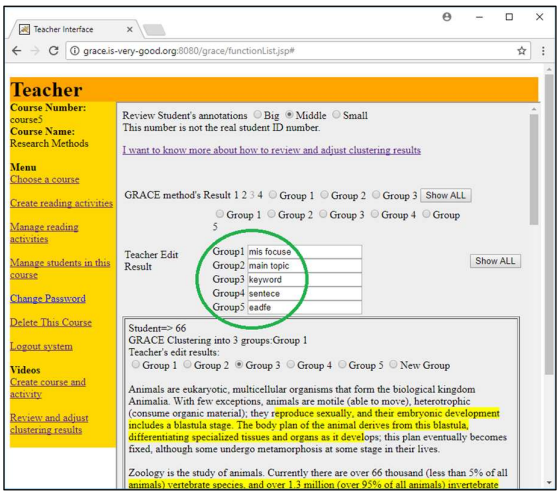


Fig. 15. Teacher can identify the potential learning problems or the characteristics that students in a group may have.

5 Conclusion

In this paper, we briefly describe the online annotation platform we designed and developed via use cases that students and teachers may have. Although the platform and its bio-inspired student clustering methodology is innovative, powerful and flexible for any teachers to adopt into their courses, the platform is brand new. This means the effectiveness and usability of the platform is not clear and confirmed yet. The research team would like to invite anyone, participating in the study, who is willing to adopt the platform for their courses and classes and having their students to do reading activities online. Besides to use questionnaire to get students' perceptions and suggestions toward the platform, we also would like to work with teachers a smart and innovative solution that helps them identify their students' learning problems automatically according to the clustering results.

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