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Can a smartphone application enhance student-learning experience during a field excursion?

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Background

Diagnosis of Diseases of Agricultural and Horticultural Plants is a 2-week international summer course for plant science students. It is a small practical course with approximately 10-15 students enrolled each year. The course involves theoretical and practical pathology sessions, which students can learn about diagnosis of various diseases both in the laboratory and on site. In 2022, the class has 12 students and I am one of the teachers responsible for both lecture and excursion.

Diagnosis of plant diseases outside a laboratory set-up is thus reliant on pattern recognition through students' experience and critical thinking, which can pose a challenge to students with limited experience. One of the teaching practices used for teaching plant pathology is to have student examining different diseases repeatedly, allowing them to recognize and form fingerprinting features of such diseases. Nonetheless, plant diseases can present in different forms in the areas where they are found. While some symptoms are unique and can refer to specific microorganisms and diseases, some are common and present in multiple diseases. Plant disease symptoms can be influenced immensely by environmental conditions, compelling a field excursion to investigate the symptoms and diseases under natural settings. While students are fully supported in making a diagnosis by the teachers in the laboratory, the support can be difficult to seek when they come across unknown or uncertain diseases in a vast agricultural field. The lack of confirmative/elaborative feedback from teachers can influence

student confidence in plant disease diagnosis and may consequently create negative impact on student learning.

The use of smartphone and its applications in education become more and more common and it extends the learning environment unlimitedly. Many smartphone applications are updated frequently with new information and knowledge, making them good resources for students, learners and educators. In many areas of education, smartphone applications are used to provide student support and improve learning outcomes (e.g. in Dilibertо-Macaluso and Hughes, 2016; Pechenkina et al., 2017). Plantix is a smartphone application for online crop disease diagnosis principally designed for agriculture practitioners. Plantix delivers stacks of information about frequently encountered diseases for most economically important crops and plants cultivated around the globe with different treatment options of choices. With the generous information about plant diseases the application contains, it can be useful for plant pathology students, especially during the field excursion. This study aims to investigate student experience in using Plantix and whether they can profit from the plant doctor-like application during a field excursion.

Methods

Under the regular circumstances, students are to hold two days of field excursions in the course. For both days, they visit different agricultural farms in Sjælland, where they learn to diagnose different diseases on site and collect samples for further examination in the laboratory. In this study, the survey was planned to implement only on the second day. Before the trip, the students received a brief about plant species and diseases they may expect to experience in the fields. They were also introduced to the smartphone application "Plantix", giving them a chance to become acquainted with the application. Plantix is however only available on the Andriod platform, while only half of the students have Android phones. The students were therefore asked to pair up to evaluate the application together as a team. A questionnaire (Appendix A) was present to the students in the morning of the excursion day and the students had a chance to evaluate benefits of the application during their visits to the two agricultural farms. The student returned their opinions about the application at the end of the day.

Results and discussion

Smartphone application can support student learning during the field trip

At the end of the day, five out of six questionnaires, equivalent to 83.3%, were returned. The student responses to such questions were summarized in pie charts shown in Figure 1. Based on the question no. 1, 80% of the students returned the question with either the score of 5 or 4, suggesting that they accepted Plantix well and saw a potential benefit of the application for a field excursion. The majority of students thought that Plantix was useful for the field excursion as a quick guide, providing useful information when they experienced unfamiliar or new diseases (question no. 3). Some of them even thought that it was a good reference for plant pathology study (question no. 7). Due to the small number of students and not all of them had an Android phone, it was not possible to split the students into two groups (with and without Plantix) and systematically evaluate whether the application can help the students with the application to better identify plant diseases. However, Quant and colleagues (Quant et al., 2016) surveyed the use of medical applications in medical study. They showed that the majority of medical students and general practitioners believed that medical apps could enhance clinical knowledge. Chandra et al. (2022) also reported the effectiveness of smartphone applications in improving academic performance and clinical practice among healthcare professionals and students from their meta-analysis study. In contrast, Thomas and Fellowes (Thomas & Fellowes, 2017) assessed the benefit of smartphone application in identification of birds and found no evidence to claim the benefits of smartphone application in the field. Although this survey seems to favor the benefits of the smartphone application, the contradicting results of Thomas and Fellowes (2017) may suggest that the beneficial effects of smartphone applications in education depend on subjects and that more thorough studies need to be done to clarify the potential benefits.

One of the important messages from this study was that, by using Plantix, the students felt more confident in making diagnosis, especially when experiencing complex symptoms and diseases (question no. 5). This is similar to the study by Meyer and colleagues (Meyer et al., 2018), where they showed that a mobile application could significantly improve a clinical decision making of US physicians. One of the reasons can be because the smartphone application contains critical information and photos with typi-

cal symptoms of diseases, which could potentially boost the students' confidence in making such diagnosis.

Photos and typical disease symptoms help students to better recognize plant diseases during the field trip

One of the main challenges in diagnosis of plant diseases is that there are hundreds of diseases presenting very similar symptoms. These symptoms can perplex inexperienced students when they are confronted with them for the first time. The survey indicated that the use of photos with typical disease symptoms in Plantix is one of the keys that help them recognize different diseases better (question 2). As expected, the students prefered to learn from photos, but not from long texts describing disease symptoms (question 9). Photos and images have been long used in teaching, especially in connection with pattern recognition such as in some areas of medicine. Cosgrove (Cosgrove et al., 2006) showed that, when introducing relevant photos and images at the right time, students could use the photos and images as metaphors to help them better understand the topic and memory retention. It is important to note that low quality of images and photos may negatively affect efficacy of the teaching when using these graphical tools (Fenesi et al., 2016). Additionally, the use of images shall be carefully linked to the lesson objectives and keywords, which allows students to link information and properly interpret them (Azer, 2007).

Mobile application: the next generation tool?

It is clear from the survey that students see the benefits of Plantix for their study (question 12) and are willing to continue using the application after the course (question 13). The answers are not far from the expectation owing to the ease of access to new knowledge and information. In fact, the use of smartphone application for education is on the rise and is not limited to only science education. While more classes begin shifting towards involving smartphone and its applications, Oliveira et al. (Oliveira et al., 2021) evaluated the use of mobile applications during the theoretical classes. The team reported that most used applications are of social network applications, including Facebook and Instagram. Based on empirical evidence, the use of mobile applications in classroom shall be called on in the given time

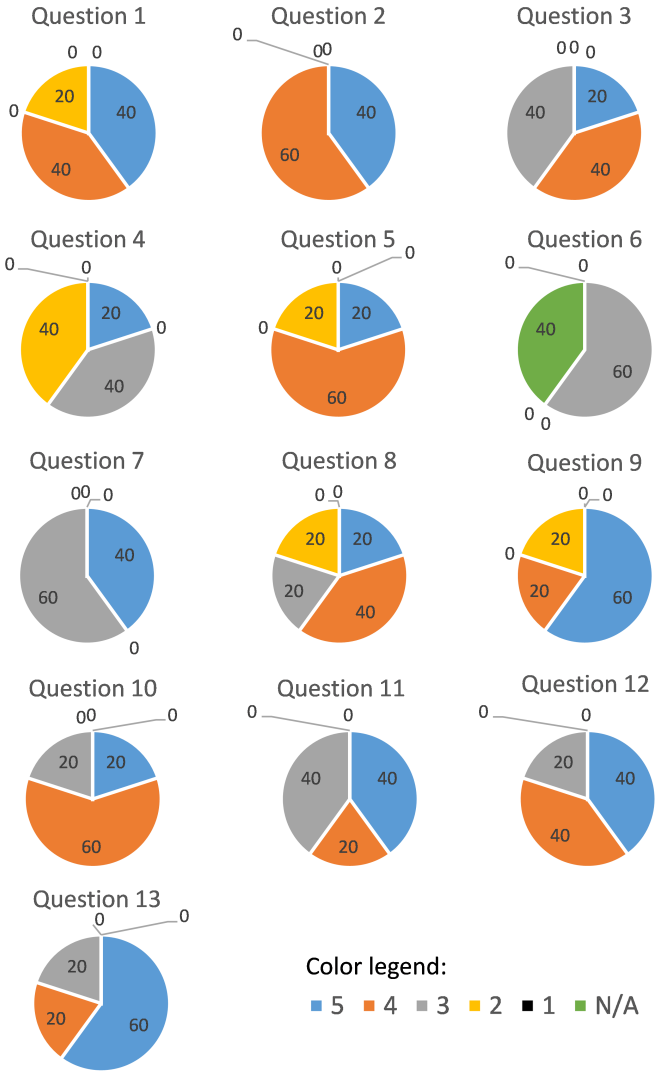

Figure 1. Pie charts illustrating percentages of scores the students assigned to different questions in the questionnaire. The responses are given N/A when the students reserved their opinion on such questions.

and on the given task as the applications can offer distraction to students and thus reduce their learning.

The minority of students prefered consulting books than Plantix when experiencing unfamiliar diseases (question 4). However, they prefered using the application for diseases with similar symptoms (question 8). It is possible that they may not have sufficient time to evaluate the application thoroughly as only half of the students provide all neutral answers to question 6, which concerns the precision and reliability in making diagnosis of the application, and question 11, which entails trust in the application. Additionally, it can be more convenient for them to use Plantix on smartphone instead of carrying a heavy textbook, particularly when they are out in the field. Plantix offers a feature offering online diagnostic support to its users. Although there was not enough time to test the feature during the excursions, the students show interest in using the function when they encounter unfamiliar diseases.

Conclusions and outlook

Students can benefit from the use of smartphone application during the field excursion, especially when they experience unfamiliar or complex plant diseases. Compared to long texts in text books, they prefer to learn from images and photos. Nonetheless, a further investigation is needed to examine whether the application can improve their diagnosis. Furthermore, a discussion with an expertise is highly valued. With the rapid successions in smartphone technologies, it would be interesting to have a gamified mobile application focused on diagnosis of plant diseases. By creating a positive and relaxed learning atmosphere while granting them an access to new knowledge at ease, the smartphone application can be seen as a good supportive tool for plant pathology study.

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A The questionnaire for observing student opinion on using the smartphone application Plantix during filed trip

Questions

The questions are about your opinion about the application Plantix for a field trip and your plant pathology study. Use the keyword "PLANTIX" to search for the application on google play (available only on Andriod). The app is free of charge.

Please answer all questions on a scale of 1 to 5 (strongly disagree to strongly agree). Thanks for your help!

1. The application was useful both for field trips and studying plant pathology in general.
2. The application helps you better recognize plant diseases because it presents photos with typical disease symptoms.
3. The application provides useful information and new knowledge when experiencing unfamiliar plant diseases.
4. You would choose consulting the application over plant pathology books when experiencing unfamiliar plant diseases.
5. The application boosts your confidence in making disease diagnosis, especially for diseases with similar symptoms (e.g., different types of leaf blights/spots).
6. The application is a precise and reliable reference (with no disease misidentifications or wrong disease descriptions) for your field trip and plant pathology study.
7. The application is a good reference for your study as it contains all important/frequently found plant diseases.
8. You would choose consulting the application over plant pathology books when experiencing diseases with similar symptoms (e.g., different types of leaf blights/spots).
9. You prefer the application over plant pathology books because it is easier to learn from photos, not from long texts describing disease symptoms.
10. Compared to reading and interpreting disease symptoms in a book, you prefer discussing with other plant pathologists (as a feature in the application) when being challenged by an unfamiliar plant disease.

11. In case your diagnosis disagrees with the application, you would believe your own diagnosis.

12. The application benefits your study of plant pathology and you would recommend the application to your friends who also study the same subject.

13. You will continue using the application even after finishing the course.