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Grass Gazers: Using citizen science as a tool to facilitate practical and online science learning for secondary school students during the COVID-19 lockdown

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Abstract

The coronavirus disease of 2019 (COVID-19) pandemic has impacted educational systems worldwide, in particular primary and secondary schooling. To enable students of the local secondary school in Brisbane, Queensland, to continue with their practical agricultural science learning and facilitate online learning, a small-scale citizen science project was designed and rapidly implemented as a collaboration between the school and a multidisciplinary university research group focused on pollen allergy. Here we reflect on the process of developing and implementing this project from the perspective of the school and the university. A learning package including modules on pollen identification, tracking grass species, measuring field greenness, using a citizen science data entry platform, forensic palynology, as well as video guides, risk assessment and feedback forms were generated. Junior agriculture science students participated in the learning via online lessons and independent data collection in their own local neighborhood and/or school grounds situated within urban environments. The project provided useful data on local distribution and flowering of grass species. The experience allowed two-way knowledge exchange between the secondary and tertiary education sectors. The unique context of restrictions imposed by the social isolation policies as well as Public Health and Department of Education directives, allowed the team to respond by adapting teaching and research activity to develop and trial learning modules and citizen science tools. The project provided a focus to motivate and connect teachers, academic staff, and school students during a difficult circumstance. Extension of this citizen project for the purposes of research and secondary school learning, has the potential to offer ongoing benefits for grassland ecology data acquisition and student exposure to real-world science.

KEYWORDS

Citizen Science, COVID-19, Grass Identification, Pollen Monitoring, Collaboration, Engagement

INTRODUCTION

As a response to the COVID-19 pandemic, declared by the World Health Organization on 11$^{\text{th}}$ of March 2020 (WHO 2020), several public health strategies have been adopted and applied in Australia, including restriction on international air travel, case isolation and home quarantine, social distancing and school closures (Chang et al. 2020). Several schools across the country temporarily closed whilst other schools were only open for children of essential workers. State governments encouraged parents to keep their children at home (NCRIS 2020). This resulted in educators from primary to tertiary sectors needing to transition to online learning. This transition to online learning significantly hindered delivery of science curriculum that depends on practical activities to facilitate learning.

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Announcement of the COVID-19 pandemic lockdown in Queensland, Australia, caught Queensland University of Technology's Allergy Research Group (QUT ARG) and Corinda State High School (CSHS) in the early stage of consideration of a joint scientific field activity. Whilst initially preparing to postpone the project until after the social lockdown measures had ceased, the idea was formed to restructure the project so that students could participate in a joint activity from home during lockdown and in a way that kept students engaged and able to undertake practical science learning. This led to the development of a small-scale citizen science project and educational modules using 'real world' research concepts and data to facilitate practical and online learning11 Citizen science refers to a process whereby volunteers from within the community are able to engage in scientific research through assisting in the collection of data and sharing information. These types of projects not only enable the community to engage in research, but also allow researchers to achieve their broader research goals (Silvertown 2009; Jordan et al. 2011). With the recent advancements in digital technology, there is now the potential for citizen science projects to recruit a larger number of volunteers across the world (Kobori et al. 2016) and there are an increasing number of freely available online tools for collecting and visualizing data (Silvertown 2009; Dickson, Zuckerberg & Bonter 2010). Access to these facilities coupled with the immediate need for online learning opened an opportunity for engaging secondary school students in interactive science learning activities while they were undertaking online school learning at home.

The 'Grass Gazers' citizen science project was designed by the QUT ARG for the purpose of grassland diversity and phenology research (Davies et al. 2015; Devadas et al. 2018). The project was developed by the academic research group and adapted by the CSHS agricultural science coordinator as a learning tool suitable for use by a group of junior high school agricultural science students. The adaptation allowed for examination of the potential for use of this citizen science tool to engage with students working from home whilst facilitating practical and online learning. It also provided an opportunity to develop an ongoing collaboration between tertiary researchers and secondary educators. The project used online tools to upload botanical and phenological data of grasses observed by students around their neighborhood or school surrounds within an urban environment. The students could then access and visualize all collected data for further educational purposes. This paper will reflect on the development, implementation, current social context, and outcomes of this project for the school students, including the collaboration's challenges and benefits, how the project could be improved, and implications for future science learning in schools.

MOTIVATION FOR THE PROJECT

Information regarding grass species distribution records is documented by herbarium sightings collated by the Atlas of Living Australia (Atlas of Living Australia 2020), but this does not include phenological data on flowering behavior at a local level in Australia, which is still not well documented. Addressing this knowledge gap is valuable because grass has been recognized as a clinically important outdoor pollen producer globally (Garcia-Mozo et al. 2017) and the most common allergenic pollen source in Australia (Davies et al. 2014). Grass pollen has been shown to be a major trigger for Allergic rhinitis (AR), a disease that impacts over 500 million people worldwide, and as many as 19.3% of Australians (Bousquet et al. 2008; AIHW 2019). Symptoms of AR such as itchy eyes and a runny nose can affect the health and quality of everyday life (Rimmer & Davies 2015) as well as impose a considerable socio-economic impact (Colás et al. 2017). AR is also a known risk factor for progression to comorbid conditions such as sinusitis, sleep apnea and asthma (Guerra et al. 2002; Davies 2014; Bousquet et al. 2019).

One method to assist AR sufferers and clinicians with public environmental health strategies to manage allergen exposure and symptom reduction, is the establishment of pollen monitoring networks to provide local current pollen information (Medek et al. 2020). Currently there are 14 out of a total of 25 pollen monitoring sites of the AusPollen Aerobiology Collaboration Network (Davies et al. 2016) across Australia that publicly report daily grass pollen concentrations during the pollen season (NEII 2020). Research teams at these sites collect daily or weekly air samples using a volumetric Hirst-type pollen and spore trap. Impacted pollen and spores are then mounted on a slide and manually counted by trained personnel by light microscopy by standardized protocols (Beggs et al. 2018). This daily pollen information is then disseminated directly

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to the community through online and mobile phone platforms. The process of pollen monitoring is labour intensive, costly and time-consuming, and moreover the reported concentrations reflect yesterday's rather than today's conditions (Thibaudon, Caillaud & Besancenot 2013; Banchi, Pallavincini & Mugggia 2019). A further problem with reporting airborne pollen concentrations for a large area such as Brisbane is that spatial variation is predicted to be high, but the representation of pollen monitored at one or a few sites over a wider geographical area remains poorly understood (Katelaris et al. 2004). Airborne grass pollen is monitored and reported daily in Brisbane by QUT ARG for only a single location in Rocklea, during the grass pollen season (November to mid-April). The group also monitors pollen levels to the west of Brisbane at a grazing farm near Mutdapilly, and there appears to be distinct timing of the grass pollen season observed between these locations. The Brisbane area has a sub-tropical climate but incorporates a range of diverse micro-climates based on urban development including bayside, riverside, urban, peri-urban and semi-rural areas. Historically in Australia or elsewhere worldwide, the sub-tropical grass pollen season (Green et al. 2004) has not been as well studied as the temperate regions. Consequently, an improved understanding of grass diversity, distribution and flowering behavior around Brisbane would be of great use in development of locally relevant pollen forecast and alert systems.

The lack of data available on grass diversity and flowering activity provided internal motivation for the QUT ARG to undertake this project. The external context of the COVID-19 situation required the CSHS to adopt online learning formats for the delivery of secondary science curriculum. Whilst there were both internal and external drivers that motivated the QUT ARG and CSHS to proceed with this project, there were also shared purposes that underpinned this collaboration (Fig. 1). Within the current circumstances, both QUT ARG and CSHS recognised an opportunity to develop and implement an online citizen science project and provide a platform to keep students engaged during the COVID-19 isolation period. Moreover, the use of technology underscores the potential to increase the engagement and motivation of learners and allows catering to different learning styles (Jones & McLean 2012).

For CSHS, this project provided the opportunity for their students to remain engaged in learning and feel a sense of connection with each other while at home during lockdown. Even though they did not share the same physical space, they still functioned as a class via use of online learning platforms. All the students were potentially able to add data to a shared online database and view each other's entries online. The activities allowed students to re-affirm and extend knowledge of plant biology topics previously taught. The students were exposed to 'real-world' scientific research, authenticating learning and encouraging development of reflective and critical thinking skills.

The COVID-19 restrictions resulted in the QUT ARG members having to work from home, requiring them to re-direct their research efforts while they were unable to undertake laboratory work. Engaging in this project also required the researchers to regularly connect and collaborate via online tools. This project provided opportunity to test and refine tools for a proposed citizen science research project on grass distribution including testbeds for data collection methods and analysis. The data collected from this project could serve the group's research goals, including the generation of better grass pollen forecasts. Undertaking and reflecting on the project allowed the research group to improve the research and engagement tools prior to larger scale application.

The aim of the collaborative 'Grass Gazers' project was to provide learning materials and an online tool for students to undertake practical science activities safely around their homes. Moreover, this project would enable CSHS and QUT ARG to establish a new collaboration involving elements in both secondary and tertiary education sectors.

PROJECT DESIGN

The collaborative 'Grass Gazers' citizen science project was designed to geolocate, categorize and indicate flowering behavior of grasses around students' homes through an activity named "Tracking Grass Species" (Fig. 2). Before the students began undertaking the practical activity, it was important that they had background knowledge on the project and safety information as well as instructions on how to undertake

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the data collection. The QUT ARG provided the agricultural science coordinator with a set of resources (documented versions of the developed risk assessments and the modules on pollen identification, tracking grass species, measuring field greenness, using a citizen science data entry platform and forensic palynology) covering this information. The science coordinator then used this information to generate online class lessons that incorporated many teaching tools (e.g. questions, activities, images using simplified language) to help the students understand the project and the risks involved. This was done using an online platform called 'Stile' (Stile Education 2019) with functionality that included uploading videos, multi-choice and open questions, mind maps, an open canvas function to annotate images and audio commentary. Once the students were familiar with this important safety information, they were then able to begin the practical component of this project. The project required the students to look outside their household or around their local neighborhood, under supervision, and identify grass species using an online data collection platform, Epicollect5 (EpiCollect5 2020). QUT ARG developed a project on this platform with an online survey that asked about the grass species observed (Appendix). This information included key phenological characteristics and images that would enable the students and the researchers to identify grasses that the students were observing. As the students submitted data and photo images into Epicollect5, they were able to visualize data collected by themselves and their school mates. This online platform also allows the student to visualize the geographical location of all data on a map. The data collected can be exported by the students for further educational activities developed by their science teachers.

PROJECT OUTCOMES

There were a number of key outcomes achieved. The first outcome was the development of a data collection survey that could be easily accessed via an online platform. Once the survey was set up onto EpiCollect5, it was ready for active use and the results can be easily visualized and analyzed. This survey can be adapted and expanded for more users.

Another key outcome was the development of a suite of learning resources and activities for junior high school students between the ages of 13 to 14 years old. These resources can be used and adapted for future students at this and other schools. With slight modifications, these resources can be adapted appropriately to suit students of different ages (e.g. senior high schoolers and university students).

The last key outcome was that during the project 60 agricultural students used these activities to facilitate their learning from home. These students learnt the features and structures used to identify plants (pasture grasses) and applied this knowledge to describe the plants they had found. This formed an important part of the plant component of the agricultural science course. Moreover, these students learnt about real-world research and gained experience in using data collection, visualization and analysis tools.

OUR EXPERIENCE – REFLECTION ON PROJECT DEVELOPMENT AND IMPLEMENTATION

The engagement between QUT ARG and CSHS was initiated prior to COVID-19, and the intention to plan this citizen science project had already been considered. Subject to receipt of external funding, the project was to take a year to execute, with time devoted to plan and implement the project. Due to current social factors; the COVID-19 situation and isolation policies, there was a desire for practical science activities for students to undertake while learning from home. This prompted rapid adaptation of the initial project concept to suit the needs of the school and accelerate the trial of proposed QUT ARG citizen science research tools.

Throughout project development and implementation, several challenges were encountered, some of which were solely due to the COVID-19 situation (Table. 1). However, by engaging in this new collaborative project, the organizations gained both expected and unexpected benefits (Fig. 3). These challenges and benefits will be discussed in the following sections.

CHALLENGES

Limited time and resources to develop and implement project

The QUT ARG had been preparing funding applications for the project at the time of lockdown. During the initial timeframe, the QUT ARG planned to consider all aspects of the project prior to commencement of activities. However, due to the cessation of face-to face schooling and closure of research laboratories, a majority of the CSHS school students quickly moved to learning from home, impacting the delivery of the agricultural science curriculum. There was a limited time to develop new educational resources and tools needed to enable the students to undertake this project at home. This time-restraint was not only due to the immediate demand for student activities but also driven by the approaching end of the grass flowering season; flowers being an important characteristic to identify grass species. Having a multidisciplinary team quickly facilitated development of the necessary educational resources and citizen science tools.

Without direct funding, members of the group worked on this project with considerable discretionary effort, and in their own time. Universities were undergoing their own transition to working-from home and this added administrative workload and logistical challenges. Having a new and engaging project, which had potential to directly helped the school students, gave a sense of altruistic purpose that connected the team during this disruptive period.

There were also limitations from the school perspective. As students had to provide their personal details to download the App, the process had to be cleared by Education Queensland. The Information Privacy Act (2009) legislates how the Department will collect, store, use and disclose personal information about students (Queensland Legislation 2019). There was a need to liaise with the school IT Manager to ascertain in which country the data was stored to ensure the security of the personal information. The process was approved by the Deputy Principal once it had been cleared by the IT Manager.

Student access to resources was variable

Students having limited or no access to electronic resources (i.e. electronic device and internet) was another major challenge to be faced. The original plan was to make use of a class set of iPads and to use the school-based internet for uploading data and photos, and for viewing results. For loading data anonymously (essential for an activity involving school students) the Epicollect5 system uses a free mobile App; this means that at home the students needed access to a mobile device of some kind, preferably with location turned on (for mapping) and with access to Wi-Fi or data for uploading their observations.

Between 2016-17, 91% of Australian households with children under 15 years of age had access to the internet and 91% of these connected households used computers or mobile phones, whilst 66% of households also connected to the internet using tablets (ABS 2018). These statistics indicated that although a large proportion of the students would have internet access, a small number of students may not. This would impact the overall effectiveness of deploying this type of citizen science project as it relied on entering data into an online tool. The way the project was delivered to the students by the school was via an online learning platform.

To overcome this challenge, a version of the learning resources that could be printed out was provided to the students. These resources included background information and instructions on how to conduct the project as well as data entry sheets that would enable the students to collect data and then submit the information to their teacher or online when they eventually had access to an electronic device.

Ability to engage students and encourage participation

Having the students learn from home for an extended period of time without constant contact with the teacher posed a challenge of effectively engaging the students and urging them to participate in the project. It was difficult for the agricultural science coordinator to monitor whether the students where completing the required schoolwork from home because they were not able to communicate with the students regularly. It was imperative that the students where self-motivated to undertake the project and/or had someone available in their home to assist or enforce them to undertake the project. However, if the students lacked that motivation or someone in their home didn't have the skills or time to assist the student with their work, then this could result in a reduced number of students participating.

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To resolve this problem, the agricultural science coordinator contacted the student's parents/guardians via email if these activities had not been 'opened' online to assist and encourage the student to complete the project activities. It was expected that the students would complete the activity as part of their on-line lessons but because there was no way of enforcing participation, the activity was not assessed.

Providing learning support to students

Undertaking this project required the installation and use of an online tool, EpiCollect5, which the school had not used before. Teaching the students how to download and use this tool was a further task that many students could find daunting, even in a supportive classroom environment. Moreover, there were students in the class who would struggle with learning via extended written instructions.

Online visual media (i.e. instructional videos) were used to assist the students in understanding how to install and use EpiCollect5. These videos provided step by step visual instructions, that the students could pause, and re-watch as often as they needed. Unfortunately, students who lacked access to an electronic device or the internet needed to rely on the physical resource documents and the support of their guardian.

Health and Safety Concerns

A risk assessment appropriate for the project was needed that encompassed both risk mitigation approaches taken by QUT and CSHS, and to determine appropriate level of responsibility. There are polices and legislative responsibility for ensuring health and safety of staff, adults and students and processes for risk management of the projects led within Universities. Risk assessments established by university researchers are comprehensive and based on adult engagement in activities, decision-making and careful realistic assessment of the project-related risks with an aim that all individuals involved in the project are aware of risks and mitigation strategies, and share in the responsibly to maintain safe work practices. A risk assessment document had to ensure that all project-related risks are considered, and all risks are evaluated and managed appropriately for junior high school aged students. The schools however have different approaches to ensure health and safety of students, as normally students would carry out the project activities at school in an environment where supervision is provided, risk reduction strategies can be implemented and monitored.

The COVID-19 isolation with online and practical learning at students' homes and/or local environment, brought a new health and safety challenge because the teacher could not monitor or enforce any of the measures outlined in the risk assessment document. The students were minors needing a degree of parentally supervision. The QUT ARG prepared a risk assessment document with suggested considerations and guidelines regarding identified safety and risk mitigation plans for the project, as seen from the perspective of researchers to share with CSHS (Table. 2). The version of the document was then considered, modified and adopted into a simplified but effective form by CSHS. The school took the responsibility to email the students' parents/guardians to make them aware of the project and highlight all of the risks identified. The core recommendation was to always have students accompanied and supervised by a responsible adult. In addition, the main risks and health and safety measures were incorporated in online lessons and explained by the agricultural science coordinator before students had undertaken the activity. The EpiCollect5 online tool itself contained a short note on safety in the introduction.

Considering governing body requirements and ethics

For universities, research activities must adopt with integrity practices consistent with The National Code for Responsible Conduct of Research (NHMRC 2018). The QUT ARG needed to evaluate the project and partnership to determine whether this project complied with guidelines and policy, and consider whether ethics approval would be required. It was important to determine whether there were any other governing bodies to consider when working directly with a school. The QUT ARG had no previous experience undertaking a collaboration with the secondary education sector. During the COVID-19 situation, the Queensland state government Department of Education issued a directive that all research activities in state schools and other educational sites were to be postponed until further notice (Queensland Government 2020). Instead of research, the project aim was to develop learning activities for them to conduct and raise awareness of rese-

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arch processes. Careful consideration throughout the development and implementation phases of the project was taken to comply with government regulations including frequently changing public health directives. This restricted the scope of this initial project, however, it may be possible in future when the Department of Education directive changes, and if ethics approval is sought, to gather survey feedback from the students themselves on their perception of the learning opportunities and material provided.

BENEFITS

Having in mind that the collaboration between QUT ARG and CSHS was established not long before the COVID-19 situation arose, communication between parties was incredibly smooth including connecting by videoconferencing to develop engagement plans, learning materials and an online platform. This project therefore provided an opportunity to establish and strengthen new relationships between individuals working within these organizations that may underpin further activities and projects.

Throughout the development of this project one of the anticipated benefits was the opportunity the Agricultural Technology students were given to enhance their knowledge about plant morphology and the identification of plants (grasses) in a real-world context. However, unexpectedly, through the process of developing learning modules for the students, individuals from different disciplines within the QUT ARG (mathematics, environmental chemistry) consolidated their own knowledge about plant morphology and identification.

The QUT ARG team has been actively learning about topics relevant to new aspects of the citizen science project, which were applied and tested. The QUT ARG team gained valuable knowledge and insight on the requirements and processes for school-university partnerships. The project had the added benefit of providing early career researchers a lived experience of communication and transfer of knowledge to junior high school level.

The set of resources developed and refined in this collaborative project will be used as a valuable teaching and learning material for future projects. These learning resources will allow for expansion of this project to extend citizen science involving other schools and community groups. Working with the school community has increased awareness of citizen science not only with students but also with their friends and families. This can be an important forum for a broader public engagement that will allow growth of awareness around the importance of grass diversity, phenology and grass pollen, as an allergy trigger and management of pollen allergies.

With this citizen science project students were given an opportunity for a hands-on experience in grassland ecology field work and online data entry to a digital platform while learning at home. The designed online learning and practical activities have exposed students to real-world science and likely facilitated a development of important scientific skills in observation, critical thinking and analysis. Students had to carefully observe features of grass, its flowers and leaves, decide on type of flower, flower head, suggest the likely grass species, and analyze generated data (Appendix). Learning approaches such as this are proven to be effective in increasing student interest in science, technology, engineering, and mathematics careers (Hiller et al. 2015). Citizen science projects like this one, can be considered as an important initial step towards professional development of young individuals.

A further collective benefit was that this project received coverage from media outlets including a national television nightly news channel as well as university and school media platforms (QUT ARG 2020). This coverage provided positive attention to all partners involved, and increased awareness of science to the community including the project motivation and scope, as well as some of the health impacts of grass pollen.

Although time to develop and implement the project was limited, this facilitated the rapid evolution of the project because all individuals involved had a heightened focused on making things happen. This benefited all parties; the school teaching staff, university researchers and school students, and above all, inspired the team to provide a unique and much needed learning experience for students in difficult times.

DISCUSSION AND FUTURE DIRECTIONS

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Working within this collaboration with a shared purpose was a mutually beneficial experience for both the academic research group and the secondary school science department, consistent with the key principle of engagement necessary for quality citizen science projects. All partners shared clear aims and expected outcomes, that were defined at the start of the project and were realistic for the time and resources available. The highly collaborative nature of the partnership was an important part of its success. It was recognized and valued that everyone involved in the project contributed different expertise. To facilitate this collaborative relationship, 'open-communication' was maintained between everyone involved in the project, which ensured that there was a clear sense of shared ownership of the project (Maclaughlin et al. 2004). This school-university partnership is recognized to have all the important elements for success and this project provided an opportunity to strengthen the new relationships which will likely evolve over time (Green at al. 2019).

As a project aiming to facilitate learning, it was considered a success because the students appeared to enjoy using the online tools during this project as well as learning about grass and pollen. The students were also able to learn about how this project related to the bigger 'public health' context, which was a challenging and new experience that the school and the students had never undertaken before.

Throughout the duration of this project 42 data points were entered into the EpiCollect5 tool and these points were distributed across Brisbane (within a ˜100km area). The students answered all of the survey questions in the tool, however, some of the required images were not properly uploaded or the incorrect part of the grass was photographed. This is partially due description of the features to be photographed, processes of this online tool, and not providing steps in sufficient detail in the learning resources. This highlighted the need for refinement of detail in the learning resources to ensure that the data collected is of high quality. Although not all of the data from the current project could be used for future research, this citizen science project did provide a significant insight into what aspects need to be improved prior to further use. Overall, it was evident that the type of data collected could be highly useful in increasing local current peri-urban and rural grassland diversity and phenology. The research team were able to identify grass species present in different regions across Brisbane and when they were seen to flower. The outcomes of this project suggest that further use and extension of this citizen science approach would therefore enhance our current knowledge of grass distribution and phenology.

Throughout development and implementation of this project, the QUT ARG and CSHS have both learned about the process and regulations of engaging in a school/university partnership. For members of the QUT ARG this was very valuable. It provided early stage researchers with insight on how they can effectively communicate their research themes to the general community. Whereas CSHS gained insights on how to use vertical integration and university partnerships to help students learn Twenty First Century skills in a real-world multi-disciplinary research context.

Although the agricultural coordinator at the school was aware that some students would struggle with extended written tests, he learnt during this project that twelve and thirteen year old's do not always have the ability to navigate their way through difficult tasks without the face-to-face assistance of a teacher. This therefore highlighted the overall importance of teaching students how to deconstruct and address complex problems.

Whilst the school and university team members used an online file sharing and messaging software to communicate, it would be advantageous to use an online communication and collaboration platform (e.g. Microsoft Teams, Slack, Discord) for the students to discuss, connect with peers and upload files relating to this project. An online hub could provide a centralized location for all project resources and data. The use of this type of platform would also provide students with an extra level of peer to peer support to communicate any issues or questions.

Another improvement that should be made is consideration of how the students can extend use of the data after it is collected. Activities should be developed for the students to graph and analyse the collected data, gather other data sets online (e.g. local rainfall or temperature) and answer a range of basic questions exploring mathematical, physical and biological relationships. Moreover, the project would also benefit from

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sample research data where the students could graph and form links between grass flowering times, pollen counts and spikes in allergy symptoms.

The QUT ARG reflected on the effectiveness of this project design and whether they are able to obtain information from this type of citizen science activity that has utility for research endeavors. The project can be modified and extended for use in other schools, community groups and the general public. However, funding will be a required input to expand activity, which will involve more grant applications to support for the research team and this citizen science project. It was evident that lay language should be used to describe scientific concepts and transfer knowledge to public audiences, but writing in plain language is a skill that needs to be developed. The ability to write effectively in this way is necessary to increase the visibility, transparency and impact of science in the community (Kuehue & Olden 2015). From this perspective, the learning modules were written for an intended audience of junior high school students, but the language was further simplified by the secondary school teacher. The learning modules should now be transferrable for effective engagement of lay people in community for a wider citizen science project.

The science coordinator at the school hopes to continue undertaking this project with the next cohort of junior high Agricultural Technology students in subsequent semesters. In the future, this project will tie in with the plant identification topics of the science curriculum which is a natural fit. Post COVID-19 lockdown, there may also be an opportunity to run hands-on activities as part of the Junior Agricultural Technology camp that is held at Oxley Creek Common, where one of QUT ARG's pollen monitoring site is located. Overall, this project has been one of the highlights of the agricultural science course and this will only improve in the future.

Whilst serving as a learning and engagement experience in the context of the unique social setting of the CoViD-19 lockdown, undertaking this type of citizen science project opens the opportunity to re-evaluate approaches to conventional science learning. Collaboration between secondary and tertiary education sectors deepens the nexus between teaching and community participation in real-world scientific research.

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Competing Interests Statement

The authors report no competing interests for this project. Outside the scope of this project, Professor Davies receives grant funding for related grass pollen allergy research from the Australian National Health and Medical Research Council (NHMRC AusPollen Partnership Project (GNT 1116107) with matching cash and in kind co-sponsorship from The Australasian Society for Clinical Immunology and Allergy, Asthma Australia, Bureau of Meteorology, Commonwealth Scientific and Industrial Research Organisation, Stallergenes Australia, Federal Office of Meteorology and Climatology MeteoSwiss, Switzerland as well as the Australian Research Council, National Foundation for Medical Research Innovation with co-sponsorship from Abionic Switzerland, The Emergency Medicine Foundation. In the past five years Professor Davies has also received grant funding from QUT Catapult scheme, Queensland Health, Bureau of Meteorology and Victorian state Department of Health and Human Servcies. She is an inventor on patents assigned to QUT. Her institute has received Honorarium payments and travel expenses for education sessions and conference presentations from Stallergenes Australia, Wymedical, and Meda Pharmaceuticals.

Data Accessibility Statement

As this is a paper that is reflecting on the development and implementation of a project and collaboration, there was no data used for statistical analysis. The data collected by the CSHS students can be accessed through https://five.epicollect.net/project/qut-corinda-grass-mappers.

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Table 1. Summary of challenges that arose during project design and implementation and the mitigation strategies to overcome them.

Challenges	**Mitigation Strategies**
Limited time and resources	Multidisciplinary team to share ideas and support Members of team worked on the project in-kind outside of work
Students not having access to resources (e.g. electronic devices and internet)	Providing paper resources and worksheets
Ability to engage students and encourage participation	Email parents to let them know that their child needed assistance
Providing learning support for students	Development of detailed visual media
Health and safety concerns	Preparation of risk assessment document Email to parents/guardians advising them of risks
Governing bodies and ethics	Restriction of project scope to learning activities

Table 2. Identified hazard and risks associated with this project and the control measures recommended to overcome them.

Hazard	**Risk**	**Control**
Working in isolation	Potential slip, trip, fall injury when no one may be able to assist. Negative effect of pre-existing medical conditions of students	Provide initial safety information prior to activity Be accompanied by an adult or advise them of your whereabouts Be familiar with surroundings
Working in sun and heat	Heat exhaustion Dehydration Sunburn	Be accompanied by an adult or advise them of your whereabouts Limit amount of time to conduct identification activity Wear sun protection Carry water and mobile phone
Working in bad weather	Get caught in rain and/or thunderstorm	Be accompanied by an adult or advise them of your whereabouts Be familiar with forecasted weather Be familiar with potential shelters Postpone activities if weather is too severe

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Hazard	Risk	Control
Potential car accident	Potential car accident injuries	Be accompanied by an adult or advise them of your whereabouts Carefully access the area and follow road rules Stop, look and listen for traffic Select alternative route
Potential snake, spider or insect bites	Could be bitten by snakes, spiders or other insects	Be accompanied by an adult or advise them of your whereabouts Be aware of exposure and presence of bite hazards Inspect area before performing activity Look before putting hands into vegetation
Current COVID-19 situation	Be exposed to or contract virus	Students will comply with recommendations by the Queensland Government Students will practice social distancing
Online cyber safety	Cyber stalking risks with students entering information about plants in their area	Identity of students will be anonymous and non-identifiable

FIGURE LEGENDS

Figure 1. Summary of individual and collective drivers of motivation for engaging in the project from the perspective of each partner organisation.

Figure 2. Overview of the practical "Tracking Grass Species" activity.

Figure 3. Summary of individual and collective benefits obtained from undertaking partnership/project

Appendix Survey questions presented on the EpiCollect5 online tool for students to collect grass data.

Question	Type of Answer
Where is the plant (Latitude and Longitude)?	Short answer
What is the date?	Short answer
Take a photo of the grass flower	Image
How would you classify the flower head?	Multiple choice
How are the leaves arranged on the flower stalk?	Multiple choice
What shape are the grass leaves?	Multiple choice
Take a photo of the grass in its surroundings	Image
Does your grass look like one of the common grass species in the provided document? If so which one?	Multiple choice
Where is the grass growing?	Multiple choice
How much of this type of grass is in this area?	Multiple choice
How many DIFFERENT types of grass are in this area?	Multiple choice
Please add any extra information that would be useful	Short answer

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figures/Figure1/Figure1-eps-converted-to.pdf

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