A report on PWSA2021

Delivered online from 30 August – 10 September

Overview

PWSA2021 involved 10 team members, 40 volunteers and 172 participants. The participants were selected after an interview process, from a pool of 487 applications received from nationals of 11 African countries, including Cameroon, Egypt, Ethiopia, Ghana, Kenya, Malawi, Nigeria, Rwanda, Swaziland, South Africa, and Uganda. The academic diversity of participants included undergraduates, postgraduates, academic staff, as well as professionals working in the industry. The workshop learning outcomes were divided into four different tracks as outlined below, with two tracks running in parallel in the first week as well as the second week.

- *Week 1 Track 1:* This track covered Python fundamentals for beginners, including: (i) variables, expressions and basic data types; (ii) sequential and conditional coding; (iii) functions; (iv) data structures (lists and dictionaries); and (v) file handling.

- *Week 1 Track 2*: This track focused on more advanced concepts for those that are familiar with the basic concepts of week 1 track 1. Topics covered include: (i) recap of data types, conditionals, loops, lists, dictionaries, and functions; (ii) file handling, recursion and memoisation; (iii) functional programming (lambda, map, reduce, and filter); (iv) advanced data structures (stacks, queues, and binary search trees); and (v) problem solving techniques.

- *Week 2 Track 1*: This track covered an introduction to data science. Topics covered include: (i) matplotlib and numpy; (ii) classification and introduction to machine learning; and (iii) clustering.

- *Week 2 Track 2*: This track gave an introduction to algorithms, complexity and object-oriented programming (OOP). Topics covered include: (i) analysing the time complexity of a program using the Big-O notation; (ii) searching and sorting algorithms; (iii) OOP (objects, variables, methods, and operator overloading).

The workshop took the form of 2-hr live lectures in the morning via Zoom, and hands-on coding session in the afternoon via Gather town with five participants paired with one tutor. In addition to engagements via Zoom and Gather town, a Slack channel was also created as a means for participants to get support from peers and tutors outside the regular learning hours. The workshop culminated in a team-based project, which includes, designing a book recommender system, analysing and visualising spotify data, and building a class of family-tree. Participants worked together in their groups to code the solution to their chosen project, and they presented their work at the workshop closing ceremony held on Zoom.

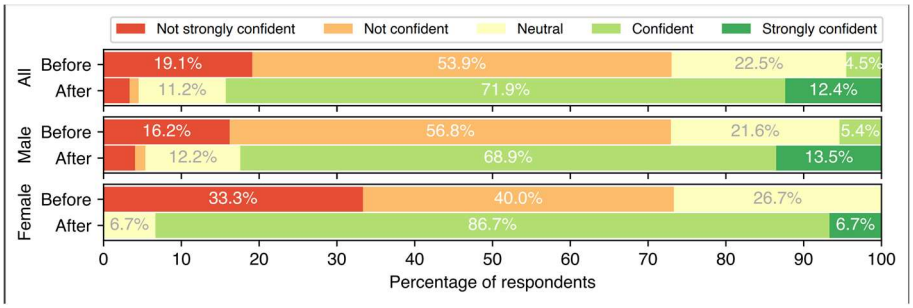
Technology

For programming environment, the workshop made use of a JupyterHub server running Anaconda distribution. This was provided by the School of Physics and Astronomy, University of Glasgow. Login

credentials were created for each participants to access the server, codes were written using Jupyter notebook, and all lecture materials as well as skeleton of coding tasks were pushed onto the server. This made it easy for us to quickly get updated materials across to all participants and it saved us from typical installation issues that would be difficult to troubleshoot online.

Outcomes and Impact

In terms of workshop impact, when we evaluated the self-rated confidence of participants, we found that they felt more confident with Python programming after the workshop than they did before (see the figure below). In addition, participants' performance with respect to the daily coding tasks that accompanied each taught content, as well as their solution to the group project was evidence that they have attained the workshop learning outcomes. On average, we found that 80% of the participants completed the tasks assigned to them during the hands-on session.



For the volunteers, about 60% of them are undergraduate computing science students studying at the University of Glasgow. Since the workshop ended a few days before the new academic year started, they reported that tutoring the participants served as a refresher of programming concepts they need as they move to a new level and take advanced courses. In addition, all volunteers reported that they felt more confident with teaching programming. Also, they felt positive about themselves considering that the workshop gave them an opportunity to make an impact in the lives of others.

For the team, we had an opportunity to develop several skills, including oral and written communication, teaching, team-work, leadership and management, course development, as well as adapting to the many challenges that accompanies running an online workshop. An additional unplanned outcome is an experience report the team is currently putting together, on participants' motivation and challenges faced during the workshop. We intend to submit this report as a paper to a computer education education conference venue. If this gets accepted, we will be contributing to scholarly literature on broadening participation of ICT in Africa.

Equality, diversity and inclusion

We are proud to report that our workshop was able to strike a gender balance on the teaching team, which was made up of 50% females and 50% males. In addition, 20% of the team shared the same racial, academic, and cultural background with the participants, which meant participants could easily identify with them. Further, while recruiting volunteers who supported our participants in a "tutor" capacity, our advertisement encouraged Africans and those who identified as female to apply for this role. In addition, our lead, Dr. Sofiat, was contacted by some ladies who were

considering applying as a volunteer but felt that they were not good enough, and she quickly used herself as an example and encouraged them to apply. As a result, our volunteers comprised 23% females, 77% males, and about 36% of them shared the same ethnic and academic background with our participants. In addition, about 60% of them are computing science students studying at the University of Glasgow, one of them is a data analyst from India, while the rest are Nigerians.

Of the 172 selected participants, only 15.7% identified as female while 84.3% identified as male. Despite positive encouragement from the workshop team during the interviews, it is clear that female participation was still severely limited. This can be attributed, among other reasons, to the low percentage of women studying STEM-related subjects in higher education in African countries, as it is from these subject areas that the majority of participants have been drawn from.

With respect to inclusion, our participants were drawn from 11 different African countries, and they included students, lecturers, lab technicians, and professionals working in the industry. This rich diversity meant we could group participants in such a way that there was at least one female in a group, and a mix of participants from different countries. As a result, this encouraged collaborative learning, respecting the differences of others, and honing their communication skills, all of which are desirable qualities of professional practitioners.

Challenges

On one hand, running the workshop online meant we could accommodate more participants from 11 different African countries. On the other hand, it posed many challenges ranging from internet connectivity issues, power, distractions from study, work and other personal responsibilities. To mitigate the internet issues, we provided 40GB of data to participants who opted for the support. Even with this, some participants were still unable to complete the training because their power supply was erratic, laptop microphone was not working, laptop has a bad battery, or a combination of everything. As a result, we had participants missing some days and finding it difficult to catch up with the content when they come back online. This was physically and mentally stressful for the team, because we were working overtime trying to track down participants and revising concepts that had already been covered multiple times.

Another main challenge that accompanied delivering our workshop was the fact that it was difficult to help participants tackle confidence issues online. During our previous physical workshops, we were able to read participants' body language and devise a way to help them get over the fear of approaching programming for the first time. However, it was difficult to identify and tackle this online with their videos turned off to boost internet connection.

With all these challenges, our participants persevered and were committed to learning. This was also confirmed by the tutors who were monitoring their progress. Some of their comments are as follows: "*doing well despite network issues*"; "*I've had a great time working with them especially with one who is a mother that still manages to get the tasks done with her daughter shouting in her ear sometimes*". The team is powered by the thirst of Africans, for quality education and technological upskilling, and with lots of hope for the future, we hope to continue to empower more learners in the continent via PWSA.

Acknowledgment

The team would like to acknowledge the technical support provided by the IT section in the School of Computing Science, and the School of Physics and Astronomy, University of Glasgow. Also, we are grateful to the School of Computing Science for giving us the opportunity to make such a significant impact in the lives of the African youths, and to the Global Challenges Research Fund, and Scottish Funding Council for funding our 2021 workshop.