How successfully are students engaging with the Python component of SM123?

Gemma Warriner and Andy Diament

27th October 2021.

1.1 Executive summary

SM123: *Physics and Space* is a Level 1 module aimed at preparing students to study physics, astronomy or planetary science at OU level 2. Most students are not new to the Open University and will have already studied S111: *Questions in Science*. SM123 is an important module within the degree qualifications within the School of Physical Sciences (SPS) as success in this module will provide students with a solid foundation to progress to higher level study.

Retention on SM123 was known to be lower than on other level 1 STEM modules. One issue that students face is getting to grips with some simple programming, with four discrete weeks dedicated to the study of Python, spread throughout the year (Appendix 1). The programming is done via Trinkets (embedded boxes of runnable code) in the module web pages. These enable students to code and run programs in two panes displayed side by side. Learning to think in a logical way and to code may be very different from other study that students have done previously and the way that the Python content is delivered needs to account for that. It is apparent from forums and SEaM comments that many students are daunted by Python and some do not make good progress in learning. This may include students that score well in other aspects of the module.

We wanted to gather evidence on students' experience of learning to program on SM123. To delve deeper into the reasons that students had difficulty, we used two questionnaires to ask them about their experience in studying Python and how it compared with the rest of the module. We particularly wanted to hear from students that felt unable to continue with Python and indeed those that felt unable to continue with SM123.

Our first questionnaire was run in November 2020 during the first week of Python study and our second in April, enabling us to see how the views of the cohort had changed throughout the module. We had 55 students complete our first questionnaire and 87 complete the second. Students were generally positive about the support from tutors, especially in forums and tutorials. However, a sizeable proportion reported difficulties with Python, including lack of time and insufficient guidance from the module materials. Responses to the second questionnaire indicated that this was not isolated to the first Python week but continued in the later Python weeks, so that progressively more students gave up on Python throughout the module. Some students reported that they found the learning experience very stressful.

After the first questionnaire we set up a meeting with the Module Team and other members of SPS outlining some suggested changes centred around the preparation for SM123 and the materials and resources available to students within their study. Some of these have been put into action with improvements being made to the *Python for Physical Sciences* website in time for 21J to better support SM123 students before and during the module. Familiarity with this resource should also benefit students when making the transition to SXPS288 *Remote experiments in physics and space*,.

Most SM123 students will move onto SXPS288 where Python programming is used extensively for data analysis. Ideally this site will house material relevant to the Python included in the new modules at Level 3. We hope that additional resources such as screencasts will be available to SM123 students in within the module website and that solutions to activities will be available to students earlier than they are now. It became apparent to us that the Python material may need to be streamlined or re written and we would hope that this would be part of a mid-module review.

If we can optimally tailor the delivery of Python for SM123 students, so that they find it a rewarding experience and can have success in this area, more students will be able to progress to level 2 and 3 and feel confident tackling Python at a higher level. Our project has become part of a wider drive in SPS to improve our delivery of Python and this is now a scholarship priority within our school.

1.2 Aims and scope of project

The aim of the project was to gain meaningful data on student engagement with, and attitude towards the Python programming material in SM123, and the resources available to help them. We had the following key research questions:

- How prepared are students for the Python in SM123? We also wanted to find out the proportion that had previous programming experience.
- Which resources students use to support their study that they find helpful (e.g. forums, tutorials, websites)? This included resources within the SM123 website and elsewhere on the internet
- How do students feel about the content of the Python material in the weeks within SM123 and the time spent learning? We also wanted to compare their experience of Python to other parts of the module.
- How confident did they feel after each study week?
- What caused students to give up on Python during their SM123 studies? Were there any particular activities that were stumbling blocks? Currently the solutions to some activities are only revealed after the week has finished.

2. Activities

2.1 Initial research in preparation for questionnaires

We looked at the SEaM data for previous cohorts and it was clear that much of the feedback, both positive and negative was about the Python content. Some of the issues raised were:

- There was not enough time to study the Python weeks. Some students reported spending days completing a programming activity that was suggested to a take two hours.

- There were not enough opportunities to practice what was learnt so that they didn't feel wholly confident before moving on. Some students found the Python weeks too steep a learning curve and that there were jumps in difficulty.

- There were complaints about not being able to see solutions to activities until the week after Python.

- Students reported that they forgot what they had learnt between Python weeks and found it difficult scrolling within the Python weeks and between weeks.

- The students more experienced in programming commented that the functionality of the Trinkets was limited and that the coding was too basic and outdated.

- Some students felt that the Python weeks didn't sufficiently fit in with the theme of "Physics and Space", or felt that the programming activities came too close after they had learnt the Physics concerned.

The issues raised here informed the questions that we asked in the questionnaires.

We also asked the SM123 tutors that ran the Python tutorials for their thoughts. A few tutors mentioned the need for extra exercises for students, differentiated for different levels of ability. It was noted that there was a range of experience of the students initially and that some students new to coding seemed to give up as soon as they see a problem. A few tutors had concerns that the students that were really struggling may be reluctant to participate in the Python forums and may not attend tutorials. One tutor observed:

> *Students can get worried by discussions on the forums when it looks as though other students are streaking ahead. Highly technical answers to questions also don't help because it makes the weaker programmers feel inadequate*

Many tutors thought that the Python weeks may work better closer together and thought that the Python difficulty ramps up quite fast, something that students had expressed in the SEaM comments and elsewhere. Students find an assessed peer review activity difficult and many run out of time. The limited functionality of Trinkets was raised and also concerns about the approach used in Python materials.

There was plenty of good practice with tutors planning tutorials together so that there was something for all levels and subsequent tutorials built on what had been covered before. Taking things slowly going back to basics in the first tutorials and setting a problem at end that tutor in next session went through encouraged students to attend tutorials. Many tutors gave students something to work on before tutorial and encouraged students to work on short examples of code within tutorials. All of this informed the structure and content of the questionnaires that we designed.

2.2 The *Python for Physical Sciences* website

The *Python for Physical Sciences* is accessible to students under "Prepare and make a head start" on the *Physics, astronomy and planetary science website.* This site was developed in for students starting SXPS288 Remote Experiments in Physics and Space, which uses programming for data processing and analysis, but draws students without programming experience. The website contained some helpful resources but was aimed very much at students preparing to study Python at Level 2. Overall, the preparation was centred around data analysis with the OpenLearn module

"Learning to code for data analysis" recommended. This was less likely to benefit SM123 students than the Openlearn course "Simple Coding", upon which the first the first Python week, *Python 1,* was based. In addition the site outlined the use of Anaconda and Jupyter notebooks, rather than Trinkets that are used in SM123. We had concerns that some of site may in fact confuse students new to programming, rather than prepare them for the somewhat different approach to Python in SM123

2.3 The first survey

We timed the first questionnaire to go out during the first week of Python in SM123, referred to as *Python 1.* We hoped that this timing would maximise participation. Our intention was to find out how students felt about Python and to identify the reasons that some gave up during *Python 1*. We used the JISC online questionnaire tool and enabled multiple answers and free text responses in addition to yes/no type responses. SRPP agreement was sought and received to contact students who were studying on SM123. We generated a link to the questionnaire and shared this with students on online forums and the news section on SM123. We also sent out an email.

The full questionnaire can be found in **Appendix 2.** We used Jisc Software and designed branching questions to try and dig into the specific issues that students were having. We split the questionnaire into the following sections:

- A comparison of the Python content with the overall experience of SM123.
- Previous experience in programming and any preparation done prior to SM123.
- The experience of studying *Python 1* including time spent, resources used and confidence at the end
- Questions about how students fared on specific activities and coding.
- We asked any students that had given up to indicate when and why they did so.
- We asked students for suggestions for further resources that might help.

Fifty-five students took part in the survey, which is 13% of the total cohort. Of these thirty-four answered the question "We are very interested in the experiences and views of people who lack confidence in Python or gave up before the end of Python 1. Would you be willing to answer a few questions about this?"

2.4 Early evaluation and presentation to the Module Team

Once we had collected the students' views and done some preliminary analysis, we presented our findings from the first questionnaire to the SM123 Module Team and other members of SPS including the scholarship leads. We timed this with the hope that some changes could be made in time for the next cohort (21J). Possible interventions that suggested themselves fell into 3 broad categories; greater preparation before the start of SM123, changes to the *Python 1* materials, additional resources provided within SM123. These are expanded upon in the "Interventions" section below.

2.5 The second survey

Our second questionnaire was designed with the intention of finding out how students had progressed through the Python later in the module. We ran the survey during the third week of Python learning called *Python 3.* As before we used the JISC online questionnaire tool and SRPP agreement was sought and received to contact students who were studying on SM123. We

generated a link to the questionnaire and shared this with students on online forums and the news section on SM123. We also sent out an email and a reminder a week later.

The questionnaire can be found in **Appendix 3** and intentionally had a very similar structure to the first, so that comparison could be between the students' opinions at different points in the module. We were aware that students continued to give up on programming in *Python 2* and *Python 3* and wanted to identify any particular sources of difficulty. We were pleased that eighty-seven students took part in the survey, which is 21% of the total cohort . Of these forty- one answered the question "We are very interested in the experiences and views of people who lack confidence in Python or gave up before the end of Python 3. Would you be willing to answer a few questions about this?"

3. Findings

3.1 Programming experience

In the first survey we asked about previous programming experience prior to the module. Most students join the course without programming knowledge, or recent knowledge as can be seen from Figure 1. Of our sample 67.3% could not program.

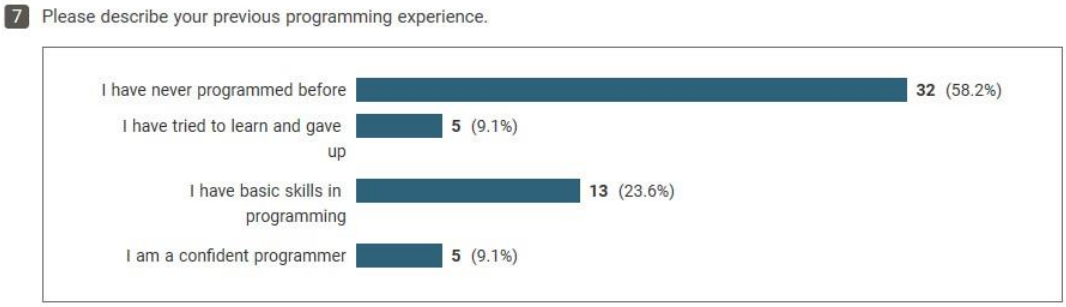

Figure 1: Previous programming experience

We were surprised to find that 20% of those in the survey didn't know that Python programming was part of SM123, prior to starting the module. These students tended to score themselves with low confidence, when answering later questions. Of those that did know, 36% did some preparation including looking online and buying textbooks. It was clear from this that there was a gap in the "in house" preparation for students and worrisome that some were not properly informed about the module content prior to the start.

3.2 Python vs other SM123 weeks

We asked students to rate their enjoyment of the study weeks they had covered so far in SM123. This included Practical work and topics such as "Forces around you" in the first survey and "Nuclei and particles in the second survey. As can be seen from Figure 2 and Figure 3 the students typically enjoy other material in SM123 and it take about the right time or less. Python is taking them a long time, longer than suggested times, and gets worse as the module progresses. They are also enjoying it significantly less than other parts of the module with 20% ranking themselves as very low enjoyment in *Python 1* rising to 30% by *Python 3.*

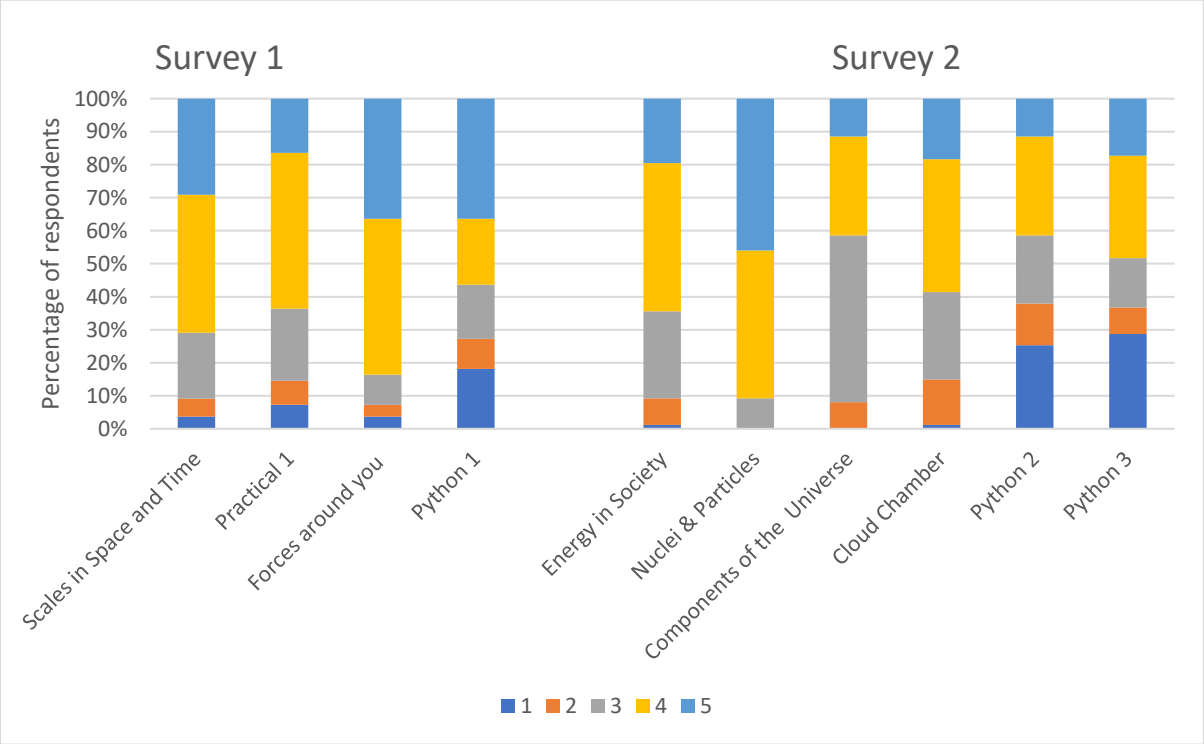

Figure 2: Students rating their enjoyment from 1 (low) to 5 (high) for different parts of SM123. The topics up to and including Python 1 were covered in survey 1, the remainder in survey 2

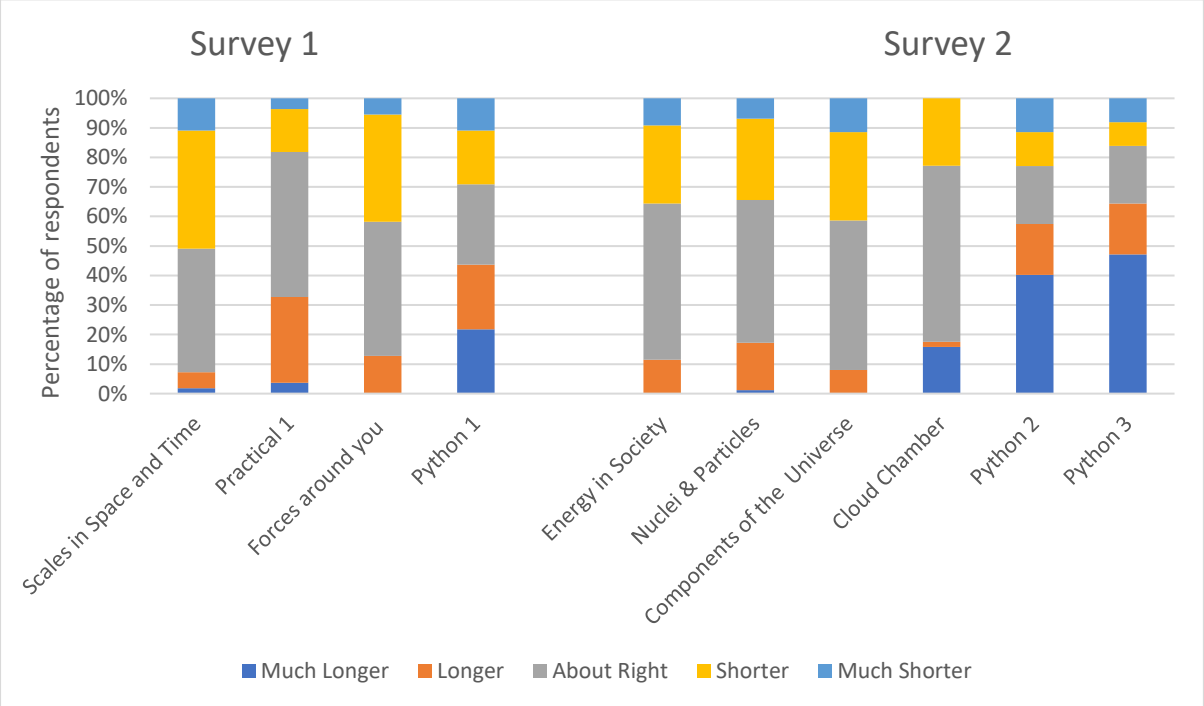

Figure 3: Time spent on study weeks in SM123 in Survey 1 and Survey 2, compared to suggested time on study planner. The topics up to and including Python 1 were covered in survey 1, the remainder in survey 2

Students are less confident at the end of *Python 1* compared with the other parts of the module and so many start *Python 2* and *Python 3* without getting to grips with the previous material.
Figure 4 below shows a marked difference in confidence between *Python 1* and other aspects of the module, with significant registering a lower confidence. 22% of students rated their confidence as 1, and 13% as 2. For other parts of the module , no one rated their confidence as 1 and 2% rated themselves as 2.

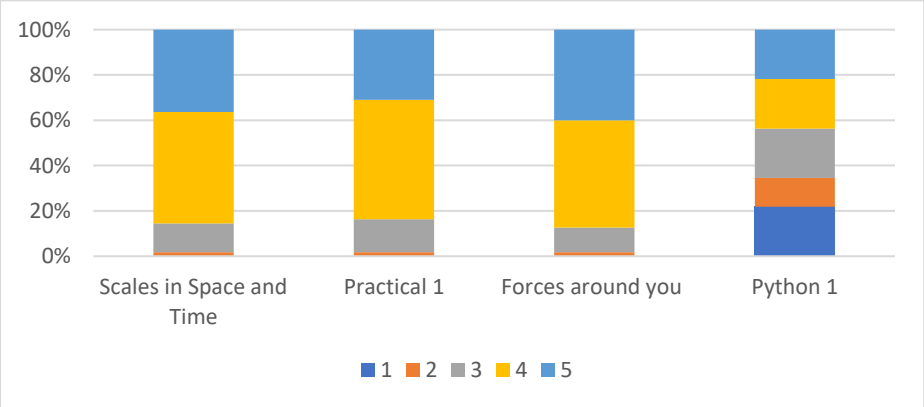

Figure 4: Students rating their confidence from 1 (low) to 5 (high) in parts of SM123 (survey 1)

After our second survey we were able to have a look at how the students' confidence levels varied as their studies continued throughout *Python 2* and *3,* as is shown in Figure 5. Most notable are the changes at the lower and upper ends of the confidence levels. There is an increase in the number of students in the lowest confidence level category 1, these may have some from category 2 which has decreased. This would suggest that the less confident feeling increasingly less confident, with a large proportion of students (28%) in the lowest category

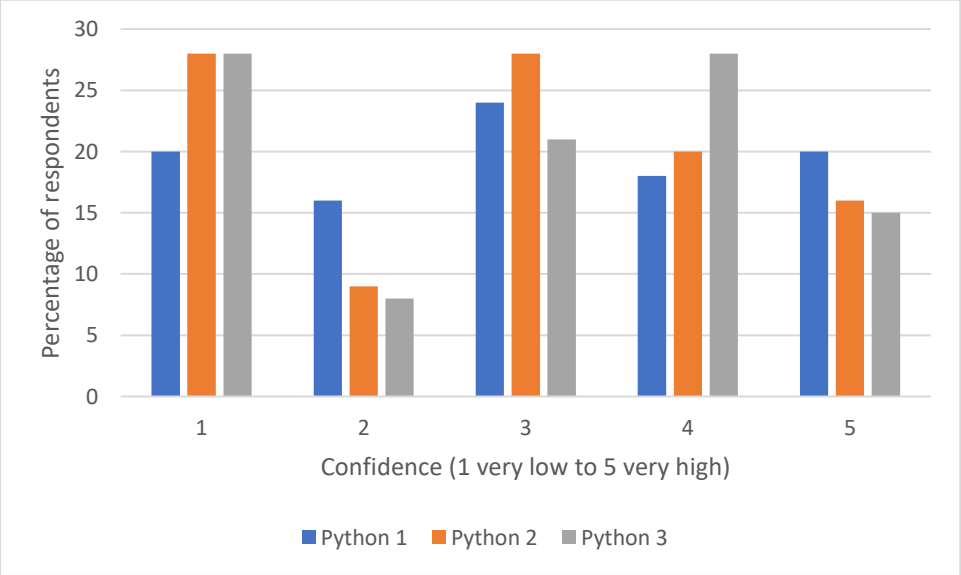

Figure 5: Students rating their confidence after Python sessions 1, 2 and 3.

At the upper end there is a rise over time in Category 4 whilst both category 3 and 5 have decreased. This suggests that some students are becoming more confident over time and

rating their confidence higher, but some of the students that rated themselves very confident after Python 1 are less s after Python 2 and 3.

3.3 Resources used within SM123 and elsewhere.

Figure 6 shows the responses from students when asked about the resources that they used in SM123. Tutorials seem popular with students, although this may be more to do with recordings than actual attendance. Forums also seem popular, even if many are reading rather than contributing. An early collaborative activity is run from the tutor group forums, meaning that students become familiar with their use early on in their studies.

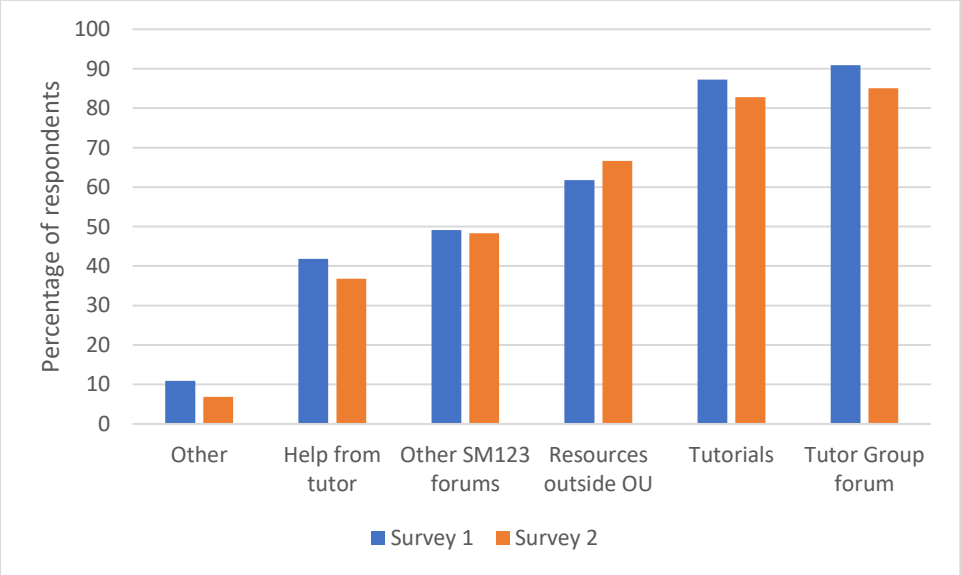

Figure 6: Resources accessed by students whilst studying SM123, recorded on both surveys.

However, it is clear that students are not finding all the answers that they need within the SM123 website and are looking elsewhere researching solutions, syntax in google, tutorials, videos, books. Many students often they can't find what they want, and this can lead to frustration. This suggests that we need to increase the bank of resources that the students have within SM123 website or the other “in -house” resource the *Python for Physical Sciences* website.

3.4 Linking Python with Physics

In the both questionnaires we asked the students: “Please comment on how well you thought that the programming was related to the science content of SM123”. This was a free text answer. In the first questionnaire 38% of the students who answered could see a link. The rest of students were less sure and responded with varying degrees of positivity. It was apparent that the majority of students couldn’t see the links between the Python and the Physics they were learning. This can be seen in Figure 7.

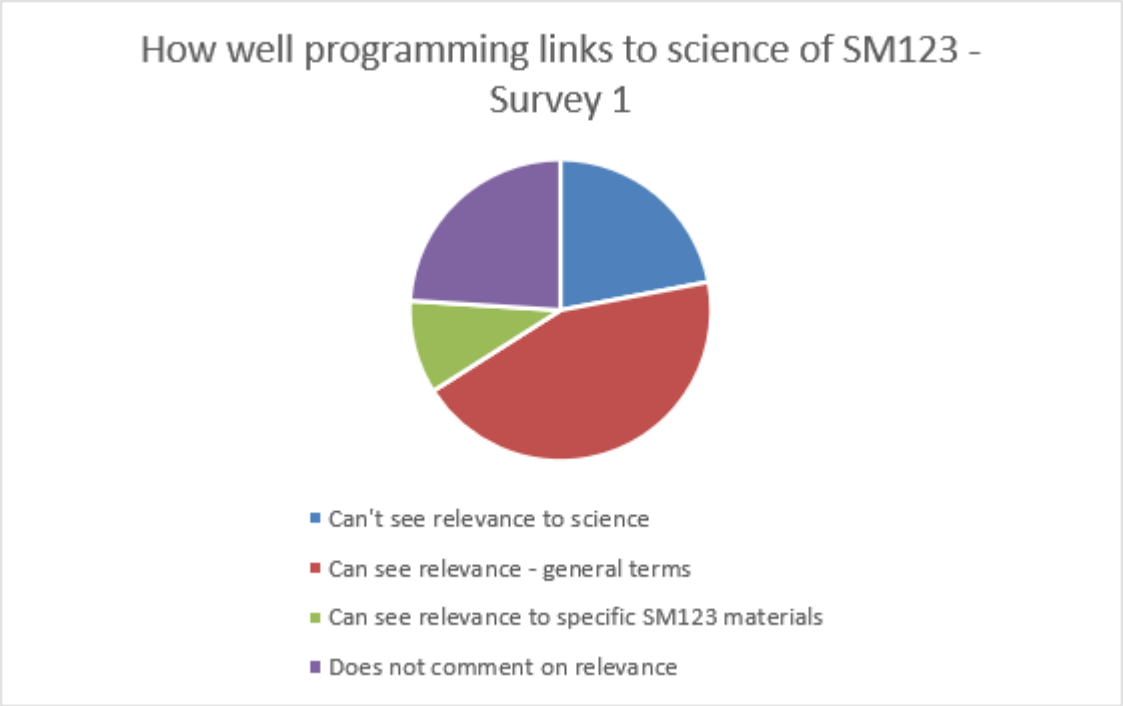

Figure 7: Students response to the links between programming and the science of SM123in Survey 1

Some of the negativity could be summed up in this comment from a student: *I wanted a course where I could study Space . I am not interested in learning programming .* This was something that we felt could be addressed by including clips of how Python is used by working physicists, something that some tutors were already doing in tutorials to engage the students. Clearly if students cannot understand why they are studying programming it will affect motivation. It was pleasing to see that by *Python 3* students had changed in this respect with nearly 75% seeing a clear link, as is shown in Figure 8.

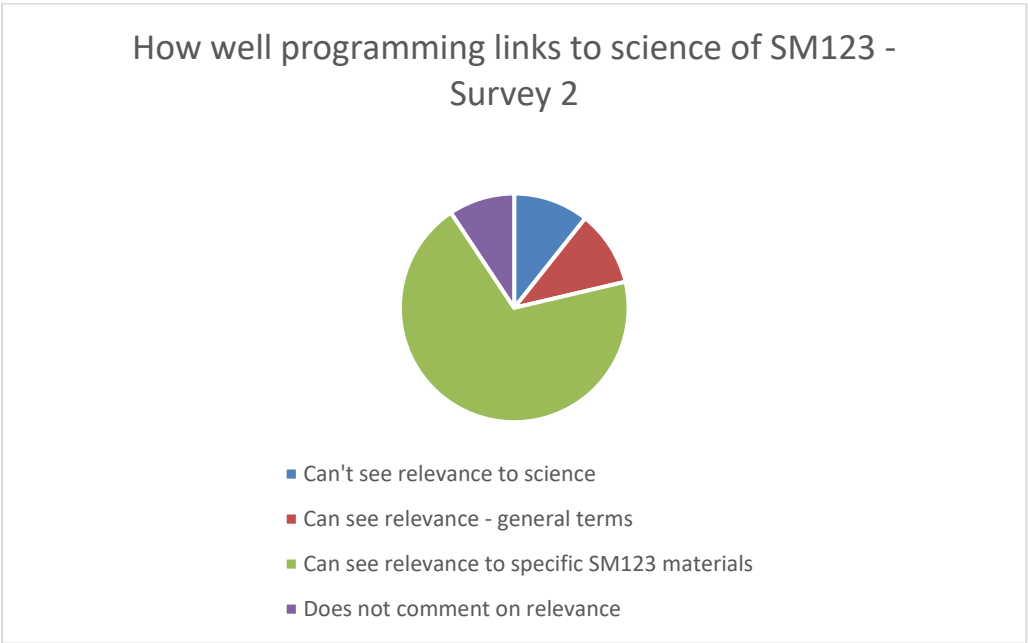

Figure 8: Students response to the links between programming and the science of SM123 in Survey 2

3.5 Difficulties with the Python material in SM123

In Q14 of each survey we asked the following :

We are very interested in the experiences and views of people who lack confidence in Python or gave up before the end. Would you be willing to answer a few questions about this?
In Survey 1, 64% of the students answered this (35 students in total) and in Survey 2 48% (42 students in total). We firstly asked students about their overall experience of studying SM123. In the first survey, 10 students enjoyed learning Python, 6 students found it difficult but persevered, 8 students said that they were finding it alright up until the while loop or Euclid's algorithm and found the TMA questions very hard. 10 students were quite negative. Not all stated specific issues but those that were raised included: difficulty with Trinkets, having insufficient time compared to the suggested study time pace of learning being too fast and insufficient detail in the module materials for beginning programmers. For a comparison, some responses were coded in 5 categories applicable to both surveys (39 comments in survey 1, 41 comments in survey 2, figure 9).

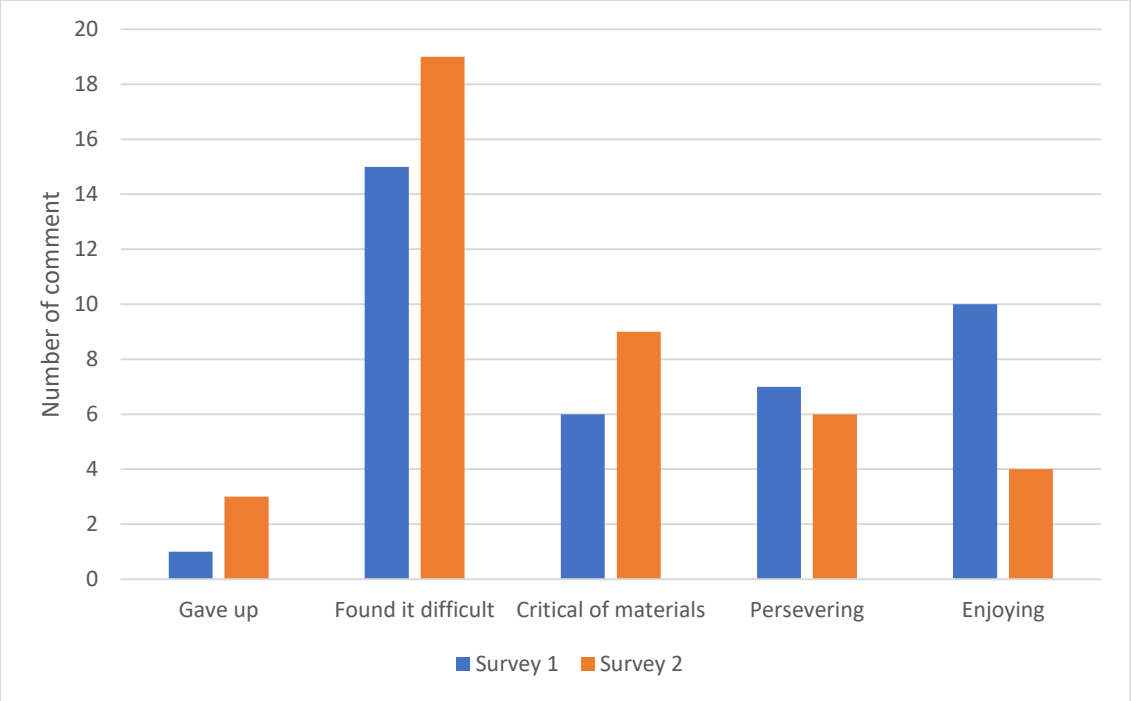

Figure 9: summary of open answers to "Please describe your own experience of studying Python" in surveys 1 and 2

The positivity of the students' experience had not improved by the time of our second survey (figure 9), indeed the number of those that were actively enjoying the Python had diminished. The issue reported by the students were similar to those reported in the first survey with reports of lack of time and having to look elsewhere on the internet for learning.
In Survey 1 we asked students about specific activities in *Python 1* to try to identify where students gave up and as can be seen, the number of students that were able to complete the activities diminished through *Python 1* (see Figure 10). Students reported struggling as soon as the while loop

was introduced (loops were present in the Shopping Basket and Euclid's algorithm activities). We felt that this could be remedied with more practise in algorithmic thinking and a better example than Euclid's algorithm, as many students were not familiar with the maths even before attempting to explain the program.

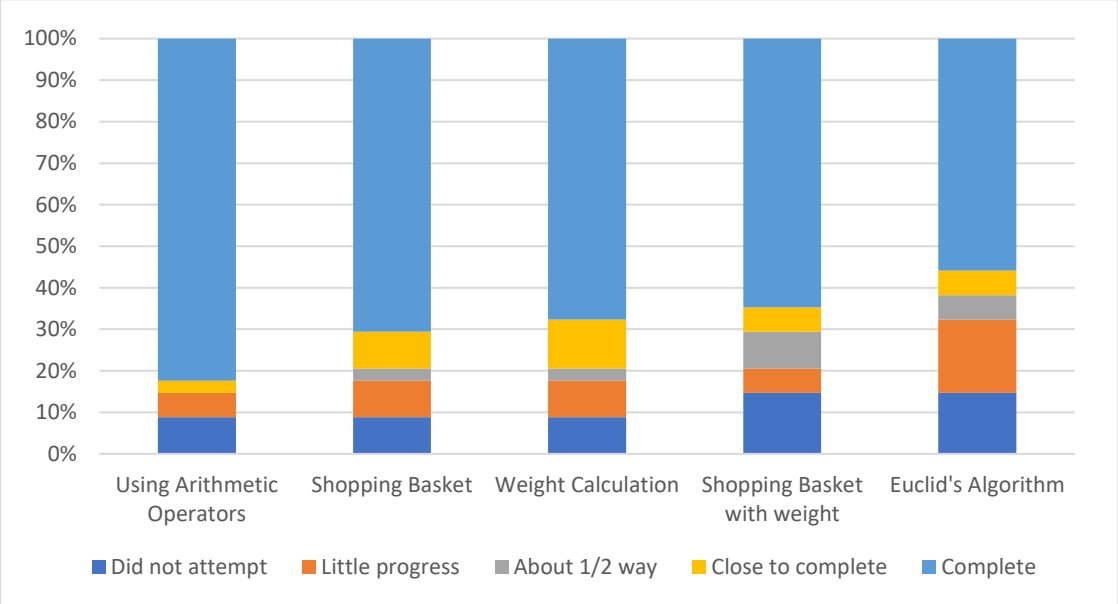

Figure 10: Students attempts at particular activities in *Python 1*

In Survey 1 we asked students to rate their success during *Python 1* for the following outcomes:

- I could run the program provided
- I could make changes to programs provided
- I could decide how to solve a programming problem
- I could write python code myself
- I could write the code I wrote successfully

We asked the students to rate their success from "never" to "always". In Survey 2 we asked the students to reflect on the same outcomes during *Python 2* and *Python 3.* The results are shown in Figure 11.

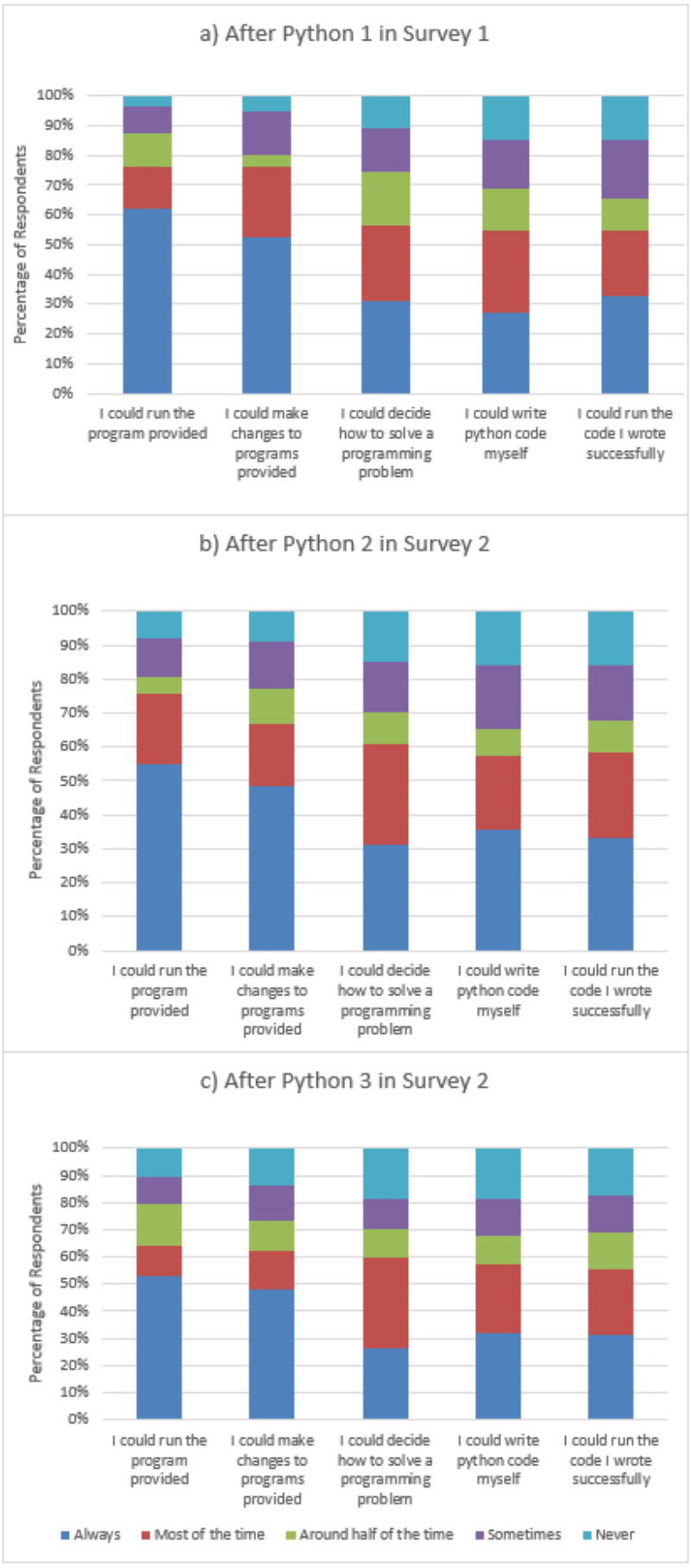

Figure 11: Students rating of their ability to complete broad programming tasks after each of the 3 Python weeks

The results are quite similar in each of the Python weeks. In *Python 1* 60% of students could run the programs provided, dropping to about 55% in *Python 2* and *Python 3.* This is a puzzling result as running the programs should be straightforward and a higher majority of students would be expected. This may indicate that students are struggling with Trinkets, or inputting data as a user, or misunderstood this question! In the later weeks about 20% of students surveyed are reporting that they can never work out to solve a problem and never write the code themselves. If this proportion holds across the whole cohort, it means a fifth of SM123 students have failed to get to grips with the Python material/

We asked students in both surveys about specific programming techniques in *Python 1*, *Python 2* and *Python 3*. These are shown in Figure 12.

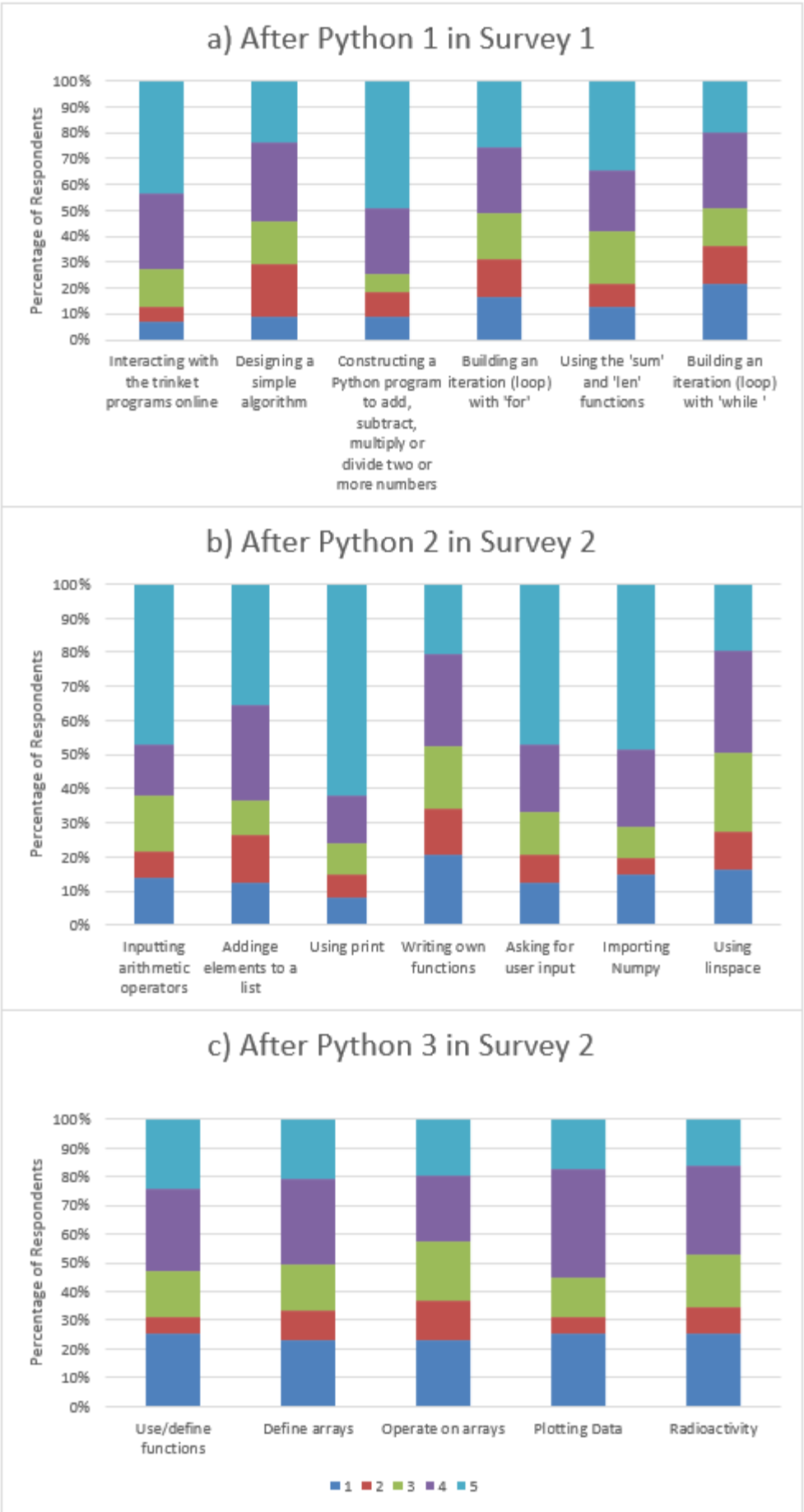
a) After Python 1 in Survey 1
Percentage of Respondents
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Interacting with the trinket programs online
Designing a simple algorithm
Constructing a Python program to add, subtract, multiply or divide two or more numbers
Building an iteration (loop) with 'for'
Using the 'sum' and 'len' functions
Building an iteration (loop) with 'while '
b) After Python 2 in Survey 2
Percentage of Respondents
Inputting arithmetic operators
Addinge elements to a list
Using print
Writing own functions
Asking for user input
Importing Numpy
Using linspace
c) After Python 3 in Survey 2
Percentage of Respondents
Use/define functions
Define arrays
Operate on arrays
Plotting Data
Radioactivity
1
2
3
4
5

Figure 12 : Students confidence at specific activities in Python 1, 2 and 3 , 1 is very low to 5, very high

From Figure 12 we can see that the following areas were found to be particularly difficult:

- While loops, importing modules,
- Defining functions within a program
- Using math vs numpy functions esp. Log/power/exp functions
- Graph potting and linspace,
- Generally algorithmic thinking/problem solving.

The patterns in *Python 2* are quite similar to *Python 1*. There is variation throughout the activities but broadly about 20% to 30% are rating their confidence as low either as “1” or “2”. It was good to see that half were confident or better across the board. By *Python 3* the number with lower confidence, particularly level ”1” was higher, over 20% for all the activities. It is possible that this reflects the step up in difficulty reported in the SeAM comments. *Python 3* contains a peer review activity where students are paired up with another member of their tutor group and critique each others’ programs that illustrate the radioactive decay of a series of isotopes and this was known to cause difficulties for many students. Many found the radioactivity program unsolvable and did not feel expert enough to contribute to peer review.

The overall picture we got from our surveys was that many students have problems with the Python material and problem solving in a programming context. Some feel very adrift in current model, that they don't know enough to approach or solve problems. Some have given up on Python and found the experience very negative.

3.6 Suggestions on improvements from students.

The students expressed a preference to see more practise material.. Some of the things that they suggested are given below

- Videos clips, such as the ones they were using elsewhere online. In other SPS modules have been used screencasts to aid learning, so this seemed like a possibility
- More example programs, to help familiarity with Python
- Help and hints with tasks and for the solutions to Activities to be made available at the time rather than later.
- A handbook. Some of the students mentioned the handbooks that they had for their maths modules and wondered is something similar was possible for Python.
- Replacing the use of Trinkets. Some students are clearly wasting a lot of time reaching the limits of free Trinkets, especially graph plotting, and spending a lot of time researching the limits online without success. In fact, these limits are explained in *Python 4*. This would be no small task but if achieved would have the benefit of consistency with SXPS288 where students use Jupyter notebooks.

The students were asked to choose interventions/additional resources from a list in both surveys (figure 13). These confirm a lot of the points made in free responses. The most notable changes as the module progressed is that more students wanted earlier access to the solutions and more details in the instructions for tasks.

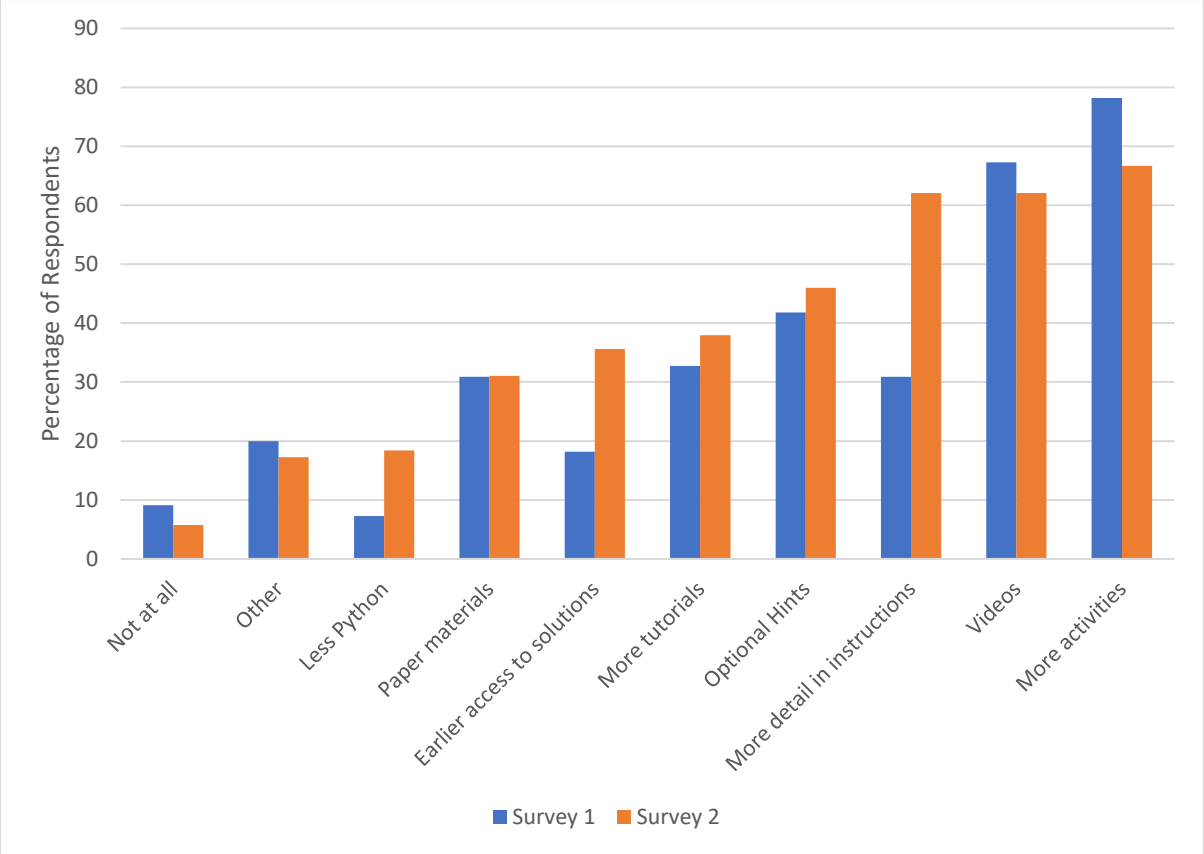

Figure 13. Responses when given a choice of types of support etc that students would like to see, recorded in both surveys

4.Possible interventions

Based upon the findings from our two surveys, some interventions were suggested by the students' feedback. We split these into three categories and suggested them initially in our presentation to the SM123 module team. We were aware that some of these would be easier to implement than others.

4.1 Before the module

We felt that

- An email going to all prospective students flagging up Python with links to the "Are You Ready For" (AYRF) activity and ideally the "Python for Physical Sciences" website, if this site is developed to cater for SM123 students.
- Development of resources for SM123 students on the Python website. Initially we thought that this could be a forum or other "head start" activities, but ideas were developed further (see "List of deliverables" below). Summer preparation with a moderated forum already exists for SXPS288 students.

4.2 *Python 1* – changes to teaching content (which would likely await a module review)

- Video examples to "sell" Python as a relevant tool with demos of its use by academics within SPS. There exist videos online where researchers explain how they use Python e.g. 5 ways I use code as an astrophysicist - YouTube and there is scope to draw on the experience of colleagues, including OU Researchers and ALs.
- Review the teaching of while loops in *Python 1* part 3 and add more examples
- Remove Euclid's algorithm from *Python 1* and TMA02, replace it with a task closer relating to processing data. For example the calculation of average/minimum/maximum of a collection of values or an iterative calculation of square root using the *while* loop
- There may be scope for changing the pattern of when Python is taught over the presentation to reduce the gaps between the 4 weeks. A possibility would be to combine the individual weeks into two fortnight sessions.

4.3 *Python 2* and *3* - changes to teaching content (which would likely await a module review)

- Video examples would work here as well as in *Python 1.*
- In *Python 2* students had difficulty with individual activities such as coding for a function and asking for and using user inputs. More practise is on these is required for many students before they can attempt "Activity 2.3 Pulling it altogether". These skills are also used in both *Python 3* and *Python 4* and so a more secure foundation is important. More and shorter activities, building up to the more complex tasks may be helpful here and is something that the students have requested.
- In *Python 3* over a third of the students that answered the questions, ranked themselves as low in confidence when attempting the radioactive decay program. As with *Python 2* this may be aided by more practise with the further skills introduced in *Python 3*, such as the use of arrays and plotting functions and data.
- The peer review aspect of activity 3.2 is too challenging for some students as they feel unable to offer advice on other student's work, as they are lacking in confidence themselves. This activity is linked to a TMA question so that a knock-on effect is that many students miss this questions out and suffer a penalty in their score. There may be other ways that the Python could be linked to the assessment that is more accessible to weaker students.

4.4 Additional resources within SM123

- Screencasts – video teaching materials used a lot by students already. These could include coding and testing solutions with structures, importing modules and plotting. Screencasts are used to show the thoughts and discussions on how to solve a problem in the style of modules TM111 and TM284.
- A Python handbook – perhaps develop the existing Python summary sheet.

- The E-book *Python & Matplotlib essentials for Scientists and engineers* is available in the OU library and is the best fit to the module as a supplementary 'textbook'. It could be linked as a resource but with the advice that it includes material beyond the scope of SM123.
- The top request from students is for more examples to see how programs could be written. This could be embedded in the Python material, or run from forums or include as part of tutorials.
- Review the tasks required for TMA04 (currently a peer review of a program written in *Python 3* and a summative programming task).

5. List of deliverables/impact

Owing to the module lifecycle, it was not possible to make significant changes to the SM123 module material in time for presentation 21J. It was also clear that the existing materials do meet the needs of a substantial number of students, enabling them to progress and succeed (as seen in good performance in programming in TMA04 and the SM123 exam by many students).

However, our presentation to the SM123 module team led to some changes that overlapped the completion of this study. The biggest impact from the study was to add additional support to students with materials and activities. The vehicle for this was the editing and expansion of the SPS "Python for Physical Sciences" site in time for use by 21J students. The original Python site contained material more relevant for new students new to SXPS288. This site was expanded upon and retitled as "Programming for Physical Sciences". Initially these two sites will ran in parallel to cater for the forums run for SXPS288 students, but from 22J onward "Programming for Physical Sciences" will take over as the only site.

The updated content was written by 2 ALs (Stella Bradbury and Andy Diament), drawing on comments made by students in Surveys 1 and 2. The intention was that the site should have material relevant for students of any SPS module that contains programming, including (in the future) those coming to level three. Tutors will be briefed to direct students to the examples and further practice there. Using an external site means that the existing SM123 site is not overloaded with additional examples and hopefully that students will need to spend less time with online searching. The site can be found at Website: Programming for Physical Sciences (open.ac.uk)

The site has a new section aimed at SM123 students, with embedded pdfs. The material covers:

- The logic of using programming languages to solve problems
- Detailed exploration of python syntax for beginners
- 'How-To' Guides covering material students have identified as being difficult in the surveys, see section 3.5 . There is scope for further video screencasts here too.
- Scaffolded further practise examples rooted in physics covered in SM123 (these or similar could be incorporated directly into SM123 in a way that maths extension materials already exist and would allow the long spaces between Python programming weeks to contain some optional practice).

- A list of carefully curated external resources, including e-books currently accessible in the OU library

The existing preparation material for SM123 was updated and included links to the revised Python website in mid-September. A CAMEL email to registered SM123 promoting this resource was sent in advance of the module start. This flagged up programming as part of SM123 and directed students to appropriate resources if they want to prepare.

It has been agreed that solutions to all programming problems in the 4 Python weeks of SM123 will be made available to students before the end of the current week, replacing the current system where they are revealed the following week.

This eSTEeM project is the first in SPS now that Python programming has become the key priority for scholarship in the school. There is scope to build on this in future investigations, for example on the impact of the changes described on learners in future presentations. We hope that our other recommendations will be possible in the future.

Appendices

Appendix 1 – Study Calendar for SM123.

Appendix 2 – Survey 1 questions.

Appendix 3 – Survey 2 questions.

Appendix 3

Study Calendar 2021J

SM123 Physics and Space

Study week	Start date	Topic	Assessments	
			Number	Cut-off date
1	9 Oct	Introduction to SM123		
2	16 Oct	Scales in space and time		
3	23 Oct	Practical 1: Weather station		
4	30 Oct	*TMA01 preparation*		
5	6 Nov	Topic 1: Forces around you	TMA01 (7%)	08/11/2021
6	13 Nov	Topic 1: Forces around you		
7	20 Nov	Python 1: Introduction to Python		
8	27 Nov	Topic 2: An introduction to energy		
9	4 Dec	Topic 2: An introduction to energy		
10	11 Dec	Topic 3: Material worlds		
	18 Dec	Christmas break		
	25 Dec	Christmas break		
11	1 Jan	Topic 3: Material worlds		
12	8 Jan	*TMA02 preparation*		
13	15 Jan	Topic 4: The quantum realm	TMA 02 (6%)	17/01/2022
14	22 Jan	Topic 4: The quantum realm		
15	29 Jan	Python 2: Functions and packages		
16	5 Feb	Topic 5: Energy in society		
17	12 Feb	Topic 5: Energy in society		
18	19 Feb	Practical 2: Cloud chamber		
19	26 Feb	Topic 6: Nuclei & particles		
20	5 Mar	Topic 6: Nuclei & particles		
21	12 Mar	*TMA03 preparation*		
22	19 Mar	Topic 7: Components of the Universe	TMA 03 (13%)	21/03/2022
23	26 Mar	Topic 7: Components of the Universe		
24	2 Apr	Python 3: Arrays and plotting		
25	9 Apr	Topic 8: Exploring the Solar System		
	16 Apr	Easter break		
26	23 Apr	Topic 8: Exploring the Solar System		
27	30 Apr	Topic 9: How the Universe works		
28	7 May	Topic 9: How the Universe works		
29	14 May	Python 4: Data analysis		
30	21 May	*TMA04 preparation*		
31	28 May	*Exam preparation week*	TMA 04 (13%)	27/05/2022
32	4 Jun	*Exam preparation week*		
	7 – 13 Jun	Exam	EXAM (61%)	date and time TBC

Appendix 2 - Survey 1 Questions

Online surveys

Python Programming in SM123 - Survey 1 Final

When creating your survey, we recommend the use of a privacy notice, this should explain to survey respondents about how you plan to use any personal information you collect, and how long you intend on keeping it. Your organisation's data protection officer may be able to provide advice and guidance on creating a suitable privacy notice for your survey.

p. 1 Page 1

Add item

Welcome to the Python in SM123 survey - this survey is about the way that Python is delivered in SM123 and will take around 15 minutes to complete. The data will be used to improve the student experience.

Participation
Completing the questionnaire is entirely voluntary, and your participation or non-participation will not be linked to, or impact upon, your studies in any way. Please make sure you complete the survey in one sitting, to ensure that all your responses are recorded.

Consent
Completing the questionnaire confirms that you give consent for The Open University to use the data that you provide (i.e. your responses to the questionnaire) as specified in the following paragraph.

Data Protection
The data you provide (i.e. your responses to the questionnaire) will be processed and stored in accordance with The Open University's Student Privacy Policy. Raw data will be seen only by Open University staff. Aggregated anonymised data will be used for research and quality improvement purposes at The Open University and beyond, and may be published in Open University reports, academic journals, or in other public contexts. You may withdraw your data at any time up until when the data is aggregated.

Accessibility
If you have a disability or an additional requirement that makes it difficult for you to complete the questionnaire online, please email: G.E.Warriner@open.ac.uk or telephone us on +44(0)1908 655019.

If you have any questions relating to the questionnaire, please do not hesitate to contact us (G.E.Warriner@open.ac.uk).

The questionnaire has been designed for use on a standard computer (desktop or laptop). Full accessibility on a handheld device (such as a smartphone or tablet computer) cannot be guaranteed.

Your contribution is very much appreciated.

Please click on the 'Next' button below to continue, and where available use the 'Previous' button in the questionnaire to navigate back through the questionnaire.

Add item

p. 2 Background

Add item

1 Please enter your PI in the box below

Add item

We are collecting your PI in order to link answers to the second questionnaire, which we hope you will complete when the time comes. Thank you for your help.

Add item

Add item

p. 3 SM123 so far

Add item

We would like to find out about your overall experience of SM123 so far. The questions below concern the weeks of study 1 to 7.

Add item

2 How much have you enjoyed the following weeks in SM123? Please select a number from 1 to 5 where 1 is not enjoyed at all, 5 is enjoyed a great deal *

	1	2	3	4	5
Scales in space and time	☐	☐	☐	☐	☐
Practical 1: Weather station	☐	☐	☐	☐	☐
Topic 1: Forces around you	☐	☐	☐	☐	☐
Python 1	☐	☐	☐	☐	☐

Add item

Add item

3 How long did the following take compared with the suggested times shown below? (Topic 1 Forces is 2 weeks)

	Much longer	Longer	About right	Shorter	Much shorter
Scales in space and time (10 hours)	☐	☐	☐	☐	☐
Practical 1: Weather station (10 hours)	☐	☐	☐	☐	☐
Topic 1: Forces around you (20 hours)	☐	☐	☐	☐	☐
Python 1 (10 hours)	☐	☐	☐	☐	☐

Add item

Add item

4 How confident are you in your understanding of the material you have covered so far in SM123? Please select a number from 1 to 5 where 1 is not at all confident and 5 is very confident. *

	1	2	3	4	5
Scales in space and time	☐	☐	☐	☐	☐
Practical 1: Weather station	☐	☐	☐	☐	☐
Topic 1: Forces around you	☐	☐	☐	☐	☐
Python 1	☐	☐	☐	☐	☐

Add item

Add item

5 Which of the following resources have you accessed whilst studying SM123?

Online SM123 Tutorials

Tutor Group Forum

Other SM123 Forums

Show all (6)

Add item

a If you selected Other, please specify: *

Add item

Add item

b Please use this box to tell us how often you used these resources and how useful you found them. If you have used resources outside of SM123 please state what they are.

Add item

Add item

Add item

p. 4 Python Programming in General

Add item

These questions are to find out a bit about your programming experience before you started SM123

Add item

6 Before you started the module, were you aware that there is Python programming in SM123? *

No

Yes

Add item

a When and how did you find out that there would be Python programming in SM123?

Add item

Add item

b Did you do any preparation for the programming for SM123?

No

Yes

Add item

i If yes, please describe the preparation that you did.

Add item

Add item

Add item

Add item

7 Please describe your previous programming experience. *

I have never programmed before

I have tried to learn and gave up

I have basic skills in programming

Show all (4)

Add item

a Please outline your skills, including programming languages learned, and how you gained them.

Add item

Add item

b Could you briefly outline why you gave up?

Add item

Add item

Add item

p. 5 Your specific Experience of the Python 1 Week

Add item

Now that you have completed the Python 1 week , please give us feedback on your first week of programming in SM123.

Add item

8 Please choose from the options how often you could achieve the tasks listed below *

	Never	Sometimes	About half of the time	Most of the time	Always
I could run the programs provided	☐	☐	☐	☐	☐
I could make changes to the programs provided	☐	☐	☐	☐	☐
I could decide how to solve a programming problem	☐	☐	☐	☐	☐
I could write Python code myself	☐	☐	☐	☐	☐
I could run the code I wrote successfully	☐	☐	☐	☐	☐

Add item

Add item

9 Please respond to the following statements assessing your confidence at the end of Python 1. They are on a scale from 1 to 5 where 1 is not at all confident, 5 is very confident *

	1 - Not at all confident	2	3	4	5 - Very Confident
Interacting with the trinket programs online	☐	☐	☐	☐	☐
Designing a simple algorithm	☐	☐	☐	☐	☐
Constructing a Python program to add, subtract, multiply or divide two or more numbers	☐	☐	☐	☐	☐
Building an iteration (loop) with 'for'	☐	☐	☐	☐	☐
Using the 'sum' and 'len' functions	☐	☐	☐	☐	☐
Building an iteration (loop) with 'while '	☐	☐	☐	☐	☐

Add item

Add item

10 Please comment on how well you thought that the programming was related to the science content of SM123

Add item

Add item

11 How would you rate your overall confidence with Python after the Python 1 week. *

	1 - Not at all confident	2	3	4	5 - Confident
After the Python 1 week	☐	☐	☐	☐	☐

Add item

Add item

12 How much have you used the following resources for Python programming, approximately? *

	Never	Once	2 to 5 times	5 to 10 times	More than 10 times
Tutor Group forum specifically for my Python queries	☐	☐	☐	☐	☐
Python Programming forum	☐	☐	☐	☐	☐
Tutor help specifically for python issues	☐	☐	☐	☐	☐
SM123 concise programming guide	☐	☐	☐	☐	☐
Resources from outside the Open University, including the internet.	☐	☐	☐	☐	☐

Add item

Add item

13 If you took notes during your study of Python 1, please describe what you did.

Add item

Add item

p. 6 Further questions about Python 1

Add item

14 We are very interested in the experiences and views of people who lack confidence in Python or gave up before the end of Python 1. Would you be willing to answer a few questions about this? *

Yes No

Add item

a Please describe your own experience of studying Python 1

Add item

i How much did you complete of the following selected activities in Python 1?

	I did not attempt it	I made a little progress	I got about half way through the task	I was close to completing it	I completed it
Activity 1.1 Using Arithmetic operators	☐	☐	☐	☐	☐
Exercise 3.1 Shopping Basket	☐	☐	☐	☐	☐
Exercise 3.2 Weight calculation	☐	☐	☐	☐	☐
Exercise 3.3 Bringing Shopping Basket and Weight together	☐	☐	☐	☐	☐
Activity 3.2 Euclid's Algorithm	☐	☐	☐	☐	☐

Add item

Add item

ii If you feel that you gave up, when in Python 1 do you think that this happened?

During Part 1 – Python introduction

During Part 2 – Good Programming Practice

During Part 3 - Iteration and built-in functions

Add item

Add item

iii Which factors do you think contributed to you giving up? Please select all that apply.

Using Trinkets

The teaching materials

Time taken

Show all (6)

Add item

a If you selected Other, please specify: *

Add item

Add item

Add item

Add item

Add item

p. 7 Suggestions that might aid your learning

Add item

15 Which of the following resources or changes do you think you would access to develop your programming? Please select all that are relevant *

None at all

More detail in instructions

Less Python content to study

Show all (10)

Add item

a If you selected Other, please specify: *

Add item

Add item

Add item

p. 8 Final Comments

Add item

16 Is there anything else that you would like to tell us about Python programming on SM123? Please tell us in the box below

Add item

Add item

Thank you very much. We will be following this with a second survey later in SM123 and hope that you could help us by completing that too.

Add item

17 We would like to enter you for a draw to win an Amazon voucher worth £25. If you agree to this, please enter your email address here.

Add item

Add item

p. 9 Final page

Add item

Thank you very much for your contributions to this survey.

Add item

Appendix 3 - Survey 2 Questions

Online surveys

Python Programming in SM123 - Survey 2

When creating your survey, we recommend the use of a privacy notice, this should explain to survey respondents about how you plan to use any personal information you collect, and how long you intend on keeping it. Your organisation's data protection officer may be able to provide advice and guidance on creating a suitable privacy notice for your survey.

p. 1 Page 1

Add item

Welcome to the second Python in SM123 survey - this survey is about the way that Python is delivered in SM123 and will take around 15 minutes to complete. The data will be used to improve the student experience.

Participation
Completing the questionnaire is entirely voluntary, and your participation or non-participation will not be linked to, or impact upon, your studies in any way. Please make sure you complete the survey in one sitting, to ensure that all your responses are recorded.

Consent
Completing the questionnaire confirms that you give consent for The Open University to use the data that you provide (i.e. your responses to the questionnaire) as specified in the following paragraph.

Data Protection
The data you provide (i.e. your responses to the questionnaire) will be processed and stored in accordance with The Open University's Student Privacy Policy. Raw data will be seen only by Open University staff. Aggregated anonymised data will be used for research and quality improvement purposes at The Open University and beyond, and may be published in Open University reports, academic journals, or in other public contexts. You may withdraw your data at any time up until when the data is aggregated (10th April, 2021)

Accessibility
If you have a disability or an additional requirement that makes it difficult for you to complete the questionnaire online, please email: G.E.Warriner@open.ac.uk or telephone us on +44(0)1908 655019.

If you have any questions relating to the questionnaire, please do not hesitate to contact us (G.E.Warriner@open.ac.uk).

The questionnaire has been designed for use on a standard computer (desktop or laptop). Full accessibility on a handheld device (such as a smartphone or tablet computer) cannot be guaranteed.

Please note this piece of research supplements our standard end of module (SEaM) survey which you may also receive, and we'd be very grateful if you could find the time to take part in both surveys.

Your contribution is very much appreciated.

Add item

p. 2 Background

Add item

1 Please enter your PI in the box below *

Add item

Add item

p. 3 SM123 so far

Add item

We would like to find out about your overall experience of SM123 so far. The questions below concern the weeks of study 16 to 24

Add item

2 How much have you enjoyed the following weeks in SM123? Please select a number from 1 to 5 where 1 is not enjoyed at all, 5 is enjoyed a great deal *

	1	2	3	4	5
Topic 5: Energy in society	☐	☐	☐	☐	☐
Topic 6: Nuclei and particles	☐	☐	☐	☐	☐
Topic 7: Components of the Universe	☐	☐	☐	☐	☐
Practical 2: Cloud chamber	☐	☐	☐	☐	☐
Python 2	☐	☐	☐	☐	☐
Python 3	☐	☐	☐	☐	☐

Add item

Add item

3 How long did these sections take compared to the suggested time shown below? Much longer, longer, about right, shorter, much shorter *

	Much longer	Longer	About right	Shorter	Much shorter
Topic 5: Energy in society (20 Hours)	☐	☐	☐	☐	☐
Topic 6: Nuclei and particles (20 Hours)	☐	☐	☐	☐	☐
Topic 7: Components of the Universe (20 Hours)	☐	☐	☐	☐	☐
Practical 2: Cloud chamber (10 Hours)	☐	☐	☐	☐	☐
Python 2 (10 Hours)	☐	☐	☐	☐	☐
Python 3 (10 Hours)	☐	☐	☐	☐	☐

Add item

Add item

4 Which of the following resources have you accessed recently in your study of SM123?

Tutorials

Tutor group forum

Other SM123 forums

Show all (6)

Add item

a If you selected Other, please specify:

Add item

Add item

b Please use this box to tell us how often you used these resources and how useful you found them. If you have used resources outside of SM123 please state what they are.

Add item

Add item

Add item

p. 4 Python 2 Specific experience

Add item

5 Please choose from the options how often you could achieve the tasks in Python 2 listed below *

	Never	Sometimes	About half of the time	Most of the time	Always
I could run the programs provided	☐	☐	☐	☐	☐
I could make changes to the programs provided	☐	☐	☐	☐	☐
I could decide how to solve a programming problem	☐	☐	☐	☐	☐
I could write Python code myself	☐	☐	☐	☐	☐
I could run the code I wrote successfully	☐	☐	☐	☐	☐

Add item

Add item

6 Please respond to the following statements with your confidence, on a scale from 1 to 5 where 1 is not at all confident, 5 is very confident *

	1 - Not at all confident	2	3	4	5-Very confident
Inputting arithmetic operators into Python code	☐	☐	☐	☐	☐
Adding elements to a list	☐	☐	☐	☐	☐
Using the print function	☐	☐	☐	☐	☐
Writing your own function	☐	☐	☐	☐	☐
Asking for user input	☐	☐	☐	☐	☐
Importing numpy package	☐	☐	☐	☐	☐
Using linspace	☐	☐	☐	☐	☐

Add item

Add item

7 Please tell us about any cases where you used external resources to solve problems in Python 2. Please mention what the problem was, what external resource or resources you used and how they helped you to solve the problem?

Add item

Add item

8 How would you rate your overall confidence with Python after the Python 2 week? *

	1- Not at all confident	2	3	4	5 - Confident
After Python 2 week	☐	☐	☐	☐	☐

Add item

Add item

p. 5 Python 3 Specific experience

Add item

9 Please choose from the options how often you could achieve the tasks in Python 3 listed below *

	Never	Sometimes	About half the time	Most of the time	Always
I could run the programs provided	☐	☐	☐	☐	☐
I could make changes to the programs provided	☐	☐	☐	☐	☐
I could decide how to solve a programming problem	☐	☐	☐	☐	☐
I could write Python code myself	☐	☐	☐	☐	☐
I could run the code I wrote successfully	☐	☐	☐	☐	☐

Add item

Add item

10 Please respond to the following statements with your confidence, on a scale from 1 to 5 where 1 is not at all confident, 5 is very confident *

	1- Not at all confident	2	3	4	5 - Very confident
Using and defining functions	☐	☐	☐	☐	☐
Defining arrays	☐	☐	☐	☐	☐
Operating on arrays	☐	☐	☐	☐	☐
Plotting data using pyplot	☐	☐	☐	☐	☐
Plotting functions using pyplot	☐	☐	☐	☐	☐
Combining everything in the radioactive decay program	☐	☐	☐	☐	☐

Add item

Add item

11 Please tell us about any cases where you used external resources to solve problems in Python 3. Please mention what the problem was, what external resource or resources you used and how they helped you to solve the problem?

Add item

Add item

12 How would you rate your overall confidence with Python after the Python 3 week? *

	1 - Not at all confident	2	3	4	5 - Confident
After the Python 3 week	☐	☐	☐	☐	☐

Add item

Add item

p. 6 Python experience in SM123

Add item

13 Please comment on how well you thought that the programming was related to the science content of SM123

Add item

Add item

14 We are very interested in the experiences and views of people who lack confidence in Python or gave up before the end of Python 3. Would you be willing to answer a few questions about this? *

Yes

No

Add item

a Please describe your own experience of studying Python 2 and 3

Add item

Add item

b If you feel that you gave up, when do you think that this happened?

During Python 2

During Python 3

Add item

i Which factors do you think contributed to you giving up? Please select all that apply.

Using Trinkets

The teaching materials

Time taken

Show all (6)

Add item

a If you selected other, please specify

Add item

Add item

Add item

ii Which of the following activities did you complete in Python 2?

Python activity 1.1 Using and printing list elements

Python activity 1.2 Using a compact assignment operator

Python activity 1.3 Using abs

Show all (5)

Add item

Add item

iii Which of the following activities did you complete in Python 3?

Exercise 1.1

Exercise 1.2

Exercise 1.3

Show all (7)

Add item

Add item

Add item

Add item

p. 7 Suggestions that might aid your learning

Add item

15 Which of the following resources or changes do you think you would access to develop your programming? Please select all that are relevant

None at all

More detail in instructions

Less Python content to study

Show all (10)

Add item

Add item

p. 8 Final Comments

Add item

16 Is there anything else that you would like to tell us about Python programming on SM123? Please tell us in the box below

Add item

Add item

17 We would like to enter you for a draw to win one of two Amazon vouchers worth £25. One voucher is available to all participants, one has been reserved for particpants who also completed the first survey If you agree to this, please enter your email address here.

Add item

Add item

p. 9 Final page

Add item

Thank you very much for your contributions to this survey.

Add item