Teaching computer programming skills to biologist

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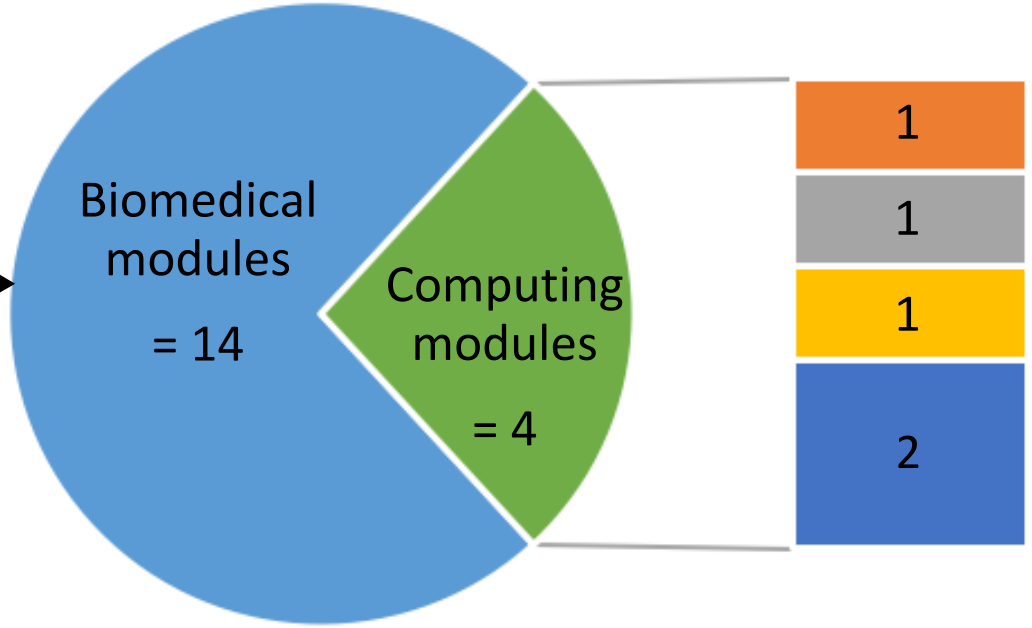
What's the Background/Context?

BSc (Hons) in Stratified Medicine

- Wet-lab skills
- Data analysis skills

Increased/better employment prospects

Industrial Liaison Committee (ILC)



Programming languages per module

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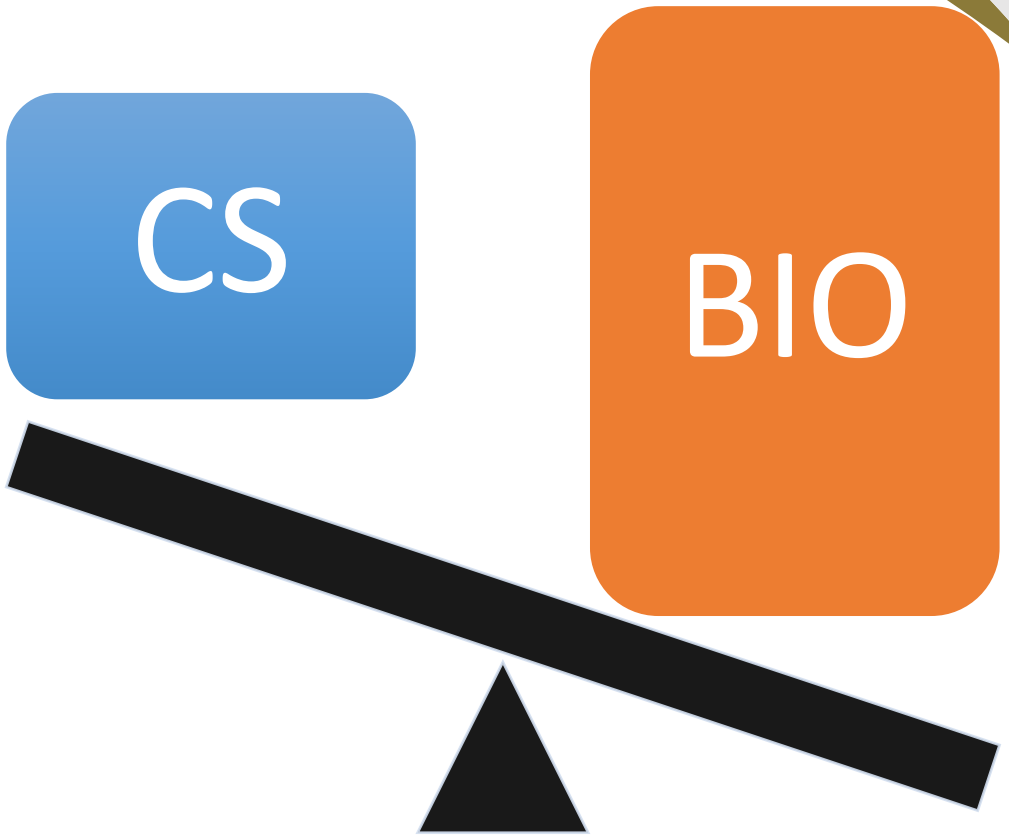
What's the problem?

Skewed student cohort!



- Learning **programming concepts** can be sometimes **very challenging**, especially abstract computer terms such as executables, subroutines, algorithms, etc (Black, 2009).
- More challenging for Life Science background students!

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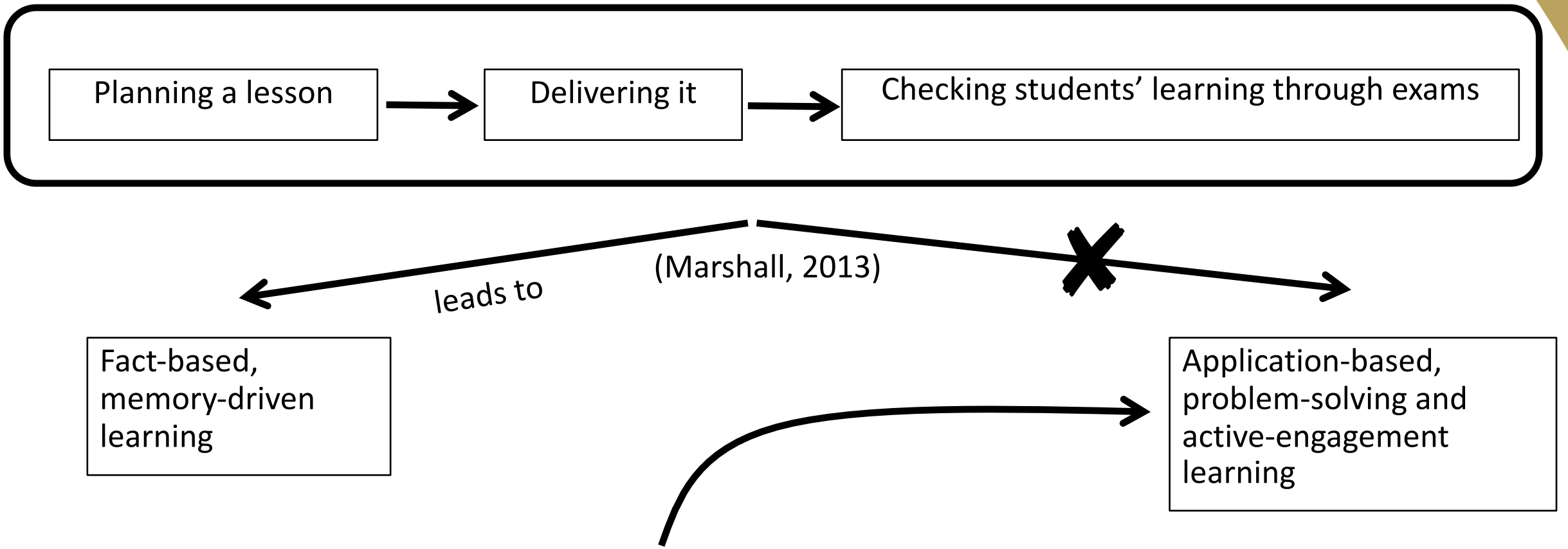
How to address it?

Explored pedagogic literature …



But, **this concept** of learning is **very crucial** for an IT-based practical module (Nuutila, Törmä and Malmi, 2005).

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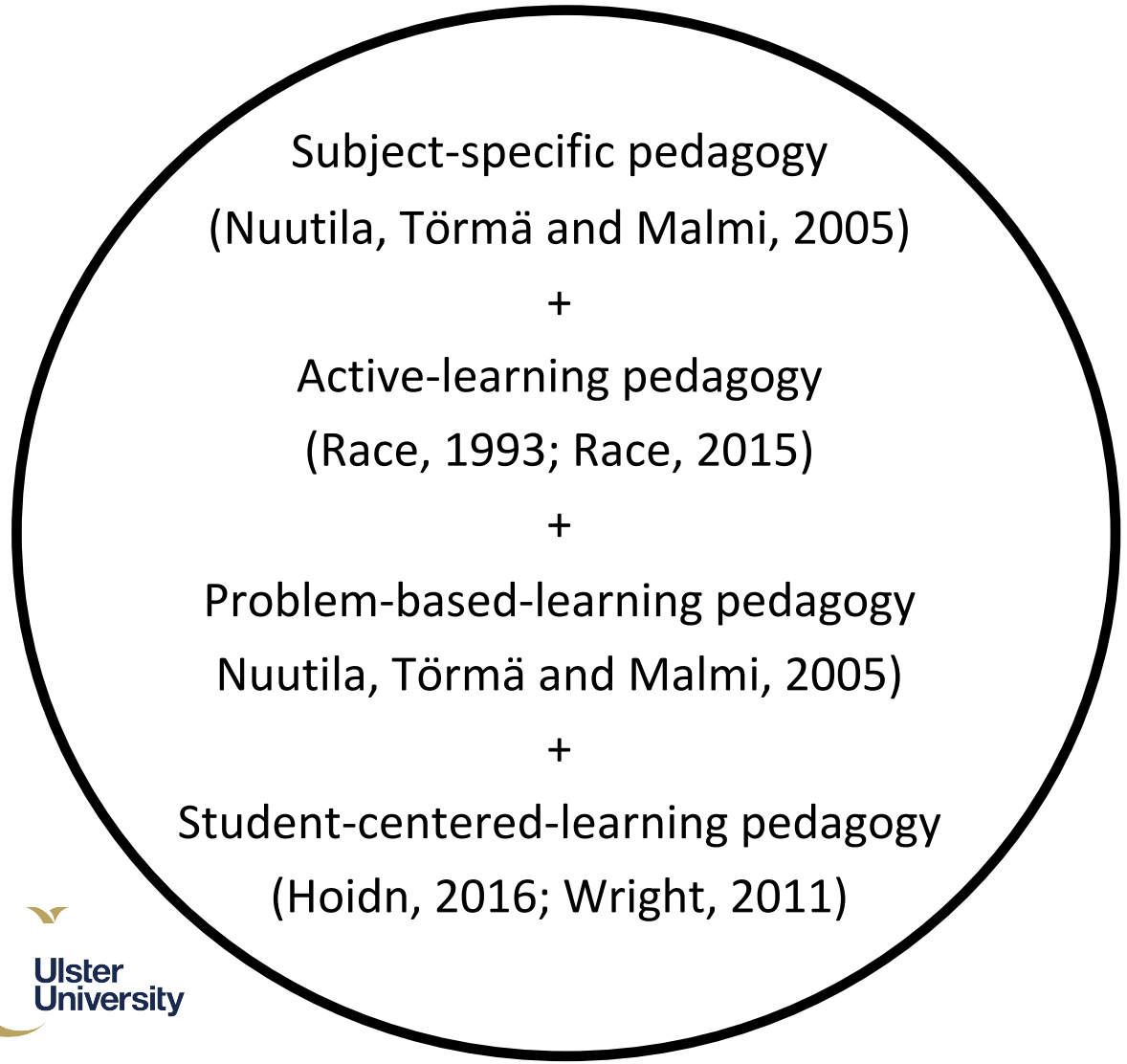
A solution!: teaching approach



→ *"Workshop-followed-by-tutorial"* model of teaching

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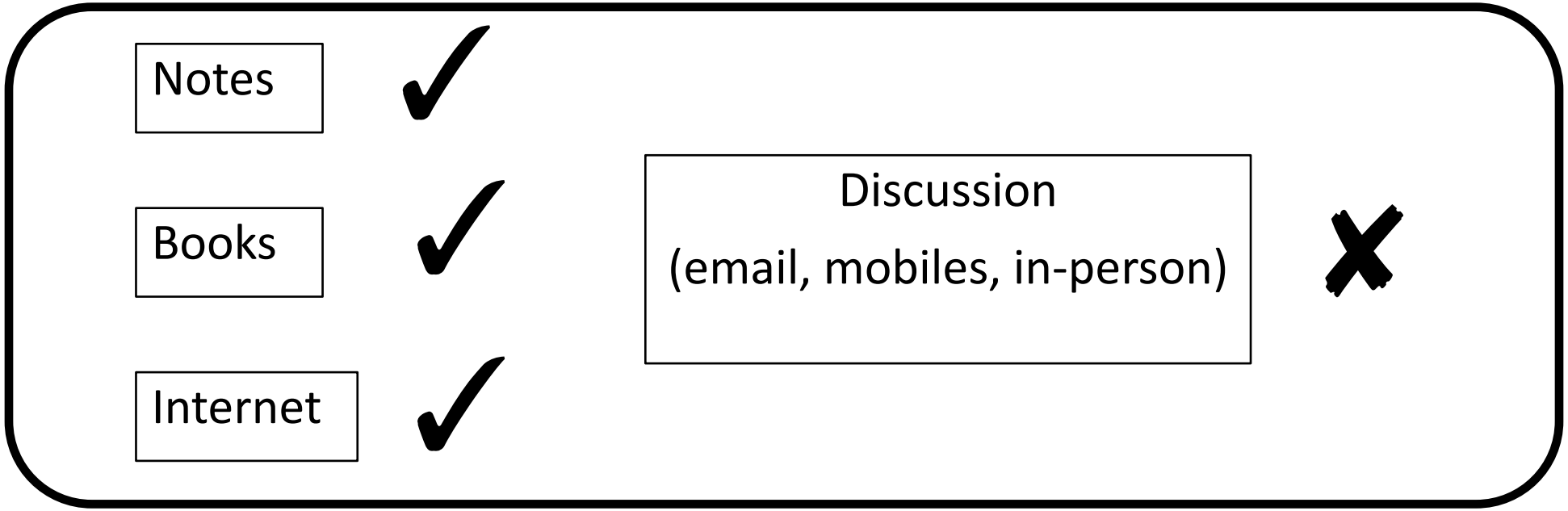
A solution!: assessment approach



An “Open-book” assessments help in preparing students for a real-world job scenario (Green, Ferrante and Heppard, 2016)

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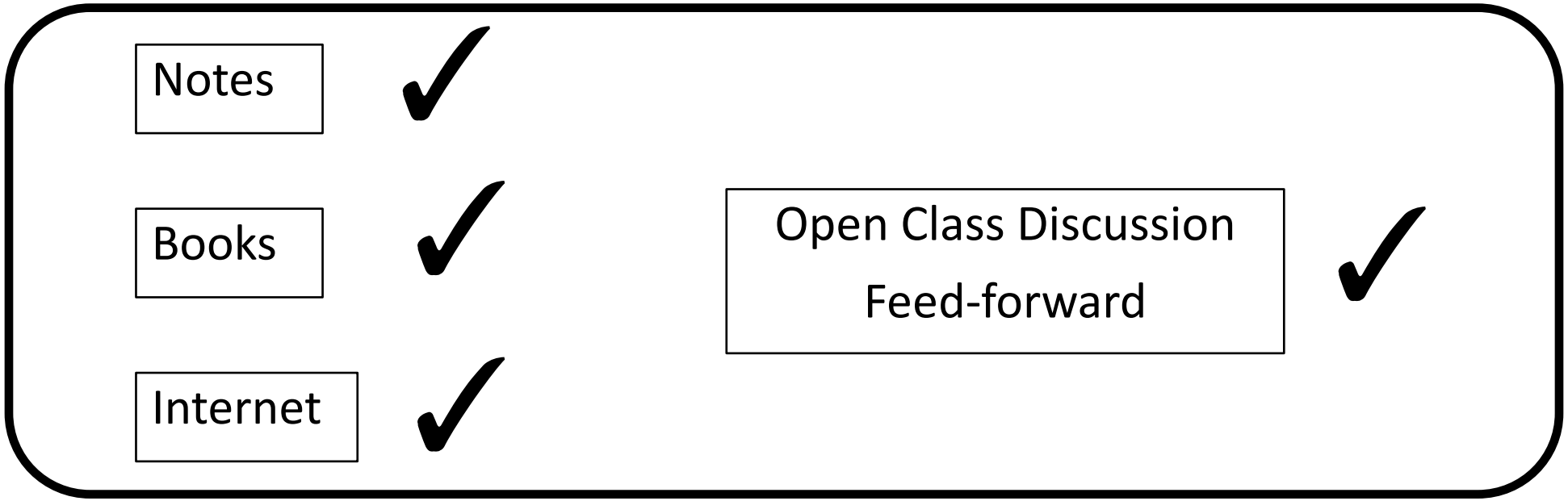
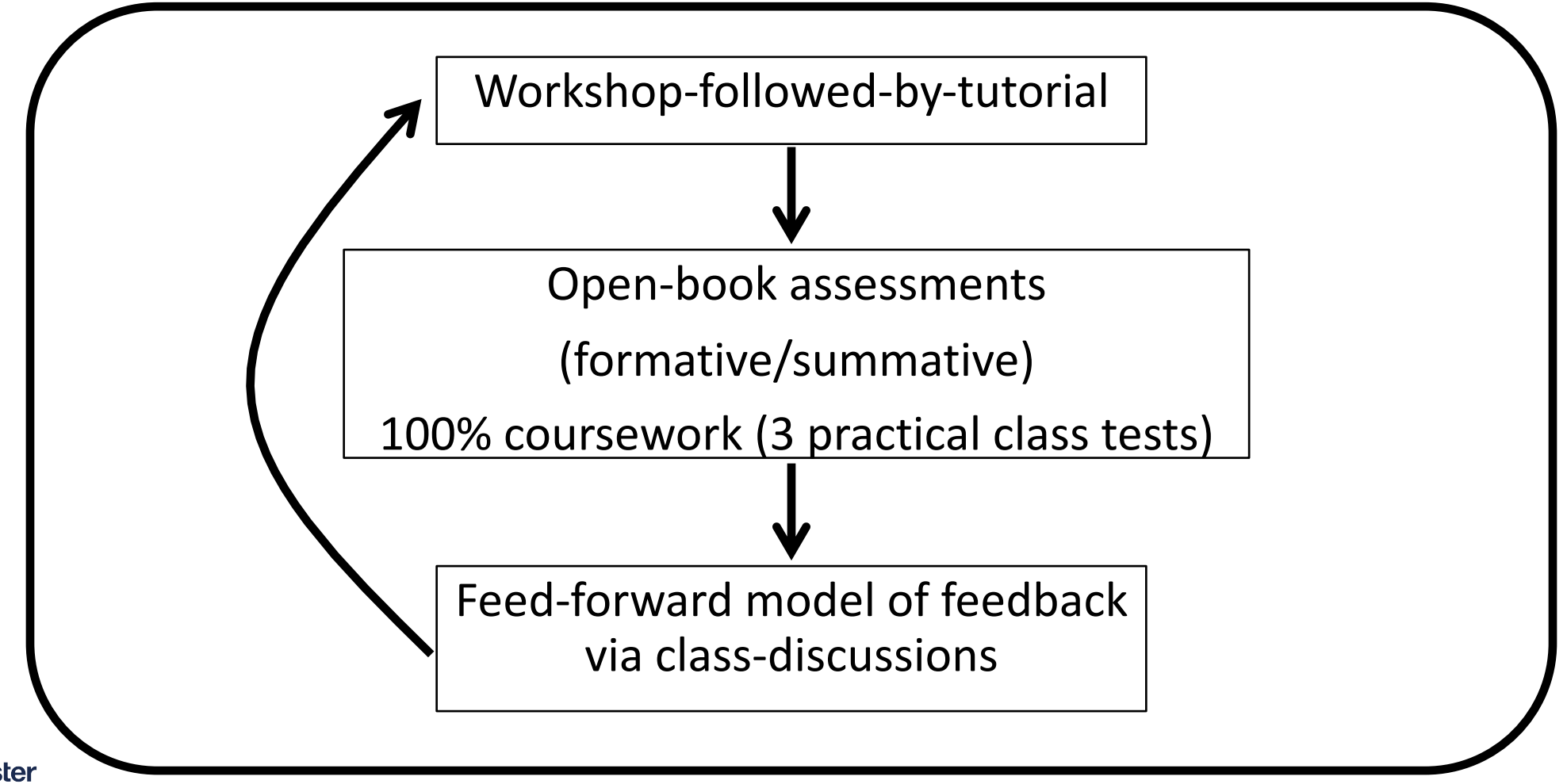
A solution!: feedback approach



An “open-feed-forward” model of feedback (Knight, 2006) via open class discussion provides opportunity to students to discuss, understand and reflect on diverse approaches they have taken, as the same programming task can have multiple solutions, both logically and syntactically.

A solution!: overall L&T approach



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Case study

Implementation and testing

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Main objectives of the case study

1. To **enhance** students' **learning experience** of computer programming.
2. Computational **skill development** – to prepare them for job.

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Participants

Academic year: 2017-18

Semester: 2

Course: BSc (Hons) in Stratified Medicine 3rd years students

Module: BIO541 (Biomedical Informatics)

Number of students: 14

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Design/Implementation

Following actions were taken in order to implement the idea:

1. Converted the 3 hours per week morning lecture sessions into workshops.
2. Increased the 2 hours per week afternoon tutorial sessions to 3 hours per week, so as to increase the total contact hours from 60 to 72.
3. Organized both the sessions of workshops and tutorials in a computing lab on the same day.
4. Converted closed-book theoretical class tests into open-book practical class tests.
5. Implemented feed-forward model of feedback via open class discussions.

Evaluation methodology

Two approaches to gauge the achievements of 2 aims:

1. For checking **learning experience** - Student **surveys** (anonymous), 3 times (Week 1, 4 & 7), with a couple of quantitative and qualitative feedback questionnaire.

2. For checking **skill development** – open-book practical class **tests**, 3 times (week 3, 6 & 11).

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Quantitative Results: Teaching Method

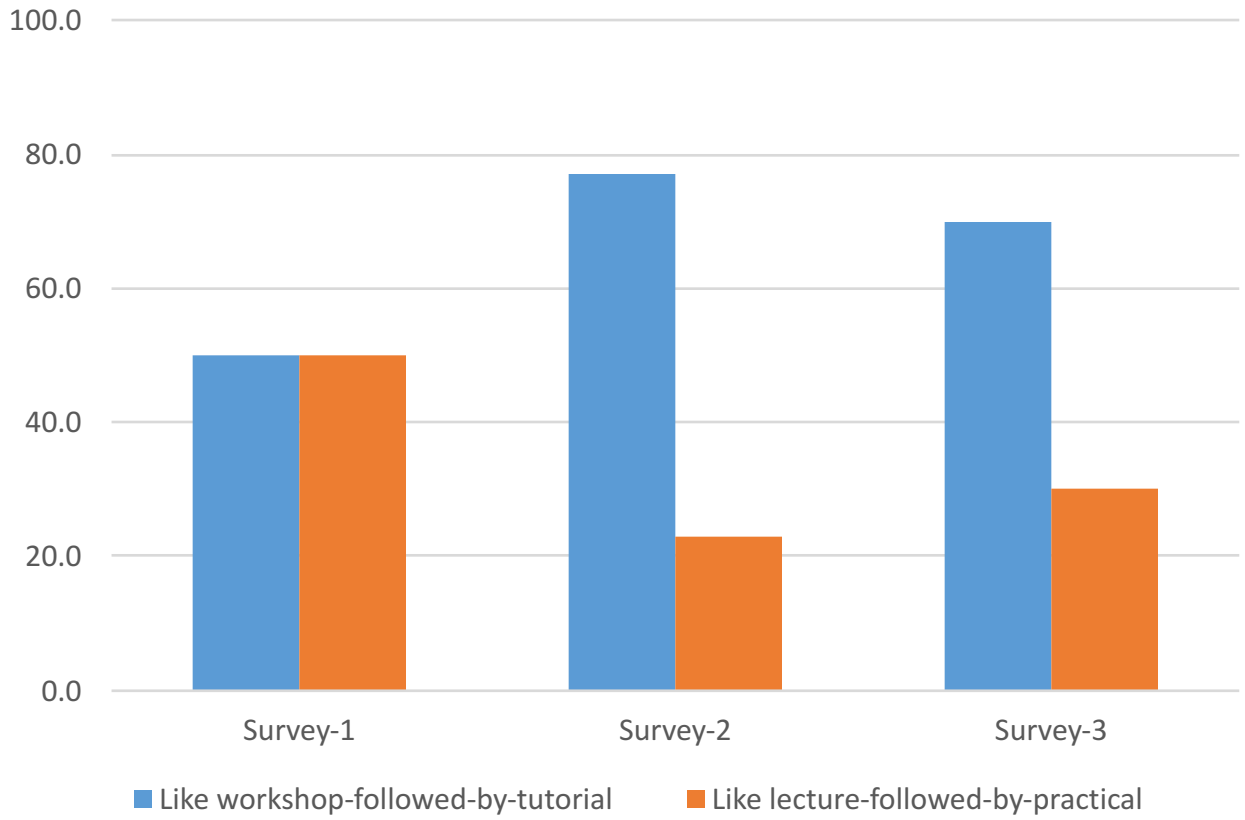

Figure 1: Percentage of students (Y-axis) having interest in 2 different teaching methods.

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Quantitative Results: Assessment Method

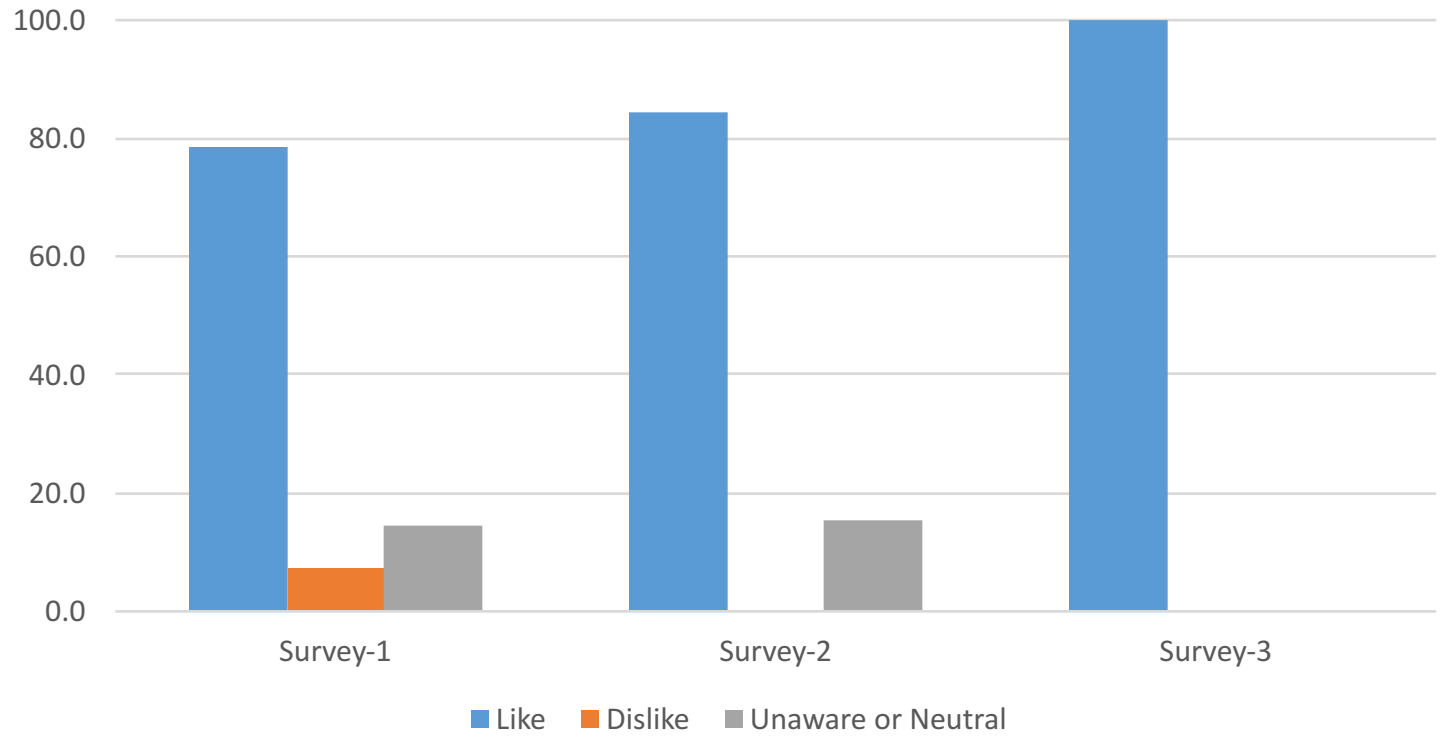

Figure 2: Percentage of students (Y-axis) having interest in open-book assessment.

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Quantitative Results: Feedback Method

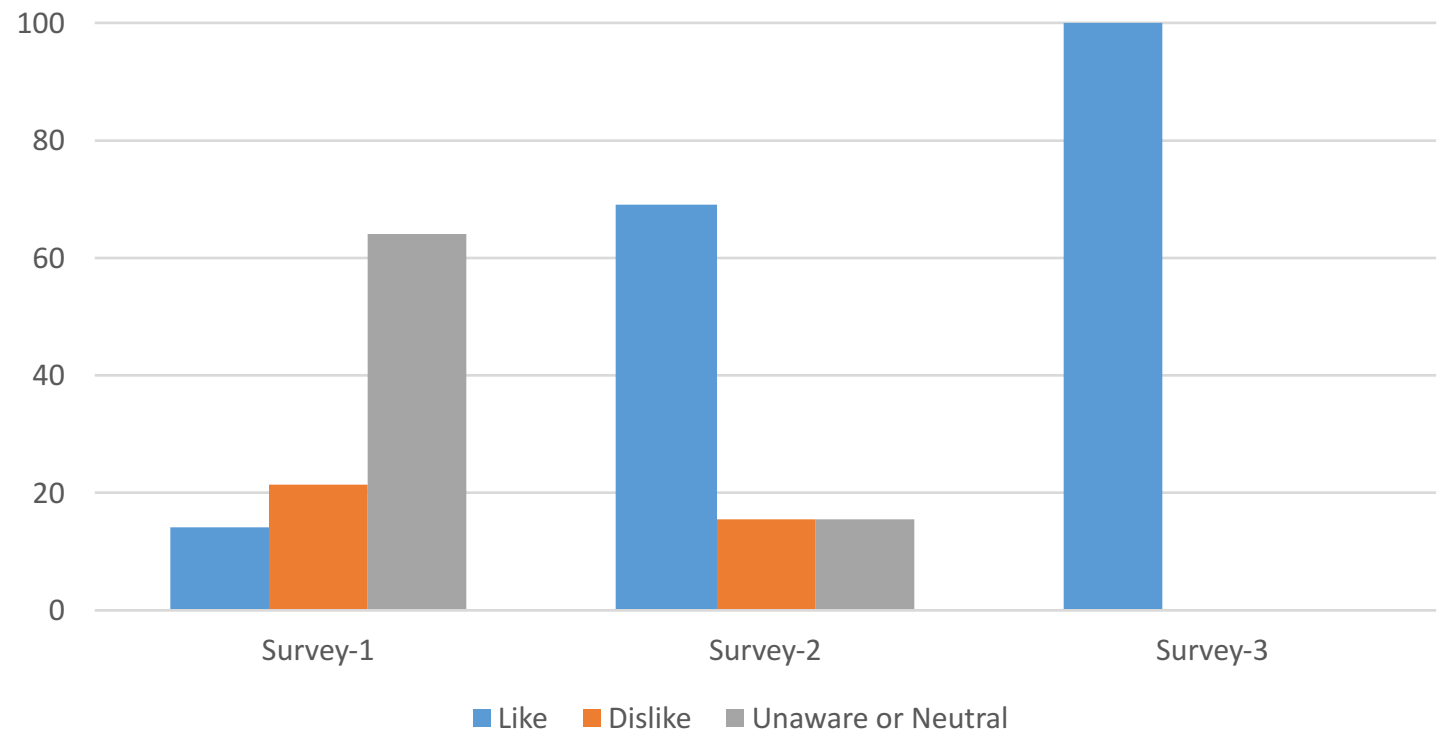

Figure 3: Percentage of students (Y-axis) having interest in feed-forward model of feedback.

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Quantitative Results: Interest in Programming

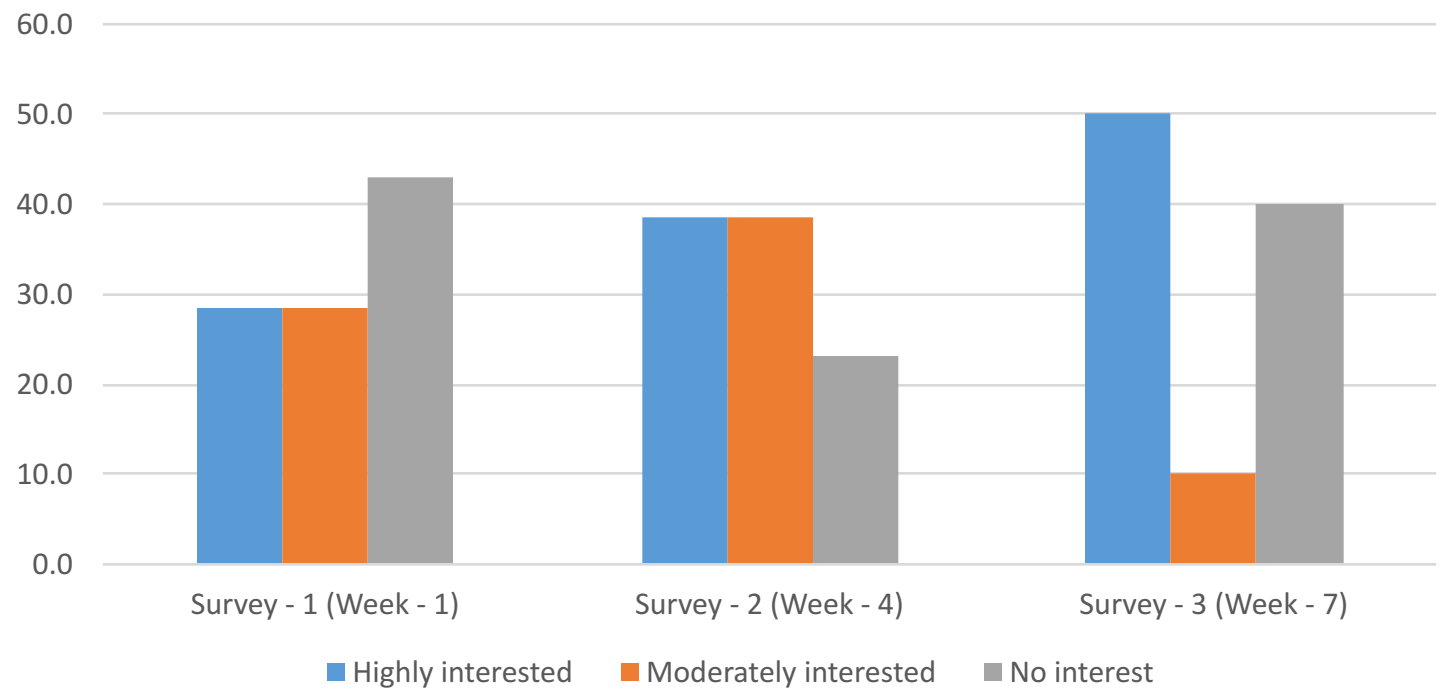

Figure 4: Percentage of students (Y-axis) having interest in computer programming.

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Quantitative Results: Class Test Performance

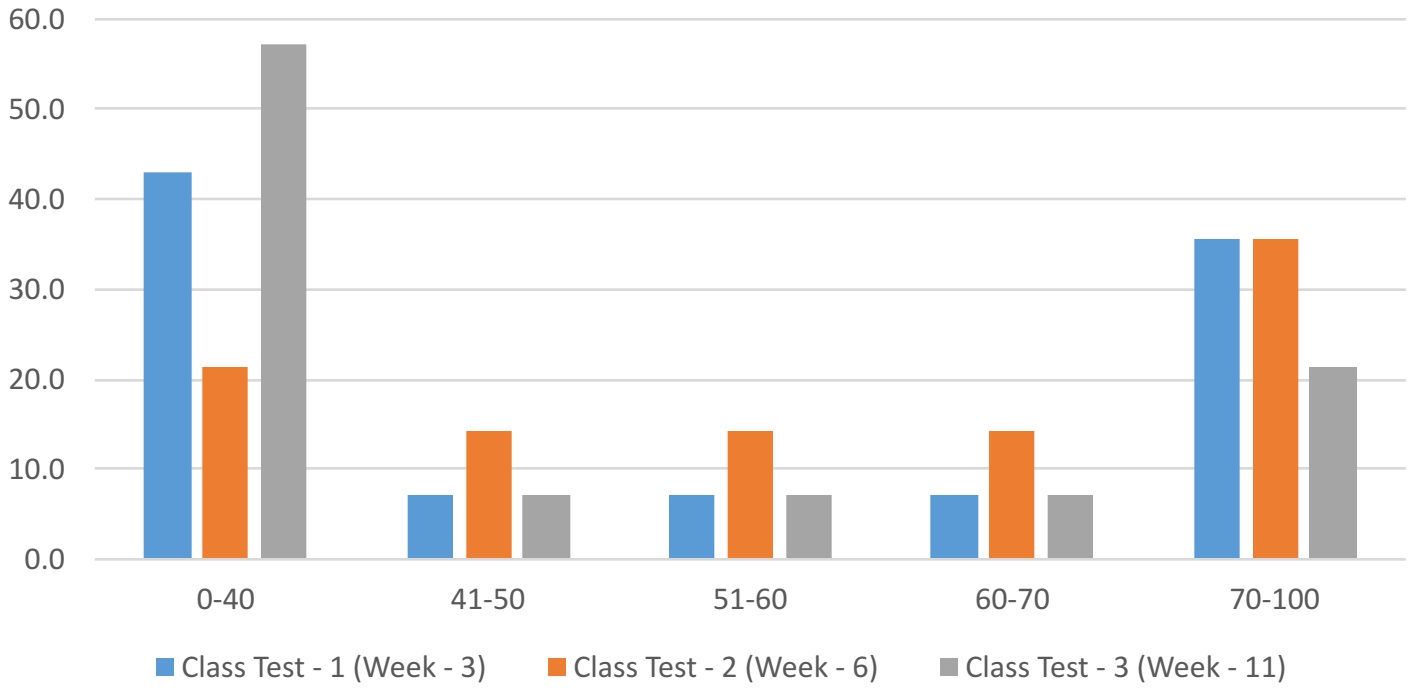

Figure 5: Percentage of students (Y-axis) with their performance (percentage of marks on X-axis) in 3 class tests.

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Qualitative Results: Teaching Method

Question 1	Qualitative Feedback
Learning to program in a "workshop" has been positive because (give as many reasons as you can think of).	**Positive feedback –** *"More active learning environment. Nice change/from traditional learning style (lecture). Opportunity for discussion with lecturer and classmates about topics. Interactive environment means everyone can help each other and learn together. Forces you to participate and be aware of what you are doing (raises awareness). Improves pacing of classes – more interesting, so time passes more quickly."* *"It encourages you to learn in your own time. It is more concrete. I have learned more at this module than any other programming module."* *"Fun. A good learning environment is being fostered. Periods of frustration are kept to minimum. Moves at a great pace. Plenty of variations in tasks + teaching."* **Moderate or Negative feedback –** None.

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Qualitative Results: Assessment Method

Question 2	Qualitative Feedback
After having couple of "open-book" practical assessments (formative and summative) in this module, what do you now think about "open-book" practical assessments? Do you like or dislike it? Please explain why you feel this.	**Positive feedback –** *"I like it because it stimulates more of a real-life i.e. real-world scenario and allows me to focus on solving the problem rather than regurgitating information."* *"I like. Reflects "doing" in the real-world. Important to link learning with future tasks/jobs."* *"Like it. Testing conditions for Computer Programming are very different from traditional testing environments, meaning they are unsettling and can make one feel very nervous / anxious. Open-book restores confidence in one's self, relaxing and maintaining an open mind to help problem-solve and perform at one's best. Allows you to believe in yourself – have faith."* **Moderate or Negative feedback –** *"For the topic of this module I feel it gives us all better chance of doing well. It doesn't necessarily mean we have all the answers. It just allows us to use what we have been given, to apply it to the question."* *"Good if relevant to what's being asked."*

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Qualitative Results: Feedback Method

Question 3	Qualitative Feedback
After having couple of "open-feed-forward" model of feedback via class discussions (following formative and summative assessments), what do you now think about this way of feedback? Do you like or dislike it? Please explain why you feel this.	**Positive feedback –** *"Like it. Shows you care about our progress."* *"I think it is fantastic, being able to go back over previous material such as tests and understand where you went wrong really helps. Especially if you made silly mistakes and realising it helps you to remember for the future."* *"Open-feed-forward is excellent. Going through answers helps greatly. It obviously shows where you went wrong."* **Moderate or Negative feedback –** *"All feedback is good and can only aid further. I have no preference on how it is delivered."* *"Still undecided. Useful for test but not really when there is a lot of code required."* *"I prefer one-to-one feedback personally. So I can explain myself privately."*

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Qualitative Results: learning experience & skill development

Question 4	Qualitative Feedback
Do you feel your programming skills are improving? Please explain why you feel this.	**Positive feedback –** *"Yes, I feel that my programming skills are improving. This term we are using Shell and Python which I seem to be understanding a lot better. The lecturer teaching the module is great and shows a lot of passion whilst teaching which helps greatly. He needs patience whilst teaching me that's for sure :)"* *"Yes. The hands-on workshop followed by tutorial is extremely effective in getting me to engage with the topic and actively participate. As I am a kinaesthetic learner, the nature of the classes has helped me to improve my programming by actually doing the exercises and observing the outcomes."* *"I feel they are improving because we are being taught by a good lecturer who clearly explains things. Previous programming was not well explained i.e. the basics of basic functions in other languages was ignored. This was frustrating. To learn anything, you cannot skip the foundation."* **Moderate or Negative feedback –** *"I feel like they are improving to a degree. As I mentioned before, it's a topic I really need to work on to fully understand so I do struggle, which has nothing to do with the way we are being taught."* *"I do feel they are improving as I can understand more, but can't seem to do it on my own."* *"No, but I blame myself as I don't feel interested in the subject and therefore don't seem to understand well."*

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Reflection, Transferability and Next Steps

- Programming part needed to be separated from the biomedical data analysis part from this module.
- In the recently successful revalidation exercise, we proposed 2 new computational modules.
- Earlier, only 1 out 4 computing modules were based on my L&T approaches.
- After revalidation, 5 out of 6 computing modules are now based on my L&T approaches.

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Transferability

Testimonials from my computing colleague/academic staff members:

"*I think your approach is very interesting and I'm going to try to apply a more problem-based element to my own teaching based on the experience you have shared with us. I'm especially interested to see if your approach can help boost the confidence of these students, as that is something the cohort has struggle with.*"

"*Probably the best arrangement for the majority of our computing orientated syllabus.*"

"*Sounds like an optimal arrangement for teaching programming and applied computing skills.*"

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Transferability

Testimonial from my collaborator on my recently funded Advance HE project:

"*Traditionally, the model for teaching programming come from HE, as before the 2014 curriculum change in England, there was limited scope for teaching programming in schools. The students typically learning programming would be those most keen to do so as part of a Computer Science pathway. Dr Shukla's work on addressing the stress and anxiety that comes from learning an unfamiliar, cross-disciplinary subject such as programming with his stratified medicine students means that we will have a better understanding of how to teach programming, which can transfer to Initial Teacher Education (ITE) for trainee school teachers, who will then in turn have to teach programming to school children from the ages of 11-18. Given that the UK government is currently investing £84 in training Computing teachers, many of whom lack sufficient programming skills, there is a real need for research in this area.*"

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Thank you for your attention!

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Questions?

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