Raspberry Pi Foundation

AI/ ML resource development design considerations

The purpose of this document is to outline some of the design considerations and decisions that were made in the development of the Experience AI learning resources. This is not exhaustive and will be added to as we go along.

1. Always look for research to inform pedagogy, content, mental models, but carefully review based on the changing nature of the subject. Many research studies are small numbers of students, delivered by researchers (rather than teachers) and in the US.
2. Be very, very strict about the use of vocabulary and shared understanding or vocabulary and concepts. There is much confusion in the field about the concepts. As we write resources - we must have a common understanding of the concepts. Don't assume that material about the subject is correct, always find three trusted sources and compare.
3. Avoid anthropomorphisation at all costs (in text and images). AI should not be used as a countable noun. Words that are used to describe the behaviour of people (seen, look, recognise, create, make) should be replaced with system type words (detect, input, pattern match, generate, produce). Attributing human form or personality to applications that use AI distracts from the understanding that it is people who design and influence the uses of AI applications, risks a reduction in the students' desire to take an active role in wanting to understand how they work and be involved in designing future applications and perpetuates dangers of AI in terms of bias and inequality. Ensure that all images are not "robots" / have faces etc.
4. Use the SEAME model to frame the learning objectives and time allocation of learning activities. This ensures that Social and Ethical concerns are as important as the more technical aspects.
5. Clearly distinguish and highlight the difference between data-driven and the traditional rule-based approach to program development, adopt the CT2.0 view of Matti Tedre as a guide. This is essential to ensure that learners understand that ML is a predictive not deterministic approach.
6. Clearly define the learning objectives and limit these to a small number per lesson, this is because of the complexity of the new concepts (see Learning Graphs). Have well defined LO, with a balanced set of Bloom's levels. Most resources teaching ML have no LO, or poorly defined LO.
7. Be specific for the age-group being targeted, we found that most current teacher resources are for all ages and therefore not appropriate for any specific groups.

8. Develop an initial set of learning objectives from a synthesis of learning goals/objectives from research activities and curricula materials. Then adapt and grow these as the lessons are developed and after feedback on pilots.
9. Reveal bias, and address it, use transitional others to do this where needed
10. As much as possible the development of misconceptions will be avoided. However, we accept that some concepts will need to be oversimplified and may cause misconceptions to be formed, but that this will be overcome as learners discover more about the detail of the concepts e.g. there may be a simplified view of some definitions.
11. Include assessment. We found there were few examples of assessment in the current resource set available to teachers. Accept that this is a new subject and assessment etc will need to be adjusted over time.
12. Provide teachers with examples, they may not have built up a view of good examples yet.
13. Assume that teachers are not likely to have a good subject knowledge here and are likely with their students to have formed many misconceptions about AI/ML already.
14. Follow a semantic wave, as there are many new complex concepts that need to be explained, and the repacking of new knowledge will be important for using in new contexts.
15. Choose everyday relevant contexts that are applicable to all gender, ethnic and socioeconomic groups; it's too easy to fall into the sci-fi example trap, and these may be more appealing to certain groups of learners. This is important for culturally relevant pedagogy (see areas of opportunity)
16. Use decision trees instead of neural networks as an example of an ML engine. Decision trees are thought to be more accessible due to students' previous experience in both mathematics and computing at this age group. Decision trees are explainable in the prediction they make.
17. When selecting examples of ML to use, consider if the type of ML engine is appropriate to the learning objective and the longer term flow of knowledge building and mental models to be formed (see decision tree decision).
18. Ensure that evaluation is central to the lessons so that students can become discerning consumers, e.g. introduce model cards.
19. Be careful in our use of technical contexts to avoid possible misconceptions around ML models. For image classification is associated with decision trees, particularly where students are asked to look at the differences they see in images (e.g. cats have long whiskers, dogs have short whiskers, cats eyes are oval, dogs are round) we predict that there is a danger of students assuming that the model learns through spotting attributes in human-like explainable way.
20. Watch out for an overreliance on tools, they may not persist. Unplugged activities are a good idea!
21. Longer term consider the research that we may be able to do both on learning about AI/ML, learning with AI/ML and using AI/ML.