Developing a prototype web-app for numeracy assessment and teaching

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Numeracy & Literacy

- Word problems as a numeracy skill children are assessed on: *verbal descriptions of problems which can be solved through mathematical operations on numerical data in the problem statement.*

  e.g. (1) Kerosene comes in 5 litre cans. Ashoka needs 17 litres of kerosene for the household. How many cans must he buy: 5, 2, 8 or 4?

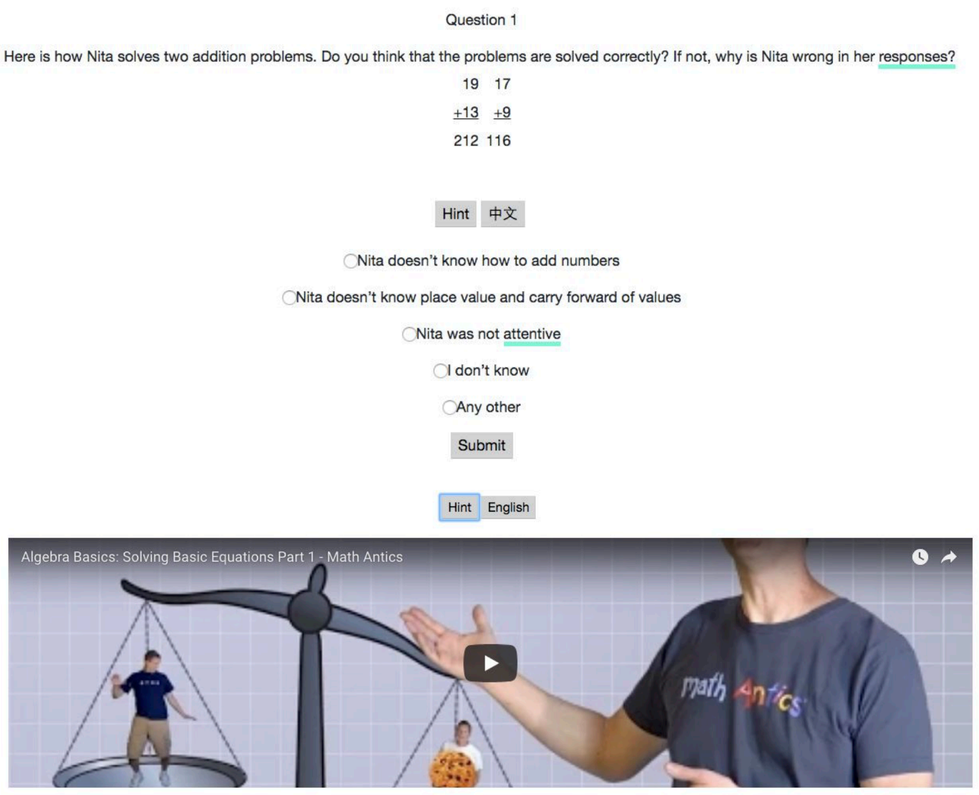
  e.g. (2) Here is a page from Seema's maths notebook:

  5 x 4 = 9 3 x 2 = 5 4 x 2 = 6

  Why does Seema make these mistakes?
- Literacy level as a prerequisite to understand and solve the mathematical problem;
- Children in India are often tested in English, which may not be their mother tongue, and which may not be taught by good speakers of English;
- The use of technology to enable understanding of mathematical word problems: a web-app with multimodal and multilingual scaffolding options for independent learning.

Prototype Web-App

- Python flask web-app developed during a 10-week UROP internship;
- An initial set of 9 multiple-choice meta-maths and word problem prompts, both text and image-and-text stimuli;
- For each prompt: mouse-over dictionary definitions for pre-defined complex English words [3], relevant video lessons as hints, option to translate the prompt to another language (currently Chinese Mandarin; will be Hindi);



Personalisation & Scaling up

- User profiles as a first step in personalisation: with a larger curriculum and lots of user data we can eventually use adaptive learning to personalise the curriculum and feedback for students [2];
- Also loaded 1000 prompts labelled with solution equation(s) and numeric answer(s) [1], allowing us to automatically assign calculation types and difficulty levels;

Discussion & Future Work

- Development of a high-quality curriculum, expanding from the initial 9 items, adding video lessons, Hindi translations;
- Addition of calculation steps as part of the student response: what are the steps they take to answer the word problems? This will give us insight into errors and why children make them, how to offer better scaffolding, and alternative paths to the correct answer;
- Testing automatic item and answer generation from the 1000 prompts, data analysis and adaptive learning developments;
- Needs ethics approval: issues in working with vulnerable groups (slum/rural children) and ensuring data protection;
- Demo app @ `http://zw322.pythonanywhere.com`

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