Synopsis of Seminar "Interactive Online Maths Problem-Solving Sessions".

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A sequence of studies from 2008 to 2016 provides evidence that few students speak in online STEM OU tutorials. Though speech occurred in the early small-group tutorials, the emphasis moved away from this toward text chat. The project discussed here has investigated how online tutorials could be designed to encourage students to speak. It began when H.E. teaching was moving online due to Covid-19 lockdowns, and so seemed particularly pertinent.

The project is centred on a problem-solving session design. This was based on initial information gathered on individual support sessions (ISS) in 2020-21. Level 2-3 Maths tutors compiled six logs documenting ISS, including what appeared to encourage speech. These were analysed thematically, and combined with responses from a small survey of tutors, to establish desirable characteristics for a session encouraging speech. These included: students seeing benefit from speaking through their needs being met, and reducing anxiety through discussing familiar content first, or by the tutor setting the direction. Other aspects were informed by sources on small-group sessions at other institutions during lockdowns and on online language tutorials. These included clear purpose, format and roles, the chance to look at content in advance, and content relating to assessment.

The session design consists of: initial quiz to establish students' needs, icebreaker on spotting errors in a solution, and problem-solving in three group-work styles. Styles A and B happen in breakout with feedback in plenary. In Style A a student writes and another gives instructions; Style B is a type of 'Consequences' game where students continue solutions started by others. Style C happens in plenary with the tutor providing structure and pointers. The design was tested in two sessions in November 2021. They ran in Adobe Connect, with additional use of MS OneNote. Data was collected in the form of recording transcripts, observations and feedback from students. This was analysed thematically in order to evaluate the effectiveness of each part and inform modifications. The modified design was tested in November 2022, and similar data collected. This was also analysed thematically, to evaluate effectiveness overall and of the modifications in particular.

This talk will discuss each aspect of the design in turn: Preparatory Materials, Quiz, Icebreaker, and the three group-work Styles. It will set out the evidence for the effectiveness of each aspect, in terms of how the students behaved and what problems arose. It will also set out the most important recommendations for improving the design aspects. A sense of some of these can be given here. The Preparatory Materials were useful, but could be improved by addition of a bullet-point list of tasks to do before the session. The Quiz was effective at guiding problem choice, but could be improved by having a smaller problem set to start with, and giving immediate brief feedback to the students.

The Icebreaker was successful in that the students participated, identifying errors in the solution and marking them on the Notebook. There was a big issue the first year, in that one error was too hard to identify at source, and in order to correct the result further down, an

unintended discussion ensued. This made the Icebreaker too exposing and too long. This was improved the next year by the removal of that error. Then, the interaction between the students was more spontaneous. Thus the main recommendation is to keep the errors straightforward. Another is to give the choice between feeding in errors verbally or in writing initially, and following up on all contributed.

Overall, Style A led to rich discussions between pairs of students. One recommendation is to make the instructions clearer, to avoid the situation with one pair where the discussion did not get going. Another is for the tutor to move between breakouts and make some teaching points where relevant, since where this happened it was found to be useful. Another is to use a problem where choices of method are needed, to prevent students relying on pre-prepared solutions and make the feedback section more lively. Lastly, it is recommended to run the feedback with whiteboards side-by-side, to facilitate comparison.

The first year, Style B did not work as planned, in that people could not continue each other's solutions. Students worked at different speeds due to difficulties writing, and some forgot to stop. Important recommendations are to build in time to practice writing, and make the format clear. With these in place, Style B went to plan the second year, and students were able to continue each other's solutions. Another recommendation is to encourage students to send messages to the host if support is needed, and especially when they finish a problem part. This is to prevent students feeling alone and unsupported, and deal with the issue of feeling exposed if you are the only one tackling a problem part. With the whiteboards side-by-side, and most decisions on what to discuss made by students, there was a rich feedback discussion. It was more student-centred than the previous year, but perhaps had less mathematical depth.

During Style C each year, the students solved the long multi-part problem together, in that one student solved each part or subpart, and people built on the work of others. The interaction between the students was richer the second year than the first. The first year, the interaction became richer with time, whereas this reversed the second year. The second year, one student began to dominate, pasting in pre-prepared chunks, and the participation of others dropped off. In order to avoid this, it is recommended to use a problem with parts that break down into subparts that lead on from each other without great leaps. Other recommendations are to pre-populate the OneNote Notebook with the problem parts, and possibly direct parts at individuals if you know them well enough.