CASE STUDY

Game information sheets: a student-produced resource to help you run a Maths Arcade

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Abstract

The Maths Arcade is an extracurricular activity to play strategy games and puzzles, aiming to provide an informal student support environment, improve staff-student interaction and develop mathematical thinking. Running a Maths Arcade presents some need for information about the games. Three projects have hired students to create game information sheets to support using the games with new players and to encourage development of strategic and logical thinking.

Keywords: Maths Arcade, Students as partners, mathematical thinking, games, student experience.

1. The Maths Arcade

The Maths Arcade is an activity operated at several U.K. universities which aims to improve the student experience by providing informal student support and an opportunity to develop mathematical thinking. It is a regular, optional drop-in session to play strategy games and puzzles. The first Maths Arcade was developed by Bradshaw (2011) at the University of Greenwich in 2010. This was expanded to eight universities in 2012 as part of the National HE STEM Programme (Bradshaw and Rowlett, 2012), with other university maths departments starting their own Maths Arcades since. The Maths Arcade has also been used in other disciplines and in schools. A Maths Arcade can be started with a fairly small grant, for example Webster and Rowlett (2013) started one with a grant of £400 from the Institute of Mathematics and its Applications which was used to buy games that are commercially available.

The games are chosen to have simple rules that appeal to strategic and logical thinking. This provides a supportive environment for students to engage with each other and staff outside of the formal curriculum on a discipline-adjacent activity. That is, the activity uses logical and strategic thinking without being reliant on prior mathematical knowledge. This makes it ideal for induction and transition activities because students with different mathematical backgrounds are able to engage equally. Those who attend can be encouraged to think about the strategy behind the gameplay and this provides an opportunity to develop mathematical thinking.

Croft and Grove (2015) highlight the Maths Arcade as "*encouraging more opportunities for staff/student interactions*" (p. 181). At Sheffield Hallam University, the Mathematics group recently moved to a new learning space "*designed around the principle of co-location, with an open learning space surrounded by staff offices to encourage informal contact between staff and students*" (Waldock et al., 2017; p. 589). This has had some success, including indications that students feel like part of a "*mathematics community*" (p. 600). Students are positive about the integration of the Maths Arcade into this new space, with positive feedback and increased popularity of the activity reported by Cornock (2015).

Carpenter (2011), giving a student view, wrote about how attending the University of Greenwich Maths Arcade was "*of enormous benefit to [him] both on an academic and social front*" and how all maths students also benefited from "*fun, enjoyment, queries, banter and a light hearted approach to all aspects of mathematics*" (p. 30). An evaluation of the Maths Arcade at five U.K. universities

found that students who attended made friends, valued staff attendance and, though numbers of responses were small, "*students who attend more frequently are drawn to the more challenging two-player games*". As such games are more open to analysis (via combinatorial game theory), this may indicate that regular attenders develop "*from simply playing games towards analysis of strategy*" (Rowlett, et al., in press).

2. Game information sheets

One issue with running a Maths Arcade is information about the games. In an induction or outreach situation, there might be many participants new to the games all trying to play at once, making it impractical to personally teach everyone how to play a game. Experience shows that the instructions that come with some games are quite impenetrable. This indicates a need for games to have a simple, clear set of instructions.

Another issue is trying to encourage deeper strategic and mathematical thinking when staff may not have investigated each game themselves, particularly when one is trying to encourage a wide range of staff to take part in a staff-student community activity. This indicates a need to develop prompts to act as "*starting points*", "*introductions to potentially rich mathematical explorations*" (Schoenfeld, 1994; p. 45), to encourage players to move beyond simply playing the games to analysis and strategic thinking.

In 2013/14, James Hind and I obtained funding from our institution (Nottingham Trent University) to hire an undergraduate student, Kingsley Webster, to work on producing game information sheets. These have two aims:

1. to provide a clear description of how to play each game, to make the games easier for new players to pick up, including in busy environments such as induction, open days and outreach activities;
2. to provide prompts to encourage players to think about strategy and logic behind the games.

Sheets are designed around a two-page layout, with instructions including instructive photos on the front and strategy hints on the back (see Figure 1). The strategy hints are designed as a series of prompting questions appropriate for the game, such as "*Is there an advantage to going first?*", "*Is it easier to win if you keep your pieces close together or separated across the board?*" and "*Is it better to remove lots of stones quickly early on in the game?*". Most sheets also include a photo of some game scenario with a question asking what would be a good move to make in that circumstance. These are designed to encourage discussion around interesting points of strategy.

This first project produced information sheets for the 15 games in the Nottingham Trent Maths Arcade. In 2015, I moved to Sheffield Hallam University where the Maths Arcade has a greater selection of games, not all covered by the existing sheets. Funding from Sheffield Hallam in 2015/16 allowed me and Claire Cornock to hire undergraduates Lisa Eccelston and Peter Tonks to produce 12 missing sheets and also investigate suitable games, recommending new games to buy. With further funding from Sheffield Hallam in 2016/17, Claire and I hired undergraduates Daniel Arnold and Joseph Sugrue to make game information sheets for the remaining 9 games.

All game sheets developed are being made available by the Institute of Mathematics and its Applications website[i]. These are made available under a Creative Commons Attribution-Non-commercial-ShareAlike license, meaning they can be edited for non-commercial use under the same license provided the original author is attributed. For example, the version of the Quarto game sheet in Figure 1 has been edited to include the Sheffield Hallam logo.

I encourage you to consider running a Maths Arcade and making use of the game information sheets provided to do so. Advice on setting up a Maths Arcade, including a list of appropriate games, is given in the booklet edited by Bradshaw and Rowlett (2012) and in the Maths Arcade pages on the IMA website[1].

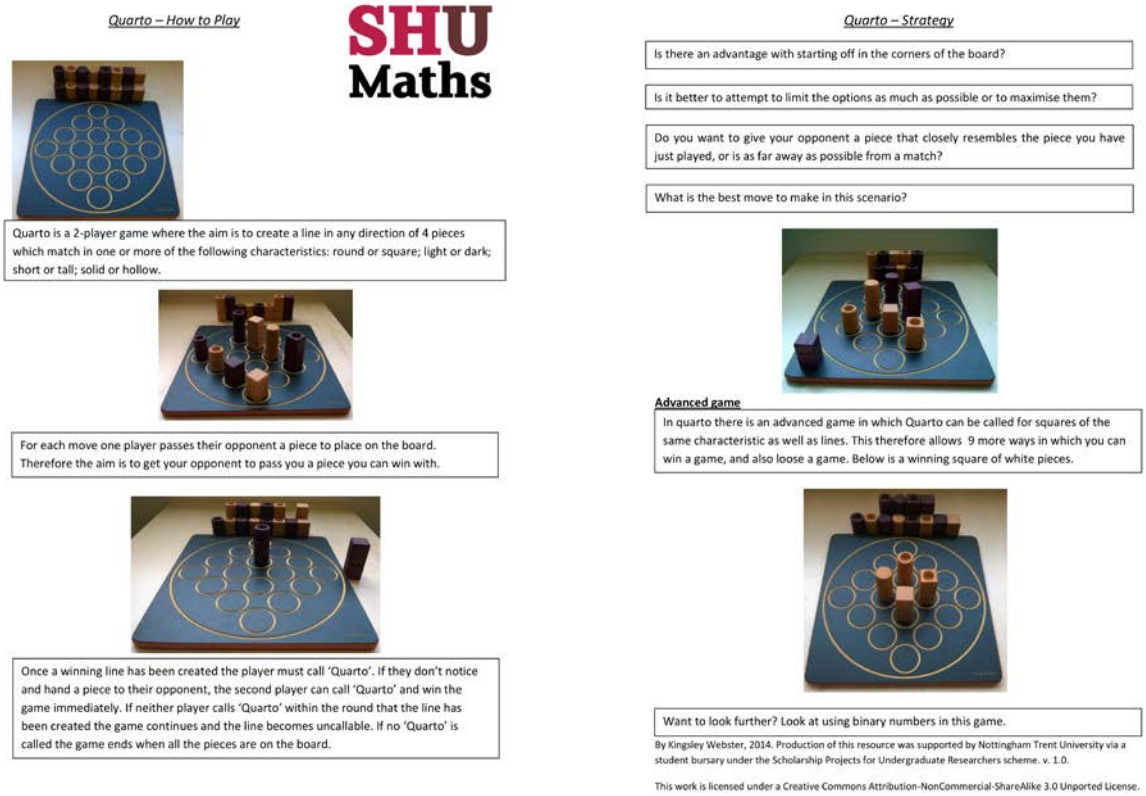

Figure 1. Two-page game information sheet for Quarto, edited to include SHU logo.

3. Acknowledgements

The work described in this article to hire students to produce game information sheets was funded by Nottingham Trent University via its Scholarship Projects for Undergraduate Researchers scheme in 2013/14 and Sheffield Hallam University via two Teaching Enhancement grants in 2015/16 and 2016/17. The Maths Arcade at Sheffield Hallam University was initially funded by the National HE STEM Programme and further developed by Sheffield Hallam University. The Maths Arcade at Nottingham Trent University was funded by the Institute of Mathematics and its Applications. Webspace to share the game information sheets is provided by the Institute of Mathematics and its Applications. I am grateful to my collaborators on these projects, James Hind and Claire Cornock, and to the students who completed the work, Kingsley Webster, Lisa Eccleston, Peter Tonks, Daniel Arnold and Joseph Sugrue.

4. References

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[i] https://ima.org.uk/865/maths-arcade-selected-games-and-resources/ or search at ima.org.uk for 'Maths Arcade'.