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Group 5: mathematics

Lesson plan: introducing the exploration

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Give each student a piece of paper and ask them to write down three things that they are really interested in. Provide some examples first so they see the width of ideas that are possible. Encourage them to think of academic areas but also what they enjoy outside of school, e.g. I might list swimming, chemistry, social justice, reading, cooking, travel, politics, films.

Lesson part 1

Now ask your students to think about ways that mathematics could be involved in each of these areas. You may wish to provide a table as a template (although I wouldn't include the headings if you do this — you want them to list their interests without concern for whether or not they involve mathematics). For example:

Swimming	Race timings Correlation between height and speed Expertise in different strokes vs height or weight Modelling different strokes using mathematical models
Chemistry	Reaction rates Boyle's law
Social justice	Poverty levels vs education
Reading	Word frequency in different types of texts
Cooking	Ratios
Travel	How prices change at different times of the year for flights Exchange rates Wing design in aircraft
Politics	Different electoral systems (how the winner is chosen in different electoral models)

Films	Profits vs costs Genres vs profits
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During this phase, encourage students to write down their thoughts first and then to share with their classmates to see if friends might be able to think of additional ways that mathematics can be involved. It should be stressed to them that there are no 'right' answers and that they can note down any ideas no matter how tenuous.

While students are doing this you can be walking around and perhaps offering small suggestions. For example if a student listed 'reading' you could suggest to them that they research Zipf's law and see if that maybe gave them ideas. You can also have students search the internet using some keywords. For example, I googled 'reading and mathematics' and came across a few scholarly articles that could have provided a starting point for an interesting exploration.

The idea at this point is just to get students thinking big about all the possibilities. The exploration process will be much more enjoyable if they get a topic that really allows them to explore something they find interesting.

Lesson part 2

Once students have spent a bit of time on this I would ask them to put their lists aside and hand them each a copy of the exploration criteria. Explain how the marking works and spend some time talking about 'easy' marks (e.g. using correct notation, proper mathematical language). I recommend handing out a sample exploration and asking students to mark it against the criteria. You can either use one provided by the IB or one of your own samples from a past student (each year I ask permission from students to use their work in future and ask whether or not they want me to keep their name attached), or even an exploration you've written yourself. The key is to find some work with fairly simple mathematics that students should be able to understand at whatever point in the course you are at. If time permits perhaps allow them to grade one piece of work that scored quite well and one that scored poorly so they can see the difference. An alternative is to have them grade every criteria except E and then just provide them with the grade for E and explain why the grade was awarded (if the sample you want to use has work that isn't accessible to them yet). This can be especially helpful at higher level where the mathematics may be quite time consuming to understand.

When I do this activity I get students to mark individually first and then put them in groups and tell them they have to agree on the grade as a group. Students need to discuss with each other and if there is disagreement explain to other members of their group why they believe their grade is the correct one before agreeing as a group on what mark to submit.

Lesson part 3

Now go through the criteria one by one and hear from the groups what they agreed on. Then reveal to them the 'real' grade and the justification for it. This is a good time for discussion over what kinds of things we are looking at in different criteria.

Lesson part 4

Share with the students some of the different types of explorations that can be done (as listed in the article on pp. 22–25 of the magazine, plus any extras you might have seen).

Ask them to go back to their own ideas and see what kind of categories their ideas might fall into.

At this point I would usually give students a homework task (with at least a few days to do it) to come up with an idea for their exploration. The key point here is that they outline what mathematics they are going to do. I also require students who are planning to use secondary data to find the data (and provide sources). As a teacher this helps me to steer students away from ideas where the data isn't accessible or requires collecting inappropriate primary data (either because I don't think it's a good idea ethically — e.g. IQ vs ethnicity — or because I think it will be too time consuming to do what they are thinking).

Students may either decide to go with one of the ideas that they came up with in the initial brainstorming or they might do something entirely different. It is unlikely that anyone has 'exploring new mathematics' as one of their topic ideas but some may be interested by this idea.

Once the students have submitted their initial idea and you've had a chance to go over them I recommend an individual meeting with each student (this can be done in class time while the rest of the class is working on mathematics unrelated to the exploration). At this meeting help the students develop their ideas more fully (unless it's completely unsuitable in which case explain why and ask them to redo this step). You may be able to suggest specific mathematics that could enhance what they are suggesting (e.g. their idea may lend itself to a chi-squared test or a t-test).

The goal is that by the end of this process every student will have an idea that, if done correctly, will allow them to write a good exploration.

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