USING PROBLEM POSING TO BRING REAL-LIFE INTO THE MATHEMATICS CLASSROOM: CAN IT BE TOO REAL?

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In Norway, there is a long tradition of encouraging children to pose a problem that they can solve using an arithmetical calculation. This process is known as *'regnefortelling'*, with the best English translation being 'number story'. In the course of our research on argumentation structures students used in their written problem posing and problem solving, we became interested in *regnefortelling*. We noticed that most of the contexts for the *regnefortelling* were similar to those in textbooks (Fosse & Meaney, submitted), something also found by others on projects about problem posing (*e.g.,* Lowrie, 2002).

There were also a small group of *regnefortelling*, that used more unusual contexts, contexts that made us uneasy and invoked a feeling of uncertainty about how we would respond to the students, if we had been their teachers (both of us had been school teachers before becoming teacher educators). In discussions about *regnefortelling* at Norwegian teacher conferences, some teachers expressed similar feelings about the contexts and how they should discuss them with children. To better understand how these feeling of uncomfortableness and uncertainty could be linked to students' possibilities to learn, we consider how our reactions to these *regnefortelling* can be linked to issues of power and our (unconscious) acceptance of a hidden curriculum about what school mathematics problems should or should not be.

Meaningful contexts are unlikely to be viewed objectively by students, regardless of whether they have chosen them, or others have chosen them (de Freitas, 2008). Nevertheless, there is little research about whether some contexts could result in affective response that reduce possibilities for learning. In a study investigating educators' views on how contexts might hinder students' learning, Sullivan, Zevenbergen and Mousley (2003) found that middle-class values connected to problem-solving contexts potentially led to a lack of recognition that working-class children might be hindered from learning because they responded differently to those contexts. One educator summarised a classroom dilemma of identifying appropriate contexts for open-ended, problem-solving situations, by stating, "the context needs to be close to the kids but not so close that it's an emotive issue" (p. 115). The presumption was that contexts that produced an emotive response in students were unlikely to contribute to learning.

From our perspective motivating contexts for problem posing must be seen not merely as useful vehicles for learning mathematics, but also a discussion needs to be had about the impact of affective responses to these contexts. According to Cai, Hwang, Jiang and Silber (2015) discussions about affective responses to problem posing have mostly been related to the impact that problem posing has on students' feelings about mathematics. We think it is more useful to consider how educators respond to students' posing problems in which they verbalise affective responses to their everyday contexts. It may be that the affective responses shown in students' *regnefortelling* could limit their learning of mathematics if educators do not respond to them respectfully. If educators view the contexts as examples of non-conformity to task requirements and not as legitimate insights into students' lived experiences, then mathematics learning is likely to be hampered. In this paper, we consider why educators, including ourselves, may feel uncomfortable about some contexts and how this could limit students' possibilities to learn. To do this, we consider how the power connected to the role of the educator and the expectations of the hidden curriculum places expectations on teachers to channel students into producing responses to academic tasks that conform, thereby reducing their uncomfortableness in having to deal with unexpected student responses.

Power and the hidden curriculum

Power relationships operate in school classrooms, because the roles of being a teacher or a student act as determining features in regard to what actions are permissible (Gordon, 1980). The teacher's knowledge is usually more powerful, than that of the students, as it is the teacher who has the responsibility to ensure that students learn what is in the curriculum (Gordon, 1980). They then have control over the choice of tasks that are be undertaken in the classroom.

The hidden curriculum can also be a powerful force for determining what is done in schools. Although mathematics education often promotes logic and creative ways of structuring problems in official documents, Skovsmose (1990) indicated that mathematics education instead teaches students to follow instructions, with many students learning that they cannot do mathematics, and "to become servile towards those who can manage" (p. 115). These undiscussed outcomes of mathematics education, Skovsmose labelled the hidden curriculum. Similarly, Zevenbergen (1996) claimed that because mathematics' abstraction has been valued so highly by society, the passing on of this knowledge and way of thinking has been rigidly controlled. Therefore,

mathematics education has concentrated on improving students' chances of learning mathematics, rather than improving students' ability to critique the role mathematics plays in society. In discussing the introduction of the NCTM *Standards* in 1991, Apple (1992) illustrated how the push for real-life problems was likely to be hijacked, unless teachers were provided with support:

> In a context of increasing conservatism in schools, unless teachers are prepared to deal with this as a serious issue, the positive vision of a mathematics curriculum more closely connected to students' social needs and experiences may be transformed once again into a curriculum based on social efficiency and on definitions of "appropriate" problems of a very limited portion of the public. (p. 425)

In writing *regnefortelling*, children have the opportunity to use mathematical knowledge in situations where they are in control. *Regnefortelling* by changing who makes the choices about appropriate contexts can upset the power relations between children and teachers. However, as Gordon (1980) stated children rarely have 'free' choice in classroom situations because implicit understandings about what is expected often affect what they understand to be acceptable choices. While outwardly presenting itself as contributing to building democratic competence by allowing students to make choices about the contexts and problems that they want to solve, *regnefortelling* is likely to be influenced by the hidden curriculum. The choices may be merely superficial, with expectations about appropriate contexts and problems more likely to have an impact on those choices. The need for mathematics problem posing and solving to be objective is a result of what Skovsmose (2008) called 'ethical filtration'. As summarised by de Freitas (2008), "ethical filtration is built into the practice of mathematics in action, that is to say, the act of stripping away the contingent and the subjective are inherent to mathematical problem solving" (p. 87).

In the next section, we describe three types of problem posing that made us uneasy and their connections to power and the hidden curriculum. From these examples, we consider how the hidden curriculum controlled our expectations about mathematics education. In so doing, we hope to provide a basis for discussing these aspects with teachers and teacher educators.

The uneasiness from students' choice of contexts in regnefortelling

We collected *regnefortelling* from about 80 children, spread across 3 classes from one Norwegian school in 2018. Regnefortelling typically have a written problem, a solution (written or symbolic) and a drawing. The classroom teachers introduced the work with *regnefortelling* by encouraging the students to either choose their own numbers and decide whether it would be an addition or subtraction problem or to draw a card from each of two different decks of cards. Each deck provided a number to be used in the *regnefortelling* and the students could then choose whether to make the problems about addition or subtraction.

Some of the *regnefortelling* made us uneasy, because of what was included in the written context, the drawing or both. Our uneasiness was connected to three different types of *regnefortelling*. The first was because we interpreted the *regnefortelling* as indicating an unwillingness to engage with the task. The second was because of the expression of distress by the characters described in the *regnefortelling* and the third was because the contexts were socially-taboo or socially-unacceptable. These examples could be considered as non-conforming because they did not match our expectations in the way that the other *regnefortelling* did. We have no information about the students' reasons for producing these *regnefortelling* and so we focus on our own interpretations and what may have contributed to them and how those reactions might limit students' future mathematics learning if we had been their teachers.

It must be stated that there were very few examples in each of these groups. This may have been because it was only a small minority of students who responded in these ways or because some of the teachers filtered out those *regnefortelling,* which they did not feel were appropriate for researchers interested in argumentation structures.

From our analysis, it became clear that the hidden curriculum made us expect that the children would be aware of the need for ethical filtration and when they did not show this awareness, by using non-emotive contexts, we became uneasy. In the following sections, we provide examples of each of the three types of *regnefortelling*. We have translated the Norwegian problems and solutions into English. These children in Grade 2 were still learning to write and so there are many spelling and grammar errors [1]. We transcribe the children's writing for legibility including errors, as well as providing English translations. Rather than try to replicate similar errors in English we have used correct spelling and grammar in the translations.

Non-engagement with the task

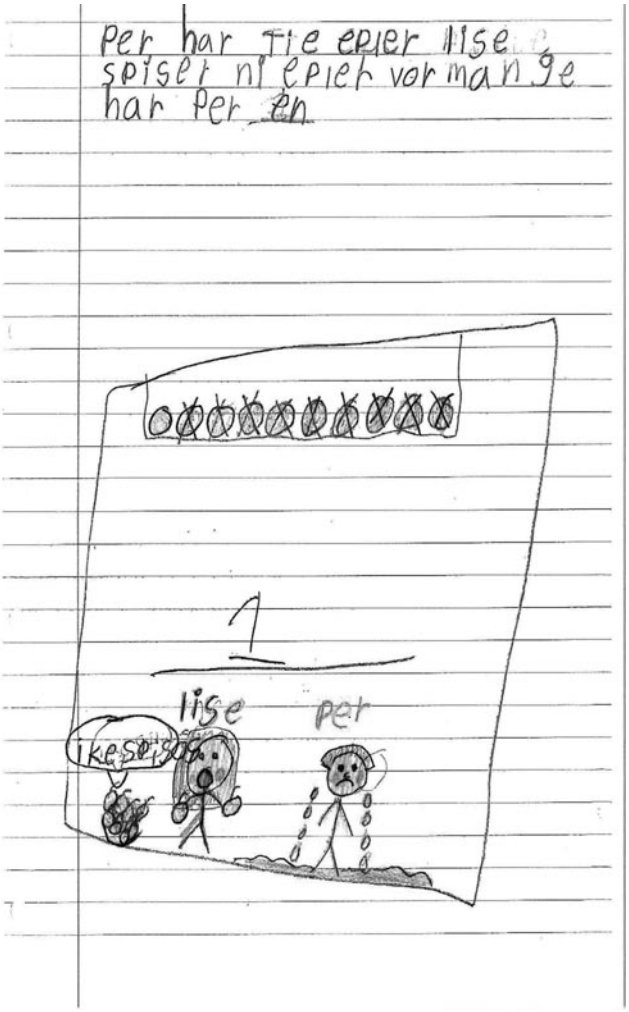
The first kind of example was where a child indicated that they did not agree with participating in the activity. In this case, they did this by not providing a *regnefortelling* but instead handing in a piece of paper which had been heavily scribbled on (see Figure 1).

Figure 1. A scribble as a regnefortelling.

This made us uneasy because it seemed to indicate that the task was not something that the child felt willing or able to do. It is unknown why this was the case as it was the class teacher who set up the task and collected the examples. Silver (1994) had suggested that students who were high achievers in doing mathematical exercises might struggle with the uncertainty that surrounds problem posing. This may have been the case with the author of Figure 1 or it may have been that they were simply bored.

As those responsible for asking the teacher to do the task with the children, even if it was an established tradition in Norwegian classrooms, the realisation that it was the power that we have over the students' lives which produced such a response, made us uneasy. If we had been the child's teacher, we could find out the cause for this response, but this information would not alter the fact that we required of the children tasks that they could not require of us. Part of the hidden curriculum is that the accepted power relations mean that educators have the right to control what children are expected to do. These expectations about who can tell whom to do what in the classroom are not easily broken, even by educators (Hansson, 2010).

When students push back by refusing to participate in expected ways, there is a need to reflect on why this is the case (Truman, Hackett, Pahl, McLean Davies & Escott, 2020 forthcoming). Here it does not seem to be a situation in which the student's non-conformity was linked to a wish to meet social needs, as has been suggested by Hand (2010) for older students, who try to either persuade others to not fulfil the requirements of the task, or align themselves with dominant students who are not doing so. This is because the completed tasks were collected by the teacher and not shared. Almost all of the students fulfilled the task appropriately because they produced a *regnefortelling*, even if there were other unexpected aspects to them. Therefore as educators, we need to ask what this student was trying to express. The risk of attempting to respond in the moment to a student producing such a response by encouraging them to simply conform to the task requirements could be that we would have lost an opportunity to find out something significant about their lives.



Per har tie epler lise spiser ni epler vor mange har Per. En
[Per has ten apples. Lise eats nine apples. How many does Per have? One]

Figure 2. Regnefortelling about apples.

Expressions of distress

The second kind of *regnefortelling* that made us uneasy were those in which the characters expressed distress. Part of the hidden curriculum in mathematical problem posing and problem solving is that distress and other strong negative emotions should not be evident. Although de Freitas (2008) considered that moral outrage could be part of problems linked to critical mathematics education, moral outrage unlike anger has the connotation of being a positive emotion.

In Figure 2, the writing includes a fairly straight-forward description of a subtraction problem, but the drawing indicates that Per is very unhappy about Lise eating his apples. The basket of apples to the left of Lise has a sign saying *"ike spis os"* [don't eat us], suggesting that the author had some empathy for the apples or the owner of the apples. Per's tears not only fall from his eyes, but make a puddle on the ground suggesting that he was deeply upset by Lise's actions. If the problem posing in *regnefortelling* are to be based on children's everyday lives, then this example suggest that everyday life may be fraught with bullying and non-respectful relationships.

In expressing their emotions, the student was able to be creative within the *regnefortelling,* through the drawing. Our uneasiness comes from recognising the drawing as a representation of a real world context for mathematics posing, but one where strong emotion was part of it. The use of a context in which someone was not respectful of another person's things and caused distress, did not meet the teacher's criteria that the context should be close to the student, but not so close that it produced an emotive response, as described by Sullivan, Zevenbergen and Mousley (2003). This student had not (yet) learnt to conform to the hidden curriculum mandate that contexts should not be emotive. However, it also illustrated to us that it was our power as educators, which led us to expect children to follow the undiscussed rule that *regnefortelling* should use real life, but not be emotive.

Nevertheless, this example opens up possibilities for discussing, with the whole class, issues of bullying and non-respectful behaviours between children, if the author agreed to it being used in this way. It also allows for discussions about how mathematics can be used to argue for what could be a fair share of the apples and what might affect a fair share, such as if one child was hungrier than another child.

Socially-taboo or socially-unacceptable contexts

The third kind of *regnefortelling* which made us uneasy were those whose contexts were connected to illegal acts, such as stealing and killing. As well, there was an example of a dog defecating which although not an illegal act, would not be a context generally found in a textbook because of its taboo nature.

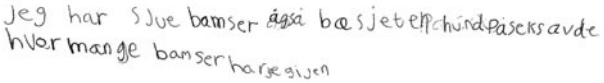
The *regnefortelling* in Figure 3 only contains the problem, with no solution and no drawing (perhaps for the best). Like the previous example, it is a subtraction word problem, built on the assumption that teddy bears, which had been defecated on, would be thrown away.

Our experiences as teachers led us to situate this problem as not 'nice', because the context would usually be socially taboo in classrooms. That this student used such a context made us uneasy, because the student did not seem to understand that the hidden curriculum requires contexts that are socially acceptable to adults or refused to conform to this expectation. Yet, why some topics are socially taboo is rarely discussed in classrooms. The teacher has the professional power to open up such discussions, but rarely chooses to do so specifically because the topics are socially taboo. Consequently young children become responsible for having to learn to conform to the hidden curriculum and can be penalised by not having their work recognised as a result. As was discussed in Sullivan, Zevenbergen and Mousley (2003), this is likely to disproportionally affect how teachers view the *regnefortelling* of children from working class backgrounds, who may consider acceptable contexts to be different from their teachers.

Other contexts used in the *regnefortelling* could be considered socially unacceptable, although perhaps not taboo in the same way that defecating is. These included stealing and murdering people and made us uneasy. We had several examples of each topic. In some examples, the first person singular *'jeg'* [I] was the protagonist (see Figures 4, 5 and 6), which was confronting because these young students were indicating that they were prepared to undertake illegal acts. There were other *regnefortelling* where something was stolen from someone, usually the author, which had similarities with Figure 2, but without the strong level of emotion expressed in it.

Figure 4 provides an example of one of the *regnefortelling* about stealing. It, like Figure 3, only has the problem, with no picture and no solution. Topics to do with illegal acts do appear in mathematics classrooms (Sullivan, Zevenbergen and Mousley, 2003, for example, include one about a police line-up). However, in the *regnefortelling* in Figure 4, the student situated themselves as the thief who stole diamonds.

Educators in Sullivan, Zevenbergen and Mousley's research suggested that social class differences might result



Jeg har sjue bamser ågså bæsjet en hund På seks av de
hvor mange bamser har jeg ijen
[I have twenty teddy bears and then a dog pooped on six of them.
How many teddy bears do I have left?]

Figure 3. Dog defecating on teddy bears.

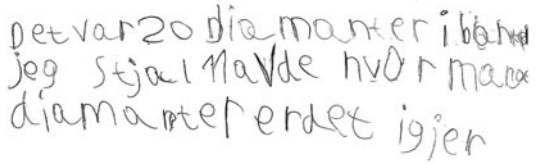
in children responding to a context in different ways. In this example, it was not the teacher's choice of context which was problematic for the students, but the student's choice of context and the situating of themselves within it which was uncomfortable for the educators. It is difficult to know what influenced the student to produce this *regnefortelling*. Perhaps being asked to write a *regnefortelling* allowed some students to explore dark aspects of their play world. Children at this age are known to oscillate between describing rule breaking as acceptable if it brings a benefit to the rule breaker and expressing empathy for the victims (Lagattuta, 2005).

Other contexts connected to illegal acts included situations in which things were exploded and these may also have allowed for an exploration of dark aspects of their play world. For example, there were several examples of exploding football jerseys. Although perhaps a slightly unusual context, these did not make us feel uneasy. However, there were some like Figure 5 which did because they indicated that the problem involved people dying.

In Figure 5, the *regnefortelling* again only includes the problem, without a solution and a picture. In it, the student claimed responsibility for exploding 10000 houses. Although unusual, we did not find the context to be uncomfortable. This changed when the student described people being thrown up, with the implication that they died. Although the student did not state it explicitly, this suggests responsibility for their deaths. Like the previous example, the author of this *regnefortelling* did not conform to our expectations of what were acceptable problems.

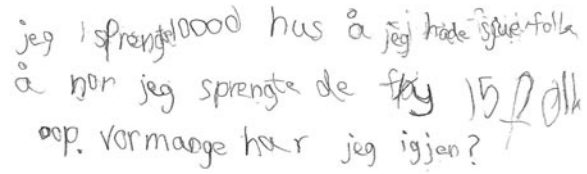
Our uneasiness became more pronounced when we viewed Figure 6. In this *regnefortelling*, the student included the problem, the solution and a drawing, all of which made us uneasy. The *regnefortelling* is about killing people with the author explicitly taking a position as the killer. It was particular confronting for us.

Other educators' initial reactions to these *regnefortelling* were that the contexts may have come from video games and



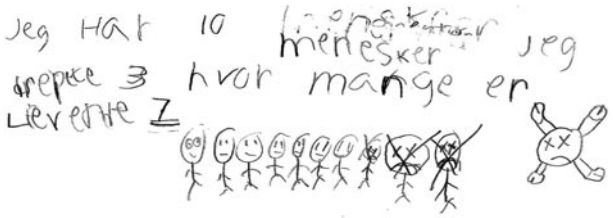
Det var 20 diamanter i banken
jeg stjal 11 av de hvor mange diamanter er det igjen.
[There were 20 diamonds in the bank
I stole 11 of them. How many diamonds were left?]

Figure 4. Stealing diamonds.



jeg sPrengte 10000 hus a jeg hade sjue folk
a nor jeg sprengte de fløy 15 folk oop. vor mange har jeg igjen?
[I exploded 10000 houses and I had twenty people
and when I exploded them 15 people flew up. How many have I left?]

Figure 5. Exploding houses.



Jeg har 10 menesker Jeg drepte 3 hvor mange er levene 7
[I have 10 people. I killed 3. How many are alive? 7]

Figure 6. The killing problem.

so could be part of exploring dark aspects of play. Video games of a violent nature, depicting acts of this kind, are prohibited from being played by children of this age in Norway. Still older siblings or even parents may allow children access either to watch or to play themselves. Nevertheless, like cartoons, the children would not consider them real-life.

However, earlier in 2018, the year these *regnefortelling* were written, there had been a mass shooting at Marjory Stoneman Douglas High School in the US and an earthquake in Mexico. News stories surround children in digital form with few prohibitions about what they see because it is assumed that they will make sense of them. As Osgood *et al.* (2019) stated,

> It is now more widely accepted that children are competent, knowing beings in and of the world, readily taking up, processing and challenging messages about a raft of uncomfortable and inequitable realities, from global warming, to sexism, to racial intolerance, to class prejudice. (p. 319)

Therefore, our uneasiness may come as a result, not of the children's illustration of a willingness to adopt a violent persona, but because these *regnefortelling* shatter our illusions of childhood innocence. Maybe in writing these *regnefortelling*, the children are processing images of violence as a way of trying to understand what they have seen, either in video games or on the news. However, in doing so they violate the hidden curriculum about the acceptable contexts for mathematics problems. It is us, as adults who need to understand where the feelings of uneasiness come from. If we do not, then we are likely to use our professional power to suppress the children's opportunities for processing what they experience and need to make sense of.

Instead educators could, with the authors' permission, open up conversations that focus on developing empathy for victims (such as can be seen in the *regnefortelling* in Figure 2), something that has been suggested is possible through the use of student-written stories (Upright, 2002). Again mathematics should not be a bit player here, but rather be shown as providing opportunities for exploring moral issues. Mathematics can add to understandings of the world, rather than real-world contexts being merely the vehicle for showing that mathematics learning has occurred.

Too real for whom?

In a discussion about refusals to engage in literacy practices, Truman *et al.* (2020 forthcoming) used the analogy of a turtle trying to explain dry land to a fish. The turtle was only able to answer the fish's questions by saying what dry land was not. When the fish requested that instead the turtle describe what it was, the turtle said that he had no words for that. Truman *et al.* use this story to discuss how refusals to engage in literacy practices could come to be ignored because the observers of these refusals may only understand them in terms of what they were not, rather than what they were. In considering the *regnefortelling* that made us uneasy, we found that in order to move from what they were not–non-conforming contexts for mathematical problem posing and problem solving–we had to turn to what they were and what they offered for potential mathematical learning opportunities. To do this, we had to better understand what produced such reactions in ourselves. This led to an understanding of how the hidden curriculum allowed our acceptance of appropriate contexts as being close to the students, but not emotive. From this awareness, we were able to identify how these non-conforming *regnefortelling* could provide mathematical learning opportunities, in that mathematics could be used to discuss fairness and empathy, using the students' own examples.

Conversations with the students about their engagement with *regnefortelling* or their choices of contexts are important, but not because educators should bring children into alignment with the hidden curriculum about what are 'acceptable' problems. If we consider problem posing as providing opportunities to make mathematics more interesting to students because it builds on their own interests (as suggested by Christou, Mousoulides, Pittalis, Pitta-Pantazi & Sriraman, 2005), then we need to be in dialogue with those students about their chosen contexts. For them, the contexts that they choose are never 'too real'. As educators, we need to engage in dialogue, where we both accept that our current understandings are inadequate and that by coming together we can further our joint understanding, including about how mathematics can be used to solve real world moral issues (Skovsmose, 1990). As educators, professional power resides with us, we have the possibility to set up such dialogues, while students do not. If we do not take up these opportunities, we risk that we will continue to mostly get *regnefortelling* which resemble textbook examples because through the hidden curriculum, students will soon learn that only certain contexts or ways of acting are acceptable and their possibilities for resistance are reduced to scribbles on a page.

Postscript

Our world has changed overnight. The pandemic has resulted in all of us having to process staggering figures of

infection and death. Alongside this, we have to make sense of people fighting over toilet paper in supermarket aisles and stealing hand sanitiser from hospitals, behaviours that go against our preconceptions of how to behave. It is all too easy to view the numbers of infected or dead as abstract data, until they represent family or friends, or to condemn people for not behaving better. Stress affects people in a variety of ways and it is only through dialogue that we can better understand what is actually happening.

Thus, when children finally return to face to face classes, we are likely to see examples of how they process the experiences that they have been through. The social media stories about children enjoying exclusive access to their parents for weeks on end probably mask a reality that is not always so naively joyful. If *regnefortelling* are to do what they are supposed to do, that of allowing students to bring their experiences into their problem posing, then we should welcome those possibilities that make us, as educators, feel uneasy because it provides opportunities to learn more about the students, as we also help them to use mathematics to process those experiences.

Acknowledgments

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Note

[1] Norway has two written forms of the language. These children were learning to write in *bokmål*, but there are usually significant differences between the spoken dialects and both written forms.

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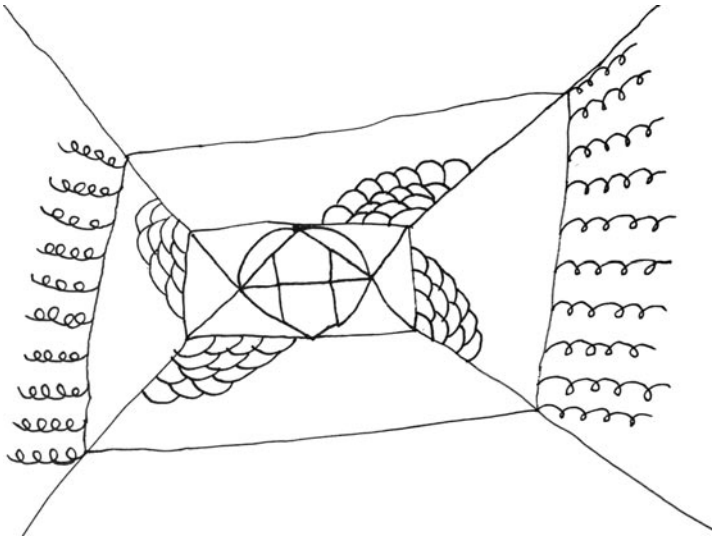

Drawn by Iris, age 12, on being asked to "Draw something mathematical."