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Is it time to start reconsidering the teaching of time?

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Is it time to start reconsidering the teaching of time?

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How students are taught about the difficult concept of time needs to be carefully considered, in terms of both the key aspects involved as well as the sequencing. Examples of concrete activities to support the teaching of time are included.

When teaching the measurement attribute of time, most teachers are aware that just getting students to read a clock is a task with its own challenges, but is developing this skill and understanding enough? What else do teachers need to make sure they cover, in order to give students a chance of developing this important component of being a numerate citizen?

Figure 1. Shepherd Gate Clock at the Royal Greenwich Observatory.

Introduction

Time is a mercurial attribute of measurement. Unlike most of the other measurement attributes, for example length or mass, time cannot be seen or felt. People can view and record its passing on a clock, but it involves nothing tangible (without getting in to deep metaphysical discussions) that a person can hold. Time is a topic which is full of linguistic inconsistencies. For example, ask a person what "Wait a minute" means and they will tell you that depending on the context it might mean wait a moment (and by the way a moment is a mediaeval measure of time equalling about 90 seconds), or a very long time if you are calling for assistance with an issue. Then there are the inconsistencies when talking about the base system of the numerical language used about the periods of time. There are 60 seconds in a minute and sixty minutes in an hour so obviously there are 60 hours in a day! Well, no there are 24 hours in a day and seven days in a week, four weeks in a non-calendar month and 12 calendar months in a year! It makes the base 10 system seem easy.

Then depending on the length of the time period or periods dealt with, or the different purposes for which people are using time, there are varying devices to employ and read: a watch or a clock (which can be analogue or digital), a calendar, a timetable, a schedule, or the occasional sundial or egg-timer. With all of these confounding features, if teachers want to give students the capacity to successfully deal with the attribute of time, then they need to make sure that they construct a thoughtful program of learning.

The three key aspects to teaching time

Siemon, Beswick, Brady, Clark, Faragher, and Warren (2015) write that there are three key aspects in developing an understanding of time. These are:

- Understanding the concept of time duration
- Appreciating the passing and sequence of time
- Determining a given point in time through the reading of a clock face (p. 471).

Of these three key aspects it seems that the one that gets most attention in schools and in the *Australian Curriculum* (ACARA, 2017) is the reading of clock faces.

Duration

Duration of time can be thought of as the time it takes from the start of an event to its end. One issue to consider with duration is that if two events start at the same time and are compared, the focus concerns when the event finishes rather than the length of the duration. That is, students concentrate on the order of the events finishing rather than how long they have taken. Therefore, when focusing on duration events should be started at different times.

Figure 2. The Dolphin Sundial at Greenwich.

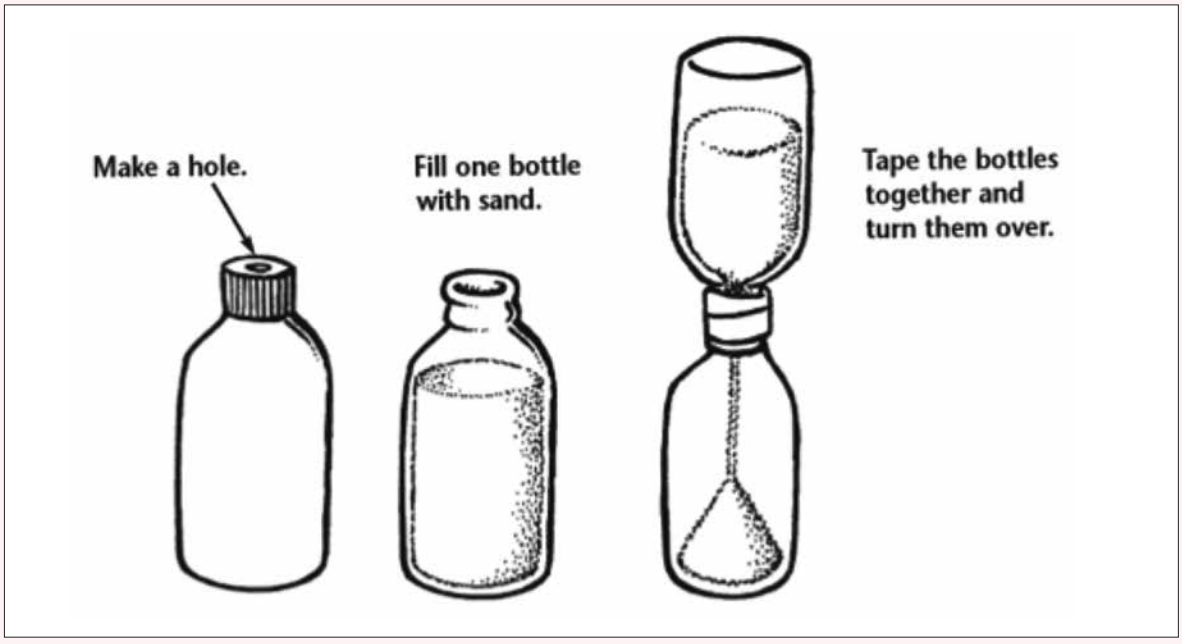
Make an hour glass/egg timer

Use two empty bottles of the same size and keep one of the lids. Drill a hole in the lid using a different drill-bit size for each student's egg timer. Add dry clean sand (a nice fine sand bought from a building supply shop is best) and tape the bottles together so that the sand flows from one to another.

Get the students to test the duration of time the sand takes to flow from one bottle to the next and alter the amount of sand to create differently timed timers (1 minute, 2 minute etc.).

These can then be used for a variety of activities. Pose some questions regarding:

- What happened when we made the holes bigger?
- What would happen if you used a bigger bottle and more sand?
- How could you make the timer time for longer?
- What might these timers be useful for timing?
- What might these timers not be useful for timing?



Source: Diagram used with permission from Department of Education. (2013). *First steps in mathematics: Measurement book 1*.

Activity 1. Make an hour glass/egg timer instructions.

Passing and sequence

The passing and sequence of time can be approached through examining the children's lives and the 'broad' divisions of their lives in days and weeks. This could be done by concentrating firstly on ideas such as morning, afternoon, evening and night, and then expanding this to the days of the week and the concepts of yesterday, today and tomorrow. This then could lead into investigating the months of the year which can be used in highlighting key events in the year: Christmas, Easter, student birthdays, ANZAC day etc. Later, students can stretch these time-lines to plot their lives, which can lead to further investigations of key historical events.

Reading a clock face

Reading a clock face is somewhat complicated by the fact that there are both analogue and digital clocks with which to contend. The reading of a clock face is a logical step after learning about morning and night, as it gives the necessary level of accuracy within those broad divisions. However, teaching children to read a clock face does have some challenges. The fact that the students have to deal with a scaled instrument (and reading of other scaled instruments is not expected until the students are in Year 4 (ACMMG084, [ACARA, 2017]) is only the start.

When working with an analogue clock face, a couple of issues need consideration. Each of the numbers on the clock face has a dual purpose; to show the hours and the minutes. For example, the three on the clock face represents the third hour of the morning or the afternoon and shows where the big (minute) hand has reached after fifteen minutes and is also referred to as a quarter of the designated hour (quarter past)! Also, each of the spaces between the numbers on the clock face is divided up into five parts, representing five minutes. These gradations are not numbered. Clearly then, students need quite a lot of experience using, and I believe constructing clocks, to start to make sense of the scaled instrument that is in front of them.

A sequence for teaching time

In a previous article published in APMC (Hurrell, 2015) it was suggested that there is a well-established and researched sequence for teaching measurement (Booker, Bond, Sparrow & Swan, 2010; Serow, Callingham & Muir, 2014; Van de Walle, Karp & Bay-Williams, 2013), and that this sequence works across all of the attributes of measurement. This sequence involves: identifying (and perceiving) the attribute to be measured; comparing and ordering; measuring using non-standard units; measuring using standard units, and; applications of measurement.

Before explaining the sequence, I would like to propose that in every lesson on the attribute of time, and in

Make a clock

Remove or obscure any analogue clocks in the classroom. Using paper plates and texta pens, get the students, without assistance, to draw a clock showing three o'clock. The idea behind this is to see what the students already know and understand regarding clock faces and the hands on a clock. Look to see if the students have:

- The numbers —12 with the number 12 at the top of the clock face
- The numbers on the clock reasonably spaced
- The number six approximately opposite the 12
- A big hand and a little hand
- The big hand pointing to the number 12
- The little hand pointing at the number 3

Ask the students to tell some things they know about clocks and time.

Depending on what this exercise raises some targeted teaching may be required. The next step is to make another clock face using a paper plate (and the newly acquired knowledge of clock faces) and construct a clock with moving hands.

Activity 2. Make a clock instructions.

fact every measurement lesson, that students should be required to engage in estimation. Estimation has many practical implications (Reys, et al. 2012) and is an essential skill. Consider for a moment the importance of estimation to people employed in a trade. Estimation can also provide intrinsic motivation for measurement, as it is engaging to see how close or accurate an estimation is (Van de Walle, Karp & Bay-Williams, 2013). The significance of estimation needs to be communicated to students, as many students tend to see estimation as trivial but problematic, and believe that a successful estimation is considered to be one that is close to the estimation of the teacher (Muir, 2005), rather than a necessary part of the measuring process.

It is suggested that teachers ask students to estimate and indicate how long 30 seconds and one minute are, by closing their eyes and putting their heads on the desk and raising their hand when they consider the appropriate length of time has passed. Allow the students to estimate how long they think certain activities or actions might take. Get them to estimate how many minutes they have been in class since the morning break or since the school began that morning. Allow them the oppor tunity to estimate how long it might take for sand to run through an egg-timer, both a commercially produced egg-timer, and even better, ones that students construct themselves. Ask questions such as, " Is it reasonable to believe that a person could run around the oval in one minute?" or "If there is enough time to play a [given] game in the time remaining before lunch?".

Make a calendar (from chairs)

- You will need 42 chairs for this activity (you might have to beg some from next door).
- Arrange the chairs into six rows of seven.
- Hand out cards to each student in the class. As there are 38 cards quite a few of the students will be given two. The cards should be the days of the week (Monday through to Sunday) and the number one to thirty one.
- Students with a day of the week card are asked to place these cards in order on chairs at the front of the room.
- One student is asked the date of their birthday and if they remember which day it was on. In the example below Thursday the 17th was identified.
- The person with the number 17 card goes to the Thursday column of chairs and is helped by the teacher (if required) to place the card on the correct chair.
- The student with the card with 16 is then asked where they think they should place their card and what day it will be. This is repeated for the 18th and then the 15th, 19th etc. until all cards have been placed.
- Repeat the activity starting with different birth dates on different days of the week.

Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Empty chair (this time)	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	Empty chair (this time)	Empty chair (this time)	Empty chair (this time)

Activity 3. Make a calendar from chairs.

Identifying (and perceiving) the attribute to be measured

Identifying the attribute of time can be achieved by looking at an activity which has time as one of perhaps multiple attributes, and then focussing on the time element. For instance, when measuring a swimming race it can be by the distance that is covered (25 metres, or 50 metres or 800 metres etc.) or by how long it takes to complete. This can then lead to discussions about the relationship between the two attributes.

Comparing and ordering

This part of the sequence is exactly how it sounds in that the students need to compare some activities and order them. For instance three daily activities such as brushing teeth, walking to school and eating an apple could be compared and then seriated according to their duration. Questions that could be asked are: what activity takes the shortest length of time, which takes the longest length of time, and which activity sits between them in the length of time it takes?

Measuring using non-standard units

To get the idea of duration it is not necessary to use standard units. Instead students can judge the duration of an activity through activities such as regular clapping or a metronome swing. The idea that one activity is longer in duration than another can be developed without the need to consider the vagaries of how seconds or minutes are read and comprehended, and their relationship to each other. Using non-standard units it is still possible to quantify the duration (ten hand claps), and even to determine the difference in duration between two activities. (For example, "Sarah took ten hand claps to do eight star jumps and Scott took twelve hand claps to do eight star jumps. So Scott takes two hand claps longer than Sarah to do eight star jumps.")

Measuring using standard units

This is the teaching and learning point where hours, minutes and seconds are used to quantify the duration of activities. Students also need to discuss other units which measure longer timespans, such as days, weeks, months and years.

Application of measurement

This is when computation and formulae can be used in problem-based activities: for instance, relating time to other attributes such as measuring the rate of water flowing from a tap, or time differences around the world and the importance of Greenwich in the calculations of these. It needs to said, though, that students should be very comfortable with making meaningful measurements with standard units before application of measurement is required.

Conclusion

For a number of reasons, time is not the easiest of the measurement attributes to teach and learn, not least of all because it is not tangible. Yet time is a concept which constantly involves us all. In order to teach time well, teachers need to develop a teaching structure to scaffold the manner in which they approach the topic, and then have a wide range of activities to support this teaching. Where possible teachers need to make these activities as 'concrete' as they can.

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