

AMoSS-junior – A new test instrument on the Apparent Motion of Sun and stars for primary school students

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Abstract. Many young children, students, and adults have difficulties describing and explaining the apparent motion of the Sun and stars. However, a good understanding is essential to study more advanced astronomical concepts. Bekaert and colleagues developed and validated a dedicated test that allows to systematically map secondary school students' understanding of the Apparent Motion of the Sun and stars (AMoSS test). However, the test instrument is not suitable for substantially younger students.

In this contribution, we report on the development and validation of an instrument based on the AMoSS test, specifically aimed at 10-12-year-old students.

Introduction and theoretical framework

Although every day and night, we see the motions of the Sun and the stars, research shows that many people cannot really explain these phenomena [e.g., 1-5]. Bekaert et al. developed and validated a dedicated test instrument that allows to systematically map upper secondary school students' understanding of the Apparent Motion of the Sun and stars (AMoSS test) [6].

As with many scientific ideas, the understanding of the apparent motion of the Sun and stars evolves from a young age until adulthood. The AMoSS test is a written test for upper secondary school students' understanding, but it is not suitable for much younger students. To study the development of student ideas over time, a revision was needed. We designed and validated – starting from the AMoSS test – a new test to measure primary school children's understanding of the apparent motions of the Sun and the stars, which we named AMoSS-junior (AMoSS-j).

Figure 1 shows the framework that underpins the original AMoSS test: characteristic elements of the apparent motion of the Sun are listed in the left column. The right column contains the parallel elements for the apparent motion of the stars. For each cell in the table, a multiple-choice question was designed for which students were also asked to justify their answer.

(I) Apparent Motion of the Sun	(II) Apparent motion of a star
(A) Daily Sun position changes: Sun's path	(A) Nightly star position changes: star trail
(B) Sun culmination changes during a year	(B) Star culmination does not change during a year
(C) Sunrise and sunset position change during a year	(C) Star-rise and star-set position do not change during a year
(D) Sun culmination depends on observer position	(D) Star culmination depends on observer position
(E) Sunrise and sunset position depend on observer position	(E) Star-rise and star-set position depend on observer position
(III) Seasons: colder and warmer periods on a specific location during a year, due to the Earth revolution	(IV) Sky map changes on a specific location during a year, due to the Earth revolution

Figure 1: Framework of the AMoSS test

Methods and Findings

To adapt the instrument for primary school children (age 10-12), the questions were first turned into interview questions. The formulation was kept in line with the AMoSS test, but questions I-E, II-E and IV were left out. A pilot interview study in the style of Plummer [1] was carried out. Results showed that the questions are difficult, but children did what was expected and could express their ideas with the available materials.

Based on the findings of the interviews, we developed a paper-and-pencil version of the questions. We avoided the multiple-choice format of the AMoSS test, and asked children to indicate their ideas in drawings instead. We also reincluded the concept IV on the visibility of stars depending on the period in the year. This resulted in a test with 13 items, most of them asking to draw or to indicate a position. An example of an item is shown in Figure 3.

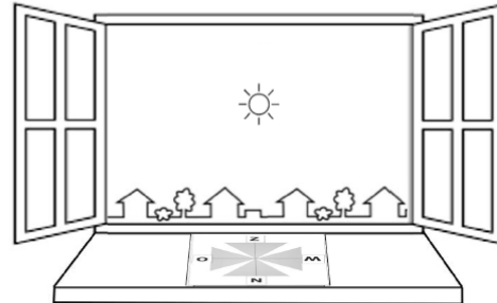
After a pilot test of the items (using think aloud interviews), some items were modified and refined. The final version was administered to 82 students of 4 different schools. Data collection has just finished, and we are currently analysing the results. All answers are coded as correct/wrong/blanco, and also the justifications students gave are being coded as correct/wrong/inexistent. In the presentation, we will report on the reliability of this new instrument, as well as on the main outcomes in terms of students' understanding of the apparent motion of the Sun and Stars, also in relation to earlier findings.

References

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Elias is looking outside from his bedroom window in March. The sun is at its highest point in the sky. The drawing shows what he sees.

One month later, in April, he looks outside from his bedroom window from the same location. Indicate with a cross where he will see the sun at its highest point.



Write below why you think this is the answer.
You can also make a drawing.

Figure 3: Example item of AMoSS-junior.