

Chapter 7

Fifth Grade Students’ Learning Processes of the Sun’s Apparent Motion: From Observation to Constructing the Underlying Motion

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ABSTRACT

The present study focuses on the design, implementation, and evaluation of an Instructional Sequence concerning the Sun’s Apparent Motion. The sequence was developed as a means of introducing the concept of the Earth’s self-rotation within a 24-hour period. A key aspect of the design was addressing students’ alternative conceptions, such as the belief that the Sun’s Apparent Motion results either from the Earth’s revolution around the Sun or from a supposed rotation of the Sun around the Earth. The implementation of the sequence with fifth graders demonstrated that the vast majority of them were able to successfully construct an accurate understanding of the key features of the Earth’s self-rotation, in their effort to explain the Sun’s Apparent Motion.

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1. INTRODUCTION

Astronomy stands out as one of the few scientific disciplines that consistently captures the curiosity and engagement of students (Yair et al., 2003). Introducing fundamental astronomical concepts at the primary school level can help children make sense of everyday natural phenomena that intrigue them. This early exposure not only deepens their understanding but can also foster a broader interest in science-related subjects across the curriculum and in scientific thinking more generally (Grady et al., 2003).

Over the last forty years, a substantial body of research has explored the ways in which both students and adults understand various astronomical phenomena (Bailey & Slater, 2003; Lelliot & Rollnick, 2009; Salimpour et al., 2024). Some of these studies focused on the Apparent Motion of the Sun, either in the context of investigating learners' alternative conceptions (Bekaert et al. 2022; Mant & Summers, 1993; Plummer, 2008; Sharp, 1996; Starakis, 2014) or in relation to the actual teaching of this specific phenomenon (Bekaert et al. 2024; Heywood et al., 2013; Plummer et al., 2011). In most studies investigating learners' conceptions, the focus has been exclusively on the phenomenological aspect of the phenomenon. Summarizing the relevant findings, it can be said that both students and adults, in their vast majority, recognize the phenomenon, from the perspective of a stationary observer on Earth. Moreover, according to Plummer (2008), the proportion of students who adopt this view increases with age. Only one study (Starakis, 2014) investigated the interpretative understanding of the phenomenon among fifth and sixth grade students. This study revealed that most of these learners spontaneously transition from the frame of reference of a stationary Earth-based observer to that of a stationary observer within the Solar System. As a result, they interpret the phenomenon in terms of isolated motions of either the Earth or the Sun, involving a 24-hour periodicity (e.g., the Earth's rotation on its axis, the Moon's rotation around the Earth, or the Earth's revolving around the Sun). In this context, it is emphasized that students who adopt a 24-hour periodicity for the Earth's rotation around the Sun or for the Sun's rotation around the Earth are typically unable to simultaneously construct the concept of the Earth's 24-hour rotation on its own axis. This specific conceptual limitation is considered to play a pivotal role in the design of instructional materials aimed at exploring learning processes related to this phenomenon.

With regard to related teaching proposals—whether targeted at primary (Plummer, 2011), secondary (Bekaert et al., 2024), or tertiary education (Heywood et al., 2013)—a key feature is that the Earth's rotation on its (imaginary) axis, from west to east, is explicitly introduced to learners by the researchers. This was accomplished through: embodied/physical simulation activities (Plummer, 2011), modeling with a globe and a lamp to represent the Sun (Heywood et al., 2013), the use of a three-

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