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Recently, much attention has been paid to scientific literacy, which can be defined in several ways. Roughly speaking, scientific literacy is defined as the knowledge and understanding of scientific concepts and procedures necessary to make personal decisions in civil, cultural, and economic matters (OECD, 2018). It is an essential outcome of school science. However, the fundamental goal of science education research is to understand and improve the learning and teaching of science to develop scientific literacy. Understanding how science concepts are learned is necessary so that teaching can be adapted to students' needs and effective learning can occur. To explore this, the increasing use of modern technologies in educational research (e.g., recording students' eye movements) has opened up new research areas in science education. With it, researchers can use various methods to collect learning data, which are relatively more objective than observations, interviews, questionnaires, and similar methods (Devetak & Ferk Savec, 2020; Docktor & Mestre, 2014; Torkar et al., 2018; Tóthová et al., 2021). However, the interpretation of psychophysiological data should be carefully considered.

The book *Applying Bio-Measurements Methodologies in Science Education Research* considers the above point and presents several chapters on the application of specific bio-measurement methods, focusing on eye-tracking

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technology that can be used in education. As written in the book's preface, teachers who examine students' oral or written responses typically have no insight into how students solved specific problems and how they arrived at their correct or incorrect solutions. Therefore, with the methods used in physiology, data can be obtained by scanning the central nervous system (brain). Solving mental tasks is accompanied by physiological responses. These not only indicate a stressful situation but are probably related to the cognitive load during the problem-solving process. Therefore, another group of devices collects data from specific parts of the human body's activities that originate in autonomic nervous system dynamics, such as measurements of heart rate, heart rate variability, blood pressure, skin conductance, skin temperature, facial thermogram, respiratory rate and amplitude, pupil dilatation, and eye movements.

The book was edited by Iztok Devetak, PhD, and Saša Aleksij Glažar, PhD, professors of chemistry education at the Faculty of Education, University of Ljubljana, Slovenia. Glažar is also a professor emeritus of chemistry education at the same university. The preface, which includes the importance of science education and a brief overview of the content, is followed by 15 chapters written by 37 authors from 8 countries (Croatia, Finland, Germany, Poland, Slovenia, Taiwan, Turkey, USA). The book starts with three general chapters describing cognitive processes and how these processes are measured using eye-tracking methods and other psychophysiological parameters, as well as motivation. This is followed by chapters presenting studies in specific scientific areas of chemistry (4 chapters), biology (2 chapters), physics (5 chapters), and geology (1 chapter). A brief description of all 15 chapters follows.

The first chapter by Anja Podlesek, Manja Veldin, Cirila Peklaj, and Matija Svetina, titled *Cognitive Processes and Eye-Tracking Methodology*, discusses psychological aspects of eye-tracking approaches in cognitive research, focusing on cases from science education. They present the case study of two 7^{th}-grade students exhibiting individual eye movement differences.

Chapter 2, *The Interplay of Motivation and Cognition: Challenges for Science Education Research and Practice*, authored by Mojca Juriševič and Tanja Črne, examines two internal variables-student motivation and visual attention-and how they affect learning processes. The authors present in detail motivation in learning, challenges in learning and teaching science, including examples of potential problems in learning motivation and the development of visual attention.

The third chapter, *Predicting Task Difficulty Through Psychophysiology*, prepared by Junoš Lukan and Gregor Geršak, argues that mental task solving is accompanied by physiological responses. An attempt to predict the difficulty of the task perceived by the subject on the basis of physiology is described. To answer the question of how best to predict the perceived difficulty of a task based on physiological responses, it was first necessary to select a measure of each physiological process. It was found that skin temperature, respiratory rate, heart rate, and skin conductance best predicted task difficulty.

Chapters 4 through 7 present the research work from the field of chemistry education.

In Chapter 4, *The Role of the Explanatory Key in Solving Tasks Based on Submicroscopic Representations,* Vesna Ferk Savec and Špela Hrast present the analysis of Slovenian chemistry textbooks with a focus on the sub-microscopic representations that were integrated into the textbooks to illustrate the particle nature of chemical concepts and processes and to facilitate learning chemistry with understanding. To facilitate students' learning of chemistry in a meaningful way, the representations must be properly understood by students, and the explanatory key accompanying them can play an essential role in this process. The role of the explanatory key in processing sub-microscopic representations in solving chemistry problems was investigated. Attention was given to the use of pictorial and textual explanatory keys accompanying the representations, which were investigated using eye-tracking and interviews with students.

In the fifth chapter, *Investigating the Role of Conceptual Understanding on How Students Watch an Experimental Video Using Eye-Tracking*, Sevil Akaygun and Emine Adadan explore how eye-tracking technology can be used to explore the role of students' (preservice science or chemistry teachers) conceptual understanding of how they navigate tasks to be solved while watching an experimental video of a redox reaction. Eye-tracking technology can be used to investigate how different levels of understanding can induce students to follow different aspects of an experimental video. Students' levels of understanding of redox reactions played a role in the patterns of their eye movements as they looked where they needed to look, remained focused, and ignored other details as they were more mentally engaged.

In the sixth chapter, entitled *Using an Eye-Tracker to Study Students' Attention Allocation when Solving a Context-Based Problem on the Sublimation of Water*, Miha Slapničar, Valerija Tompa, Iztok Devetak, Saša A. Glažar, and Jerneja Pavlin present the importance of 3D-dynamic sub-microscopic representations for solving specific chemical tasks. The students' attention allocation on the areas of interest in solving context-based tasks involving macroscopic and sub-microscopic levels of sublimation of water representations was investigated. The research objective was to identify differences between successful and unsuccessful students in overall fixation duration, visit count, and average pupil size. The research results provide an insight into the learning process (cognitive load) specific to the information processing of 3D-dynamic sub-microscopic representations.

Iztok Devetak prepared Chapter 7, entitled *Using an Eye-Tracking Approach to Explain Students' Achievements in Solving a Task about Combustion by Applying the Chemistry Triplet*. The author examined the chemistry triplet, including macroscopic, sub-microscopic, and symbolic levels of chemical concepts representations, as an essential part of teaching and learning chemistry and stressed that it is important to understand how students cognitively move between these representations when solving specific context-based task or problems. The significance of this research is in understanding how important the different levels of the chemistry triplet are to students in solving specific problems (in this study, the chemical reaction of burning) and how teachers can predict which levels should be more emphasised in chemistry lessons, depending on the level of chemical knowledge and skills of other students.

Two chapters (8^{th} and 9^{th}) presenting studies from the fields of biology and medical education follow.

The eighth chapter, *Pre-Service Teachers' Determination of Butterflies with Identification Key: Studying Their Eye Movements,* written by Tanja Gnidovec and Gregor Torkar, examines the ability of pre-service teachers (biology and primary school) to determine butterfly species with a simplified dichotomous identification key that includes illustrations, photographs, and a written description, using the eye-tracking method (determining students' visual attention). Analysis of eye movements showed that students preferred illustrations over photographs of butterflies in the identification process. Students mostly looked at both images (photographs and illustrations) in the process.

Chapter 9, *Case Processing in the Development of Expertise in Life Sciences-What Can Eye Movements Reveal?,* prepared by Ilona Södervik and Henna Vilppu, presents future experts in the life sciences with innovative forms of reasoning and the ability to use knowledge and skills adaptively in unforeseen and adverse contexts. The authors synthesise two studies (Study 1 about examining the effect of the level of expertise on case processing and Study 2 about students' processing of a non-routine case and its relationship to the level of their basic biological knowledge) using the eye-tracking method, in which routine and non-routine text-based case tasks were used to investigate processing and problem-solving by medical personnel with different levels and types of expertise. Eye-tracking provides interesting insights into knowledge integration and problem-solving through medical case processing.

Physics education studies are presented in the next five chapters (10 to 14).

Chapter 10, *Analysis of Aspects of Visual Attention when Solving Multiple-Choice Science Problems*, authored by Miroslava Sajka and Roman Rosiek, presents the aspects of visual attention when solving multiple-choice science problems involving mathematics or physics concepts; they were analysed using eye-tracking technology. The authors also examined how problem-solving strategies affected learners' visual attention. They emphasised that the methodology used in this study may be useful in determining the cognitive load of solving multiple-choice tasks during the decision-making process.

Jerneja Pavlin and Miha Slapničar, in Chapter 11, *The Impact of Students' Educational Background, Formal Reasoning, Visualisation Abilities, and Perception of Difficulty on Eye-Tracking Measures when Solving a Context-Based Problem with Sub-microscopic Representation*, emphasise the importance of several independent variables that can influence solving context-based tasks at the macroscopic and sub-microscopic levels. The exercise addresses the phenomenon of gas released when a bottle of sparkling water is opened. Their study aimed to find out how educational level, formal reasoning, and visualisation abilities influence the way students solve these tasks. Eye-tracker measurements (total fixation duration, visit count, average pupil dilatation) were taken while solving the task.

Chapter 12, prepared by Pascal Klein, Stefan Küchemann, Ana Susac, Alpay Karabulut, Andreja Bubic, Maja Planinic, Marijan Palmovic, and Jochen Kuhn, entitled *Students' Understanding of Diagrams in Different Contexts: Comparison of Eye Movements Between Physicists and Non-Physicists Using Eye-Tracking*, examines the understanding of line charts as a skill necessary for understanding information in science and everyday life. They compare physics and non-physics students on their understanding of graph slope and area under the graph in the context of physics and finance in two datasets from Germany and Croatia. Eye-tracking technology was used to investigate students' competencies in solving problems related to the slope and area under the graph.

Chapter 13, entitled *Task-Evoked Pupillary Responses in Context of Exact Science Education*, written by Roman Rosiek and Miroslawa Sajka, also addresses the importance of graphs in physics and mathematics. The results of eye-tracking research, in which changes in pupil diameter are observed and analysed when solving tasks related to graphs, are evaluated to determine if there are significant differences in the physiological response of individuals. Analysis of relevant changes in pupil diameter may be an indicator of subjective assessment of task difficulty and an indicator of motivation.

Chapter 14, the last chapter in the series of physics education papers, entitled *An Investigation of Visual and Manual Behaviors Involved in Interactions Between Users and Physics Simulation Interfaces*' and written by Guo-Li Chiou, Chung-Yuan Hsu, and Meng-Jung Tsai, illustrates the importance of computer simulation in physics education. Although computer simulations have been shown to have a positive impact on improving science learning, little is known about how users interact with simulation interfaces. The authors address the question of whether students with different learning performances distribute their visual attention while manipulating the simulations and whether students with different learning performances have different visual and manual behaviour patterns.

The final chapter, Chapter 15, of the book titled *Visualising Student Navigation of Geologic Block Diagrams* was written by Karen S. McNeal, Rachel Atkins, and Elijah T. Johnson. It relates to the problems of 3D visualisation in geosciences. The exploratory eye-tracking study provided unique insights not yet available to the geoscience education research community about how students with spatial skills navigate geological block diagrams, a 2D visualisation tool used in the geological sciences to represent conditions within a 3D geological formation. Eye-tracking was used as an exploratory method to investigate students' visual navigation approaches to spatial problems, particularly geological block diagrams used in the geological sciences. Spatial and temporal information about students' gaze patterns was collected and analysed using the different facets of the block diagrams as prominent locations, and the relationship between spatial abilities and visual patterns in problem-solving was investigated.

The book brings expertise and views from science education research to the discourse on broadening horizons in understanding learning processes when eye-trackers are incorporated into research in science education and in general. The book attempts to fully frame the topic and refers to a complex study on the topic of integrating eye-tracking measurements into science education research and lists interesting further research opportunities to understand learning even more comprehensively.

The book is aimed at science teachers and science education researchers, both in terms of the topic chosen and the way it is written. It contains some presentations of eye-tracking studies on concrete topics that can be elaborated at different educational levels. It also encourages science educators to include them in their didactics courses for pre-service and in-service teachers.

In summary, the book *Applying Bio-Measurements Methodologies in Science Education Research* provides a comprehensive overview of the use of eye-tracking in science education and its potential to explore and fully understand the learning process of students with different abilities. It provides a deeper understanding of the learning process and offers several guidelines for designing lesson plans with the goals of scientific literacy in mind.

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