M. Gabriela T. C. Ribeiro 11.31
University of Porto

Article

Reaction and spontaneity: the influence of meaning from everyday language on fourth year undergraduates' interpretations of some simple chemical phenomena

M. Gabriela | T. C. Ribeiro | Duarte J. V. Costa Pereira | Roger Maskill

International Journal of Science Education (Impact Factor: 1.23). 07/1990; 12(4):391-401.
DOI: 10.1080/0950069900120406

ABSTRACT Fourteen fourth-year undergraduate chemistry students were interviewed in the context of some simple chemical phenomena to find out their concepts of 'reaction' and 'spontaneous'. The students were asked to discuss and to decide in four situations [more]

Article: Using Static and Dynamic Visuals to Represent Chemical Change at Molecular Level

Dilek Ardac, Sevil Akaygun

[Hide abstract]

ABSTRACT: The study examines the effectiveness of visually enhanced instruction that emphasizes molecular representations. Instructional conditions were specified in terms of the visual elaboration level (static and dynamic) and the presentation mode (whole class and individual). Fifty-two eighth graders (age range 14 15 years) participated in one of the three instructional conditions (dynamic individual, dynamic whole class, and static whole class) designed to improve molecular understanding on chemical change. The results indicated significantly higher performance for students who used dynamic visuals compared with those who used static visuals. Furthermore, students who used dynamic visuals on an individual basis were more consistent in their use of molecular representations compared with students who received whole-class instruction with dynamic or static visuals. The results favour the use of dynamic visuals (preferably on an individual basis) over static visuals when presenting molecular representations. The results also imply that the effectiveness of instruction will improve if teachers challenge and question the inconsistencies and contradictions between verbal explanations and corresponding molecular representations

International Journal of Science Education 01/2005; 27(11):1269-1298.
DOI:10.1080/09500690500102284 · **1.23 Impact Factor**

Article: Effectiveness of multimedia-based instruction that emphasizes molecular representations on students' understanding of chemical change

Dilek Ardac, Sevil Akaygun

[Hide abstract]

ABSTRACT: The present study makes use of the capabilities of computerized environments to enable simultaneous display of molecular representations that correspond to observations at the macroscopic level. This study questions the immediate and long-term effects of using a multimedia instructional unit that integrates the macroscopic, symbolic, and molecular representations of chemical phenomena. Forty-nine eighth graders received either multimedia-based instruction that emphasized molecular representations (n = 16), or regular instruction (n = 33). Students who received multimedia-based instruction that emphasized the molecular state of chemicals outperformed students from the regular instruction group in terms of the resulting test scores and the ease with which they could represent matter at the molecular level. However, results relating to the long-term effects suggest that the effectiveness of a multimedia-based environment can be improved if instruction includes additional prompting that requires students to attend to the correspondence between different representations of the same phenomena. © 2004 Wiley Periodicals, Inc. J Res Sci Teach 41: 317–337, 2004

Journal of Research in Science Teaching 04/2004; 41(4):317 - 337.
DOI:10.1002/tea.20005 · **2.64 Impact Factor**

Article: An investigation on the scientific thinking ability of fourth year university students

Hong-Kwen Boo, Kok-Aun Toh

[Show abstract]

Research in Science Education 12/1998; 28(4):491-506.
DOI:10.1007/BF02461512 · **1.34 Impact Factor**

Article: Identifying Alternative Conceptions of Chemical Kinetics among Secondary School and Undergraduate Students in Turkey

Gültekin Cakmakci

[Hide abstract]

ABSTRACT: This study identifies some alternative conceptions of chemical kinetics held by secondary school and undergraduate students (N = 191) in Turkey. Undergraduate students who participated are studying to become chemistry teachers when they graduate. Students' conceptions about chemical kinetics were elicited through a series of written tasks and individual interviews. Several alternative conceptions exhibited by secondary school students persisted among undergraduates, indicating the persistence of such alternative conceptions. The results suggest that students' lack of understanding in thermodynamics and chemical equilibrium significantly influences their conceptions about chemical kinetics. Implications for instructional approaches particular to chemical kinetics are discussed.Keywords (Audience): First-Year Undergraduate/General; High School/Introductory Chemistry; Upper-Division Undergraduate

Journal of chemical education 03/2010; 87(4). DOI:10.1021/ed8001336 · **1.00 Impact Factor**

Source

Article: Undergraduate students' conceptions of enthalpy, enthalpy change and related concepts

Tor Nilsson, Hans Niedderer

[Hide abstract]

ABSTRACT: Research shows that students have problems understanding thermodynamic concepts and that a gap exists at the tertiary level related to more specific chemistry concepts such as enthalpy. Therefore, the aim of this study is to construct undergraduate students' conceptions of enthalpy, its change and related concepts. Three explorative small-scale studies were conducted at two Swedish universities. Questionnaires, exam questions, hand-ins and interviews covered a range of issues from chemical thermodynamics in general to specific questions about enthalpy and its change, internal energy and its change, heat and work. Data were analysed iteratively and qualitative categories were constructed (F1–F2, F4–F9). The underlying conceptions indicate that constant pressure is explicitly expressed but disregarded as the answer is given (F1), that work is described as mechanical work (F2), that enthalpy is used as a form of energy (F4), and that enthalpy is used for enthalpy change and vice versa (F5). The logical conceptions indicate that molar enthalpy determines the heat given off by a reaction and not the path taken (F6), that constant pressure/constant volume and the definition of enthalpy change are problematic (F7), that students argue for the case when DH = DU instead of DH = q (F8), and that there are different ways to interpret the given tasks (F9). This study offers insight into the way students use enthalpy and its change when arguing and solving qualitative tasks. How the categories may be used as well as other implications for teaching and research are addressed in this paper.

Chemistry Education Research and Practice 07/2014; 15(3):336-353.
DOI:10.1039/c2rp20135f · **1.31 Impact Factor**

Article: University Students' Understanding of Chemical Thermodynamics

Bellam Sreenivasulu, R. Subramaniam

[Hide abstract]

ABSTRACT: This study explored undergraduate students' understanding of the chemistry topic of thermodynamics using a 4-tier diagnostic instrument, comprising 30 questions, and follow-up interviews. An additional objective of the study was to assess the utility of the 4-tier instrument for use in studies on alternative conceptions (ACs) as there has been no study done on it since its introduction in the literature in the year 2010. A total of 296 students majoring in Chemistry at a university in Singapore participated in this study—88 students in the preliminary study, 102 students in the pilot study and 106 students in the main study. This article reports on the results obtained with students in the main study; their age ranges from 20 to 22 years. Comprising answer and reason tiers plus associated confidence ratings, the 4-tier diagnostic instrument

enabled the eliciting of 34 ACs harbored by the undergraduates as well as the strengths of these ACs. Of concern to note is that even for questions which were answered correctly, the mean confidence was not very high. The results of this study reiterate the point that thermodynamics is a topic fraught with conceptual difficulties and ACs. Based on the results from this study, the potential of the 4-tier test for AC studies is further underscored. Some implications of the study are discussed.

International Journal of Science Education 01/2012; DOI:10.1080/09500693.2012.683460 · **1.23 Impact Factor**

Article: Pre-service teachers' conceptions of basic inorganic qualitative analysis

Kim-Chwee Daniel Tan

[Hide abstract]
ABSTRACT: Graraaduate teachers teaching secondary chemistry in Grades 9 and 10 in Singapore are required to prepare their students for a one-off practical examination that forms part of the General Certificate of Education Ordinary Level (O-level) chemistry examinations taken at the end of Grade 10. A qualitative analysis experiment is usually part of the practical examination. Previous research has shown that secondary students have difficulty in explaining the reactions and procedures involved in qualitative analysis (Tan, Goh, Chia, & Treagust, 2001, 2002), and a possible reason for this situation is that their teachers may also not have adequate understanding of the reactions and procedures involved, and hence, are unable to teach for understanding. A diagnostic test on O-level qualitative analysis was administered to a total 270 pre-service chemistry teachers from 1999 to 2003, and it was found that they had problems explaining the ion-exchange reactions that resulted in the formation of precipitates, the use of dilute acid in tests for anions and reactions involving complex salts such as zincates. The pre-service teachers also had difficulty explaining procedures and reactions involved when substances were heated. If the pre-service teachers have difficulty in understanding the reactions and procedures involved in qualitative analysis, it will not come as a surprise if their students also have similar difficulties with qualitative analysis.

Canadian Journal of Science Mathematics and Technology Education 01/2005; Science & Technology Education(Vol. 5):7-20. DOI:10.1080/14926150509556641

Source

Article: Development and application of a two-tier multiple choice diagnostic instrument to assess high school students' understanding of inorganic chemistry qualitative analysis*

Kim Chwee Daniel Tan, Ngoh Khang Goh, Lian Sai Chia, David F. Treagust

[Hide abstract]
ABSTRACT: This article describes the development and application of a two-tier multiple choice diagnostic instrument to assess high school students' understanding of inorganic chemistry qualitative analysis. The development of the diagnostic instrument was guided by the framework outlined by Treagust. The instrument was administered to 915 Grade 10 students (15 to 17 years old) from 11 schools after they had learned the theory involved in qualitative analysis and after a series of qualitative analysis practical sessions. The Cronbach alpha reliability of the instrument was .68, the facility indices ranged from .17 to .48, and the discrimination indices ranged from .20 to .53. The study showed that the Grade 10 students had difficulty understanding the reactions involved in the identification of cations and anions, for example, double decomposition reactions, the formation and reaction of complex salts, and thermal decomposition. The findings of the study and literature on practical work were used to develop a qualitative analysis teaching package. © 2002 Wiley Periodicals Inc. J Res Sci Teach 39: 283–301, 2002

Journal of Research in Science Teaching 04/2002; 39(4):283 - 301. DOI:10.1002/tea.10023 · **2.64 Impact Factor**

Article: Dual meaning vocabulary (DMV) words in learning chemistry

Youngjin Song, Shannon Carheden

[Hide abstract]
ABSTRACT: Learning chemistry vocabulary that has both scientific and everyday meanings, which we call dual meaning vocabulary (DMV), can be challenging for many students. This qualitative study investigated how college students understand 11 selected DMV words before and after traditional chemistry instruction and to what extent they retain the scientific meanings of them. The challenges these students encountered as they learned DMV words were also examined. Thirteen non-science major students with limited chemistry background were interviewed throughout the study. Data were analyzed by inductive analysis utilizing a grounded theory approach and constant comparative methods. Our results indicate that (1) most college students initially held everyday meanings of the selected DMV words, which were deeply associated with their personal experiences from early years; (2) the everyday meanings of DMV were continuously rooted in students' thinking after instruction so that they struggled with retaining the scientific meanings of it; and (3) the

infrequent use of DMV in meaningful contexts, students' rote memorization of DMV, and a lack of prior understanding of other science vocabularies were identified as challenges in learning DMV. These themes are discussed in-depth with various theoretical perspectives in investigating the relationship between everyday and scientific language and understanding. Concrete implications for teaching DMV in chemistry are proposed. The study also calls for further research on the role of the language of science in chemistry education.

04/2014; 15(2). DOI:10.1039/C3RP00128H

Source

Article: Undergraduate students' understandings of entropy and Gibbs free energy

E. M. Carson, J. R. Watson

Article: Major Sources of Difficulty in Students' Understanding of Basic Inorganic Qualitative Analysis

Kim Chwee Daniel Tan, Ngoh Khang Goh, Lian Sai Chia, David F. Treagust

[Hide abstract]
ABSTRACT: Most students' introduction to qualitative analysis in the United States occurs in general chemistry courses at college or university; in Australian universities this occurs as part of analytical chemistry courses for chemistry majors. In Singapore, however, students are first introduced to qualitative analysis in grade 10 chemistry (when they are 16 years old), even though the topic is generally considered to be conceptually difficult to understand and there is inadequate time for comprehensive experimental work. Using extensive interviews, this study was designed to identify the sources of these difficulties. Students had difficulty understanding the formation of precipitates and complex salts, and the reactions of acids in qualitative analysis experiments. Many students thought that the formation of precipitates in reactions involving exchange of ions was because of more-reactive ions displacing less-reactive ones, and that ammonia was included in the reactivity series. The students also regarded the formation of complex salts such as zincates as a mere dissolution process, and did not understand the reactions involving acids; for example, they thought that neutralization reactions involved redox processes, and that the order in which acids were added determined whether unknown anions could be identified. Instructional implications arising from the study are discussed.

Journal of chemical education 05/2004; DOI:10.1021/ed081p725 · **1.00 Impact Factor**

Source

Article: Analysis and Identification of Students' Threshold Concepts in High School Chemistry

Eun Jung Park

[Hide abstract]
ABSTRACT: Concerning the difficulty of learning science and reduced interest in science, the authors of this study searched for potential threshold concepts which are portals or gateways in the field of science (particularly chemistry). The nature of these concepts and how to overcome their troublesomeness were further questioned. For this study, 239 high school students completed chemistry II provided information about what difficult concepts and potential threshold concepts in high school chemistry are and how they affect learning chemistry. In particular, the mastery experience of the threshold concepts was explored in detail. Two, "mole and atomic structure" were selected as threshold concepts in chemistry. Not only as important but also as threshold, this study emphasized the importance of the two concepts in terms of features characterizing them as threshold concepts. In particular, the features objectify subjective experiences of students and provide information describing the scientific meaning and distinctive nature of threshold concepts in science. Along with the data from teachers, this study shows the integrative feature as key criteria for students to make meaningful understanding of the two threshold concepts.

Journal of the Korean Chemical Society 02/2014; 58(1). DOI:10.5012/jkcs.2014.58.1.126

Source

Article: Entropy and spontaneity in an introductory physics course for life science students

Benjamin D. Geller, Benjamin W. Dreyfus, Julia Gouvea, Vashti Sawtelle, Chandra Turpen, Edward F. Redish

[Hide abstract]
ABSTRACT: In an Introductory Physics for Life Science (IPLS) course that leverages authentic biological examples, student ideas about entropy as "disorder" or "chaos" come into contact with their ideas about the spontaneous formation of organized biological structure. It is possible to

reconcile the "natural tendency to disorder" with the organized clustering of macromolecules, but doing so in a way that will be meaningful to students requires that we take seriously the ideas about entropy and spontaneity that students bring to IPLS courses from their prior experiences in biology and chemistry. We draw on case study interviews to argue that an approach that emphasizes the interplay of energy and entropy in determining spontaneity (one that involves a central role for free energy) is one that draws on students' resources from biology and chemistry in particularly effective ways. We see the positioning of entropic arguments alongside energetic arguments in the determination of spontaneity as an important step toward making our life science students' biology, chemistry, and physics experiences more coherent.

American Journal of Physics 08/2013; 82(5). DOI:10.1119/1.4870389 · **0.80 Impact Factor**

Source

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Chemistry Education Research and Practice 07/2014; 15(3):336-353. DOI:10.1039/c2rp20135f · **1.31 Impact Factor**

Article: Conceptual difficulties with isomerism

Hans-Jürgen Schmidt

[Show abstract]

Journal of Research in Science Teaching 11/1992; 29(9):995 - 1003. DOI:10.1002/tea.3660290908 · **2.64 Impact Factor**

Chapter: From Chemical Energetics to Chemical Thermodynamics

Martin Goedhart, Wolter Kaper

12/2002: pages 339-362;

Article: Students' understandings of chemical bonds and the energetics of chemical reactions

Hong Kwen Boo

[Hide abstract]
ABSTRACT: The purpose of this study was to investigate Grade 12 students' understandings of the nature of chemical bonds and energetics elicited across five familiar chemical reactions following a course of instruction. Based on a chemist's analysis of the conceptual area, a list of relevant concepts involved was identified, and the range of five reactions was chosen. These then served as the framework for drawing up a semistructured interview protocol, which was administered to 48 students. The students' responses revealed a range of conceptions at variance with the chemist's view, some of which have not yet been reported in the literature. The implications of the research are that grasping chemistry concepts and principles from the students' perspective is full of pitfalls. There are numerous ways in which students can misconstruct concepts and principles. Teachers, curriculum developers, and textbook writers must be aware of the various ways in which material presented could be misconstrued and hence be a hindrance to student learning. © 1998 John Wiley & Sons, Inc. J Res Sci Teach 35: 569–581, 1998.

Journal of Research in Science Teaching 12/1998; 35(5):569 - 581. DOI:10.1002/(SICI)1098-2736(199805)35:5<569::AID-TEA6>3.0.CO;2-N

· **2.64 Impact Factor**

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Article: A Study of Turkish Chemistry Undergraduates' Understanding of Entropy

Judith M. Bennett

[Hide abstract]

ABSTRACT: This study explores Turkish chemistry undergraduates' understanding of entropy and identifies and classifies their misunderstandings. For this purpose, a diagnostic questionnaire and semi-structured interviews—before and after teaching—were used. Two diagnostic questionnaires were developed and used as pre-tests and post-tests with 91 students enrolled in a physical chemistry course from two different chemistry education departments in two different universities in Turkey. Just after the administration of the tests, 22 pre-interviews and 7 post-interviews were carried out. The misunderstandings identified were categorized into these five broad headings: (i) Defining entropy as "disorder" and considering visual disorder and entropy as synonymous; (ii) Inaccurate connection of entropy to the number of inter-molecular interactions; (iii) Inaccurate connection of entropy of a system and the accompanying entropy changes in its surroundings; (iv) Entropy of the whole system decreases or does not change when a spontaneous change occurs in an isolated system; and (v) Entropy of carbon dioxide is bigger than that of propane or the same at the same temperature. The findings have implications for tertiary-level teaching, suggesting that a substantial review of teaching strategies is needed. Keywords (Audience): Upper-Division Undergraduate

Journal of chemical education 06/2007; 84(7). DOI:10.1021/ed084p1204 · **1.00 Impact Factor**

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International Journal of Science Education 01/2012; DOI:10.1080/09500693.2012.683460 · **1.23 Impact Factor**

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Article: First-Year University Chemistry Textbooks' Misrepresentation of Gibbs Energy

Juan Quílez

[Hide abstract]

ABSTRACT: This study analyzes the misrepresentation of Gibbs energy by college chemistry textbooks. The article reports the way first-year university chemistry textbooks handle the concepts of spontaneity and equilibrium. Problems with terminology are found; confusion arises in the meaning given to ΔG, ΔrG, ΔG°, and ΔrG°, which results in many textbooks not differentiating between ΔG and ΔrG. Also, there is confusion over when standard conditions apply and when they do not. A problem with the proper use of units is also found. Finally, it is suggested that most of these difficult concepts could be removed from the first-year university chemistry syllabus because (i) an accurate presentation of Gibbs energy would be far beyond an introductory chemistry level and (ii) current attempts to introduce those difficult concepts in first-year university chemistry courses are usually full of misleading formulations.Keywords: First-Year Undergraduate/General; Curriculum; Physical Chemistry; Misconceptions/Discrepant Events; Textbooks/Reference Books; Equilibrium; Thermodynamics

Journal of chemical education 10/2012; 89(1):87-93. DOI:10.1021/ed100477x · **1.00 Impact Factor**

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Journal of Research in Science Teaching 04/2004; 41(4):317 - 337. DOI:10.1002/tea.20005 · **2.64 Impact Factor**

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Journal of Research in Science Teaching 04/2002; 39(4):283 - 301. DOI:10.1002/tea.10023 · **2.64 Impact Factor**

Article: From inert object to chemical substance: Students' initial conceptions and conceptual development during an introductory experimental chemistry sequence

Christina Solomonidou, Heleni Stavridou

[Hide abstract]

ABSTRACT: Children develop common conceptions about substances as inert objects as a result of their everyday life experiences. In order to promote conceptual development, 168 Greek students (aged 13–14)

were involved in a new sociocultural situation, a specially designed introductory chemistry sequence. During the sequence, the students observed and expressed their ideas about 11—unknown to them—substances, and 18 interactions between these substances, by answering a written questionnaire on various tasks. These tasks comprised description and differentiation of the initial substances, and prediction, description, and explanation of the interactions between them. Twelve of the 168 students were also interviewed. The analysis of the students' answers showed that conceptual development did occur during the sequence: the students moved from the "concrete substance" conceptual scheme toward the "unknown substance plus properties" scheme, and from the "inert mixture" idea to the "interaction" idea. Moreover, the students' initial reasoning—based on the "recognition" of substances—evolved toward a primitive "identification" process. Informed by these data, we formulate propositions regarding a chemical substances approach, in order to further improve students' conceptions during the teaching of chemistry. © 2000 John Wiley & Sons, Inc. Sci Ed84:382–400, 2000.

Science Education 04/2000; 84(3):382 - 400. DOI:10.1002/(SICI)1098-237X(200005)84:3<382::AID-SCE4>3.0.CO;2-D · **2.92 Impact Factor**

Article: How to teach the concept of heat of reaction. A study of prospective teachers' initial ideas

O. de Jong

[Hide abstract]
ABSTRACT: This paper presents a study of prospective teachers' initial knowledge of how to teach the energetics of chemical reactions. The research was designed as a naturalistic case-study. Fourteen prospective chemistry teachers were invited to individually prepare the first two lessons on the heat involved in reactions in solutions. The lessons were for grade 11 classes (age 16-17) from pre-university schools. The prospective teachers were not allowed to consult any textbook, but they were asked to incorporate two specific classroom experiments in their lesson plan. During a group meeting, the lesson plans were exchanged and discussed. Research data were obtained from audiotaped semi-structured interviews with the individual prospective teachers. In addition, their written lesson plans were collected and analysed. The group discussions were also audiotaped and analysed. The results reveal a number of interesting characteristics of prospective teachers' pedagogical content knowledge. Implications of the study for science teacher preparation courses will also be presented. [Chem. Educ. Res. Pract. Eur.: 2000, 1, 91-96]

01/2000; DOI:10.1039/A9RP90009H

Article: An investigation on the scientific thinking ability of fourth year university students

Hong-Kwen Boo, Kok-Aun Toh

[Hide abstract]
ABSTRACT: This paper reports on a study which examined the ability of a sample of fourth year university students to think scientifically when presented with a range of chemical phenomena. The main data collection instrument was the clinical interview. Each subject was interviewed in-depth for about one hour on a one-to-one basis. Each interview was taped, transcribed verbatim and then analysed. Five familiar chemical reactions ere used as foci for discussion in the interviews. For each reaction, each interviewee was asked, among other things, to make predictions about the overall energy change involved, and to make explanations as to why the change took place, i.e., the driving force for the change. The results show that the majority of the interviewees were using perceptually dominated thinking rather than conceptually dominated thinking; at the same time, they were unable to use science concepts consistently across the five reactions. It can thus be inferred that they were unable to think scientifically. Reasons for the lack of scientific thinking ability are explored and suggestions on alleviation of the problem are offered.

Research in Science Education 12/1998; 28(4):491-506. DOI:10.1007/BF02461512 · **1.34 Impact Factor**

Chapter: Linking the Macroscopic, Sub-microscopic and~Symbolic Levels: The Case of Inorganic Qualitative Analysis

Kim Chwee Daniel Tan, Ngoh Khang Goh, Lian Sai Chia, David F. Treagust

[Hide abstract]
ABSTRACT: Basic Grade 10 inorganic qualitative analysis in Singapore requires students to carry out procedures using chemicals, apparatus and appropriate techniques for which they record their observations and make inferences based on the observations. As students are assessed mainly on their written observations, they focus on getting the correct results and writing 'standard' observations. Thus, many students merely follow instructions given in the worksheet and seldom think about or understand the reactions involved especially in terms of what is occurring in these reactions at the sub-microscopic level. To respond to this

situation, the authors first designed the Qualitative Analysis Diagnostic Instrument to identify students' understanding of the reactions involved in qualitative analysis. Secondly, the authors developed the Qualitative Analysis Teaching Package to help students learn qualitative analysis by facilitating their understanding of the sub-microscopic and symbolic level explanations of the macroscopic level experiences of the procedures and reactions involved, as well as the manipulative, observational and inferential skills and thinking processes required. The diagnostic instrument and teaching package are especially important with the imminent change from the current one-off national practical examination to school-based assessment in 2008 with the focus on manipulative, observational, analytical and planning skills.

12/2008: pages 137-150;

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Article: Kajian mengenai pelajar pencapaian tinggi dan pelajar pencapaian sederhana dalam penyelesaian masalah sains dalam Bahasa Inggeris dan Bahasa Melayu

Shuh Shing Lee

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ABSTRACT: Tujuan kajian ini adalah untuk menentukan tahap penyelesaian masalah pelajar pencapaian tinggi dan pelajar pencapaian sederhana bagi topik haba dalam bahasa Inggeris dan bahasa Melayu. Kajian ini juga meninjau pengalaman pelajar mempelajari sains dalam bahasa Inggeris. Soal selidik telah digunakan dalam kajian ini dan telah diedarkan kepada 354 pelajar tingkatan Dua di dua buah sekolah di Johor Bahru. Kajian yang dijalankan menggunakan dua set soalan, bahasa Melayu dan bahasa Inggeris, yang ditadbir pada hari yang berlainan. Soal selidik mengandungi tiga bahagian: latar belakang pelajar, pengalaman mempelajari sains dan juga soalan penyelesaian masalah. Dalam pengalaman mempelajari sains, keputusan menunjukkan pelajar pencapaian sederhana lebih memahami pelajaran sains yang diajar dalam bahasa Melayu berbanding dengan pelajar pencapaian tinggi. Dapatan kajian juga menunjukkan pelajar jarang menggunakan bahasa Inggeris dalam pertuturan harian. Keputusan tahap penyelesaian masalah pula menunjukkan pelajar pencapaian sederhana adalah kurang memuaskan dibandingkan dengan pelajar pencapaian tinggi. Ini mungkin disebabkan penguasaan bahasa Inggeris mereka yang lemah. Kebanyakan pelajar menghadapi masalah dalam menjawab soalan amali bertulis. Daripada analisis korelasi, keputusan kajian juga menunjukkan bahawa penguasaan bahasa Inggeris yang ditunjukkan dalam pencapaian ujian bahasa Inggeris mempengaruhi pencapaian penyelesaian masalah. Selain daripada itu, pengalaman mempelajari sains dalam bahasa Inggeris juga serba sedikit mempengaruhi tahap penyelesaian masalah pelajar. Secara umumnya, kajian mendapati bahawa ramai pelajar menghadapi masalah dalam memberi penerangan dalam bahasa Inggeris. Keadaan ini dapat dilihat melalui kesilapan-kesilapan mereka dalam menyelesaikan masalah sains dalam bahasa Inggeris.

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