Diversity in Science towards Social Inclusion – Non-formal Education in Science for Students` Diversity

Symposium

Strand number: 9

Silvija Markic, [a],
[a]*Ludwigsburg University of Education*
* Corresponding author: markic@ph-ludwigsburg.de

Chairperson: Silvija Markic
Discussion: Rachel Mamlok-Naaman, Weizmann Institute of Science, Israel, achel.mamlok@weizmann.ac.il

Approaches for inclusive science teaching currently tend to focus on only one dimension of diversity at a time. This neglects the fact that diversity is multidimensional in nature and the consideration of only one dimension of diversity can yield inclusive practices of only limited scope.

The goal of the DiSSI project (Diversity in Science towards Social Inclusion – Non-formal Education in Science for Students' Diversity) is, therefore, to promote inclusive teaching practices for dealing with several dimensions of diversity simultaneously. Researchers from Ireland, Germany, the UK, Slovenia, and Macedonia, will develop a teaching approach that considers the needs of (i) students with a low socio-economic status, (ii) students of ethnic minorities or with cultural backgrounds that differ from the mainstream culture, (iii) with low linguistic skills, and (iv) gifted students. These groups are particularly disadvantaged in science education as it has been shown in research.

The symposium is a collection of presentation from DiSSI partner which will focus on the first phase of the project where each of us is working on innovation of one dimension. The so collected knowledge will be exchanged between the partners and create environment for inclusive science education.

The symposium is carried out by following presenters:

1. "*DiSSI- Beginning of Inclusive concepts for the secondary school students´ laboratory*" by Sarah Kieferle and Silvija Markic
2. "*Exploring ethnic, cultural and linguistic diversity in science*" by Jane Essex, Ingeborg Birnie, Kirsty Ross, Marina Stojanovska, Katerina Rusevska, Lambe Barandovski, and Vladimir Petruševski
3. "Diversity in Science for Social Inclusion: Community consortia approaches to non-formal education" by Sarah Hayes and Martin McHugh
4. "*Inquiry based chemistry activities in the in-formal educational setting for gifted students*" by Iztok Devetak, Miha Slapničar, Luka Vinko, Janez Vogrinc, and Vesna Ferk Savec

Disclaimer:

The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

Part of the Symposium 'Integrating transferable skills into chemistry teaching and learning' organized by Silvija Markic

DiSSI- Beginning of Inclusive concepts for the secondary school students´ laboratory

Strand number: 9
Sarah Kieferle[a], Silvija Markic[a]
[a] *Ludwigsburg University of Education, Germany*
* Corresponding author: sarah.kieferle@ph-ludwigsburg.de

It is known that society has changed considerably in the last decades. This results in a change in the composition of classes in schools. The demand for education for all is to be implemented nationwide (UNESCO, 2009). One approach to follow this demand is inclusive education. Inclusion is defined as seeing differences as an asset and learning resource (Sliwka, 2009). However, recommendations for linking inclusive and science principles are sometimes more normative than practical. There is a lack of concrete and effective practical examples for diverse groups.

In the ERASMUS PLUS project "*Diversity in Science towards Social Inclusion - non-formal education in science for students` diversity*" innovative concepts to foster inclusive science education in non-formal learning environments are developed, implemented, and evaluated. The four dimensions of diversity: (I) linguistic ability, (II) cultural and ethnic background, (IV) socio-economic status, and (V) giftedness of the students are particularly considered. The development of inclusive learning environments occurs in two phases: (i) focusing on one dimension of diversity, and (ii) expanding the offerings for all dimensions of diversity. In the current first phase, the University of Education Ludwigsburg focuses on the dimension of students' linguistic skills in the students' laboratory.

The development of the language-sensitive/inclusive learning settings in the students` laboratory follows the aims to enable inquiry-based learning and active participation of all students. To achieve these aims, different methods and tools of language-sensitive teaching are tested and evaluated in the students´ laboratory. In a mixed-methods approach, concrete statements can be formulated about the practicability and use of the methods, tools, and activities as well as about the success of inclusion. Approved methods and tools will then be established and shared with the project partners. In the talk, the first phase of the project will be presented as well the first results of the language-sensitive learning settings discussed.

Disclaimer:
The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

References:

UNESCO- Kommission e.V. (2009). Inklusion: Leitlinien für die Bildungsolitik. 3. erweiterte Auflage. https://www.unesco.de/sites/default/files/2018-05/2014_Leitlinien_inklusive_Bildung.pdf.

Sliwka, A. (2010). From Homogeneity to Diversity in German Education. In Centre for Educational Research and Innovation (Ed.), *Educating Teachers for Diversity: Meeting the Challenge* (205–216). OECD.

Part of the Symposium 'Integrating transferable skills into chemistry teaching and learning' organized by Silvija Markic

Exploring ethnic, cultural and linguistic diversity in science

Strand number: 9

Jane Essex[a,]*, Ingeborg Birnie[a], Kirsty Ross[a], Marina Stojanovska[b], Katerina Rusevska[b], Lambe Barandovski,[b] and Vladimir Petruševski[b]
[a]*University of Strathclyde, UK*
[b]*Ss. Cyril and Methodius University, Faculty of Natural Sciences and Mathematics, North Macedonia*
* Corresponding author: jane.essex@strath.ac.uk

This presentation will discuss the preliminary results from three inter-related studies which are part of the Erasmus+ DiSSI project (*Diversity in Science towards Social Inclusion*) and aim to explore how cultural and/or ethnic diversity can be used a springboard to enhance involvement in informal science activities. The study is underpinned by the notion of the 'sociology of scientific knowledge' (Bloor, 1976) and seeks to explore mechanisms for the under-representation of certain demographic groups in science education and science-based jobs (Campaign for Science and Engineering, 2014). The studies all took as their premise that canonical science education represents science as a mono-cultural activity, conducted in 'educated' languages (Bansal, 2021) and thus divorced from the wider cultural perspectives found in modern society. The interventions presented actively sought to present alternative views of science through the use of 'informal' outreach, which was unrelated to any formal educational provision (Krishnamurthi and Lennie, n.d).Additionally, attempts were made to increase students' engagement by applying game-based learning and other student-centered activities. This was achieved through the acknowledgement of diverse cultural contributions to science, including the use of diverse languages, and the role of colonialism in appropriating or silencing these non-hegemonic perspectives (Raju, n.d.). The interventions were hosted in venues accessible to community participants, and participation in social groups, such as families, was encouraged. In addition, opportunities were created to report science in 'community' languages and the impact on participants was then evaluated. In keeping with the notion of diverse conceptualisations of science, the evaluations were undertaken in ways that directly mirrored the ethos of the three activities that were run. The qualitative data gathered included drawings, photos and videos volunteered by participants, photos of artefacts created by them as well as written comments. In addition, validated questionnaire data was obtained for cross-study comparison.

Disclaimer:
The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

References:

Bloor, D. (1976). *Knowledge and Social Imagery*. University of Chicago Press, Chicago.
Campaign for Science and Engineering. (2014). *Improving Diversity in STEM A report*. King's College, London. Available at: 50c4b928-d252-4ce8-825065f92d8deca3.pdf (sciencecampaign.org.uk)
Raju, C.K. (n.d.). *Decolonising Science*. Available at: uct-panel-decolonising-science-ckr-summary.pdf (ckraju.net)
Krishnamurthi, A. and Rennie, L.J. (n.d.) (Informal Science Learning and Education: Definition and Goals Available at: Informal STEM education – what is it and what are its goals (nationalacademies.org)
Bansal, G. (2021).The hegemony of English in science education in India: a case study exploring impact of teacher orientation in translating policy in practice. *Cult Stud of Sci Educ* . doi.org/10.1007/s11422-021-10068-2

Part of the Symposium 'Integrating transferable skills into chemistry teaching and learning' organized by Silvija Markic

Diversity in Science for Social Inclusion: Community consortia approaches to non-formal education

Strand number: 9

Sarah Hayes[a], Martin McHugh[a]
[a]*SSPC, the SFI Research Centre for Pharmaceuticals, Department of Chemical Sciences, Bernal Institute, University of Limerick, Ireland*
* Corresponding author: sarah.hayes@ul.ie

The DiSSI project is focused on working across a number of dimensions of diversity, to understand pragmatic pedagogical approaches to each in isolation, prior to determining which approaches offer opportunities to address multiple dimensions of diversity. Meanwhile, many papers have proposed the potential of informal and non-formal education initiatives, noting that the greater freedom and flexibility available in non-formal education provide rich opportunities for learning and engagement. The University of Limerick's role in this study is to work with socio-economically disadvantaged groups through informal and non-formal settings. Socio-economic deprivation is a meaningful focus in this instance, as it is one of the most significant factors in under-representation in many aspects of life. Limerick, the geographic location for our work, has high highest relative deprivation score in Ireland, indicating that communities in Limerick are among the most socio-economically disadvantaged in the country.

Those who grow up in, and with economic insecurity are diverse. Poverty is not just about being poor. It is an aggregate of adverse factors ranging from social to economic (Leibtag, 2016). This argument has played out in international assessments as Agasisti *et al.,* (2018, pg. 2) notes "Most of the students who perform poorly in PISA come from socio-economically disadvantaged backgrounds."

Our approach has been to develop a community consortia partnership. Often universities enter into communities intent on 'solving a problem' or 'providing a solution'. This is disempowering and patronising to the people who live in those communities and fails to recognise existing expertise and community 'know how'. These partnerships provide an innovative community co-created infrastructure to advance engagement, particularly amongst under-represented groups and hard to reach communities.

Co-funded by the Erasmus+ Programme of the European Union

References:

Agasisti, T., Avvisati, F., Borgonovi, F., & Longobardi, S. (2018) Academic resilience: What schools and countries do to help disadvantaged students succeed in PISA", OECD Education Working Papers, No. 167, OECD Publishing, Paris, https://doi.org/10.1787/e22490ac-en.

Leibtag, E. (2016) Equitable Education for Students in Poverty Starts with the Teacher. Getting Smart. Retrieved from https://www.gettingsmart.com/2016/08/equitable-education-for-students-in-poverty-starts-with-the-teacher/

Part of the Symposium 'Integrating transferable skills into chemistry teaching and learning' organized by Silvija Markic

Inquiry based chemistry activities in the in-formal educational setting for gifted students

Strand number: 9

Iztok Devetak[a]*, Miha Slapničar[a], Luka Vinko[a], Janez Vogrinc[a], and Vesna Ferk Savec[a]
[a]*University of Ljubljana, Faculty of Education, Kardeljeva ploščad 16, 1000 Ljubljana, Slovenia*
*Corresponding author: iztok.devetak@pef.uni-lj.si

In an effort to provide students with authentic science instruction, inquiry-based science education (IBSE) has been proposed as a framework for conceptualizing its values and priorities. In inquiry-based learning (IBL), learners reach conclusions and acquire specific knowledge based on a given problem or scenario. Students are placed in a learning situation where they can control the course of learning and strive to understand the scientific concepts behind the experiments they conduct. They design the procedure of the experimental work, carry it out and evaluate the results obtained (Mandler et al., 2014). It is important to emphasize that IBSE can positively influence gifted students' chemistry conceptions (Juriševič & Devetak, 2018). Therefore, further development of learning modules that include IBSE and analysis of their impact on chemistry learning of gifted students is needed.

The purpose of this presentation is to illustrate the development of learning modules for teaching chemistry in the context of the IBSE approach in in-formal educational settings for gifted students (DiSSI modules) and their implementation at the lower secondary school. The modules were developed by pre- and in-service teachers.

As part of the pre-service chemistry teacher's education, students created 55 DiSSI modules in various workshops. The students familiarized themselves with the DiSSI philosophy and its purpose. They used the IBSE approach in developing activities for gifted lower and upper secondary students. DiSSI modules include topics on natural compounds, forensics, molecular gastronomy, environmetal and green chemistry. In the first phase of the DiSSI project, seven gifted secondary students and one pre-service chemistry teacher conducted four research projects. The goal of these projects was to develop DiSSI modules for use in a in-formal learning environment. The topics "Green Chemistry" and "Chemistry of Natural Compounds" were part of these activities. Based on the optimized experiments with pectin microcapsules from essential oils, one master student conducted an experimental workshop with upper secondary school students using the principles of green chemistry. The other master's student completed an online workshop on hydrosphere pollution, due to the COVID -19 situation, and evaluated the effectiveness of the online workshop. The workshop, which developed DiSSI learning modules, was also attended by 16 in-service lower-secondary science teachers.

Disclaimer:
The European Commission's support for the production of this publication does not constitute an endorsement of the contents, which reflect the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Co-funded by the Erasmus+ Programme of the European Union

References:

Juriševič, M. & Devetak, I. (2018). Learning science through PROFILES: are the any benefits for gifted students in elementary school? In K. Taber, M. Sumida, & L. McClure (Eds.). Teaching gifted learners in STEM subjects: developing talent in science, technology, engineering and mathematics, London: Routledge. 125-144.

Mandler, D., Blonder, R., Yayon, M., Mamlok-Naaman, R. & Hofstein, A. (2014). Developing and implementing inquiry-based, water quality laboratory experiments for high school students to explore real environmental issues using analytical chemistry. *Journal of Chemical Education, 91*(4), 492-496.