

# REINVENTING THE STEM VET VIA PEER ASSISTED LEARNING AND INNOVATIVE PEDAGOGY

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*Abstract:* The science, technology, engineering and mathematics (STEM) vocational education and training (VET) sector faces many challenges in the 21st century, such as the rapid changes in technology, the increasing demand for skilled workers, the diversity of learners and the environmental and social issues. To address these challenges, this article proposes a novel approach to STEM VET that combines peer assisted learning (PAL) and innovative pedagogy (IP). PAL as a form of collaborative learning involves students helping each other to achieve learning outcomes, while IP refers to the use of new and effective methods of teaching and learning. The article discusses the benefits and challenges of PAL and innovative pedagogy for STEM VET, and provides some examples of how they can be implemented in practice. The article also suggests some recommendations and directions for future research and development in this area.

*Keywords:* STEM VET, peer assisted learning (PAL), innovative pedagogy (IP), collaborative learning, 21st century skills

## Introduction

The STEM (Science, Technology, Engineering and Mathematics) disciplines are crucial for the development of a skilled and innovative workforce that can meet the challenges of the 21st century. However, many students face difficulties in engaging with STEM subjects, especially in the vocational education and training (VET) sector, where the dropout rates are high and the outcomes are often poor. To address this issue, we propose a novel approach that combines peer assisted learning (PAL) and innovative pedagogy (IP) to enhance the quality and effectiveness of STEM VET. PAL is a student-centred method that involves collaborative learning among peers of different abilities and backgrounds, while IP is a pedagogical strategy that fosters creativity, inquiry, problem-solving and critical thinking skills. By integrating PAL and IP, we aim to

highlight a supportive and stimulating learning environment that can motivate and empower STEM VET students to achieve their full potential. The paper presents the theoretical insights about integration of PAL and IP in the area of the STEM VET.

STEM VET is a key component of the education system that prepares students for careers in science, technology, engineering and mathematics (STEM) fields. STEM VET plays an important role in fostering innovation, economic growth and social development, as well as addressing global challenges such as climate change, health and security (OECD, 2019).

However, STEM VET also faces many challenges in the 21st century, such as:

- The rapid changes in technology and the labour market that require constant updating of skills and knowledge (World Economic Forum, 2018).
- The increasing demand for skilled workers in STEM fields that exceeds the supply of qualified graduates (OECD, 2019).
- The diversity of learners in terms of their backgrounds, abilities, interests and motivations (European Commission, 2017).
- The environmental and social issues that require STEM VET to promote sustainability, equity and inclusion (UNESCO, 2017).

In this article, we will review the literature on PAL and IP in STEM VET contexts, discuss the benefits and drawbacks of this approach, and provide some recommendations for future research and practice.

### **Peer assisted learning (PAL)**

PAL is a form of collaborative learning that involves students helping each other to achieve learning outcomes (Topping & Ehly, 2001). PAL can take various forms, such as peer tutoring, peer mentoring, peer feedback or peer assessment. PAL can be implemented in different settings, such as face-to-face or online, formal or informal, structured or unstructured. PAL can also involve different types of peers, such as same-age or cross-age, same-level or cross-level, same-discipline or cross-discipline. PAL has many benefits for STEM VET students, such as:

- Enhancing academic achievement by providing additional support and practice opportunities (Topping & Ehly, 2001; Guraya & Abdalla, 2020; Zhang & Maconochie, 2022).
- Developing metacognitive skills by encouraging reflection and self-regulation (Hattie et

al., 2017).

- Improving motivation and engagement by creating a sense of belonging and community (Ryan & Deci, 2000).

- Increasing confidence and self-efficacy by providing positive feedback and recognition (Tullis & Goldstone, 2020).

- Promoting social skills and intercultural competence by facilitating interaction and cooperation among diverse peers (Johnson & Johnson, 2009).

PAL involves students from similar social groups who help each other to learn and learn themselves by teaching (Topping, 1996). PAL activities allow students to practice and develop their healthcare and teaching skills in a collaborative and supportive environment (Burgess et al., 2020). However, PAL also poses some challenges for STEM (science, technology, engineering and mathematics) VET (vocational education and training) students, such as the quality of tutor training, the availability of resources, the motivation of participants, and the evaluation of outcomes (Secomb, 2008).

Peer-assisted learning (PAL) is an educational method that involves students from similar social groups helping each other to learn and learning themselves by teaching (Topping, 2001). PAL has been widely used and accepted in various health professional education settings, such as clinical schools, where students can practice and develop their healthcare and teaching skills (Burgess et al., 2020). However, the effectiveness of PAL in a vocational education setting has not been extensively studied. This article aims to review the existing literature on PAL in vocational education and to provide some practical tips for planning, implementing and evaluating PAL activities in this context.

PAL in vocational education can offer several benefits for both tutors and tutees, such as enhancing motivation, confidence, communication, collaboration, feedback and skill acquisition (Leijten & Chan, 2010). However, PAL also poses some challenges, such as ensuring the quality of peer teaching, managing conflicts, addressing individual differences and providing adequate training and support for peer tutors (Boud & Lee, 2005). Therefore, it is important to design PAL activities that are aligned with the learning objectives, curriculum and assessment of the vocational courses, and that are based on sound pedagogical principles and evidence.

Some of the key steps for planning PAL activities in vocational education are: identifying

the learning outcomes and content to be covered by PAL; selecting appropriate peer tutors and tutees; designing effective peer teaching strategies and materials; providing tutor training and ongoing feedback; and monitoring and evaluating the PAL process and outcomes (Burgess et al., 2020). Additionally, some of the factors that can influence the success of PAL activities are: the agency of the students, that is, their willingness to participate and take responsibility for their own learning; and the affordance of the activity and the workplace, that is, the invitational quality and support provided by the vocational school and the instructors (Raupach et al., 2022).

In conclusion, PAL is a valuable educational method that can enhance the learning experience and outcomes of students in vocational education. However, PAL requires careful planning, implementation and evaluation to ensure its effectiveness and quality. Further research is needed to explore the impact of PAL on different vocational disciplines, settings and student groups.

### **Practical implementation**

PAL and IP methodology in the field of STEM VET is applied in Erasmus+ project “Reinventing the STEM VET via Peer assisted learning and Innovative pedagogy” (iPeer) with the aim to enhance the quality and relevance of vocational education and training (VET) in the fields of science, technology, engineering and mathematics (STEM). The project uses peer assisted learning (PAL) and innovative pedagogy (IP) as the main methods to foster the development of key competences and transversal skills among VET learners and teachers. PAL as a collaborative learning approach involves students helping each other to learn and improve their academic performance, while IP is a creative and student-centred teaching approach that uses various tools and techniques to enhance learning outcomes and motivation. The project involves 8 partners from Bulgaria, Lithuania, Kazakhstan, Portugal, Germany, Slovenia and Spain, who designed, implemented and evaluated a comprehensive STEM VET curriculum, a PAL and IP toolkit, an online platform and created a network of STEM VET ambassadors. The project expects to reach more than 2000 VET learners and teachers, as well as other stakeholders in the STEM VET sector, and to contribute to the improvement of the quality, attractiveness and innovation of VET in Europe (iPeer, 2023).

STEM VET (Science, Technology, Engineering and Mathematics Vocational Education

and Training) is a key area of education that prepares learners for the challenges and opportunities of the 21st century. STEM VET can foster creativity, problem-solving, collaboration and innovation skills that are essential for the future workforce. However, STEM VET also faces some challenges, such as low enrolment and retention rates, lack of diversity and inclusion, and gaps in quality and relevance.

One possible way to address these challenges is to adopt peer assisted learning (PAL) and innovative pedagogy (IP) in STEM VET. PAL is a form of cooperative learning that involves students helping each other to learn through structured activities, feedback and reflection. IP is a broad term that encompasses various teaching and learning approaches that aim to enhance student engagement, motivation, autonomy and achievement. Examples of IP include project-based learning, inquiry-based learning, gamification, flipped classroom and blended learning.

PAL and IP can offer several benefits for STEM VET, such as:

- Improving academic performance and retention rates by providing students with more opportunities to practice, review and apply their knowledge and skills in authentic contexts.
- Enhancing social and emotional skills by fostering positive peer relationships, communication, teamwork and leadership.
- Increasing diversity and inclusion by creating a supportive and respectful learning environment that values different perspectives, backgrounds and abilities.
- Promoting lifelong learning by encouraging students to take ownership of their learning process, set goals, monitor progress and reflect on outcomes.

Practical implementation of PAL and IP in the field of STEM VET is successful in many cases, however, requires careful planning, coordination and evaluation to ensure its success in different contexts.

### **Recommendations and conclusions**

This paper recommends that STEM VET educators and stakeholders consider implementing PAL and IP in their courses and programs. To do so, they need to:

- Conduct a needs analysis to identify the specific learning objectives, outcomes and challenges of their STEM VET context.
- Select appropriate PAL and IP strategies that align with the needs analysis and the

curriculum standards.

- Design and plan the PAL and IP activities with clear instructions, roles, expectations and assessment criteria.

- Implement the PAL and IP activities with adequate support, guidance and feedback from teachers and peers.

- Evaluate the PAL and IP activities with valid and reliable methods to measure their impact on student learning and satisfaction.

- Check existing educational resources such as Erasmus+ project „iPeer“ (ipeer.org) or other resources.

By following these steps, STEM VET educators and stakeholders can enhance the quality and relevance of their education provision, as well as the skills and competencies of their learners.

Although a number of scientific papers is prepared in PAL, IP or STEM VET fields. However, scientific researches in complex of the mentioned fields are not so often found. Therefore, more scientific attention could be paid to these fields as a complex, its application in practice and impact on VET teachers and students.

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