# A New Sequence Model of Interdisciplinary STEM Learning: From Theory to Practice

Marina CONNELL

*Former University Professor & Teacher, EdTech STEM Strategist*
*in Asian Development Bank funded project, Managing Director at Marina and John Connell Education Ltd., Edinburgh, Scotland, UK*

**Abstract.** The presentation explores the concept of A New Sequence Model of Interdisciplinary STEM Learning (NSMISL) that does not require any radical initial change to a country's established curriculum. NSMISL aims to integrate the four core disciplines of science, technology, engineering, and mathematics, as well as subjects such as geography, economics, physics, chemistry, and art, through Collective Planning, Project-based Learning and Inquiry based learning. NSMISL also emphasises the importance of teaching and learning Physics and Artificial Intelligence, especially in relation to the emergence of Large Language Models.

## Introduction

To address this New Sequence Model of Interdisciplinary STEM Learning (NSMISL) as a unique approach which can improve Physics Education, the author reports a pilot-test of NSMISL in a Central Asian country.

## The Methodology of a New Sequence Model of Interdisciplinary STEM Learning

*The New Sequence Model of Interdisciplinary STEM Learning is currently under consideration as a core component of an ongoing major secondary STEM education project in a Central Asian country.*

The NSMISL approach holds promise as a pedagogical innovation that can reshape the educational landscape and promote student-centred learning. A variety of methodologies are incorporated into NSMISL that fosters interdisciplinary learning [1] and teaching [2], including Collective Planning (comprising two parts: General Teacher Planning and Individual Teacher Planning), Project-Based Learning [3] and Inquiry-Based Learning [4]. The key initial aspect in the New Sequence Model of Interdisciplinary STEM Learning is Collective Planning, involving collaboration among STEM teachers who enrich the specific activities by bringing in their subject expertise/perspective.

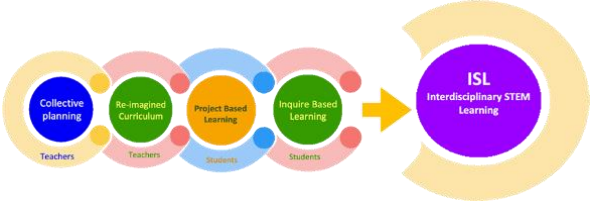


**Fig. 1.** Variety of methodologies drawn into Alternative Model of Interdisciplinary STEM Learning (AMISL).

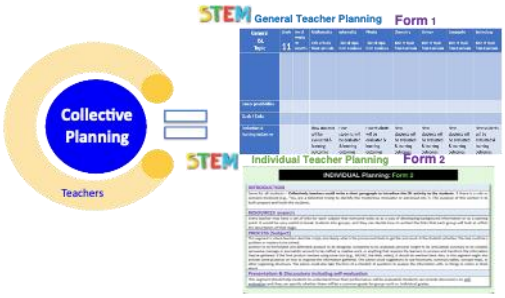


**Fig. 2.** Collective Teacher Planning involves General Teacher Planning and Individual Teacher Planning.

In summary, NSMISL prepares students to tackle real-world challenges and to develop the skills needed for lifelong learning and success in a rapidly changing world.

**Physics Education in NSMISL complemented by Artificial Intelligence, including Large Language Models**

NSMISL integrates AI concepts allowing students to explore machine learning, neural networks, and natural language processing. GPT-4 exemplifies one aspect of the power of AI. These models, trained on vast amounts of textual data, can generate human-like responses and perform complex physics tasks. AI apps and websites that AMISL integrate includes:

- Smodin. A powerful AI assistant that revolutionises physics homework by simplifying equations and theories, grading assignments, and detecting plagiarism.
- KerbalEdu. An engaging physics and engineering learning tool based on the game Kerbal Space Program, where students build rockets and conduct orbital missions.
- Osmo Newton. A captivating physics and problem-solving game that uses the device's camera to detect objects and lines drawn by the player to solve puzzles.
- Pocket Physics. A valuable education app that offers a comprehensive collection of physical formulas with detailed descriptions and helpful images.
- *Sandbox – Physics Simulator*. A free physics-based game that allows players to create and experiment with different physical phenomena using various objects and materials.
- *ChatGPT4.* Uses natural language processing and deep learning to answer, for example, physics questions and explain concepts in a conversational way.
- Gemini Google. A creative AI tool that generates physics-related experiments and problems based on the user's input or choice of topic.
- Albert Einstein AI Tool. A fun and educational AI tool that lets users interact with a virtual Albert Einstein, who can teach physics concepts, tell jokes, and give advice.
- Physion. A web-based tool that enables users to create interactive physics simulations using simple drawing tools and joint constraints.
- *PhET Interactive Simulations*. A collection of over 150 online simulations that cover various topics in physics, such as motion, forces, energy, waves, electricity, and magnetism.

**Summary**

The presentation proposes a New Sequence Model of Interdisciplinary STEM Learning that promotes student-centred and interdisciplinary learning and does not require any radical initial change to a country's established curriculum, offering a conceptual framework to guide its design and implementation. A pilot-test implementation of NSMISL is under way in a Central Asian country.

In relation to the emergence of Large Language Models (LLMs). NSMISL also suggests some ways of integrating Physics and AI, such as using simulations, games, chatbots, and creative tools.

**References**


[1] X. Gao, P. Li, J. Shen, H. Sun, Reviewing assessment of student learning in interdisciplinary STEM education, *Int. J. of STEM Educ.* **7**(1) (2020) 1-14.

[2] M. Vasilev, V. Bakeva, T. Vasileva-Stojanovska, T. Malinovski, V. Trajkovik, Grandma's games project: bridging tradition and technology mediated education, *TEM Journal* **1**(3) (2014) 13.

[3] R. Tytler, V. Prain, L. Hobbs, Rethinking disciplinary links in interdisciplinary STEM learning: A temporal model, *Research in Science Education* **51** (2021) 269 287.

[4] M. V. Connell, D. Taleski, Digitalization in Early School Education in North Macedonia. In: M. Streit-Bianchi, M. Michelini, W. Bonivento, M. Tuveri (eds) *New Challenges and Opportunities in Physics Education. Challenges in Physics Education.* Springer, Cham, 2023.