

**EMPOWER expert pools:
Institutional Support,
Curriculum development
& Course design**

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Innovative impact

This summary describes a new design framework to support science education through blended learning, based on a participatory and interactive approach supported by ICT-based tools, called *Science Learning Activities Model* (SLAM). This design framework is important as a response to complex changes in society and education (e.g. high turnover rate of knowledge, changing labour market), which require a more creative response of learners to the world problems that surround them. The framework is concerned with the assumption that science-learning activities should be applicable and relevant to contemporary life and transferable to 'real-world' situations. The design framework proposes three design dimensions: context, technology and pedagogy, and aims at integrating learning in formal and informal contexts through blended learning scenarios by using today's flexible, interactive and immersive technologies (e.g. mobile, augmented reality, virtual reality).

Key Pedagogical and Technological Factors for Effective Blended Learning Design

Introduction

Teaching and learning opportunities for youth are now available in an expanding learning ecosystem (Guetl & Chang, 2008), next to the traditional educational institutions, for example, encompassing science discovery centres, community spaces, social networks and non-profit organisations. So, considering the gap between education for a changing society and current educational models, we started the development of this design framework as a response to complex changes such as high turnover rate of knowledge and changing labour market, which require a more creative response of learners to the world problems that surround them. Many of these challenges are related to science and it would be expected that students are attracted to science, however the contrary is the case. One of the origins of this disinterest can be found in the way science is taught.

We cannot ignore that students are no longer the same target population for which our education systems were designed a few decades ago. These students grew up in a new technological environment, with its own techno-culture, and they will live in a demanding, competitive, complex and increasingly connected world. The technological revolution has produced a generation of students who grew up with multidimensional and interactive media sources, a generation whose expectations and perspectives are different from those that preceded it. Unfortunately, the majority of universities does not support a guided exploration of the real world, with authentic tasks, that allow for the development of skills to face this societal complexity; currently it looks like many curricula are just dispersed pieces of a puzzle. This suggests the need for convincing learning scenarios and designs that will engage learners, with emphasis on science topics and curricula.

Blended Learning

Online interaction has become a way of life for students wherever they are: at home, on the move, or in schools. For the

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institutions this is good news, as for the first time in history we have educational technologies that cost (almost) nothing to governments and schools: smart mobile phones (most students have one), networking software (freely available, e.g. Hangouts, Messenger, Skype), learning applications (freely and increasingly available, e.g. Apple Store, Google Play) and open educational resources (in growing supply, e.g. MOOCs, iTunes U, Khan Academy). There are other free tools available for learning organizations, such as collaborative tools (e.g., blogs, wikis, knowledge-building software), immersive environments (e.g. virtual worlds), media production and distribution tools, and many more. Furthermore, teachers and educators have always emphasized the importance and need for "authentic learning activities", where students can work with real world problems (Brown, Collins & Duguid, 1989). Therefore, the development of educational activities for students, that combine learning resources from the real world with those from the digital world, has become an important and challenging research topic for science educators. Online activities may be accomplished, for example, through the use of mobile communication and wireless technologies, allowing for experimentation, inquiry, data collection, knowledge sharing, and communication with other students, anytime and anywhere (Sharples et al., 2015).

The SLAM approach

Following up on this, taking a learner-centred approach to connect three umbrella concepts – context, technology and pedagogy – we propose a new blended learning design model. The *Science Learning Activities Model* (SLAM) has ten seamless dualities that may co-exist in multimodal activities, explicitly indicating the extremes of a continuum. These may originate learning scenarios that contain multiple learning activities set within the boundaries of the indicators. For instance, a learning scenario may consist of a learning activity where learners explore the various types of architecture, and the structural principles that underlie those buildings. More informally, learners are asked to bring in their experiences with the construction of structures (e.g. building a tree house facilitates learning of the structural principles of a real building).

Context

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| 1. Formal, non-formal, and informal learning | Specification of topics and types of activities and how they fit together in a learning scenario. |
| 2. Individual and collaborative learning | Specification of study modes and related resources (allowing for learners' PLEs). |
| 3. Open and closed learning environment | Structure of free and restricted access to learning environment and resources (e.g. MOOC and SPOC). |

Technology

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| 4. Synchronous and asynchronous learning | Technology supporting learning modes (time dimension in Johansen's matrix). |
| 5. Virtual and physical interaction | Technology for blended learning interaction (space dimension in Johansen's matrix). |
| 6. Single platform and multi platform | Online learning platform integration (e.g. Moodle, Moodle Mobile, Elgg, Edmodo). |

Pedagogy

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| 7. Theoretical and hands-on activities | Mix of learner-centred activities set in a blended learning programme (including activities based on PLEs). |
| 8. Restricted and open learning design | Design of structured activities for restricted outcomes (e.g. multiple-choice tests and tutor marked assignments), and design of open activities (e.g. games, simulations, portfolios, and open discussions). |
| 9. Centralized and open assessment | Modes of learner assessment components in a learning scenario with many activities (e.g. formative and summative assessment, peer assessment, self-assessment). |
| 10. Pre-structured and open guidance | Modes of scaffolding the learning process and tutoring of activities. |

The SLAM model will help design and explore learning activities and ensure the attainment of specific learning objectives based on the seamless integration of new technology in blended learning, and if backed by an appropriate pedagogy will enable authentic learning experiences.