

Managing learning in environments where students move: a panorama of problems and contributions

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Abstract - Educational activities where students do not stay at a fixed, predetermined location, has been growing in research output. The pedagogies and processes for these environments where students move are typically less documented than those of traditional classrooms. We have surveyed the areas of problems addressed by the literature on the field, and the areas of its contributions, to build a panorama of the research foci for managing learning in environments where students move. This was done by means of an exploratory literature review, followed by thematic analysis and triangulation. We established that research focuses on problems and contributions dealing with the design, creation, and deployment of these learning activities, and to a lesser degree, on problems and contributions dealing with the potential of use of technology. However, there is a lack of research focusing on other areas relevant to more widespread implementation across the educational system, namely structural, logistic, and assessment problems and contributions. This points towards a need to develop research in these areas, in order to contribute to more grounded and successful efforts to implement learning activities in environments where students move.

Keywords: mobile learning, mobile environments, learning beyond the classroom, widespread implementation

1 Introduction

Learning activities which involve students in motion, but are not related to sports, are difficult to manage, regardless of whether they occur within or beyond the classroom space. Pedagogic literature and models dealing with such activities leave educators with open issues on how to conduct processes and practices, being much less detailed than pedagogic models targeting traditional classroom activities (MacQuarrie, 2018).

This lack of methodological background in support of educators' practice grows in relevance, as we witness a growth of interest, both from educators and researchers, of learning activities where students move. These activities include those in classrooms which break the boundaries of seating or space assignments, using dynamic pedagogies that are inventive and project-based, but also activities that take these pedagogies outside, as learning becomes ever-present and pervasive, blended within the students current societal environment, which is tech-rich and ever-connected (Schlemmer, 2019).

To explore the contours of this research gap, which hinders the widespread adoption of learning activities where students move, we have sought to survey the current focus of research in this field, identifying its areas of problems and contributions. The goal was to reveal specific research topics which are most lacking, and thus help the community target its future efforts.

By conducting an exploratory literature review based on Google Scholar, we collected works by combining keywords from various related pedagogical concerns, as detailed in section 2. After an initial iterative search-collect-refine process for terminology and keywords, we retained the peer-reviewed papers published up to 10 years ago, extracted problems & contributions, conducted thematic analysis and triangulated via keywords themes, and examine the outcome.

2 Background

Learning in environments where students move, as a phenomenon, is the core interest of this work, as opposed to learning occurring in educational activities in which students are at a specific location, such as a classroom desk, auditorium seat or laboratory bench. While experiencing a burst of interest, in association with new mobile technologies, hence often called "mobile learning", its roots intertwine other fields: metaphorical perspectives such as technological, conceptual, socio-interactional or temporal motions, or indeed the students' physical mobility, which is our focus (Grunewald Nichele & Schlemmer, 2015). Regarding physical mobility, relevant approaches employ terms such as *experiential learning*, *learning/education outside/beyond the classroom*, *mobile/ubiquitous/pervasive/context-aware learning*, *out-of-class/outdoor learning/education*.

Their shared problem space includes mobility within classrooms, but also in alternative spaces. No single objective term is consensual to address learning involving students physical motion, besides actual physical education & sports. Some concepts only address it peripherally, such as "active learning", and were not included in this literature review. We summarize below literature perspectives which include the notion of students' physical motion as a core element.

An early, broad concept is *experiential learning*. It refers to activities where learning is the outcome of students experiencing and reflecting upon an active learning process, while experiencing places outside or within school (Kolb, 1984). Several approaches evolved from Kolb's seminal work, by focusing on learning entirely outside the classroom context, where physical motion of students is common: *learning outside the classroom*, *learning/education beyond the classroom*, or *out-of-class learning*. These contexts may include school playgrounds, trips to cities, museums and similar spaces (Hawxwell et al., 2019). Also related are *outdoor*

learning (Thorburn & Allison, 2010) and *outdoor education* (Higgins, 2002), focusing on open air activities, interacting with nature, e.g., within woods or natural parks.

Spatial mobility is forefront in efforts using the term *mobile learning/m-learning* (Crompton, 2013). This perspective focus on technology-enabled learning while students are moving. It may include leveraging students' relationship with space and aspects related to mobile devices: smartphones, tablets, wearables, etc. Several perspectives evolved from mobile learning, such as *ubiquitous learning*, learning from the perspective of ever-present availability of wireless computing and connectivity (Ogata et al., 2009); *context-aware ubiquitous learning*, which considers how students' positions and other contextual factors impact interaction with content and information (Peng et al., 2009); or combining Internet-connected sensors in everyday objects, the concept known as Internet of Things or IoT (Atzori et al., 2010) to further the awareness of context and connectivity (Ru Xue et al., 2011). A perspective that furthers this is *pervasive learning*, from the realization that computing - and hence automated, intelligent interaction - is not confined to a device, or even noticed as arising from a device, but transparent, present without being conspicuous, increasing the learners' freedom to move and to interact (Barbosa et al., 2006).

Overall, in these learning models learners move in space. Therefore, teachers need to manage, design, and implement processes for creating, running, monitoring, and assessing activities. This may lead to excessive workload (Pishtari, G. et al., 2019) or to teachers being unable to pursue these activities with enough breadth and depth, thus lacking in pedagogical quality and consistency of feedback (Munoz-Cristobal et al., 2015). It may also lead to assessment approaches not fully considering social and individual specificities of learning.

This paper explores open issues in the field, conducting a literature review about this pedagogical management issue: teachers employing learning activities where students are moving physically. Since issues can be expressed as such (problems) or inferred from intent (contributions) we based the review method upon the following working definitions:

Definition 1:

“Problems” are reported difficulties or issues lacking consensus regarding the management of learning in environments where students move;

Definition 2:

“Contributions” are proposals for resolution of problems (under the scope of definition 1) or that aims towards that resolution.

3 Methods

To develop the exploratory literature review of problems and contributions in this field, we employed search terms that encompass the various perspectives detailed in the background. By using Google Scholar, we iteratively searched for literature, analysed top results for keywords and terms, refined the list of search terms and repeated until results stabilized - using this as an proxy for exhaustion. The outcome was the following set of search terms:

- *mobile learning;*
- *learning/education outside the classroom;*
- *tracking outdoor learning;*
- *outdoor learning management;*
- *mobile activities management;*
- *mobile learning management;*
- *mobile learning tracking;*
- *outdoor activities management.*

These were employed in Google Scholar with the following criteria:

Inclusion criterion:

C11) Articles with at least one of the search terms in the title;

Exclusion criteria:

CE1) Articles not subjected to peer review;

CE2) Articles published over 10 years ago;

CE3) Articles which were not related to learning in environments where students move, from reading their titles and abstracts.

Resulting articles were sanity-checked, correcting references and duplicates. They were then read entirely, extracting problems and contributions in this field, per Definitions 1 & 2. We also extracted articles' keyword metadata, as a parallel, self-reported indicator of interest areas. Identified problems and contributions were subjected to thematic analysis, as well as the keywords metadata. Both sets of themes were triangulated for validation and discussion.

4 Results and analysis

The application of the search process and criteria yielded 28 articles. Reading them entirely for problems and contributions under definitions 1 & 2 yielded 157 items: 61 problems and 96 contributions. Articles' metadata provided 116 keywords. All these elements are provided as a publicly-available online dataset (Lima et al., 2020).

The 157 items underwent thematic analysis, by assigning tentative themes to each, in the context of education. Tentative themes were subjected to validation, by detecting overlap, duplication, and other inconsistencies. Afterwards, tentative themes were revised and the process repeated. After two more iterations of this process, we reached the five themes in Table 1. This table includes theme definitions, emerging from the iterative thematic analysis validation. Their relative prevalence is shown in Fig. 1.

ID	Theme	Description and contributions	#
T1	Design & Creation	Related to the design and creation of activities, instruments, or applications for learning in environments where students move. This includes personalization concerns of that design and creation.	41
T2	Employed technology	Related to the analog or digital technology used to create or deploy activities for learning in environments where students move. Some examples include QR codes, RFID tags, augmented reality applications, smartphone, tablets, and wearables.	15
T3	Structures & Logistics	Related to equipment, materials, and motions required for making possible learning activities in environments where students move. Examples include transportation, physical items, Internet connections, permits, and bring-your-own-device policies.	14
T4	Monitoring	Related to monitoring students involved in learning activities in environments where they move. Examples include data collection, providing hints and support, orchestrating the pedagogical intervention, and conducting observation.	62
T5	Assessment	Related to assessment of the learning of competences/skills developed by students while involved in learning activities in environments where they move. This includes assessing students' satisfaction.	25
TOTAL			157

Table 1. Themes of problems and contributions on management of learning activities in environments where students move and their absolute frequency, emerging from the exploratory literature review

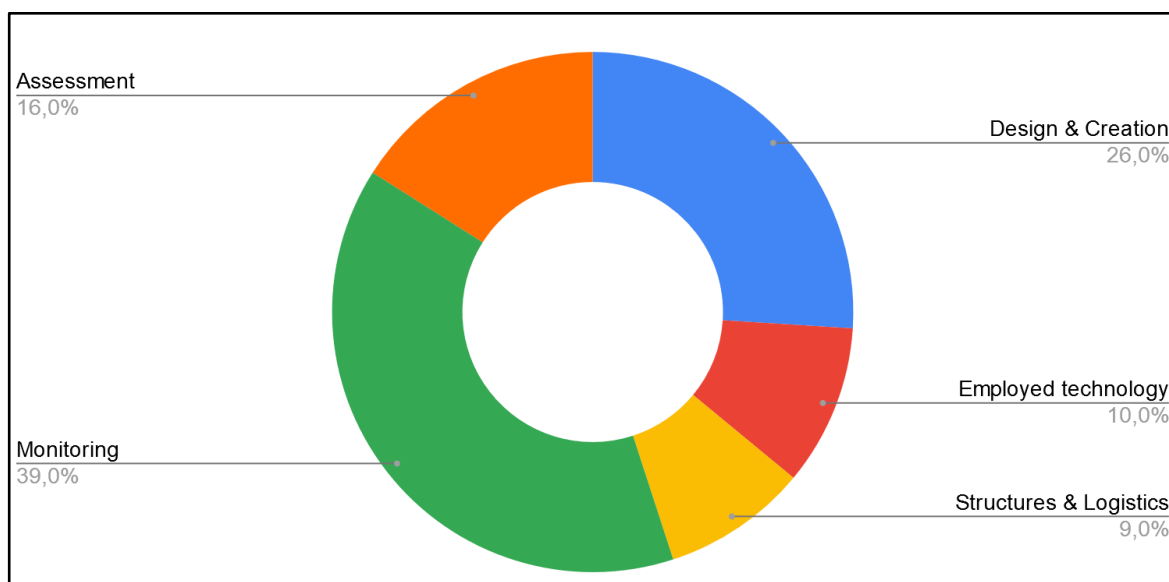


Figure 1. Proportions of themes of problems and contributions from the literature on management of learning activities in environments where students move

We proceeded similarly for thematic analysis of metadata keywords, yielding the themes in Table 2 and the prevalence in Fig. 2. Due to space restrictions, we present only themes comprising

more than 1 metadata keyword.

ID	Description	#	Prevalence	Linked to
K1	Mobile learning, learning outside the classroom, outdoor learning	21	29,5%	T1
K2	Games/Gamification	17	24%	T1, T2
K3	Technology	17	24%	T2
K4	Design/Learning Design	4	5,5%	T1
K5	Ubiquitous Learning	3	4%	T4
K6	Place-based Learning/Activities	3	4%	T4
K7	Collaborative Learning	2	3%	T1
K8	Learning analytics	2	3%	T4, T5
K9	Teacher Orchestration/Strategies	2	3%	T1, T4

Table 2. Themes from metadata keywords

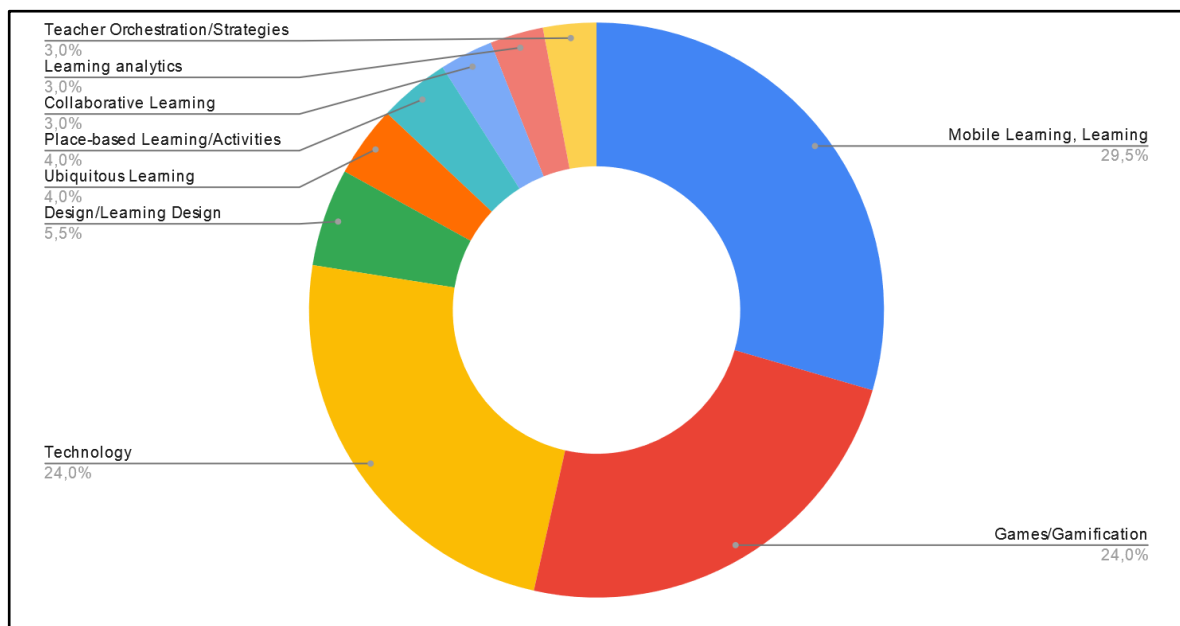


Figure 2. Proportion of themes from the metadata keywords

Themes emerging from the collected problems and contributions (Table 1) emphasize practical implementation aspects. Contrarily, themes emerging from metadata keywords (Table 2) emphasise supporting theories and overall topics. We interpret these results considering that problems & contributions themes reveal the articles' knowledge application perspective, whereas metadata keywords themes reveal articles' self-perspective, i.e., their drive or inspiration areas.

For analysis, we lay this interpretation as an axiom. Thus, we deduced that by triangulating the application perspective (revealed by the problems & contributions themes) with the inspiration perspective (i.e., the articles' self-perspective from metadata keywords themes) we will achieve a stronger interpretation of survey results. For triangulation, we judged potential links between themes, shown in column "Linked to" (Table 2). Below we explain our judgment rationale.

Keywords theme K1 - Mobile learning/learning outside the classroom/outdoor learning, from an inspiration perspective, points towards applications aiming to accomplish activities. Thus, we deemed it linked to application themes T1 (Design & Creation) and T4 (Monitoring). Keywords theme K2- Games/Gamification, from an inspiration perspective, also points towards aiming to accomplish activities (with games or their mechanics) but also towards mere intention to employ them, a technocentric perspective. Thus, we deemed it linked to application themes T1 & T4, as in the previous case, but also to application theme T2 (Employed Technologies). Keywords theme K3 - Technology, from an inspiration perspective, points towards applications focusing on the use of technologies. Thus, we deemed it linked to application theme T2. Keywords theme K4 - Design/Learning Design, from an inspiration perspective, points towards aiming to design or create activities. Thus, we deemed it linked only to application theme T1. Keywords theme K5 - Ubiquitous Learning, from an inspiration perspective, points towards contextual concerns of activities, but also towards ubiquitous-enabling technologies. Thus, we deemed it linked to application themes T4 and T2. Keywords theme K6 - Place-based learning, from an inspiration perspective, points towards context concerns of activities. Thus, we deemed it linked only to application theme T4. Keywords theme K7 - Collaborative Learning, from an inspiration perspective, points towards ensuring collaboration as an educational dynamic. Thus, we deemed it linked only to application theme T1. Keywords theme K8 - Learning Analytics, from an inspiration perspective, points towards enabling the monitoring or assessment of activities. Thus, we deemed it linked to application themes T4 and T5. Lastly, keywords theme K9 - Teacher Orchestration/Pedagogies, from an inspiration perspective, points towards the design and creating of activities. Thus, we deemed it linked only to application theme T1.

By confronting the prevalence of application themes and inspiration theme, we reached the results in Table 3.

Problems and contributions	Application prevalence	Inspiration prevalence	
T1 - Design & Creation	26%	K1/2+K2/3+K4+K7+K9	34%
T2 - Employed technologies	10%	K2/3+K3+K5/2	34%
T3 - Structures & Logistics	9%	-	0%
T4 - Monitoring	39%	K1/2+K2/3+K5/2+K6+K8/2	30%
T5 - Assessment	16%	K8/2	2%

Table 3. Problems & Contributions themes: application vs. inspiration prevalences

5 Discussion

The most frequent themes are T1 (Design & Creation) and T4 (Monitoring): together, they represent two thirds of all problems and contributions found in the literature. Then theme T5 (Assessment) with 16% prevalence. Lastly, with similar prevalences, themes T2 (Employed technologies, 10%) and T3 (Structures & Logistics, 9%).

Thus, technological and logistical themes (T2 and T3) have much less prevalence than those for creation and monitoring (T1 e T4), indicating lesser research concern with these instrumental aspects of pedagogic activity development (transportation, safety, technological infrastructure, etc.). We hypothesize that their interest is arising as an afterthought, a reflection of interest on more prevalent themes.

There is low prevalence of theme T5, Assessment. Thus we also hypothesize its research interest is a reflection of interest in design, creation, and monitoring of activities. But from a pedagogical viewpoint, we acknowledge a relationship between monitoring (T4) and assessment (T5). Perhaps the differences in interest may reflect that some monitoring problems and outcomes encompass assessment, albeit not explicitly? We did not account for this possibility in the data collection protocol, which is a limitation. However, triangulation contrasted problems/contributions themes with keywords themes (Figs. 1 & 2), and does not support this possibility. When considering problems & contributions themes from the self-perspective of their authors, their inspiration prevalence (i.e., prevalence of linked keywords themes), the prevalence of Monitoring (T4) over Assessment (T5) increases, rather than diminishing. This strengthens the hypothesis that assessment, as research interest, emerges as a reflection of interest on more prevalent themes.

When similarly triangulating for technologies themes, the outcome differs: from an inspiration perspective, T2 (Employed Technologies) increases prevalence, matching Design & Creation. While not enough to be as relevant as Design & Creation + Monitoring, it does lessen its low significance, so for technology itself our hypothesis is not reinforced by triangulation. For

structures & logistics, however, it is: from an inspiration perspective it doesn't even register among themes with more than one item.

6 Conclusions

The background in section 2 highlighted two focus areas: learning experiences in spaces beyond traditional classrooms, which we associate with themes T1 - Design & Creation and T4 - Monitoring; and the potential of technologies to facilitate learning activities where students move, which we associate with theme T2 - Employed Technologies.

The results support the notion that these focus areas are indeed the prevalent ones regarding problems and contributions provided by the surveyed articles, albeit with greater preponderance of problems and contributions related to learning experiences than to technologies. Before triangulation, that preponderance (T1+T4 = 65% vs. T2 = 10%) seemed larger than after triangulation (T1+T4 = 64% vs. T2 = 34%), but both were salient.

Other problems & contributions themes emerged, related to instrumental aspects, such as Structures & Logistics (T3) and Assessment (T5), with much lesser prevalence (25% pre-triangulation, 2% subsequently). This points towards research interest being mostly on creating and monitoring activities, and to a lesser degree, on exploring the potential of new technology. It also reveals lack of research interest regarding T3 and T5 factors that, while possibly not as inspiring, are still essential to successfully implement educational activities in the educational system.

These results are consistent with literature, which reports that unlike the creation and monitoring of activities taking place within traditional learning contexts, activities beyond the classroom, where students move, are not as well documented in pedagogical approaches and processes (MacQuarrie, 2018).

Consequently, these less explored areas of problems and contributions demand more effort from the research community, since they reflect development of knowledge in critical aspects for widespread adoption across the educational system of pedagogic activities where students move: development of knowledge on the materials, equipment, and motions required to perform them (T3 - Structures & Logistics), and development of knowledge about activities for assessing learning of competences and skills developed in the activities, and student satisfaction (T5 - Assessment).

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