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Utilizing learning analytics in primary school in two diverse learning processes

Teacher reflections

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Abstract

This case description explores the experiences of using learning analytics (LA) in primary school classrooms in two diverse pedagogical settings. The first, a highly structured individual learning process, Space, emphasised individual learning and used the learning management system (LMS) to guide pupils' learning, allowing teachers to monitor progress and make more data-informed decisions. The second, a collaborative and more open learning process Sustainable Development, demanded teachers to take a more active role in guiding the learning process and the LMS was underutilized by the pupils. This case description underscores the importance of time availability, data reliability and alignment with teachers' needs for effective LA use. Accordingly, teacher training and reflection are needed for teachers to understand the role of LA in different learning processes to scrutinize the usage of LA. It suggests that pedagogical aspects and learning theories should be key elements in learning designs utilizing LA.

Keywords: e-learning; learning analytics; self-regulated learning; primary school; case description.

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Introduction

This case description discusses the insights made during two diverse primary school study modules utilizing learning analytics (LA) to support pupils' self-regulated learning (SRL) from the teacher's perspective. The focus is on the practical implementation of the study and the reflections on the combination of teachers' pedagogical thinking and learning analytics. In addition to the research findings from the OAHOT project (cf. Paavilainen et al., 2024; Väisänen et al. 2022), it is based on the first author's role and experiences as a classroom teacher during the utilization of the study modules. The viewpoints of a teacher to utilize LA are considered important as those remind us about the important relationship between teachers' pedagogical thinking, learning design, learning context and learning analytics and help us to further develop the design of human-centred LA (cf. Buckingham Shum et al. 2019) to support different learning designs.

Learning analytics to support self-regulated learning in primary school

The main aim of the OAHOT project was to gain insights into the use of LA to support SRL in diverse blended learning processes in primary schools. Although the research and use of LA has largely focused on the university level (Lee et al. 2020; Siemens 2013), it has been acknowledged that the scope of LA should be extended to primary schools as the use of digital learning becomes more common. As LA is defined as the measurement, collection, analysis and reporting of data about learners and their environment, with the primary purpose of understanding and optimising learning (LAK, 2011), LA methods have the potential to inform how pupils learn in primary schools and how this can be further enhanced (Kovanovic et al. 2021).

Research has shown that LA has the potential to support pupils' SRL, which is regarded as an essential skill in more student-centred learning processes, such as phenomenon-based learning (e.g. Symeonidis & Schwarz 2016). Self-regulated learning is generally considered as students' active engagement in the learning process to obtain their personal goals (Zimmerman & Schunk 2011). It combines the cognitive, behavioural, metacognitive, motivational and emotional aspects of learning (Panadero 2017). In SRL processes, students regulate their learning by cyclically setting goals, using learning strategies, monitoring their progress and finally reflecting (Panadero 2017).

The regulation of learning can come from internal or external regulation (Merikko 2023; Vermunt & Van Rijswijk 1988). Following Merikko´s (2023) model of the locus of regulation, in primary schools the external support for regulation could come from different combinations of teachers and technology. Consequently, if we want technology to help teachers support pupils in regulating their learning, we need to consider which aspects of the learning management system (LMS) help pupils regulate their learning to reduce teachers' workload. However, it has also been questioned whether the automatized use of LA might even prevent

pupils from becoming self-regulative learners (Molenaar 2022) if the responsibility of regulation is too much externalised to technology. Therefore, it is important to acknowledge, that the aim is for the responsibility of the regulation to transfer gradually to the learner. To gain this, technology should be adaptive (Molenaar 2022).

Since SRL is increasingly becoming a critical skill to manage in a digitalized society, it should be considered a learning object already in primary school. However, research has stated that teachers generally lack the skills to support SRL (Dignath & Büttner 2008). Therefore, we need novel ways to support pupils in developing the skills to regulate their learning. LA solutions collect and analyse digital traces of student behaviour, such as visits to the LMS, completion of tasks or time spent online. These provide an understanding of how pupils use the LMS to regulate their learning. LA could therefore inform pupils' reflection and teachers' decision-making to enhance SRL. However, as primary school learning differs from university learning, characterized as blended learning (see e.g. Bonk et al. 2006) and teachers play a major role (van Leeuwen & Janssen 2019), to beneficially implement LA in primary schools, we need to understand primary school classroom learning and the role of teachers in different pedagogical learning designs. As LA is widely developed in the context of computer sciences, it has been criticized for excluding the pedagogical aspects, such as the effects of learning design or teachers' pedagogy to log data collected. Conversations about the learning theory behind learning analytics have raised the question of whether there is a great presentation of positivism, such as behaviourism (Rogers 2015; Wilson et al. 2017) or "new behaviourism" (Selwyn 2019) affecting the LA research. The critiques against learning analytics have also demanded more human-centred approaches (Buckingham Shum et al. 2019) and learning processes to be less behaviouristic in nature (Rogers 2015; Wilson et al. 2017). This leads to the need for a human factor in LA development – the need to co-design LA systems in collaboration with teachers (Rodriguez-Triana et al. 2021; van Leeuwen et al. 2021; Wiley et al. 2023).

Teachers using learning analytics

The implementation of LA in primary schools is still in a stage of development (Hirsto et al. 2022). Besides the technological challenges faced, it is to be remembered that "embedding innovative technology in authentic contexts is as much a human challenge - … - as it is a technical challenge" (Buckingham Shum et al. 2019). Although teachers generally are masters of pedagogy, they randomly are experts in understanding the algorithms and possibilities of LA. As learning platforms utilizing LA are generally built by others, the pedagogical thinking might not meet the needs of the teacher and therefore LA is not utilized. Therefore, there is a need to involve educators and bring more pedagogical viewpoints to the discussion on utilizing LA (Hirsto et al. 2022; Macfadyen et al. 2020; Mangaroska & Giannakos 2019).

Research states, that when utilized, teacher dashboards are influencing teachers' pedagogical actions in the classes (Molenaar & Knoop-van Campen 2019). Teachers using LA data were shown to be better able to use their pedagogical knowledge to interpret the log

data and gave more diverse (Molenaar & Knoop-van Campen 2019) feedback with a better focus on the learning process (Knoop-van Campen et al. 2023). However, it is not a straightforward process, as teachers first need to become aware of the data, reflect on it to make sense of the individual pupils' needs that the data indicates and then translate it into action (Verbert et al. 2014). As a pedagogical intervention to analytics data teachers generally exploit either whole-class or targeted, individual scaffolding or revise their learning design as well as acquire a wait-and-see tactic or reflect on the pedagogy (Wise & Jung 2019). Still, teachers generally also activate their existing knowledge about students and use other sources of information, such as observation (Wise & Jung 2019) to confirm their interpretation.

Teachers' level of using LA to support pedagogical decision-making varies at the primary school level. Van Leeuwen (2021) found out that factors influencing this are rather complex such as teachers' pedagogical knowledge, routines and data literacy. To be worth using, research has highlighted the importance of teacher dashboards to be easy to use and meet the needs of the teachers (Kaliisa et al. 2020; Mohseni et al. 2023; Molenaar & Knoop-van Campen 2019). Accordingly, teachers seem to need time to get used to the information provided by LA and still, may not fully trust the dashboard suggestions (van Leeuwen & Janssen 2019).

The design and implementation of the study modules

Two diverse study modules were planned for the LMS in close collaboration with teachers, pre-service teachers and researchers. The collaboration ensured that both theoretical and practical aspects were considered during the design process. Identifying critical stakeholders, their relationships and the context are considered important to make technology human-centred (Buckingham Shum et al. 2019). Teachers were responsible for example of the content to be learned, the integration of Finnish National Core Curriculum (Finnish National Board of Education 2014) principles and the pedagogical design principles as well as the needs of the pupils. Pre-service teachers produced the content material to be implemented in the LMS. Researchers ensured the aspects of support for SRL were considered in the design, the integration of LA and also structured the modules to LMS according to the SRL principles. This collaboration is needed for LA to meet the needs of actual learning situations and help teachers (Wiley et al. 2023).

The designs of the two study modules followed the principles of phenomenon-based learning, emphasizing pupils' active role and wider knowledge constructions (e.g. Symeonidis & Schwarz 2016). Additionally, The LMSs were designed to support SRL as pupils were encouraged to set goals, monitor and reflect own learning, check for progress through learning analytics data and evaluate their performances concerning their objectives. However, the two processes were designed according to different pedagogical designs, as indicated in Table 1. The first study module, Space, was designed to foster pupils' individual learning through the structured LMS. Therefore, the second module, Sustainable Development, emphasized collaboration and pupils as active creators. The variation in

learning designs was considered vital to understanding the usage of LA in different learning settings. From the perspective of utilizing LA, the group-based learning process was seen as highly interesting for the teachers, as this was something there was no prior experience to rely on.

The study modules were organized in a Finnish teacher training school in two different class groups. The pupils were 5th (n=39) and 6th (n=44) graders (11-13 years). The learning space was a half-open flexible learning environment, a hub, where fifth and sixth grades had their areas divided. Classes were studying in large class groups with two classroom teachers, a teaching assistant and generally two pre-service teachers. At the beginning of each lesson, teachers introduced the content main ideas and the materials on LMS to work with. After that, pupils started working independently or in groups (depending on the study module) with materials and assignments on their personal tablet devices. During this, teachers were going around observing pupils and helping them. At the end of the lessons, teachers guided pupils to make self-reflections at the LMS.

	Space (January-February 2021)	Sustainable Development (May 2021)
Learning environment	Learning management system, pupils' personal tablet devices, half-open physical learning environment	
Duration	5 x 90 min during two weeks	8 x 90 min during three weeks
Themes	Five themes, each lasting two times 45 minutes: The structure of the Earth, The Earth rotates and the Moon orbits the Earth, The Earth orbits the Sun, Universe and The Earth's gravity	Eight themes guiding the process of presenting the life cycle of one chosen product (e.g. football or jeans): Start, Explore and Find Out, Manuscript, We Create 1, We Create 2, Editing, Show Time, Final
Learning design	Pupils' active role, personal goals, individual learning, tasks with automated feedback	Collaborative, student-centred, pupils as active and creative producers. Shared goal to make a digital media artefact
Regulation of learning	Self-regulated learning	Co-regulation and socially shared regulation of learning
LMS	Goal-setting, content with multimodal materials, quizzes, automated feedback, assignments and reflection	Instructions, content material for scaffolding, to return the assignments and final artefact and self-reflections
LMS to support the regulation of learning	Goals, materials, assignments, reflection in each theme	Materials, assignments, reflection in each theme

Table 1: Comparisons between the two study modules Space and Sustainable Development

A vast amount of data was collected during the study modules, such as pupils' log data and written reflections and questionnaires on motivation and regulation of learning. Teachers and pupils were also interviewed at the end of both modules. However, this case reflection relies more on pedagogical reflections^and observations made during the learning processes and discussed between teachers and researchers. Accordingly, it relies on the documents and observations made during the research process, from the viewpoint of a teacher.

Teacher reflections

Space

In the study module Space, the LMS was designed to support pupils' individual SRL. Every theme was structured for pupils to first obtain the general goals, set their own goals, study the content with multimodal material, check their understanding through quizzes and finally reflect on their learning (for a more detailed description, see Väisänen et al. 2022).

As in the first module Space, the LMS was very structured and heavily guided pupils' SRL in the LMS, the need for teacher support decreased. Structured digital learning processes are thought to help pupils concentrate on aspects meaningful for learning and also to monitor and self-regulate their learning (Corno 2001). The atmosphere in the classes was very peaceful as pupils were mostly deeply concentrated on their individual learning with their tablet devices. However, as some of the pupils were very fast learning the

materials and doing the tasks, the voice level increased as lessons proceeded towards the end. Pupils were able to track their progress through visualisations, for example, percentages according to their task completion and success. As for some pupils, this seemed to work as a motivating aspect, teachers were also worried if some pupils were just clicking things through or if they were actually learning the materials. Still, the feedback through analytics also made some pupils worry about their grades since they had not been able to get the full scores.

The integration of LA was successful as pupils followed the planned pathways in the LMS. The LA visualizations allowed teachers to see the real-time progress of the pupils in different tasks and assignments and the percentage of correct answers. Following this, teachers were able to see if pupils were doing what they were supposed to do with their tablets and some information on learning the content. However, the teacher dashboard was not that advanced to further inform teachers about pupils learning. If individual pupils struggled to proceed, they generally directly asked for help from their peers or their teachers. Through dashboard information, teachers were also able to find the pupils struggling and direct their pedagogical support to the ones in need. Accordingly, if pupils needed some extra tasks, teachers were able to see that from the dashboard.

Additionally, as the LMS heavily guided pupils' SRL, teachers had the time to follow pupils' progress through the LA visualizations. This way, learning design and LA helped teachers with their workload. According to teachers' observations, some pupils with special needs, generally struggling to proceed with their studying, seemed to enjoy and benefit from this highly structured learning method. However, some other pupils felt that although learning individually through the LMS was easy it was not that interesting.

Sustainable Development

The second study module was more open and emphasized collaborative learning and knowledge building and pupils as creators of a media artefact. As pupils had more freedom to make choices concerning their learning, such as choosing the product and media format, the process was highly different between groups. The atmosphere in the classes was

enthusiastic, hectic and during group work even noisy. As most of the pupils enjoyed being able to more freely and creatively work in a group, some groups also had difficulties regulating their group process and involving each member of the group to collaborate. The learning space extended beyond classroom and hub walls as groups needed quiet places to record video or audio. This can be seen as another challenge for pupils' ability to regulate their learning.

The LMS was structured according to the same basic principles as in the study module Space – to support pupils' regulation of learning in a collaborative learning process by setting goals and reflecting on their cooperation. However, compared to Space, the LMS served more as giving general guidelines for carryingout the process, such as general tips for making a manuscript or editing the media artefact. An important distinction was, that as the process was more complex for students, teachers felt the need to guide the process more at the beginning of each lesson before pupils were spread all over the learning space to work in their groups. Following this, the start of the lessons was heavily teacher-guided. As materials in the LMS were shown by the teachers, pupils didn't feel the need to utilize those during their group work. Still, the role of the LMS was meaningful as it was a place for pupils to check the instructions, return the assignments, get feedback from teachers and do the reflection tasks. It seemed, that pupils utilized the LMS only when it was needed or teachers told them to do so, for example, to do the reflection tasks at the end of each lesson. For teachers, the LMS showed if the groups had done the assignments needed in different phases and this way to follow each group's progress and give feedback if needed.

Consequently, LA visualizations still served little information for teachers of pupils' learning. As pupils worked in teams, they also divided work between group members, and some might just quickly visit the LMS to mark things done. Also, during the pupils' work, teachers were heavily busy as their help was needed for various reasons, for example, to give more instructions, guide individuals or groups struggling to carry on with the process, help with technological aspects or find a place to record video or audio. Therefore, teachers didn't have the time to check the LA visualizations on pupils' progress during the classes.

Conclusions

This case description illustrates the utilization of LA in primary school classrooms from the teacher's point of view. It does so by describing two phenomenon-based, pedagogically diverse, self-regulated learning processes and the experiences gained in planning, implementing and reflecting on these processes in two primary school classes.

By implementing two diverse learning processes, this case description also highlights the changing role of the teacher in different learning settings and the implications this has for the utilization of LA. In the individual and highly structured learning process Space, the teachers' role as an external regulator of the learning process was reduced as they relied on the LMS to guide the pupils´ learning. Subsequently, teachers had the time and also the need to monitor pupils' progress through LA visualizations, as otherwise they could not effectively follow pupils' progress as they worked individually with their tablet devices. In this study module, the usage of LA helped teachers by providing accurate information and following

this, to make better adjusted data-based pedagogical decisions. Accordingly, pupils were able to track their progress and receive feedback from the LMS to self-regulate their learning. However, it must be acknowledged, that in the long term, while technology is very much needed to help teachers meet the needs of each individual pupil, the presence and live feedback of the teacher is seen as vital in primary school. Teachers have shared their concerns that following this pedagogical direction alone could lead to a situation where the important interaction between teachers and primary pupils is partially replaced by technology.

In the second study module Sustainable Development, the teachers' role in guiding the learning process was very different. At the beginning of the lessons, teachers heavily instructed the learning but as the group work started, the teachers' role was to assist and coach individuals and groups according to those needs. Guidance was mostly needed for those struggling to proceed but also to adjust the learning environment to meet the needs of the pupils. In this situation, where teachers were highly busy answering each group's needs, the support for the regulation of learning from the LMS would have been significant. However, as the LMS design of this module wasn't perhaps able to meet these pupils' needs, they randomly used it to regulate their learning.

The experiences gained during the study modules imply, that LA was more able to help pupils to regulate their learning and give teachers accurate feedback on pupils learning when the learning was individual and highly constructed. Instead, in collaborative processes, pupils didn't utilize the LMS, perhaps relying more on face-to-face and group regulation, and therefore the log data is more scattered. Controversially, the need to support pupils' regulation of learning is even greater in collaborative processes, such as the Sustainable Development module, as collaborative learning is seen as more demanding for pupils. Due to the teacher's role as an assistant and a coach for pupils learning, also teachers' time is limited to support SRL.

Previous research has stated that for teachers to utilize LA dashboards, those need to be easy to use and meet the needs of the teachers (Kaliisa et al. 2020). The experiences gained in this case, contextualised in primary school, highlight the importance of the following factors. First and critically, teachers need to have the time to check the dashboards. According to this case, the time available in primary school depends on the learning design and pupils' ability to proceed independently. Secondly, since primary school teachers' days are generally very hectic and pupils need a lot of attention and care, the data from the dashboard must provide information that cannot be obtained through classroom observation. Teachers need to be confident that the information provided by LA data is reliable and answers crucial questions about how pupils are working and learning.

To benefit from LA data, Li and Wise (2021) highlight the importance for teachers to discuss, which questions they want LA to answer. As this was probably clear in the individual learning process Space (progress on materials and tasks, number of correct answers), it might have been more problematic in the Sustainable Development highlighting the importance of collaboration and openness. The questions for LA were perhaps new, unclear and more complex to answer as teachers would have needed information on each group's progress and therefore the usage of LA information stayed low. In the future, to effectively implement the possibilities of LA, teachers would benefit from both training and reflection to finally scrutinize the usage (Li et al. 2021).

Research indicates that teachers who have more experience in using LA can use the information provided by LA more effectively (Knoop-van Campen et al. 2023; Wise & Jung 2019). For teachers to be able to fully participate in the co-construction of learning designs utilizing LA, it would also be recommended that teachers are already familiar with the basic concepts and possibilities of LA. As the concept of LA is still rather unknown to teachers and the images of LA rely on some specific systems, teachers might not be able to understand all the possibilities of LA systems (see also Holstein et al. 2019). It takes time for teachers to understand the added value of LA and integrate it into their pedagogies and daily routines (Li et al. 2021). Accordingly, it is important to remember that although log data may seem easier to obtain through more traditional or behaviourist learning processes (see e.g. Selwyn 2019; Wilson et al. 2017), such as the Space in this case, the pedagogical aspects and learning theories need to be properly considered as a key element for the learning designs utilizing LA. The construction of learning in primary schools, even when utilizing LA, should not be technology and data-driven. Instead, it should emphasise the objectives and skills that are meaningful in the curriculum and important for the future of the pupils, implemented through different pedagogies and learning designs.

References

Bonk, C. Jay; Graham, C. Ray; Masie, Elliot; Hofmann, Jennifer; … Zeng, Tingting: The handbook of blended learning: Global perspectives, local designs. Pfeiffer, San Francisco, 2006.

Buckingham Shum, S.; Ferguson, R.; Martinez-Maldonado, R.: Human-Centred Learning Analytics. In: Journal of Learning Analytics, 6(2), 2019. https://doi.org/10.18608/jla.2019.62.1 (last check 2026-07-28)

Corno, L.: Volitional aspects of self-regulated learning. In: Zimmerman, Barry J.; Schunk, Dale H. (Eds.): Self-Regulated Learning and Academic Achievement: Theoretical Perspectives. Routledge, New York, 2001, pp. 191–225.

Dignath, C.; Büttner, G.: Components of fostering self-regulated learning among students. A metaanalysis on intervention studies at primary and secondary school level. In: Metacognition and Learning, 3(3), 2008, pp. 231–264. https://doi.org/10.1007/s11409-008-9029-x (last check 2026-07-28)

Finnish National Board of Education: National Core Curriculum for Basic Education 2014. Porvoon, Kirjakeskus, 2014.

Hirsto, L.; Saqr, M.; López-Pernas, S.; Valtonen, T.: A systematic narrative review of learning analytics research in K-12 and schools. In: Proceedings of the 1st Finnish Learning Analytics and Artificial Intelligence in Education Conference (FLAIEC2022), Joensuu, Finland. CEUR Workshop Proceedings, 2022, pp. 60-66. https://ceur-ws.org/Vol-3383/FLAIEC22_paper_9536.pdf (last check 2026-07-28)

Holstein, K.; McLaren, B. M.; Aleven, V.: Co-Designing a Real-Time Classroom Orchestration Tool to Support Teacher–AI Complementarity. In: Journal of Learning Analytics, 6(2), 2019, pp. 27–52. https://doi.org/10.18608/jla.2019.62.3 (last check 2026-07-28)

Kaliisa, R.; Kluge, A.; Mørch, A. I.: Combining checkpoint and process learning analytics to support learning design decisions in blended learning environments. In: Journal of Learning Analytics, 7(3), 2020, pp. 33–47. https://doi.org/10.18608/JLA.2020.73.4 (last check 2026-07-28)

Knoop-van Campen, C. A. N.; Wise, A.; Molenaar, I.: The equalizing effect of teacher dashboards on feedback in K-12 classrooms. In: Interactive Learning Environments, 31(6), 2023, pp. 3447–3463. https://doi.org/10.1080/10494820.2021.1931346 (last check 2026-07-28)

Kovanovic, V.; Mazziotti, C.; Lodge, J.: Learning analytics for primary and secondary schools. In: Journal of Learning Analytics, 8(2), 2021, pp. 1–5. https://doi.org/10.18608/JLA.2021.7543 (last check 2026-07-28)

LAK ´11: What is learning analytics? In: 1st International Conference on Learning Analytics and Knowledge 2011. ACM, New York, Vol. 2022, 2011, Issue 7.2. https://dl.acm.org/doi/proceedings/10.1145/2090116 (last check 2026-07-28)

Lee, L.-K.; Cheung, S. K. S.; Kwok, L.-F.: Learning analytics: Current trends and innovative practices. In: Journal of Computers in Education (the Official Journal of the Global Chinese Society for Computers in Education), 7(1), 2020, pp. 1–6. https://doi.org/10.1007/s40692-020-00155-8 (last check 2026-07-28)

Li, Q.; Jung, Y.; Friend Wise, A.: Beyond first encounters with analytics: Questions, techniques and challenges in instructors' sensemaking. In: LAK21: 11th International Learning Analytics and Knowledge Conference, ACM, New York, 2021, pp. 344–353. https://doi.org/10.1145/3448139.3448172 (last check 2026-07-28)

Macfadyen, L. P.; Lockyer, L.; Rienties, B.: Learning design and learning analytics: Snapshot 2020. In: Journal of Learning Analytics, 7(3), 2020, pp. 6–12. https://doi.org/10.18608/JLA.2020.73.2 (last check 2026-07-28)

Mangaroska, K.; Giannakos, M.: Learning Analytics for Learning Design: A Systematic Literature Review of Analytics-Driven Design to Enhance Learning. In: IEEE Transactions on Learning Technologies, 12(4), 2019, pp. 516–534. https://doi.org/10.1109/TLT.2018.2868673 (last check 2026-07-28)

Merikko, J.: Technological support for self-regulated learning: The tripartite relationship between learner, teacher and technology in the regulation of the learning process. University of Helsinki, 2023. http://hdl.handle.net/10138/565333 (last check 2026-07-28)

Molenaar, I.; Knoop-van Campen, C. A. N.: How Teachers Make Dashboard Information Actionable. In: IEEE Transactions on Learning Technologies, 12(3), 2019, pp. 347–355. https://doi.org/10.1109/TLT.2018.2851585 (last check 2026-07-28)

Paavilainen, T.; López-Pernas, S.; Väisänen, S.; Kontkanen, S.; Hirsto, L.: Using Learning Analytics to Support Self-Regulated Learning in Primary Education – A Learning Design Perspective. In: Technology, Knowledge and Learning, Vol. 30, 2025, pp. 1299–1319. https://doi.org/10.1007/s10758-024-09808-4 (last check 2026-07-28)

Panadero, E.: A review of self-regulated learning: Six models and four directions for research. In: Frontiers in Psychology, Vol. 8, 2017, pp. 422–422. https://doi.org/10.3389/fpsyg.2017.00422 (last check 2026-07-28)

Rodriguez-Triana, M. J.; Prieto, L. P.; Dimitriadis, Y.; de Jong, T.; Gillet, D.: ADA for IBL: Lessons Learned in Aligning Learning Design and Analytics for Inquiry-Based Learning Orchestration. In: Journal of Learning Analytics, Vol. 8(2), 2021, pp. 22–50. https://doi.org/10.18608/jla.2021.7357 (last check 2026-07-28)

Rogers, T.: Critical realism and learning analytics research: Epistemological implications of an ontological foundation. In: LAK '15: Proceedings of the Fifth International Conference on Learning Analytics And Knowledge. ACM, New York, 2015, pp. 223–230. https://doi.org/10.1145/2723576.2723631 (last check 2026-07-28)

Selwyn, N.: What's the problem with learning analytics? In: Journal of Learning Analytics, Vol. 6(3), 2019, pp. 11–19. https://doi.org/10.18608/jla.2019.63.3 (last check 2026-07-28)

Siemens, G.: Learning Analytics: The Emergence of a Discipline. In: The American Behavioral Scientist (Beverly Hills), Vol. 57(10), 2013, pp. 1380–1400. https://doi.org/10.1177/0002764213498851 (last check 2026-07-28)

Symeonidis, V.; Schwarz, J. F.: Phenomenon-based teaching and learning through the pedagogical lenses of phenom-enology: The recent curriculum reform in Finland. In: Forum Oswiatowe, Vol. 28 (2), 2016, Journal Article, pp. 31–47. https://cejsh.icm.edu.pl/cejsh/element/bwmeta1.element.ojs-issn-0867-0323-year-2016-volume-28-issue-2_56_-article-oai_ojs_forumoswiatowe_pl_article_458 (last check 2026-07-28)

van Leeuwen, A.; Janssen, J.: A systematic review of teacher guidance during collaborative learning in primary and secondary education. In: Educational Research Review, Vol. 27, 2019, pp. 71–89. https://doi.org/10.1016/j.edurev.2019.02.001 (last check 2026-07-28)

van Leeuwen, A.; Knoop-Van Campen, C. A. N.; Molenaar, I.; Rummel, N.: How teacher characteristics relate to how teachers use dashboards: Results from two case studies in k–12. In: Journal of Learning Analytics, Vol. 8(2), 2021, pp. 6–21. https://doi.org/10.18608/JLA.2021.7325 (last check 2026-07-28)

Verbert, K.; Govaerts, S.; Duval, E.; Santos, J. L.; Van Assche, F.; Parra, G.; Klerkx, J.: Learning dashboards: An overview and future research opportunities. In: Personal and Ubiquitous Computing, Vol. 18(6), 2014, pp. pp. 1499–1514. https://doi.org/10.1007/s00779-013-0751-2 (last check 2026-07-28)

Vermunt, J. D. H. M.; Van Rijswijk, F. A. W. M.: Analysis and development of students' skill in selfregulated learning. In: Higher Education, Vol. 17(6), 1988, pp. 647–682. https://doi.org/10.1007/BF00143780 (last check 2026-07-28)

Väisänen, S.; Hallberg, S.; Valtonen, T.; Tervo, I.-A.; Kankaanpää, J.; Sointu, E.; Hirsto, L.: Pupils' experiences of learning analytics visualizations in supporting self-regulated learning in an elementary school classroom. In: Seminar.Net, 18(1), 2022. https://doi.org/10.7577/seminar.4690 (last check 2026-07-28)

Wiley, K.; Dimitriadis, Y.; Linn, M.: A human-centred learning analytics approach for developing contextually scalable K-12 teacher dashboards. In: British Journal of Educational Technology. 2023. https://doi.org/10.1111/bjet.13383 (last check 2026-07-28)

Wilson, A.; Watson, C.; Thompson, T. L.; Drew, V.; Doyle, S.: Learning analytics: Challenges and limitations. In: Teaching in Higher Education, Vol. 22(8), 2017, pp. 991–1007. https://doi.org/10.1080/13562517.2017.1332026 (last check 2026-07-28)

Wise, A. F.; Jung, Y.: Teaching with analytics: Towards a situated model of instructional decisionmaking. In: Journal of Learning Analytics, Vol. 6(2), 2019, pp. 53–69. https://doi.org/10.18608/jla.2019.62.4 (last check 2026-07-28)

Zimmerman, B. J.; Schunk, D. H.: Handbook of self-regulation of learning and performance. Routledge, New York, 2011.