

Towards Teacher-led Design Inquiry of Learning

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This paper proposes “teacher-led design inquiry of learning” as a new model of educational practice and professional development. This model combines four existing models. It integrates teacher inquiry into student learning, learning design, and Learning Analytics, and aims to capture the essence of the synergy of these three fields. Furthermore, we identify how Learning Analytics and the integrated model inform each other and could help integrating Learning Analytics into teachers’ practice. The last claim is demonstrated through an illustrative scenario. We envision that the integration of the four models could help teachers align both the improvement of their practices and the orchestration of their classrooms. Future empirical investigation is envisaged using a design based research framework and participatory design approach to engage teachers with the integrated model in a professional development process. We envisage that the integrated model will promote quality enhancement in education at a personal and collective level, and will be used to design better Learning Analytics, learning design and learning enactment tools. The main limitation of the integrated model is that it requires organizational changes, and allocation of resources, in order to allow it to significantly impact practice.

1. Introduction

This paper introduces the first version of an integrated model of teacher inquiry into student learning, learning design, and Learning Analytics. As an outcome of an Alpine Rendez-Vous workshop held in January 2013, the integrated model aims to capture the essence of the synergy of the three fields, leading us towards a new strand of inquiry, which we are calling teacher-led design inquiry of learning. The paper seeks to investigate how Learning Analytics can give teachers an understanding of students learning processes in order to improve their experiences. We envisage that the integrated model will be used to design better Learning Analytics tools, specifically tailored to the learning scenarios which can now be viewed from a multitude of perspectives. We provide the context for understanding how these different fields can complement one another and build on each other’s strengths. Beginning with a brief introduction of the fields, we go on to review four existing models. These form the foundations for the integrated model, which we propose as the central contribution of this paper. We proceed to identify the relationship of Learning Analytics to the steps of the integrated model and conclude by highlighting directions for future research.

Teacher Inquiry into Student Learning

Teacher Inquiry into Student Learning (TISL) is a focus of the European Integrated Project NEXT-TELL (<http://www.next-tell.eu>). It addresses the professional development of teacher practice by investigating student learning through action-oriented, evidence-based teacher-led research, with a particular focus on e-assessment. TISL (Clark, Luckin, & Jewitt, 2011), a systemic approach to teacher inquiry, has its roots in “insider view” approaches such as critical inquiry, action research, and teacher research, where teachers conduct their own research, in real classrooms and school settings, focusing on local practices. There has been a gradual shift from researcher-centered approaches to a more teacher-centered and design-centered approach that uses inquiry methods to support and guide teachers when participating in evidence-centered and evidence-based decision-making (Clark et al., 2011). It is this move towards evidence-centered design, together with a focus on technology support for teacher inquiry that TISL aims to support. TISL emphasizes teacher-led research in the development of effective e-assessment models, teacher assessment literacy and certification and the alignment of the preceding elements to schools’ strategic planning as a sustainable form of teacher professional development. The ability to find research questions driven by teachers’ own interests gives them ownership of the questions and of the findings and may encourage them to implement change derived from their own inquiries (Clark et al., 2011). Data from student activities gives teachers an opportunity to develop themselves as professionals through their own practice, for better learning. TISL is therefore one key issue in formative assessment.

Learning Design

Learning Design (LD) is the act of devising new practices, plans of activity, resources and tools aimed at achieving particular educational aims in a given situation. It is informed by subject knowledge, pedagogical theory, technological know-how, and practical experience. At the same time, it can also engender innovation in all these areas and support learners in their efforts and aims (Mor & Craft, 2012). Research and practice of learning design have evolved along two paths: one concerned with the automation of workflows from conceptualization to enactment, the other with sharing design knowledge among practitioners. The first strand focuses on machine-readable representations of learning design, such as IMS-LD (Koper, 2006). The second focuses on design practices, tools and human-readable

representations, such as design patterns, scenarios and swim lanes (Conole, 2010).

A LD process typically begins by describing the learning context, the aims of learners, teachers and institutions, the resources at their disposal and the constraints under which they operate. The designer generates and tests conceptual models of learning activities intended to achieve those aims and the resources that would support them. The chosen models are elaborated at growing levels of detail until they are implemented in the enactment environment. Ideally, at every step along the way, the designer should be able to share the designs with peers for feedback, and review the designs of others to consider what could be adopted and adapted to the situation at hand. Each step in this cycle – capturing context, conceptualization, elaboration and deployment – requires appropriate representations and tools to manipulate these.

Learning Analytics

Although Learning Analytics (LA) can simply be seen as “the measurement, collection, analysis and reporting of data about learners and their contexts” (LAK 2011), it aims to extend beyond proposing tools responsible for analyzing learning outcomes, providing a holistic, dynamic and formative view of learning processes. A multitude of LA techniques have been identified, pertaining to different research communities and ranging from simple statistics, to data-mining tools, intelligent tutoring systems, discourse analytics, social network analysis, all with emphasis on information visualization (Cooper, 2012). Yet there is a clear need for further research on how to integrate these tools effectively within TISL or LD models. A computational perspective considers the identification of inputs, analysis methods (which can be external to the tutor performing the educational experiment) and formats for output. By contrast, an integrative approach strives for continuous refinement of the learning scenario, integrating outcomes from Learning Analytics throughout the entire process. Ultimately, a meta-level feedback loop should be established, where results from LA act as promoters or incentives for conducting new teacher inquiries and the design of new educational scenarios. Therefore, the visibility, the impact and interconnection of LA with TISL and LD expands beyond providing the tools and means to evaluate learning outcomes.

2. Foundational Models

This section introduces each of the four models that lay the foundation for the integrated model. The models are the TISL Heart, the Design Inquiry Model, the Scenario Design process model, and the Model for Integrating Design and Analytics in Scripting (MIDAS). Each one of these proposals have been co-designed and tested with teachers, obtaining positive results.

The target audiences of these models, methods and tools are mostly practitioners – teachers, trainers, instructional designers: teachers who wants to inquire into the learning of their students for the TISL Heart Model, teachers/practitioners as designers of pedagogical scenarios for the Scenario Design process model, teachers who want to monitor students’ activity for the MIDAS model.

The TISL Heart

The first TISL model developed by the London Knowledge Lab (Clark et al., 2011) was based on the teacher inquiry and knowledge-building cycle that promotes valued student outcome developed by Timperley, Wilson, Barrar, and Fung (2007), forming the basis of the model and method described here. The TISL Heart model and its corresponding method (Hansen & Wasson, 2013; Hansen & Wasson, submitted), developed at Uni Health, is rooted in teacher practice as captured in a focus group study of teachers at a Norwegian high school. During the focus group sessions, the teachers discussed

how they collect, analyze, document, use and share data on student learning, to further develop teaching. The focus group concluded with the teachers drawing their own model of how to conduct student research. An analysis of the drawings and the discussions showed that the teachers were engaged in aspects of teacher inquiry into student learning, though not in a systematic way (Cierniak et al., 2012; Avramides et al., 2013).

The analysis resulted in the TISL Heart model (Hansen & Wasson, 2013; Hansen & Wasson, submitted), a conceptual model that combines an understanding of teacher practice and the theoretical aspects of evidence-based-change. The TISL Heart method supports professional development by leading teachers to use student data to improve practice, and thus student learning. Furthermore, in order to have a visual presentation that can be used to explain TISL to teachers, the theoretical TISL Heart model and the TISL Heart method have been combined into the TISL Heart (see Figure 1).

The top of the TISL Heart is the Kick-off, when a teacher first identifies the issues in which s/he is interested. Related to these issues are Assumptions and beliefs that flavor the teacher’s understanding of the issues. Once aware of the issues and assumptions, a manageable Research question (?) would need to be formed. The “?” feeds into the heart of the TISL Heart, the Method, which expounds how to collect student data to answer the “?”. Student data is collected during teaching and assessment, which results in a Learning outcome, the analysis of which feeds into Feedback (for students), is shared (with

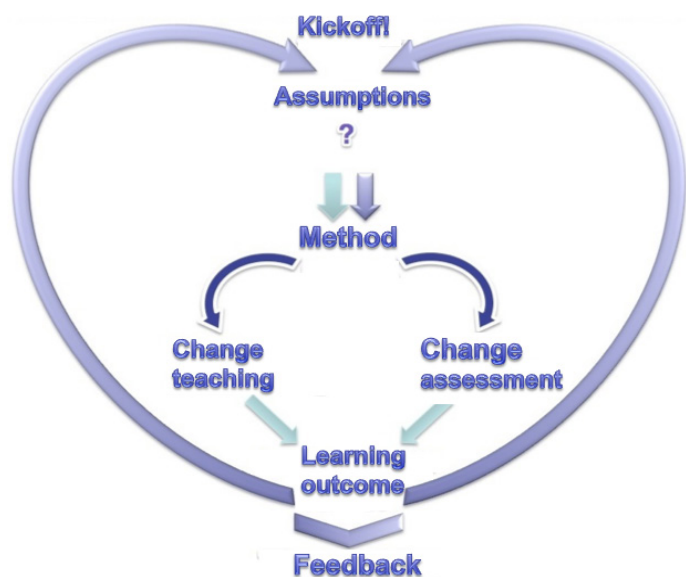


Figure 1. The TISL Heart

Steps	Description
Kick-off	Is there something you would like to know? What are the students’ learning needs? Your learning need?
Assumptions	State your assumptions! Formulate and explain your first thoughts from the Kick-Off!
Research question	Develop a research question! Formulate& reformulate!
Method	Find a method! How will you find/collect the answers?
Changing teaching and assessment	Change! Collect data from teaching and assessment!
Learning outcome	Analyze! What is the result of changed practice?
Feedback and sharing	Change based on evidence! Report!W

Table 1. The TISL Heart method

other teachers), and is used for reflection, which leads to new assumptions, new practice (teaching and assessment), and thus, further change. Table describes the steps in the TISL Heart method.

Design Inquiry Model

The Design Inquiry model (see Figure 2.) combines the iterative structure of educational design research (Mor & Winters, 2007) with the principles of inquiry learning (Edelson, Gordin, & Pea, 1999; Anastopoulou et al., 2012). Educational practitioners follow a cycle of ① defining their project, ② investigating the context in which it is situated and identifying appropriate techno-pedagogical theories, ③ reviewing relevant cases, ④ conceptualizing a solution, ⑤ implementing a prototype of that solution, ⑥ evaluating it and ⑦ reflecting on the process. Although this cycle is presented as a neat linear progression, in reality project work is messy and iterative. Practitioners revisit various points as their understanding evolves.

Laurillard (2012) argues that teaching should be repositioned as a design science, in line with paradigmatic distinction of Simon (1996) between natural science which describes how the world is, and design science which is concerned with how it should be. Ideally, we would want teachers to adopt a design science stance towards their practice. However, as the TISL work above demonstrates, it would be unrealistic to expect practitioners to allocate the resources required for rigorous and systematic scientific investigation. Instead, we propose a model of design inquiry – a projection of the ideal of design science into realistic settings.

Mor and Craft (2012) define learning design as “the act of devising new practices, plans of activity, resources and tools aimed at achieving particular educational aims in a given situation”. In that sense, every learning design is a hypothesis about learning: when we design a learning activity, resource or tool we are implicitly claiming that within a given context, learners engaging with the designed artefact will achieve particular educational aims. Such a claim can be the seed hypothesis for a process of inquiry. Recent studies demonstrate how training teachers as learning designers enhances not only their practical skills, but also their theoretical understanding (Laurillard, 2008; Ronen Fuhrmann, Kali, & Hoadley, 2008; Voogt et al., 2011). Positioning their design initiatives in an inquiry cycle can further enhance their development, by adding an extra layer of rigor, and connecting educational theory to concrete experiences.

The design inquiry of learning approach is at the core of the Learning Design Studio model (Mor & Mogilevsky, 2012), which has been used in several MA courses and in the recently conducted Open Learning Design Studio MOOC.

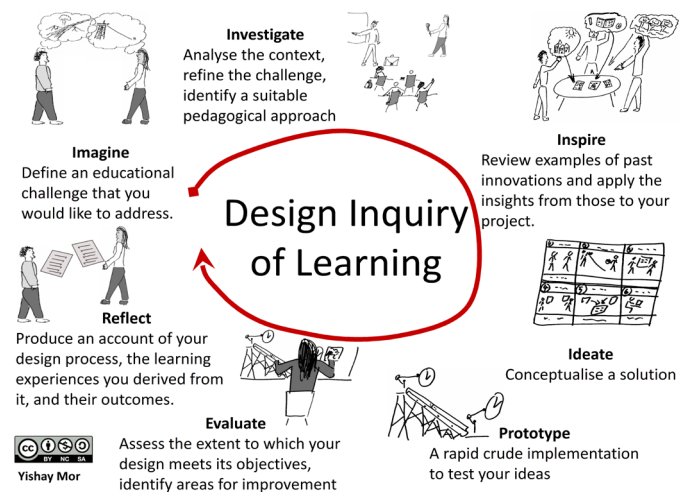


Figure 2. The Design Inquiry model

Scenario Design Process Model

The model of “Scenario Design process” (see Figure 3) has been co-designed with groups of *teacher-designers* in the French secondary educational system (pupils from 11 to 18) during the research project on learning scenarios design and uses (CAUSA) at French Institute of Education (2005-2009). The considered *teacher-designer* has a good grasp of the knowledge domain to be taught and can be considered, to some extent, as a domain-specialist. S/he is supposed to master a certain range of basic technological competencies defined by national certification and, in general, s/he is not assisted by technical specialists in charge of implementation of his/her design.

Our goal is to model the steps followed by a teacher-designer while designing and using a learning scenario. This scenario would digitally represent the organization of the system and of the learning situations to set up. We focus on the life cycle of the scenario, following three main steps: design, enactment and evaluation, with a view to capitalizing or using it again. This life cycle, shown by Figure 3, was based on teachers’ everyday practices, it relies on an empirical study based on two steps: firstly, the elicitation of the design process from two expert teachers and, secondly, the validation of this process by several groups of teachers (Emin, Pernin, & Guéraud, 2009).

The Scenario Design process model describes a process as follows. The first step in the design of a pedagogical scenario by a teacher-designer is to define the intentions (in terms of learning outcomes, competencies and knowledge) and the pedagogical approach (e.g., the way of teaching, the role of the teacher). The result is a general *sketch/idea* of the learning scenario.

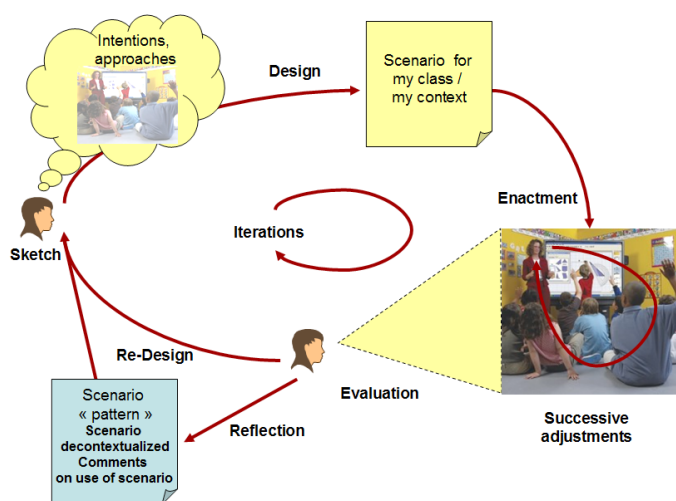


Figure 3. The Scenario Design process model

From this starting point, the *design* of the scenario for the class, tightly linked with the specific context, can begin. The teacher integrates iteratively and progressively the different constraints of his specific context. We defined four types of constraints: domain constraints (e.g., didactical constraints, availability and/or adaptability of existing resources), pedagogical constraints (e.g., class size, audience characteristics, roles, type of grouping), situational constraints (e.g., location, schedule, duration, tools and services available, face-to-face or hybrid), and economical or administrative constraints (e.g., financial, organizational, political) (Emin, Pernin, Prieur, & Sanchez, 2007).

The next step assumes the implementation of the “a priori” scenario; this is the step of enactment, where the teacher adjusts/adapts the scenario and achieves a different, “on the fly”, orchestration than the one s/he initially envisioned and designed.

After the actual implementation, the teacher *evaluates* the scenario and its successive adjustments; this enable *redesign*, comments on the scenario for further use and a step of -, the definition of a “scenario pattern” in order to share it with other teachers or to reuse in another context. These patterns

or de-contextualized scenarios can be used as an input in the first step of “scenario sketching”. According to our empirical study, the design of a scenario relies also on know-how, reuse of strategies (Schank & Abelson, 1977) and imitation of recognized good practices, associated with personal representations of the profession of the teacher and of the expert within the domain.

We have pointed out previously that this is an iterative process of design and enactment and changes can be made at each step of the loop. The process model we propose is based on principles, valid for both conventional training and digitally enhanced training methods.

MIDAS4CSCL: Model for Integrating Design and Analytics in Scripting for CSCL

Scripting and monitoring are two long-discussed techniques to foster effective collaboration in Computer-Supported Collaborative Learning (CSCL) (Jermann, Soller, & Lesgold, 2004). These two techniques are respectively related to Learning Design and Learning Analytics. On the one hand, scripting structures the learning scenario and provides students with a set of instructions that guide potentially fruitful collaboration. On the other hand, monitoring facilitates the intervention of the teacher in order to redirect the group work in a more productive direction.

Though scripting and monitoring have demonstrated to be effective supporting teachers in the orchestration of CSCL scenarios, the alignment of both techniques could provide additional benefits. Following this approach, we developed a model for integrating scripting and monitoring throughout the life-cycle of CSCL scenarios (MIDAS4CSCL - Model for Integrating Design and Analytics in Scripting for CSCL) (Rodríguez-Triana, Martínez-Monés, Asensio-Pérez, Jorrín-Abellán, & Dimitriadis, 2011; Rodríguez-Triana, Martínez-Monés, Asensio-Pérez, & Dimitriadis, 2012). The purpose of this model is to provide teachers with design and management support capable of linking their pedagogical intentions and run-time information needs, by aligning scripting and monitoring techniques.

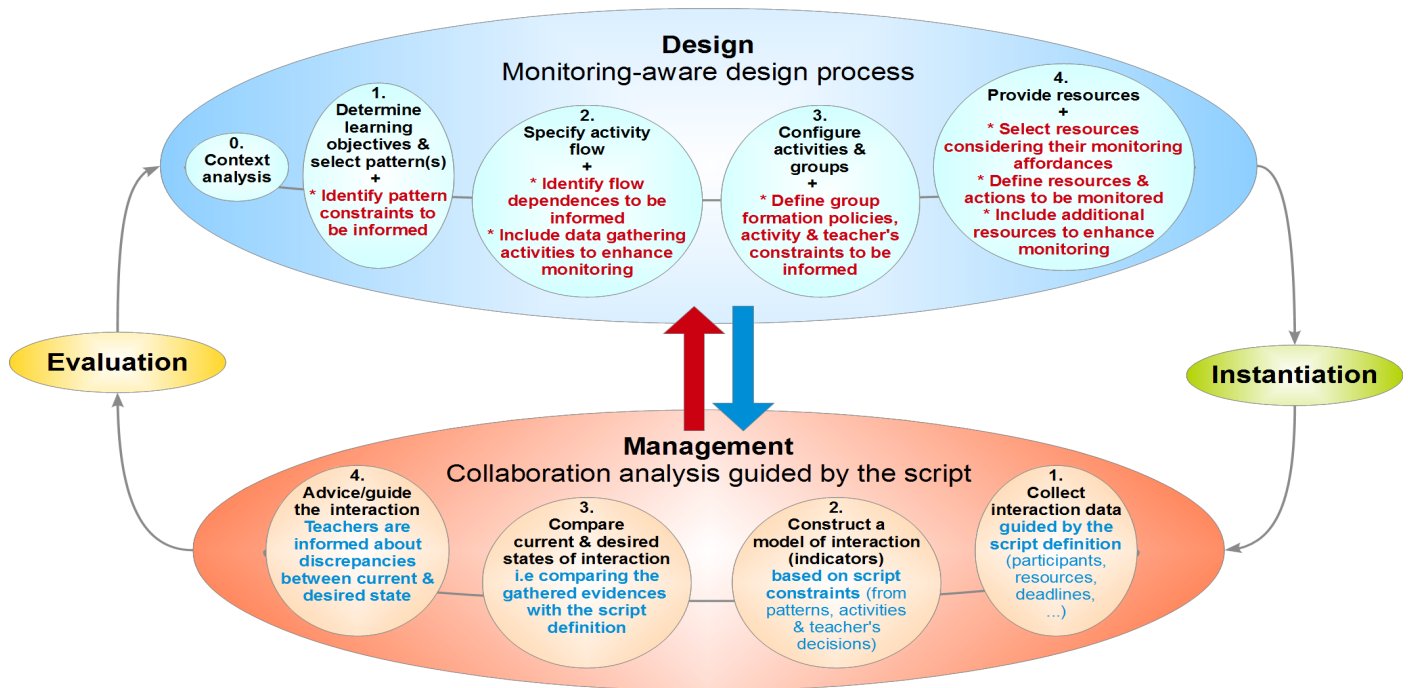


Figure 4. Scripting and Monitoring throughout CSCL Scenario lifecycle

According to the literature, the lifecycle of CSCL scripts goes through several phases. Though there is no consensus, they could be summarized in the following ones (see Figure 4): the design of the learning scenario; the instantiation the designed activities to address the concrete tool instances, participants and groups that will participate in their execution; the execution of the activities themselves and run-time management and, eventually, the evaluation of those activities. Our model focuses on the design and management phases, describing the connections between scripting and monitoring. To build this model, we used existing proposals related to the design and collaboration management of CSCL scripts (Soller, Martínez-Monés, Jermann, & Muehlenbrock, 2005; Villasclaras-Fernández et al., 2009).

For the design phase, we proposed a *monitoring-aware design process of CSCL scripts*, Figure 4 (top) (Rodríguez-Triana et al., 2012). This process guides teachers to reflect and make explicit the design decisions that could eventually affect monitoring: the pattern(s) that the script implements -if any-, the activity flow, the configuration of each activity and group, and the resources and tools to be used in the scenario. The process comprises two cycles: the first one guides teachers in identifying basic constraints to be monitored regarding activities, groups and

resources; the second one extends the script with new data gathering and/or monitoring support activities.

For the management phase, we proposed a process of *collaboration analysis guided by the script*, Figure 4 (bottom) (Rodríguez-Triana et al., 2011). This process defines how the design-time pedagogical decisions captured in the script may guide the analysis of users' interactions to provide teachers with relevant monitoring information. The collection of interaction data is guided by the specification of each learning activity, focusing on the data sources and the user' interactions most relevant to inform about the script constraints. Afterwards, a model of interaction is built, using script constraints to define the "desired state". Then, the gathered evidences (current state) and the script definition (desired state) are compared in order to identify the accordance and discrepancies between them. Finally, teachers interpret this output and intervene in the learning situation if needed.

This model has been co-designed and tried out with different teachers in several authentic CSCL scenarios carried out in university settings (Rodríguez-Triana et al., 2011; Rodríguez-Triana et al., 2012). The participant teachers valued the proposal positively and stated that it was helpful for the orchestration of their scenarios.

Discussion

As Table 2 shows, the aforementioned models are based on the areas previously presented. The TISL heart is based on TISL and aims to improve teachers' practice through teacher research. Similarly, the design inquiry model combines teacher inquiry and learning design to enhance teacher's practice. The scenario design process model uses the design of the learning scenario to regulate the current situation and improve future designs. Finally, the MIDAS4CSCL combines learning design and analytics in order to support the orchestration tasks.

Table 2. Overview of the areas addressed in each model and their purposes

MODELS	AREAS			PURPOSES	
	TISL	LD	LA	Improve teachers' practice	Improve orchestration (adaptation/assessment)
The TISL heart	X			X	
Design inquiry model	X	X		X	
Scenario design process model		X		X	X
MIDAS4CSCL		X	X		X

Despite the purposes and the strategies followed in these models are different, there are several commonalities in the phases that constitute them (as it is described in the following section). Thus, we envisioned that the integration of the four models could help teachers to align both the improvement of their practices and the orchestration of their classrooms. Besides, as we verified in the MIDAS4CSCL model, we hypothesize that Learning Analytics could provide the required resources to apply our integrated model in real scenarios.

3. Integrated Model

Starting from all the previous models, we propose an integrated model (see Figure 5) that provides an integrated view and traceability between the particularities of each existing approach. This integrated model is described in seven phases: ①Initiation; ②Context analysis or investigation; ③Formulation of the design objective and the research question; ④Design of the method to achieve the learning objective and to answer the research question(s); ⑤Enactment; ⑥Evaluation; ⑦Reflection and Re-design.

A possible scenario for the integrated model follows Carla, a chemistry and mathematics teacher in an Upper secondary school. Her analysis of students' assessment last year suggested some common misconceptions in the understanding of converging series. This year she decided to inquire this problem more thoroughly. She consults the integrated model to plan her teacher research project. The *Initiation* was her realization of the students' misconceptions. She has some idea as to why the misconceptions are happening. To investigate (*Investigation*) this thoroughly, she forms a concise conjecture (*Research question*) based on what she knows and what she thinks is the solution to this issue. Next, she uses learning design tools to translate this conjecture into a plan of action she can implement in class (*Design*). In doing so, Carla projects her research question into a realistic setting. Designing the learning activity, the resources and the use of tools, makes Carla's teaching more reflexive, because she documents her changes, based on previous learner data and her assumptions in order to achieve a particular educational aim. Collecting new data, by aligning scripting and monitoring techniques, Carla is provided with design and management support in order to link her pedagogical intentions and run-time information needs. After the actual implementation (*Enactment*), Carla evaluates (*Evaluation*) and shares her findings with peers and experts and reflects on their feedback. This results in a new *Initiation*: new assumptions and the need to form a new research questions. In this sense the different parts of inquiry, learning design and Learning Analytics helps Carla to develop as a teacher, for professional development through own practice.

TISL Heart	Design Inquiry Model	Scenario Design Model	MIDAS4CSCL	Integrated Model
Kick-off	Imagine	Idea of the learning scenario, intentions and pedagogical approaches		Initiation
Set assumptions	Investigate		Context Analysis. Definition of prerequisites	Context analysis or investigation
Define R&D Question		Design of the scenario for the class/ context, successive iterations	Define learning objectives	Formulation of the design objective and the research question
Design method to answer the question	Inspire and ideate		Select the pedagogical pattern. Configure the activity flow, groups and resources	Design method to achieve learning objectives and to answer research question(s)
Enact changed teaching and assessment	Prototype	Enactment and successive adjustments	Instantiate the design. Enact the design	Enactment
Evaluate learning outcomes. Provide summative feedback	Evaluate	Evaluation of the scenario enactment	Evaluate learning situation and design. Provide feedback	Evaluation
Refine overall model (formative feedback loop)	Reflect	Reflection on the design, comments and patterns. Re-design and decontextualization	Re-design	Reflection and re-design

Figure 5. Integrated Model

There is a synergy between the Integrated Model and Learning Analytics (LA) as they provide each other with data. For example, data from LA may trigger the teacher to investigate student learning, while the student data collected from teacher inquiry feeds LA.

Table 3 presents these relationships between the Integrated Model and Learning Analytics.

Learning Analytics provides	Integrated Model	Learning Analytics requires
· Insights that trigger teachers to change practice	· Initiation	· Data from previous analysis
· Partial image of context based on historical or related data	· Context analysis or investigation	· Historical data from the context or related data (comparing with similar situations or contexts)
Systematic way of organizing data		· Context model, normalizing the data to be analyzed
	· Formulation of the design objective and the research question	· Constrained formulation of the design and the research question. · Connections to be established between them
· Suggestions in the decision-making process (e.g., providing info about tools that may offer data for the analysis) · Support for comparing the research questions with the design: may the current design answer the question(s)? (if not, iterate)	· Design of the method to achieve the learning objectives and to answer the research question(s)	· Collection of information about available data sources/tools (capabilities/affordances regarding monitoring purposes) Identification of the assumptions /constraints to be verified · Comparison of information needs of assumptions/constraints/ probable outputs and the data sources · Input and output integration
· Real-time monitoring of the learning situation · Detection of critical situations · Visual representations of the results · Suggestions about ways of regulating the situation (for the teacher or for the students – for SRL)	· Enactment	· Collection and integration of data from the different sources · Comparison with assumptions/ constraints · Generation of visualizations · Feedback to teacher based on previous regulation actions · Documentation of teacher regulation of actions and changes (e.g. to take them into account in future)
	· Evaluation	· Interpretation of the data gathered (questions, learning objectives, assumptions, constraints, indicators) · Extrapolation of trends · Correlation of results with external data sources
· Trend analysis · Results (the data monitored, the documentation collected and the evaluation) connected with the research questions	· Reflection and · Re-Design	

Table 3. Relationships between the integrated model and Learning Analytics

4. Discussion

Personal Inquiry vs. Generalization

The primary concern of the TISL model is teachers' personal professional development through their inquiry. By contrast, scientific method is oriented towards sharing, scrutiny and aggregation of knowledge. The Learning Design tradition tries to combine both: supporting the individual designer in their tasks, by sharing and reusing design knowledge. Yet this often lacks the rigor of scientific inquiry. An integrated model, as presented here, would strive to balance these forces: allowing practitioners to perform their work, while at the same time developing their professional abilities and sharing the knowledge they construct within a critical and supportive community.

Overscripting, Orchestration, Regulation and Re-design

One problem raised by several authors (Dillenbourg & Tchounikine, 2007) concerns the limits of a too prescriptive approach in learning design. This seemingly rigid facet of learning design is sometimes contrasted with an "orchestration" approach (Dillenbourg & Jermann, 2010). By making an analogy with theater or music, it is possible to distinguish two contrasting views. The first states that it is necessary to define very precisely all the tasks to be performed by each type of actor in the process, providing detailed deterministic scripts. At runtime, there is no room for improvisation; the text must be followed to the letter. The second, used for example in jazz or in improvisational theater, provides actors with a general frame within which each may play their own part. In this case at runtime, the quality of the result depends not only on the performance of each actor, but also on players' ability to listen to each other and on the ability of a team leader (a conductor) to "orchestrate" (before and during the play) the different parts by giving an "intention".

Many limitations of the first approach can be raised, most notably that it does not allow for unplanned developments, emergent phenomena and personal adaptations. It promotes a "process-centric" attitude, where learners and teachers focus on the tasks to be performed and lose sight of the original aims behind them. It matches with a behaviorist approach where an appropriate sequence of tasks is systemically supposed to reach a learning goal.

By contrast, a "design-orchestration" approach may offer a more robust alternative, where the designer concentrates efforts on the essence of the design; the learning intentions or objectives, by defining a "synopsis" based on "open interactional situations" selected for their capacity to sustain specific learning practices in specific contexts. For each "open interactional situation" the teacher-designer provides actors with a set of resources or tools that can be used or enriched by the learners themselves. The teacher-designer knows that this initial scenario could be "adjusted" or "refined" at runtime by the tutor or by another actor. The inevitable unforeseen problems can often be solved more easily by human intervention than by an automatic system; regulation is thus made easier.

Integrated Model and Learning Analytics

The integration of LA in the teacher's practice may play a crucial role in the enhancement of learning. Nowadays, teachers have to carry out overwhelming amount of tasks to manage their lessons, reducing the possibility of devoting time to inquire and reflect on students learning. To face such problem, the integrated model presented in this paper offers some clues about how LA may be integrated in teacher's practice, describing the required input and the potential affordances. Though we do not have empirical evidence of the acceptance of the integrated model, we have based our proposal on models that have been co-designed with teachers and that have obtained positive evaluations. Nevertheless, we expect to validate and refine our proposal involving teachers in a short-medium term.

The main limitation of the Teacher-led design inquiry of learning model, presented in this paper, is that it requires organizational changes, and allocation of resources, in order to allow it to significantly impact practice. Despite the growing acknowledgment of the potential of Learning Analytics, most institutions see its implementation as a centrally provided service, with teachers and learners as consumers of pre-packaged information. By contrast, the approach described here would ideally see teachers (and perhaps learners) as active partners in the design of Learning Analytics tools.

Likewise, the adoption of learning design and teacher inquiry, as professional practices, is lagging far behind the desired state. Examples such as the teacher development trust, which promoted teacher inquiry as a framework for professional development, are far from the norm. Learning design is acknowledged predominantly in the context of online learning

(e.g. at the Open University, UK), and is often misinterpreted as limited to the visual design of learning resources. The model we propose demands not only the adoption of both teacher inquiry and learning design, but the integration of both elements into a coherent framework of practice.

Future work

The Teacher-led design inquiry of learning model draws on the synergy of several strands of empirical work supported by established theoretical frameworks. Nevertheless, its proposed form is still a conjecture and needs to be validated and elaborated empirically. Such empirical investigation will expose the strengths and weaknesses of this approach and ultimately demonstrate its impact on the quality of the learning experience. To carry out such a project would require (1) engagement of educational institutions and the practitioners within them, (2) participatory design of suitable practices that implement the model and the tools to support them (3) formative and summative evaluation of these practices and tools and (4) dissemination of the outcome of this process to the wider community.

5. Conclusions

This paper explored the potential synergy of three traditions of research in TEL: Teacher Inquiry into Student Learning (TISL), Learning Design (LD) and Learning Analytics (LA). Four existing models that partially connect TISL, LD and/or LA were reviewed, to propose an integrated model. Then the models' possible interactions with LA were considered. This can be a promising direction for future development of educational practice, as well as a rich field for research. LD and LA are currently gaining ground as potent approaches to technology-enhanced educational practice. Yet, to gain validity – LD needs to incorporate data, and to gain impact – LA needs to influence design. Thus, both LD and LA can only manifest their full potential if they are integrated in a coherent cycle of inquiry and teachers professional development through research from own practice and innovation scaffolded through a method that supports the teacher step-by-step. We see the model proposed here as a first step in this direction.

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