



# Teaching and Learning Analytics to Support Teacher Inquiry

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## Abstract

Teaching In this article we are going to introduce the concept of reflective practice as an important instrument for practice-based professional development, as well as organizational learning and improvement; and define the concept of teacher inquiry as a key method for data-driven reflection on-action, related to the process where teachers build useful knowledge about teaching and learning through the deliberate and systematic study of their own practice. It also discusses some Teaching Analytics tools in our platform ASTEMOI to show how teacher can reflect on their teaching design. This study employs focus group as qualitative research methodology to discuss benefits of Teacher inquiry in the help of data-reflection on-action.

**Keywords:** *Reflective practice, teacher inquiry, teacher inquiry, data-reflection on-action*

## 1. Introduction

Generally, Teacher Inquiry (or teacher research) has been mostly used as a process by which teachers can build useful knowledge about teaching and learning in the classroom through the deliberate and systematic study of their own activities and practices. Teacher inquiry is considered as a key element in reflective teaching practice. Nevertheless, it can be an elaborate and cumbersome process for individual teachers, given that their typical teaching workload allows limited time for reflection on their teaching practice. That is why technologies that support and facilitate teacher inquiry, such as Teaching and Learning Analytics tools, are becoming increasingly relevant.

## 2. Reflective Teaching Practice: A Key Issue in Teachers' Professional Development

Schon [1] introduces the concept of reflective practice for both individual professionals and organizations. The main thesis of reflective practice is that purposeful and systematic reflection on experience is a key for continuous learning. As a result, reflective practice has been identified as an important instrument for practice-based professional development as well as organizational learning and improvement. To make it easier to understand the concept of reflective teaching practice at a surface level, Barr et al. [2] come to define it as “the means by which learning, renewal, and growth continue throughout the development of career”. In this sense, reflective teaching practice is also considered by Osterman and Kottkamp[3] as “a means by which practitioners can develop a greater level of self-awareness about the nature and impact of their performance, an awareness that creates opportunities for professional growth and development.” Clearly, reflective teaching practice is proved to be “a process that involves thinking about and critically analysing one's actions with the goal of improving one's professional practice” [4].

Therefore, all definitions of reflective teaching practice require the self-evaluation of classroom teacher's own teaching practices, which is based on observations and data collected targeting to improve it; and are related to continuous individual teacher professional development, as well as school improvement.

Types of Reflective Teaching Practice. It is worth noting that there are two different types of reflective practice, and both have been differently identified by Schon[1] according to their usage in different contexts: one is known as “reflection-in-action,” which takes place while practice is executed and the practitioner reacts on-the-fly: a teacher realize that his/her students are not engaging in the lesson; therefore, he/she would likely take action to adjust their instruction which will involve more students.

The other type is called “reflection-on-action,” which takes a more systematic approach in which practitioners intentionally review, analyse, and evaluate their practice after it has been performed; in this stage, the teacher may collect data from the delivery of their lessons and use it to identify whether aspects of their teaching design contributed to the students' low engagement, or it needs to change some part of lesson plan.

The key difference between these two types of reflection is that reflection-on-action engages the practitioner in explicitly investigating their practices with the ultimate goal of identifying areas which could be improved. For this reason, this type of reflection can also be considered as a self-guided form of professional learning.

Our paper is going to be focused not only on reflection-in-action and demonstrated how Teaching Analytics and Learning Analytics can help classroom teachers to reflect on their practice as they design their lessons or as they deliver them; but also on reflection-on-action and show how it can be presented, and how combining both Teaching and Learning Analytics can support classroom teachers to become reflective practitioners.

More importantly, a method of data-driven reflection-on-action is going to be taken into consideration so as that teacher inquiry can be effectively applied to teaching activities and practices.

### 3. Teacher Inquiry: A Method for Data Driven Reflective Practice

Teacher inquiry is considered as a process “conducted by teachers, individually or collaboratively, with the primary aim of understanding teaching and learning in context” [5]. Marian Mohr and her colleagues [6] identify teacher inquiry as an “intentional, systematic, public, voluntary, ethical and contextual [process].” All in all, we can say that teacher inquiry is thought to be as process undertaken by teachers to obtain a better insight into their classroom practices in an effort to improve it; to develop reflective practitioner competencies; and to contribute to classroom self-evaluation and improvement planning; with the aim of supporting students' learning and wellbeing.

**Steps to apply teacher inquiry appropriately:** Teacher inquiry (or teacher research) as mentioned before refers to the process where teachers build their own useful knowledge about teaching and learning through the deliberate and systematic study of their own practices [7]; [8] this involves asking relevant questions and using appropriate methods to investigate them. In this case, the following cycle will illustrate these methods to be used intentionally and deliberately.

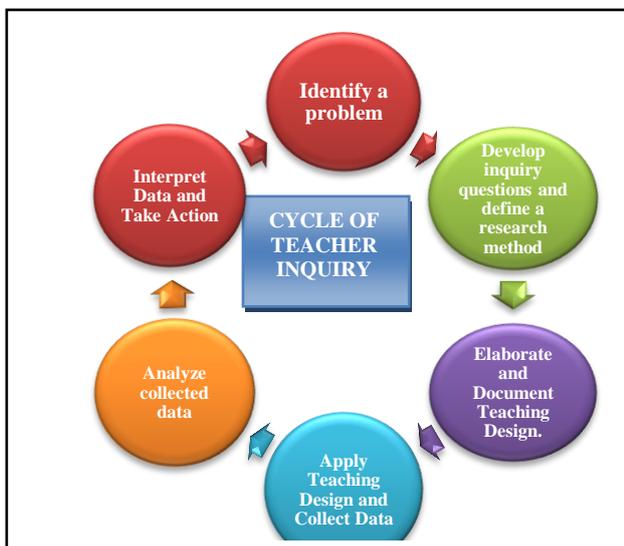


Fig.1: graphic of teacher

As shown in the graphic above, teacher inquiry typically involves the teacher in a cyclical process that follows a number of steps, so the following items are going to explain each one in more details: Identify a Problem to Investigate: The teacher identifies an issue of concern in relation to a specific aspect of their teaching design (e.g. lesson plan) that they wish to investigate and evaluate in order to possibly improve it.

**Develop Inquiry Questions and Define Inquiry Method:** The teacher develops specific questions to investigate the identified problem and defines the appropriate method to study these questions. This includes the definition of educational data that need to be collected, processed and analysed during the inquiry, and the diverse sources from which they can be collected.

**Elaborate on and Document Teaching Design:** The teacher defines and documents all elements of teaching design (e.g. lesson planning) to be implemented during the inquiry.

**Implement Teaching Design and Collect Data.** The teacher implements their teaching design (in the classroom) and collects the relevant educational data to analyses.

**Process and Analyse Data.** The teacher processes and analyses the collected data to obtain insights related to the defined inquiry questions

**Interpret Data and Take Action.** The teacher makes an effort to interpret the analysed data in relation to their own conceptualization of the identified problem, and then takes action in relation to their teaching design (e.g. refines or revises elements of their lesson plans).

These steps demonstrate how classroom teachers can use Teaching Analytics to reflect on their teaching practice as they design lessons for classroom delivery, and Learning Analytics to reflect on their teaching practice during classroom delivery. In the next stage, it will be shown how combining Teaching and Learning Analytics can support teacher inquiry.

### 4. Teaching and Learning Analytics: a Technology to Support Teacher Inquiry

Teacher inquiry can be an elaborate and cumbersome process for individual teachers, particularly as often heavy workloads allow limited time for reflection on teaching practice. Teacher inquiry can also be challenging when it happens in isolation from other teachers. Digital technologies can be used to support teacher inquiry [9]. In particular, the synergy between teaching analytics and learning analytics has the potential to facilitate the efficient implementation of the full cycle of inquiry [9]. The following illustration demonstrates how the process of teacher inquiry works collaboratively and effectively with other important elements:



Fig.2: graphic of demonstrates how the process of teacher inquiry works

Teacher inquiry is a method collaboratively used to find answers. Specifically, Teaching and Learning Analytics (TLA) can work in combination by using the structured description and analysis of the teaching design provided by Teaching Analytics to help identify the inquiry problem [10], develop specific questions to guide inquiry, and to document the teaching design; and by using the data collection, processes and analytical capabilities of Learning Analytics to make sense of students' data in relation to the teaching design elements, and help the teacher to take action.

This means that the concept of TLA can be embedded into the teacher inquiry cycle and used to support teachers to engage in continuous reflection. In other words, teaching analytics can be used to capture and analyse the teaching design and help the teacher to pinpoint the specific elements of their teaching design that relate to the problem they have; and elaborate on their inquiry question by defining explicitly the teaching design elements they will monitor and investigate in their inquiry.

Learning analytics can be used to collect the student data that the teacher has defined to answer their question. Furthermore, learning analytics can be used to analyse and report on the collected data in order to facilitate interpretation.

The combined use of teaching and learning analytics can be used to map the analysed data to initial teaching design, answer the inquiry question and generate insights for teaching design revisions.

### 5. Tools Used in Teaching and Learning Analytics

This section will initially present the ASTEMOI [11] [12]; Learning Analytics tools that we will use to manipulate students'

data, in addition to a focus discussion in the order to improve teacher inquiry.

**TLA tools.** Our method used in the analysis of teaching and learning will be based on the combination of different tools that can help the teacher to reflect on these actions in their teaching design.

Using students' data related to their level of engagement in learning and assessment activities as well as their level of interaction with the educational resources and tools. Based on this data, a dashboard will be generated to help the teacher visualize how, when and to what extent the students have engaged with the learning and assessment activities, as well as with the educational resources.

- Generating dashboards that depict the level of use of different educational resources in the teaching design, in different time-points during the delivery of the lesson.
- Using data, the tool generates dashboards that provide insights into the most frequent actions that the students performed, in terms of each teaching design elements. The added value of this tool is that it presents the analysed student data in the form of actions.

**Focus group.** Our present article has been applied for Focus group as a qualitative method to have as much information about the use of Teacher inquiry based on the personal experiences of teachers. Through engaging with qualitative research methodology, we will build a new overview of teaching reflective practice.

This study opened a discussion between teachers who have got much more experience and ideas of teaching reflective practices to share with outsider. The arrangement included four teachers discussing the benefits of classroom-based research, and how it helps them to better understand and meet their students' needs.

These teachers have been conducting research to help them better understand and meet their students' needs they describe their research as critical, necessary, fun, exciting, guided thinking, innovative transformational, and so on, a doorway to possibilities and professional growth, engaging and meaningful, knowledge to put into action.

➤ *The teacher 1* said, "The only way to change student learning is to change instructional practice and I believe the most profound way to change student learning is actually through collaborative research. When teachers get together in classrooms, looking critically at what they're doing, thinking collaboratively about the impact that their instruction is having on their students, thinking together about what worked, what didn't work, what could we change, what could we do slightly differently? That's when instruction starts to change."

➤ *The teacher 2* argued, "Being a classroom researcher has really been the best professional learning in my career. I've been a teacher for a long time and I've always been involved in professional development, workshops, conferences, different symposiums, but being in classrooms with teachers and having that collaborative relationship has really opened up a whole new world of questions and ideas about teaching and the relevance is that it's in the classrooms with the students and so you can immediately see the impact."

➤ *The teacher 3* agree with the teacher 2 through saying, "Having the opportunity to be a classroom researcher over the last few years has been just amazing and quite often when I tell people what I do; the research that I'm taking part in, I tell them that I've won the job lottery and I really do feel that way."

➤ Here, we can prove the fact that these teachers all intend to keep learning through research. Their success comes from being able to gather and analyse data to find answers to their research questions.

➤ *The teacher 3* admitted, "If you look at my classroom, four or five years ago even, you would have seen chalkboard, pencil-and-paper tasks, a lot of really direct instruction with not a lot of student engagement. They were learning, but they weren't learning the way they wanted to learn. So if you're looking at my classroom now you're seeing technology extravaganza. I have the Smart board; I've got my LCD projector. I use the Smart

Notebook program and I wouldn't have known that unless I had taken the first step into research."

➤ All these sayings have supported the idea that research provides evidence to inform Teachers actions. It enables them to understand and improve their practices by answering questions about how to help students.

➤ *The teacher 3* added, "There are some key things that teachers need to keep in mind if they would like to be classroom researchers," and she truly believed, "All teachers can be classroom researchers. First they have to have some curiosity, a spark of questioning, something that they want to know about in the classroom and next they need to keep an open to learning stance and what I mean by that is they need to suspend their judgment, gather evidence, gather data from their students, use that triangulation of data that they talk about in Growing Success. Analyse it, use some outside research and make a decision and try something. And then go back and repeat the process."

➤ Here, all these teachers gathered many forms of data and researched initiatives they were already involved in such as Teaching with Technology, Student Work Study, Student Voice.

➤ *The teacher 2* answered confidently, "Well the classroom researches relies on uncovering student thinking, and classroom researchers come together with a starting point of releasing our preconceptions about what the students can know and can do. So how we go about it is we collect a wide variety of student data: audio clips, video clips, pictures of student work, questions and answers about what students are thinking while they work and that broad landscape of information really helps us into their world of learning and gives us ideas about how we might be able to meet their needs as teachers."

➤ Learning through research helps these teachers to dig deeper and learn more about how to support student success. Teachers here found support in turning their questions into research projects through their school boards or through collaborating with university professors.

➤ *The teacher 4* said, "I was involved in a wonderful collaborative inquiry project with my teaching partner and it was looking at how engaged students were with or without technology use. And in a nutshell it was an eye-opening experience for me. I was supported every step of the way through our board's department; as a result, I became a researcher."

*The teacher 1* told *the teacher 4*, "Two things you said resonate with me and that is collaboration and support because when I think of the work we did in our board those two things surfaced frequently. We started with a very small group of teachers, we looked at some research we were investigating how to teach math differently, so we worked collaboratively in a classroom based on research. They were then paired with the University partner which was a wonderful experience, and they continued that research and one of the groups actually ended up publishing their research, which was empowering for them and exciting and just an amazing way to share real research with real teachers."

Due to collaboration, teachers felt more confident conducting research and when research questions, collaboration, support and confidence all come together, real progress is made.

➤ *The teacher 1* agreed, "Research happens on so many different levels. We can become a community of researchers thinking critically, how are we learning that metacognitive piece for both students and teachers and I think all of those things work together in a very synergistic and complex way that moves both teaching and learning forward."

At the end of the discussion, all teachers are searching for ways to support student success. Research is a way to find answers.

➤ *The teacher 4* ended up by saying, "Every teacher can be a researcher, just like every researcher is a teacher. They are two peas in a pod and I think that when teachers have questions, when they want to have answers, when they know where to go

within their school boards or ministry they can get the tools to help them move their students and themselves forward.”

## 6. Conclusion

This article is hoped to share the experiences of teachers who found answers through their classroom-based research which will inspire more teachers to connect and become researchers. Working collaboratively can build a research community that can help you and your students reach new heights.

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