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Using Practitioner Stories to Design Learning Experiences in Visual Analytics

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Abstract
Data visualisation has been recently named as one of the fast approaching future trends in Business Intelligence and Analytics, placing easy-to-use decision-making tools into the hands of decision makers at all organisational levels. There is a worldwide shortage of skilled professionals in this area and this trend is expected to worsen due to the rapid advancement of technology and wide proliferation of data (i.e. big data) into all aspects of our work and life.

This paper describes an applied research project that aims to capture and analyse leading real life industry practices in using Visual Analytics (VA) and “translate” them into innovative learning activities. The main idea here is to enable business students to experience the types of problems that industry practitioners are dealing with and help them to develop skills to tackle these problems, using state of the art VA tools. The resulting learning activities are captured as high-level learning designs (using learning design theory) and stored in an online (open) repository of learning designs, made available to other educators to use and continue to learn from each other.

Keywords: Data Visualisation, Innovative Teaching Practices, Business Intelligence and Analytics, Learning Designs, Practitioner Stories

I. INTRODUCTION
Business Intelligence & Analytics (BI&A) continues to dominate business and technology priority lists worldwide, as confirmed by very recent industry reports and academic research, see for example [Garner, 2013; Luftman, et al., 2013]. As companies are starting to reach higher levels of analytical maturity across all industry sectors, reporting and simple analytical tools are no longer sufficient for today’s decision-support needs.

“Knowing what happened and why it happened are not longer adequate. Organizations need to know what is happening now, what is likely to happen next and what actions should be taken to get the optimal results” [LaValle, et al, 2011: p. 22].

A very prominent industry survey of more than 3,000 business executives, managers and analysts conducted by MIT Sloan and IBM Institute for Business Value [La Valle, et al., 2011] offered an interesting overview of advanced analytical practices that can be expected in the immediate future. The top two included: 1) data visualisation, and 2) simulations and scenario development. Less than three years later, these practices are already here.

“Data visualization is taking hold now because of two trends. The first: Big data is here, it must be analyzed, and one of the best ways to make sense of it is with visual representations. The second: The tools to create good data visualizations are being democratized, which has led to a growing community of programmers, designers, and statisticians who can apply their analytical and intuitive powers to creating meaningful visual stories.” [HBR Insight Center, 2013].

Consequently, there is a new term “visual analytics” being coined to describe data visualization combined with new practices for analytical reasoning, test-and-learn inquiry, and advanced computation [Stodder, 2013]. Visual analytics (VA) is thus different from the mainstream business analytics that remains focused on numerical data.

Furthermore, the latest development in visual analytics can be best described as “story telling with visual data”. For example, vendor-based and other industry thought leaders, such as Davenport [2013], Naidoo [2013] and Kosara and Mackinlay [2013], call for new practices of using visual analytics to tell stories, thus making it more suitable for business decision-makers who normally don’t have skills for deep analytics. “We’ve grown up on
pie charts and bar charts, but there are probably at least tens, if not hundreds of alternative approaches to visual analytics…Narratives are a pretty good way to convey information in the past, so maybe we should be converting our data and analysis into stories…we've got a long way to go in terms of doing a better job of that” [Davenport, 2013, p.1].

However, in spite of the widespread awareness, current industry practices in data visualisation are still limited. “The greatest concern centers on whether employees will have adequate knowledge and skills to make effective use of the tools and whether deployment can be justified from a business perspective” [Stodder, 2013, p. 5]. The skill-shortage is expected to worsen [Eckerson, 2011] further preventing organizations from bringing VA solutions to a wider range of users, beyond data scientists and IT professionals.

“There are still a lot of companies that don’t have visualisation solutions in place, or if they do, it’s only for a small number of people...But the demand is growing” [Eckerson and Hammond, 2011, p.5]. Given the current industry developments and demand, one could expect a greater demand for Visual Analytics, especially among (non-specialists) business students.

The research project described in this paper was inspired by this very recent and rapid industry progress towards visual analytics as well as a serious skill-shortage in this emerging area. While the universities around the world are increasing their offerings in the mainstream BI&A, as recently confirmed by the international survey of BI&A educators [Wixom, et al. 2014], current industry trends are likely to create an even-bigger demand for VA, especially among non-BI&A specialists (e.g. business managers).

The main objective of this paper is to present an innovative educational research project that aims to capture and analyse the leading real life industry practices in using VA and “translate” them into innovative learning activities in VA. The main idea here is to enable business students to experience the types of problems that leading industry practitioners are dealing with, and in this way help the students to develop skills to tackle these problems at all organisational levels. The resulting learning activities are captured as high-level learning designs (using the learning design theory) and stored in an online (open) repository of learning designs, made available to other educators to share and learn from each other. Looking at the recently published international survey of BI&A educators [Wixom, et al, 2014], educational practices in VA are yet to make their way into the international BI&A curricula. Therefore, our pioneering work, described in this paper is novel and set to inspire new practices.

The paper is organised as follows. Section II offers an overview of the main challenges of teaching BI&A, as reported in the literature. Section III describes the main phases of our project design. Section IV focuses on the practitioner stories in VA and describes the process of collection and analysis of best practices in VA from leading VA vendors. This is followed by Section V that illustrates our process of translating practitioner stories into high-level educational stories (scenarios). These educational stories are then captured by high-level conceptual models of learning designs (Section VI) and stored in an online repository of learning designs to facilitate their sharing and reuse by educators (Section VII). The concluding section (VIII) offers some observations and conclusions followed by a brief description of our current and future work in this context.

II. RELATED WORK – CHALLENGES OF TEACHING BI&A

A well-known industry study by the McKinsely Global institute published in 2011 predicts a greater shortage of BI&A professionals in the near future with USA alone facing a shortage of 140,000 to 190,000 professionals with deep analytical skills and 1.5 million managers capable of analysing big data and making data-driven decisions [Manyika, 2011]. Furthermore, the emergence and wide proliferation of the so-called big data – data coming in different forms (text, video, signals) from a greater variety of sources, in unprecedented high volumes and with high velocity – has made the worldwide shortage of skills even more visible [Eckerson, 2011; Gartner, 2012].
In order to meet this fast growing industry demand, universities are also starting to rapidly increase the number and variety of BI&A courses, programs and degrees. For example, the latest international survey of university offerings conducted in 2012 and presented at the Business Intelligence Congress 3, identified 131 full-time BI&A university degrees compared to only 15 identified in the previous 2010 survey [Wixom, et al., 2014]. Among new programs 47 are being offered at the undergraduate level – a significant improvement compared to only 3 just two years earlier, as reported in Wixom and Ariyachandra [2011].

The same survey by Wixom, et al., [2014] also offers some very interesting insights into the current challenges of BI&A educators, as well as very specific expectations and recommendations of industry employers whose perspective was also included in the survey. Thus, the biggest problem is reported to be students’ lack of real-world knowledge with a strong recommendation being made to offer relevant and realistic learning experiences, currently lacking.

In order to create real-world experience for their students, many universities continue to create strategic alliances with BI&A vendor companies that often offer their software as well as industry-based case studies to university educators free of charge. Without any doubt, having access to up-to-date software tools creates valuable learning experience for students in terms of improvement of their practical skills.

However, as experienced educators would know, skilled-based training is not the same as using technology to support learning activities designed to lead to learning at a deeper level. As the world of IT applications continues to change at a very rapid pace, acquisition of skills ("how to do something") needs to be combined with the development of knowledge of the underlying principles and best practices ("what to do in order to address a particular business problem and why"). This is much more sustainable in the long term. In fact, only the latter will make the acquired knowledge portable from one software platform to another or even to new, yet unavailable, platforms and technologies of the future.

It is very unlikely that vendors providing software could also design effective learning activities to achieve the intended learning objectives that would help students develop higher level learning skills. As Ericsson et al. [2007] observed, development of expertise requires time as well as an educator’s expertise to development the most appropriate and effective educational methods. Therefore, adopting the vendor-developed skill-based training is very unlikely to result in students’ ability to "learn-how-to-learn" considered to be one of the key components of learning and practice in the unknown future [May, 2010].

The same international survey [Wixom et al., 2014] offers another important insight to further strengthen the case of “learning with technology” as opposed to “learning about technology”. “Certifying students in real-world software is not the answer. In fact, less than 25 percent of employers consider software and hardware certification when recruiting for BI/BA positions. When specifically asked about certifications that matter, only 15 employers provided input — with most suggesting that technical or vendor certification was merely an added bonus rather than a requirement when recruiting” [Wixom, et al. 2014, p.10].

Even though the BI&A industry practices are still evolving, it is possible to distinguish different broad categories of professionals. For example, Watson [2014] identifies a continuum of the Big Data analytics users positioning Business Users on one end of the spectrum to Data scientists on the other, with BI analysts in the middle. Business users are seen as information consumers, accessing and using data through BI&A tools such as reports, OLAP, dashboards/scorecards and data visualisation tools. These users have extensive business knowledge and need to know what data exists, where to find it and how to manipulate it in a simple way. They don’t need to be experts on the details of the algorithms and models. Furthermore, Watson distinguishes BI analysts from more common business analysts. BI analysts typically work for a BI or analytics department and understand the data and available tools better than business analysts. On the other
hand, business analysts work in a functional (business) unit and perform their analytics work there. Finally data scientists are highly trained professionals who discover new insights in data, using for example various quantitative methods.

Focusing predominantly on business users and BI&A (i.e. BI) analysts and their use of VA, rather than data scientists, as depicted by Figure 1, we aim to develop innovative learning activities based on stories of leading industry practices and practitioners currently in the corresponding roles our students are aspiring to. As argued in the introductory section of this paper, these categories of BI&A professionals are expected to be the main users of VA tools, both as information consumers (e.g. business users) and producers (e.g. BI analysts). Our approach is consistent with one of the key recommendations of the 2012 BI Congress [Wixom, et al., 2014] to consider tailoring the curriculum for different types of BI&A professions, due to their very diverse skills and needs. The following section describes our project design.

![Figure 1: Different types of BI&A users (after [Watson, 2013])](image)

**III. DESIGN CHALLENGES AND PROJECT DESIGN**

Informed by the latest industry developments in VA, current world-wide practices of BI&A educators (through three international surveys [Wixom, et al., 2014; Wixom and Ariyachandra, 2011; Wixom, et al., 2010] as well as the authors’ own experience in teaching BI&A and VA to business students, this applied research project focuses on the following design challenge:
- How to “translate” leading industry VA practices into innovative learning activities?
- How to share these activities among BI&A educators to speed-up development and refinement of teaching practices in VA through collaboration?

Guided by the principles of design research [Hevner, March and Park, 2004], action research [Baskerville and Myers, 2004] and action design research [Sein et al, 2004], as illustrated by Figure 2, we came up with a high-level project design, as depicted by Figure 3. The following sections describe the main steps of the project design.

![Figure 2: Our research method](image)
IV. ANALYSIS OF PRACTITIONER STORIES

Inspired by the needs to offer a relevant and realistic learning experience, we started this project by focusing on a set of published case studies provided by two industry leaders in VA. More precisely, we downloaded a large number of customer-success stories (65 industry cases) from vendors’ web sites (SAS VA and Tableau). We chose the vendor companies among widely recognised analytical leaders in visual analytics. For example, the latest 2014 Gartner’s Magic Quadrant report on BI&A platforms, positions both companies in the Leaders and Visionaries quadrant [Sallam, et al., 2014].

After the customer success stories were collected, we proceeded to analyse them using the following research questions as a lens:

- Who is using VA and for what purpose?
- What types of decisions do they make?
- What are their current challenges related to VA?
- What are the new opportunities created by VA?
- What are the required skills for using VA?

Given the fact that VA tools are used by decision-makers to analyse and solve different types of problems in their context, it was possible to identify and/or infer sufficient data to answer the stated research questions.

The analysis and coding was completed by the main researcher (with both industry and teaching experience in VA) using thematic analysis [Miles, 1994], with major themes corresponding to the above stated questions. A sample of cases was independently coded by a research assistant with relevant industry experience, using the same set of questions.

This particular method of data collection, by downloading and analysing customer success stories from the vendors’ web sites, was previously proposed and used by prominent BI&A researchers, see Seddon and Constantinidis, [2012], Seddon, Calver and Yang, [2010] to study for example, the ways business analytics contribute to business value.

As pointed out by Seddon et.al, [2012], “The downside of using vendor’s customer-success stories is that they always paint a rose-colored picture of the use of their software. However, success stories are built on a scaffolding of facts about people and processes that can be used, with care, to gain much easier access to a wide range of BI-
using organisations than is possible through, say, organising and conducting case studies or surveys oneself” [Seddon, et al., 2012, p.3]. To support their choice of data collection method, the same authors quote previous studies in BI&A reporting very low response rates to industry surveys.

We further justify our chosen data collection method by the fact that industry know-how in visual analytics is still emerging, as confirmed by Eckerson and Hammod, [2011]; Stodder, D, [2013]. “There are still a lot of companies that don’t have visualisation solutions in place, or if they do, it’s only for a small number of people” [Eckerson and Hammer, 2011, p.5].

Therefore, even the task of identifying suitable case organisations in order to conduct in-company case study research and observations of leading examples of industry practices would be very challenging. At the same time our objective was to expose students to simulated examples of “best practices” found among industry leaders and their customers, in order to enable them to take the much needed leadership in this area in their current and future workplaces. Therefore, our method was judged as appropriate for the intended purpose, as it enabled us to gain a deeper understanding of industry practices from the perspective of leading industry practitioners.

V. FROM PRACTITIONER STORIES TO EDUCATIONAL STORIES

The analysis of practitioner stories enabled us to identify high-level patterns of VA use, across customer stories, even from different industries. For example, in a number of cases decision makers using VA were facing the following types (patterns) of challenges:

1. Organisational silos
2. Different sources of data
3. Data quality issues
4. Collaboration to bring in different perspectives
5. Challenges of combining and reconciling different insights in order to propose an action
6. Need to use storytelling to communicate the findings and intended action.

Given the complexity and highly contextual nature of each organisational environment, any effort to replicate the exact organisational scenario of any given success story in a classroom environment would not be possible.

Instead, we focused on the identified patterns of VA-related challenges decision-makers faced across different organisational contexts, with a sample of those listed above. These patterns were used as foundation for realistic scenarios (educational stories), with the main objective to expose students learning to use VA to the same types of challenges facing industry leaders.

The following example illustrates a resulting scenario (educational story) obtained by combining insights from practitioner stories, as explained below:

“A business has anecdotal evidence that is taking longer to deliver product to their top 20 customers since they changed their transport company in the previous financial year. There has been a measured drop in revenues from these customers in the past two quarters. There is a service level agreement (SLA) in place to ensure delivery quality. Management want to find causes for this drop in revenue.”

This scenario was designed on the basis of the following underlying patterns of challenges. Thus, in order to solve this problem:

- It is necessary to analyse it from different functional roles (challenge 1)
- Use different sources of data (challenge 2) or work independently with the same data set.
- This is likely to lead to data quality challenges including different interpretations of data, or different formats across different data sets (challenge 3)
- As different functional roles are likely to have an incomplete (functional) insight they need to collaborate in order to bring together different perspectives (challenge 4)
- As they need to turn their shared insight into an action, functional roles need to collaborate and perhaps negotiate a proposed action, dealing with challenges in organisational culture (challenge 5)
- Functional roles also need to collaborate in order to design a persuasive story to present their intended action to management (challenge 6).

Therefore, by giving students different functional roles (e.g. marketing manager, accounting manager) and different data sets and/or the same data set that needs to be analysed from different functional perspectives it is possible to re-create the above listed challenges all observed in leading industry practices. The same set of underlying patterns could be used to come up with other scenarios, all dealing with a business problem that requires multidisciplinary collaboration, data-driven analytical insights from different perspectives and sharing of these insights in order to come up with a proposed action that needs to be communicated to management and other stakeholders through stories.

Hence, the above educational scenario captures, in essence, what needs to be done in a classroom. However, the same scenario may be implemented in many different ways in different educational contexts to suit different learning objectives and different types of learners. Therefore, this “what” component is not sufficient to capture the “how” component i.e. different types of learning activities that could be designed around this particular scenario. To capture the “how” component, we use the so-called learning designs, as described in the next section.

VI. FROM EDUCATIONAL STORIES TO LEARNING DESIGNS

The main idea behind learning designs is a systematic high-level description of innovative teaching practices to enable knowledge sharing among educators. Due to the emerging nature of the BI&A discipline, there is a pressing need for better sharing of innovative teaching practices, to ensure faster and more effective development of innovative curriculum [Wixom, et al., 2014, Wixom, et al., 2010]. This is especially the case with visual analytics, already here in practice, but yet to make its way into our BI&A curriculum.

Prior research confirms the same challenge of effective sharing of teaching practices as well as the need for more effective and systematic ways of representing the teaching guidance and practice how to create innovative pedagogy, to enable their sharing and reuse [Agostinho, 2008]. “There is a substantial unmet demand for useable forms of guidance and a systematic representation of reusable ideas, rather than fixed, pre-packaged content-based solutions” [Oliver, 2007]. “There would be great value in programme of work to identify effective learning activity models and build standardised descriptions of the form they take” [Laurillard, 2002].

Furthermore, educational literature offers examples of representational systems used to capture innovative teaching practices, predominantly in eLearning [Koper and Tattersall, 2005; Caroll et al., 2002, Agostinho, 2008 and Oliver, 2007]. Examples include sharing ideas of how to best use various ICT tools in eLearning activities that led to development of new machine-readable languages, so once expressed these constructs could be automated. More importantly, more than a decade of this research has confirmed that the more appropriate guidance on effective pedagogy, given in the appropriate form, enables teachers to apply, adopt and, better reuse their practices [Littlejohn and Pegler, 2007]. At the same time, to be appropriate any such guidance should be designed only to inform rather than prescribe teaching practices, because they are always situational and as such are best left to educators using them [Goodyear, 2004].

Our idea to capture innovative teaching practices in VA as high-level learning designs has been informed by the theory of learning designs by Koper and Olivier [2004]. Conceptually, a learning design (in this paper denoted as LD) represents and documents a teaching practice (learning activity) using some notational form, so that it can serve as...
a description, model, or a template, that can be adapted or reused by a teacher to suit his/her context [Agostinho, 2008].

To make it easier for practitioners to understand LDs, Koper and Olivier [2004] use a metaphor of a theatrical play. Thus, the model of a play is a script that can be shared, in order to be “instantiated” (staged) many different times by different actors, in different environments and, for different audiences. Obviously, the script needs to be written in a systematic way, using a notational system that is widely understood to facilitate knowledge transfer. Also it has to be generic enough to enable its sharing and reuse. The actual performance (an instance of the process) is always unique and highly contextual.

Even though the concept of LD uses a “script”, it is meant to be less prescriptive and more flexible than the actual “theatrical script”. This will ensure that learning activities are truly flexible and driven by the teacher, rather than constrained by the script.

In spite of a number of notable projects that emerged over the last decade, the research related to LD, their representation and use, is “still considered to be in the emergence stage. ...Consequently, there is no consensus over definitions and what really constitutes a LD” [Agostinho, 2008]. Our literature review confirms that LDs are currently documented in many different ways, are used for many different purposes, and, are modelled at very different levels of granularity. A good overview of the six major learning design representations is given in Agostinho [2008].

It is also important to clarify that in some (but not all) cases, commonly used lesson plans, may be also considered as examples of instantiated LDs, depending on their structure, instructional details, granularity, notation but most importantly, their intended use. For example, LDs are typically represented at the higher level of abstraction than the lesson plans, and written to promote knowledge sharing and reuse in a future unknown context, by the other educators, who understand the notation as well as the meaning of the content being represented, to be able to reuse it. Typical lesson plans are designed for a known context and used to guide an individual teacher’s practice in a particular class.

As shown by Table 1, a conceptual model of a LD consists of one or more loosely coupled (suggested) learning tasks. Educational grounding for LDs was found in the so-called Revised Bloom’s taxonomy by Andersen et al., [2002]. Thus, each task is aimed at specific level of knowledge and conceptual skills, enabling educators to scaffold students’ learning towards higher-level skills, within one or across several LDs. The overall progression of learning, and a possible scaffolding opportunity is captured by LD’s Knowledge level attribute.

It is also important to observe a clear separation among (i) educational resources (“what to use?”), (ii) learning tasks (“what to do?”) and (iii) one or more instructional design patterns (“how to do it?”). Therefore, the same learning resource could be used by more than one task or even LD. The instructional design patterns (IDP) describe different coordination and collaboration patterns of tasks and roles (teachers and students) (“Who needs to do what” in the chosen learning activity. By providing the alternative instructional design patterns to teachers, it is possible to create very different implementations of the given learning design, to suit different learning groups as well as different teaching styles. For example, collaborative work could be implemented as online discussion, in-class peer-review, in-class whiteboard gallery, learning circles etc. – all suitable for different purposes. These high-level models of LDs can be shared among VA educators as described in the next section.
Table 1: A conceptual model of a Learning Design

<table>
<thead>
<tr>
<th>LD Components</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Design: LDxx</td>
<td>LD’s Unique ID</td>
</tr>
<tr>
<td>School of Thought / Discipline</td>
<td>Suitable teaching discipline (e.g. Business Analytics, Knowledge Management</td>
</tr>
<tr>
<td>Suitability</td>
<td>Undergraduate or postgraduate course</td>
</tr>
<tr>
<td>Knowledge Level</td>
<td>Reference to Bloom’s extended taxonomy by Anderson et.al., (2002) – commulative for all tasks</td>
</tr>
<tr>
<td>Learning Design Objective &amp; Overview</td>
<td>The main learning objectives and overview of the whole LD</td>
</tr>
<tr>
<td>Required Resources</td>
<td>Learning and Teaching resources</td>
</tr>
<tr>
<td>Specific Instructions</td>
<td>Specific instructions are offered for each task</td>
</tr>
<tr>
<td>Task 1</td>
<td>Task id</td>
</tr>
<tr>
<td>Teacher’s briefing</td>
<td>An introduction to each task designed to set the scene</td>
</tr>
<tr>
<td>Taxonomy Relationship</td>
<td>Mapping of the task to the specific level of knowledge and cognitive skills of the extended Bloom’s taxonomy</td>
</tr>
<tr>
<td>Resources</td>
<td>Specific learning resources for each task</td>
</tr>
<tr>
<td>Instructional Design Patterns</td>
<td>Different ways how to go about teaching a specific task</td>
</tr>
<tr>
<td>IDP Pattern 1</td>
<td>A suggested instructional design pattern</td>
</tr>
<tr>
<td>IDP Pattern 2</td>
<td>The second alternative IDP etc.</td>
</tr>
<tr>
<td>IDP Pattern n</td>
<td></td>
</tr>
<tr>
<td>Task Notes</td>
<td>Additional notes for Task 1</td>
</tr>
<tr>
<td>Task 2</td>
<td>…</td>
</tr>
<tr>
<td>Task n</td>
<td>…</td>
</tr>
<tr>
<td>Suggested Next LDs</td>
<td>A suggested learning progression and the most suitable subsequent LDs</td>
</tr>
<tr>
<td>Related LDs</td>
<td>Related activities that teach similar concepts or additional activities for the same level.</td>
</tr>
<tr>
<td>NOTES</td>
<td>Additional notes for the whole LD (e.g. an average duration)</td>
</tr>
</tbody>
</table>

VII. SHARING OF INNOVATIVE TEACHING PRACTICES IN VA

An open collaborative environment for sharing and co-design of innovative teaching practices, expressed as the above described learning designs, was implemented in 2013, using wikispaces (http://oltproject.wikispaces.com) and continues to be used to date. Figures 4 and 5 show two screen shots from the actual environment, that together illustrate an example of learning design (LD13), created and stored in this environment and then made available to other educators to use. This learning design corresponds to the educational scenario described in Section VI.

Figure 4 illustrates some aspects of the collaborative environment. The LDs listed on the left show a list of currently available learning designs, with LD13 being selected and open (middle of the screen). Table of contents (on the right) shows the main components of a LD.
This collaborative environment is designed to enable its users (educators) to design a new learning design (with the guidance provided, especially around educational taxonomy), store it and make it available to other educators to use, expand and provide feedback. They can also use the search function to look for other similar LDs, or their components including resources, they may like to adopt. Educators interested in, for example, scaffolding student learning through progressive LDs, across several weeks or a whole semester, may use the search option to look for LDs at a particular level of the revised Bloom’s taxonomy. They could adopt the existing sequencing of LDs or design their own, suitable for their own context.
Alternatively, they could look for a particular resource (e.g. a case study) and then explore all LDs using this resource in a variety of ways. They could also look for different instructional design patterns to get ideas about how to make their activities more interactive regardless of the context. With the guidance provided, they could explore possibilities to assemble different components from different LDs in a new way.

Figure 5, focuses on the first two tasks of LD 13. They represent the How component i.e. a suggested high-level task used to implement the given educational scenario. Thus, in Task 1 students are given the above described educational scenario (“a problem of longer product delivery time to the company’s top customers”) and are expected to analyse possible root-causes, taking different perspectives (e.g. “sales and marketing”, “production” etc.), as per previous discussion. As shown, students are also given additional resources (including a case study) to help them to gain a better understanding of the problem. As students are expected to collaborate to complete the task, it is possible to suggest different instructional design patterns, suitable for a particular context, including for example online collaboration of distributed teams (across different universities).

Then in Task 2 students are expected to collaborate in order to come up with a solution that needs to be demonstrated using a provided visual analytics tool (Tableau). Because the actual tasks are decoupled from resources, including software, it is possible to implement the same set of tasks by using different visualisation software that is available in other educational environments and contexts.

Since its inception and design in 2013, this online environment has been continuously used and evaluated in-use through reflection-in-action and reflection-on-action. Initially, this was done by the original designer of this environment (the author) in their own teaching practice. Then, the online repository was made available to a wider group of BI&A educators, whose knowledge sharing is currently enabled and supported by this environment, thus confirming its knowledge-sharing purpose.

VIII. CONCLUSIONS AND FUTURE WORK

The main objective of this research was to advance the emerging practices of teaching Visual Analytics, following the leading industry practices. The main idea is to “translate” practitioner stories in using VA into innovative teaching activities in VA and to share these activities in a systematic way with other educators.

Based on our experience thus far, we argue that knowledge sharing among educators in emerging technology-driven disciplines such as BI&A is now even more important than ever before. This is especially the case with visual analytics, already practiced by industry, but yet to make its way into our curriculum. Due to the fast-changing nature of this emerging area, just following the mainstream practices is not sufficient and sustainable in the long-run. Therefore, it is important to learn from leading practitioners and their practices. However, it is equally important to observe the underlying patterns of VA-related challenges they are facing and new opportunities they are creating across industry sectors. Only then could we possibly contribute to educating new industry leaders and not just followers of current trends that are bound to change.

Our further research includes designing of a more comprehensive set of learning designs, further refinement of the conceptual language and the collaborative environment, as well as designing new methods for evaluation of their knowledge sharing and reuse potential. The readers are invited to join our community, contribute their learning designs and get inspired by an evolving collection of innovative ideas and innovative practices.

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