East versus West

An Aggregation Problem in a Learning Analytics Study

Student name: S.J. (Sanne) Soer, BSc
Student number: 850874900
University: Open University in The Netherlands
Faculty: Management, Science & Technology
Department: Organization
Education: Management
Course: Master’s Thesis B9431B
Master Thesis theme: Organizational Development from a Multidimensional Perspective
 Examiner: W.E. (Wim) Jurg, PhD
1st Reviewer: H. (Hendrik) Drachsler, PhD
2nd Reviewer: S. (Slavi) Stoyanov, PhD
Date: August 31, 2014
Figure 1 Cluster map of related strategic change statements on Learning Analytics (Drachsler, Stoyanov, & Specht, 2014, p. 160)
Summary

Higher educational organizations are currently confronted with budget cuts and tightened quality standards (Siemens & Long, 2011). These confrontations ask for a revision of their strategic agendas. One of the developing knowledge fields that might facilitate these revisions is Learning Analytics, an advanced method for conducting educational research (Drachsler, Stoyanov, & Specht, 2014). However, Learning Analytics (LA), like many other developing research fields, suffers from a gap between theory and practice (Siemens, 2012). Research is often done in isolation from practitioners. This challenges the interaction between conducting educational research and implementing its outcomes in practice, undermining an effective implementation of LA outcomes. To bridge theory and practice, Siemens (2012) advises researchers to address problems relevant to practitioners. A holistic researcher-practitioner model for LA is proposed, in which researchers and practitioners work together.

Drachsler et al. (2014) apply Siemens’ (2012) holistic LA researcher-practitioner model for Dutch higher educational organizations. They are pioneering a Group Concept Mapping study among Dutch LA stakeholders. Group Concept Mapping is a methodology that facilitates participants to develop consensus on a particular strategic issue in three phases: (1) an idea generation phase, yielding statements about a particular strategic issue; (2) a sorting phase, generating clusters of the related statements; and (3) a rating phase, valuing the statements regarding the dimensions importance and feasibility.

The strategic LA change statements of the idea generation phase in Drachsler et al. (2014) are generated by 31 LA stakeholders, who were questioned during a local LASI event in Amsterdam in 2013. Each strategic LA change statement represents one specific strategic change notion regarding the importance or feasibility of LA. The sorting and rating phase of their study followed after the LASI event with a new group of participants. The 39 stakeholders participating in these last two phases are 19 LA experts and 20 novices with a management, research or teaching role in education. The sorting and rating participants consist of 16 teachers, 13 managers, 6 researchers and 4 teachers/researchers. In this investigation, the 4 teachers/researchers are regarded and analyzed both as teacher and as researcher.

Drachsler et al. (2014) distinguish seven different clusters of related LA change statements based on the sorting by these participants. These seven clusters identify seven strategic LA change themes: (1) Student Empowerment, (2) Personalization, (3) Research & Learning Design, (4) Teacher Empowerment, (5) Feedback & Performance, (6) Risks and (7) Management & Economics. Figure 2 shows these seven clusters and their positional interdependence as a measure of their similarity; statements and clusters spatially positioned close to each other are more similar than those positioned further away.
Based on Figure 2, Drachsler et al. (2014) distinguish two basic areas of strategic LA change clusters: the East Coast and the West Coast. The East Coast contains the clusters ‘1. Students Empowerment,’ ‘2. Personalization,’ ‘3. Research & Learning design,’ ‘4. Teacher Empowerment,’ and ‘5. Feedback & Performance’. The West Coast encloses the clusters ‘6. Risks,’ and ‘7. Management & Economics’. The East Coast covers the educational stance and the West Coast is connected to the economical view on LA. Drachsler et al. (2014) claim, contrary to their expectations, that LA experts and novices demonstrate consensus regarding the importance and feasibility of the strategic LA change themes and that there is thus consensus among Dutch LA stakeholders.

However, experts and novices are not the only subgroups that need to be distinguished. The holistic LA researcher-practitioner model advised by Siemens (2012) requires a differentiation between researchers and practitioners. In addition, within these practitioners, teachers and managers have dissimilar perspectives: while teachers have a more educational stance, managers have a more economical view (Clow, 2013). Yet, Drachsler et al. (2014) do not explicitly differentiate between the LA change perceptions of teachers, managers and researchers. This raises the question whether the study of Drachsler et al. (2014) is confronted with a hidden aggregation problem concerning their claim that there is consensus among Dutch LA stakeholders. An aggregation problem refers to the difficulty that group effects are often crucial for setting a strategic agenda but need a comparison on a subgroup level (Baetschmann, 2014).

Therefore, this investigation compares the consensus among teachers, managers and researchers regarding the strategic LA change perceptions on the educational and the economical dimensions, using the same data as Drachsler et al. (2014). This comparison focuses on the most and least important perceptions by these three subgroups rather than their feasibility. It further concentrates on the three clusters that, by their names, directly refer to these three subgroups: (4) Teacher Empowerment, (7) Management & Economics and (3) Research & Learning Design. These clusters are referred to in this thesis as ‘Teaching,’ ‘Managing,’ and ‘Researching’, respectively.
The objective of this investigation is to conclude whether a hidden aggregation problem underlies the claim of Drachsler et al. (2014) that there is consensus among Dutch LA stakeholders regarding the strategic LA change themes. Consensus concerns insights into the level of key similarities and differences (Markóczy, 2001). Consensus is operationalized in this investigation as more key similarities than differences regarding the most and least important strategic LA change statements. Thus, this investigation compares the key similarities and differences regarding the most and least important strategic LA change statements among the subgroups teachers, managers and researchers.

To identify these levels, a secondary investigation is conducted using the sorting and rating data generated by Drachsler et al. (2014). For this, a triangulated research strategy is designed employing two methods: (1) Group Concept Mapping, as was conducted by Drachsler et al. (2014) and (2) Strategic Consensus Mapping. The main question in this investigation is:

Is there a hidden aggregation problem in Drachsler et al. (2014) concerning their consensus claim regarding the strategic LA change themes among teachers, managers and researchers?

Both the Group Concept Mapping and the Strategic Consensus Mapping findings indicate that there is a very low level of consensus regarding the importance of the strategic LA change statements among teachers, managers and researchers on both the educational and the economical dimensions; except for the subgroups teachers and managers, who perceive the same most and least important strategic LA change statements on the economical dimension: “Increased teachers’ role complexity” and “Cutting costs”, respectively. This contrasts Drachsler et al. (2014) on a subgroup level, who claim that on a group level there is consensus among Dutch LA stakeholders regarding the strategic LA change themes. It is therefore concluded that this claim indeed contains a hidden aggregation problem.

Theoretically, this thesis recommends further research on the joint applications of Group Concept Mapping and Strategic Consensus Mapping. This investigation shows that Strategic Consensus Mapping has complementary value to Group Concept Mapping. It provides a new methodology to analyze consensus among subgroups. In particular, the application of strategic themes generated through Group Concept Mapping as base for the Strategic Consensus Mapping analysis can provide a more robust method for determining stakeholders’ strategic priorities, which is highly needed according to Tarakci et al. (2014).

Practically, this thesis focuses on recommendations for the subgroup researchers. First, researchers should realize that their perceptions differ from those of teachers and managers. Second, researchers should play a role in bridging the differences within the practitioner subgroups teachers and managers by synthesizing the educational stance and the economic view; for instance, on the application of LA “to provide insight into educational quality” and on how “adaptive learning” can be of value from both perspectives.

Learning Analytics is about the empowerment of educational organizations and their stakeholders, and through these, education itself. Its potential as a driver for educational change is clear (Siemens, 2013). However, its success depends on whether LA research is able to bridge the researchers-practitioners gap, and within the practitioners, the teachers-managers gap manifested in the disconnection between the educational stance and the economical view on LA. This study provides a road ahead, empowering LA researchers to be where they should be: at the heart of educational change; where East meets West.
## Contents

Summary ............................................................................................................................ iii  
Preface ............................................................................................................................... ix  
1. Introduction ....................................................................................................................... 1  
   1.1 Thesis theme .............................................................................................................. 1  
   1.2 Learning Analytics ................................................................................................... 1  
   1.3 Drachsler, Stoyanov, & Specht (2014) ...................................................................... 1  
   1.4 Consensus among LA Stakeholders .......................................................................... 3  
   1.5 Thesis problem .......................................................................................................... 3  
   1.6 Overview ................................................................................................................... 4  
2. Literature review .............................................................................................................. 5  
   2.1 Define, search & select stage ..................................................................................... 5  
   2.2 Analyze stage of literature review ............................................................................ 6  
3. Methodology ................................................................................................................... 11  
   3.1 Group Concept Mapping study Drachsler, Stoyanov, & Specht (2014) .................. 11  
   3.2 Group Concept Mapping methodology .................................................................... 12  
   3.3 Strategic Consensus Mapping ................................................................................... 14  
   3.4 Comparison between GCM and SCM ..................................................................... 20  
4. Findings ........................................................................................................................... 21  
   4.1 Findings from Group Concept Mapping .................................................................... 21  
   4.2 Findings from Strategic Consensus Mapping ........................................................... 22  
   4.3 Comparison ............................................................................................................... 24  
5. Evaluation ....................................................................................................................... 27  
   5.1 Conclusions ............................................................................................................... 27  
   5.2 Discussion on reliability ........................................................................................... 29  
   5.3 Discussion on construct validity ............................................................................... 31  
   5.4 Discussion on relevance ........................................................................................... 34  
   5.5 Recommendations .................................................................................................... 34  
References ......................................................................................................................... 37  
Tables and Figures .............................................................................................................. 41  
Content memory card ........................................................................................................ 43
Preface

This thesis consists of an independent and responsible scientific research report (OUNL, 2014). It is the final part of the Master’s degree of the Faculty of Management, Science & Technology of the Open University in The Netherlands (OUNL). The Faculty offers its students the opportunity to study "Organizational Development from a Multidimensional Perspective". The literal assignment is included in Appendix A1.

The idea underlying “Organizational Development from a Multidimensional Perspective” is that our brain is only able to perceive one perspective at a time. However, a multidimensional perspective is a necessity for a thorough understanding of a phenomenon (Jurg, 2014, p. 1). It is with this mindset that I started my thesis in the fall of 2013.

My first encounter with the knowledge field Learning Analytics (LA), was in January 2013. I was immediately intrigued by the multidimensional aspects of this subject: combining teaching, managing and researching perspectives for educational improvement. Improving education effectively, I had already experienced, needs an ‘out-of-the box’ perspective (Drachsler et al., 2014, p. 158) which LA can provide (Siemens, 2012, p. 7).

Implicitly, I knew that the adoption of LA is not a straightforward matter. It means bridging the perspectives of LA stakeholders teachers, managers and researchers on education and management (Clow, 2013, p. 684). Explicating implicit knowledge is not a simple task, however, as I have experienced during my thesis period.

One specific problem I have encountered regarding the different stakeholder perspectives is that overall group perceptions can be completely different from what subgroups perceive. This problem is referred to as the aggregation problem (Baetschmann, 2014, p. 398). And even though the aggregation problem has been the central theme during the premaster phase of my Master’s, to my surprise it was very hard to find a sensible reference to this problem in literature. At the end, I have the impression that this problem may be referred to in a different way in the literature, maybe as the homogeneity/heterogeneity problem.

The aggregation problem was also present in my own work. All along I was – in hindsight - overconfident that my findings would show statistical differences among the three investigated subgroups. However, it turned out that these differences were not significant, leading to a reshuffling of my thesis story and a qualitative analysis of specific statements instead. In the end, however, I managed to compare the three subgroups from insightful perspectives leading to the findings presented in this thesis.

I would like to thank Wim Jurg, my tutor and examiner in the academic field. You have always been there for me to take the next step and I have enjoyed our fruitful dialogs, even though your drive for high quality did not always match my drive for a result. Further, I like to thank my reviewers Hendrik Drachsler and Slavi Stoyanov for their support and helping me to clear a tough theme. Also, I want to thank the peer group of graduates for their support and helpful feedback.

The biggest reward though, goes to my wife, Daniëlle and my two kids Jordy and Sofie. Your warmth, understanding, smiles and endless support were crucial to me in finishing this tough journey. I am confident that now, I can make up for all the frustration and pain you’ve paid on my behalf to see me through this. My gratitude is eternal!

Sanne Soer,

August 31, 2014.
1. Introduction

This introduction presents the research theme ‘Organizational Development from a Multidimensional Perspective’ (1.1) and the research field ‘Learning Analytics’ (1.2), which cover the context of this Master thesis. Then, the ‘Group Concept Mapping’ method is presented (1.3), followed by description of consensus among Learning Analytics stakeholders (1.4). Then, the thesis problem is presented (1.5). An overview (1.6) of the other chapters in this thesis closes this chapter.

1.1 Thesis theme

The Faculty of Management, Science & Technology of the Open University in The Netherlands offers students the opportunity to write their Master thesis within the research theme “Organizational Development from a Multidimensional Perspective”. Organizational Development refers to changing cultures, behaviors and incentives within organizations (Norris & Baer, 2013, p. 33). It creates a healthy environment for innovations, like the application of analytics in education. Meanwhile, the multidimensional perspective, aiming to enrich the conclusions and implications compared to applying a single perspective, is widely applied, for instance in Educational ICT research (Wopereis, Kirschner, Paas, Stoyanov, & Hendriks, 2005, p. 683). To reach a multidimensional perspective on Learning Analytics, which is closely related to ICT, this study applies complementary methodologies, as suggested by Duriau, Reger, & Pfarrer (2007, p. 16).

1.2 Learning Analytics

Learning Analytics an advanced method for conducting educational research (Drachsler et al., 2014, p. 158). It is a young and developing research field with a supposed great potential for education (Siemens & Gasevic, 2012, p. 1). Among this potential are solving resource allocation problems, improving the quality and value of learning and the development of a competitive advantage (Siemens & Long, 2011, p. 38). These potentials can, in turn, aid educational organizations in changing their strategic agenda’s with regard to educational efficiency and quality. This is important in the light of budget cuts and global competition in higher education.

Learning Analytics (LA), like many other developing research fields, suffers from a gap between theory and practice (Siemens, 2012, p. 5). Research is often done in isolation from practitioners. This challenges the interaction between conducting educational research and implementing its outcomes in practice, and undermines an effective implementation of LA outcomes in practice. To bridge theory and practice, Siemens (2012, p. 7) advises researchers to address problems relevant to practitioners and proposes a holistic researcher-practitioner model for LA, in which researchers and practitioners work together.

1.3 Drachsler, Stoyanov, & Specht (2014)

Drachsler, Stoyanov, & Specht (2014) apply Siemens’ (2012, p. 7) holistic LA researcher-practitioner model for Dutch higher educational organizations. They pioneer a Group Concept Mapping study among Dutch LA stakeholders. Group Concept Mapping is a methodology that facilitates participants to develop consensus on a particular strategic issue in three phases: (1) an idea generation phase, yielding statements about a particular strategic issue; (2) a sorting phase, generating clusters of the related statements; and (3) a rating phase, valuing the statements regarding the dimensions importance and feasibility.
The strategic LA change statements of the idea generation phase in Drachsler et al. (2014) are generated by 31 LA stakeholders, who were questioned during a local LASI event in Amsterdam in 2013. Each strategic LA change statement represents one specific strategic change notion on the importance or feasibility of LA. The sorting and rating phase of their study followed after the LASI event with a new group of participants. The 39 stakeholders participating in these last two phases are 19 LA experts and 20 novices with a management, research or teaching role in education. The sorting and rating participants consist of 16 teachers, 23 managers, 6 researchers and 4 researchers/teachers. In this investigation, the 4 researchers/teachers are regarded and analyzed as both researcher and as teacher.

Drachsler et al. (2014, p. 160) distinguish seven different clusters of related LA change statements based on the sorting by these participants. These seven clusters identify seven strategic LA change themes: (1) Student Empowerment, (2) Personalization, (3) Research & Learning Design, (4) Teacher Empowerment, (5) Feedback & Performance, (6) Risks and (7) Management & Economics. Figure 3 shows these seven clusters and their positional interdependence as a measure of their similarity; statements and clusters spatially positioned close to each other are more similar than those positioned further away.

Based on Figure 3, Drachsler et al. (2014, p. 160) distinguish two basic areas of strategic LA change themes; the east coast, containing the clusters ‘1. Students Empowerment,’ ‘2. Personalization,’ ‘3. Research & Learning design,’ ‘4. Teacher Empowerment,’ and ‘5. Feedback & Performance’, which covers the educational stance; and the west coast, containing the clusters ‘6. Risks,’ and ‘7. Management & Economics’, which is connected to the economical view on LA. Drachsler et al. (2014) claim, opposite to their expectations, that LA experts and novices demonstrate consensus regarding the importance and feasibility of the strategic LA change themes and that there is consensus among Dutch LA stakeholders.
### 1.4 Consensus among LA Stakeholders

Strategic consensus refers to the shared understanding of strategic priorities at strategic, tactical and operational levels within the organization (Kellermanns, Walter, Lechner, & Floyd, 2005, p. 721). It is recognized as an important concept in the literature on the Organizational Development themes ‘strategy formation’ and ‘implementation processes’ (Tarakci et al., 2014, p. 1053). With regard to its importance in implementation processes, Markóczy (2001, p. 1013) argues that strategic processes contain consensus building processes in which organizational members agree on organizational goals.

Drachsler et al. (2014) implicitly fully employ consensus as the multidimensional concept developed by Markóczy (2001, p. 1013), containing four aspects: locus, scope, degree and content. In Drachsler et al., locus refers to the positions of the seven clusters as displayed in Figure 3. Scope covers the size of the stakeholder sample. Content deals with the subject of each cluster. Finally, degree resembles the distances between the clusters. Thus, consensus among stakeholder groups is analyzed.

Drachsler et al. (2014, p. 158) distinguish between expert and novice LA stakeholders. However, other differentiations of stakeholders can also be identified such as teachers, managers, researchers and students (Greller & Drachsler, 2012, p. 44). With regard to these, the holistic LA researcher-practitioner model advised by Siemens (2012, p. 7) requires a differentiation between researchers and practitioners. This investigation focusses on the practitioners teachers and managers as they have dissimilar perspectives: while teachers have a more educational stance, managers have a more economical view (Clow, 2013, p. 684). Yet, Drachsler et al. (2014) do not explicitly differentiate between the LA change perceptions of teachers, managers and researchers. This raises the question whether the study of Drachsler et al. (2014) is confronted with a hidden aggregation problem regarding their claim that there is consensus among Dutch LA stakeholders. An aggregation problem refers to the difficulty that group effects are often crucial for setting a strategic agenda but need a comparison on a subgroup level (Baetschmann, 2014, p. 398).

### 1.5 Thesis problem

A thesis problem consists of an objective, a main question and a number of sub questions (Jurg, 2010: 7). The thesis objective describes the goals of the thesis in terms of desired outcomes (Baarda, De Goede, & Teunissen, 2009, p. 24). First, the thesis objective is formulated (1.5.1) and subsequently the thesis question and sub questions (1.5.2).

#### 1.5.1 Thesis objective

The objective of this investigation is to conclude whether a hidden aggregation problem underlies the claim of Drachsler et al. (2014) that there is consensus among Dutch LA stakeholders regarding the strategic LA change themes. Consensus concerns insights into the level of key similarities and differences (Markóczy, 2001, p. 1022). Consensus is operationalized in this investigation as more key similarities than differences regarding the most and least important strategic LA change statements. Thus, this investigation compares the key similarities and differences regarding the most and least important strategic LA change statements among the subgroups teachers, managers and researchers.
1.5.2 Thesis questions

In the previous section, the objective of this thesis was addressed. This objective leads to the thesis questions, in the light of the problem addressed here. Based on the inferences in the work of Drachsler et al. (2014, p. 162) claiming that there is consensus among Dutch LA stakeholders, the following thesis question is derived:

Is there a hidden aggregation problem in Drachsler et al. (2014) concerning their consensus claim regarding the strategic LA change themes among teachers, managers and researchers?

The sub questions are:

SQ1. Applying Group Concept Mapping, what are the key similarities and differences among teachers, managers and researchers regarding the most and least important strategic LA change statements on the educational and economical dimensions?

SQ2. Applying Strategic Consensus Mapping, what are the key similarities and differences among teachers, managers and researchers regarding the most and least important strategic LA change statements on the educational and economical dimensions?

SQ3. How do these two findings compare to the consensus claim among teachers, managers and researchers regarding the strategic LA change themes by Drachsler et al. (2014)?

1.6 Overview

Chapter 2 presents the literature review on LA covering a conceptual, methodological, integrative and theoretical review. Chapter 3 covers the methodology of this thesis. Chapter 4 presents the findings. Chapter 5 closes this thesis with the evaluation.
2. Literature review

This chapter presents the literature review. It follows the Master Thesis theme “Organizational Development from a Multidimensional Perspective” (OD-MP) methodology for a systematic literature review, initiated by Schaap (2014). Ghauri & Grønhaug (2005, p. 52) argue that the purpose of the literature review is to identify the most relevant concepts, methods and claims. The literature review follows Wolfswinkel, Furtmueller, & Wilderom (2013, p. 3) who provide a guide to systemize the literature reviewing process consisting of a define stage, a search & select stage and an analyze stage. Thus, this review starts with the define, search & select stage of the literature review (2.1), and is followed by the analyze stage of the literature review (2.2).

2.1 Define, search & select stage

This section describes the define stage of the literature review (2.1.1) and the search & select stage (2.1.2), as suggested by Wolfswinkel, et al. (2013, p. 48). The search & selects stages are combined as these are intertwined.

2.1.1 Define stage

The define stage by Wolfswinkel et al. (2013, p. 48) concerns four steps. First, the criteria for inclusion of literature are defined; second, the identification of the fields of research; third, the determination of appropriate sources; and fourth, the decision on specific search terms. These four steps are substantiated in Appendix A2. Table 1 covers the define stage steps and the criteria of the literature review.

<table>
<thead>
<tr>
<th>Steps</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Criteria for inclusion</td>
<td>Publication types</td>
</tr>
<tr>
<td></td>
<td>Time frame</td>
</tr>
<tr>
<td></td>
<td>Impact factor list journal articles</td>
</tr>
<tr>
<td></td>
<td>Language</td>
</tr>
<tr>
<td>2. Identification of the fields of research</td>
<td>Knowledge domain</td>
</tr>
<tr>
<td></td>
<td>Learning Analytics</td>
</tr>
<tr>
<td>3. Determination of the appropriate sources</td>
<td>Internet source</td>
</tr>
<tr>
<td></td>
<td>Google Scholar</td>
</tr>
<tr>
<td>4. Decision on specific search terms</td>
<td>Search terms</td>
</tr>
</tbody>
</table>

Table 1 Define stage steps and criteria of the literature review

"Learning Analytics,” “model” and “figure".
2.1.2 Search & select stage of the literature review

Wolfswinkel et al. (2013, p. 48) argue that the search stage consists of the actual search in the identified sources. As stated in Appendix A2, the search was conducted with the search engine Google Scholar. The select stage covers the selection of the sample of publications (Wolfswinkel et al., 2013, p. 5). This literature review focuses on the Learning Analytics domain. The search & select stages are iterative processes that proceed the following five steps (Wolfswinkel et al., 2013, p. 5): (1) filter out doubles; (2) refine sample based on title and abstract; (3) refine sample bases on full text; (4) forward citations; and (5) backward citations. When no new articles come up in the last iteration, the process is closed.

First, this investigation conducted a close reading of the journal titles. When a journal title was evaluated as fit for being taken into account in the literature review, the abstract was subjected to a further close reading. Based on the close readings of the abstracts, the key publications were selected for this literature review. Close reading covers mindfully extracting the important meanings implicit in statements (Paul & Elder, 2014, p. 9). The search & select stage closes with an overview of the selected literature (Wolfswinkel et al., 2013, p. 5). Table 2 presents the publications years, the authors, the titles, the types of publications, the impact factors and explanations.

Table 2 Publications, titles, publication types, impact factors and explanations

<table>
<thead>
<tr>
<th>Years</th>
<th>Authors</th>
<th>Titles</th>
<th>Publication types</th>
<th>Impact factors</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>Siemens</td>
<td>Learning analytics: the emergence of a discipline</td>
<td>Article in American Behavioral Scientist</td>
<td>0.690</td>
<td>Description of a holistic model for Learning Analytics</td>
</tr>
<tr>
<td>2012</td>
<td>Greller &amp; Drachsler</td>
<td>Translating learning into numbers: A generic framework for Learning Analytics</td>
<td>Article in Journal of Educational Technology &amp; Society</td>
<td>1.010</td>
<td>Description of a generic framework for Learning Analytics</td>
</tr>
<tr>
<td>2012</td>
<td>Chatti, Dyckhoff, Schroeder, &amp; Thüs</td>
<td>A reference model for learning analytics</td>
<td>Article in International Journal of Technology Enhanced Learning</td>
<td>-</td>
<td>Description of a reference model for Learning Analytics</td>
</tr>
</tbody>
</table>

Thus, the literature review compares Drachsler et al. (2014) to Siemens (2013), Greller & Drachsler (2012) and Chatti et al. (2012).

2.2 Analyze stage of literature review

The analyze stage offers insights into what might be seen as relevant for the sake of theorizing (Wolfswinkel et al., 2013, p. 8). The analyze stage in this section is divided into four parts, following Ghauri & Grønhaug (2005, p. 52). First, in a conceptual literature review, the concept of Learning Analytics is reviewed in the selected publications (2.2.1). Then, a methodological review presents the employed methodologies in these publications (2.2.2). An integrative review covers a comparison of their findings (2.2.3). The analyze stage closes with a theoretical review: a comparison of their theories (2.2.4).
2.2.1 Conceptual literature review on Learning Analytics

The organizing framework of a literature review is determined by concepts (Webster & Watson, 2002, p. 16); key concepts frame the core of the problem addressed and its context. In this investigation, the organizing framework is determined by conceptualizing the concept of Learning Analytics. Conceptualizing consists of developing a definition that can be operationalized (De Leeuw, 2005, p. 105). A systematic analysis of the concept of Learning Analytics is presented in Appendix A2. Table 3 presents the conceptualizations of Learning Analytics in the selected publications, based on this systematic analysis.

Table 3: Conceptualizations of Learning Analytics

<table>
<thead>
<tr>
<th>Publications</th>
<th>Conceptualizations of Learning Analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drachsler et al. (2014, p. 158)</td>
<td>An advanced method for conducting educational research</td>
</tr>
<tr>
<td>Siemens (2013, p. 1382)</td>
<td>A research method for educational data aimed at educational optimization</td>
</tr>
<tr>
<td>Greller &amp; Drachsler (2012, pp. 47-48)</td>
<td>A research method for reflection, predicting and personalization of learning, and evaluating educational effects of pedagogic strategies</td>
</tr>
<tr>
<td>Chatti et al. (2012, p. 319)</td>
<td>An educational data analysis method for discovering, predicting and advising on students’ learning performance.</td>
</tr>
</tbody>
</table>

The definition by Drachsler et al. (2014) is in line with the conceptualizations by Siemens (2013) and Greller & Drachsler (2012), but differs from Chatti et al. (2012) in the sense that the latter is restricted to the data analysis part of educational research.

2.2.2 Methodological literature review on Learning Analytics

The methodological literature review concentrates on the research methods that are employed (Randolph, 2009, p. 2). Table 4 covers the methodological literature review on Learning Analytics. The columns contain, consecutively: authors (years of publication), publication types, types of study and methods employed, based on the OD-MP theme procedure as presented by Schaap (2014, p. 10).

Table 4: Methodological literature review on Learning Analytics

<table>
<thead>
<tr>
<th>Authors (years)</th>
<th>Publication types</th>
<th>Study types</th>
<th>Methods employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siemens (2013)</td>
<td>American Behavioral Scientist</td>
<td>Review article</td>
<td>Literature review</td>
</tr>
</tbody>
</table>

Siemens (2013), Greller & Drachsler (2012) and Chatti et al. (2012) are all review articles, applying a literature review design. This is in contrast with Drachsler et al. (2014), which applies a pioneering study applying a Group Concept mapping design. Siemens (2013), Greller & Drachsler (2012) and Chatti et al. (2012) apply a literature review as dominant methodology. Their methodology is, however, not well addressed.
2.2.3 Integrative literature review on Learning Analytics

The integrative literature review compares the claims of Drachsler (2014) with the inferences by Siemens (2013), Greller & Drachsler (2012) and Chatti et al. (2012), in order to investigate if this claim is supported by the key literature. De Groot, Van Hoek, & Van Zanten (2006, p. 10) describe a claim is what ultimately is being asserted based on the available information. The goal of this integrative literature review is to compare the claims of Drachsler (2014) on Learning Analytics with the inferences of Siemens (2013), Greller & Drachsler (2012) and Chatti et al. (2012) about this claim.

Table 5 Claims by Drachsler et al. (2014) on the importance of strategic LA change themes

<table>
<thead>
<tr>
<th>#</th>
<th>Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>There is consensus among Dutch LA stakeholders on the importance of strategic LA change themes</td>
</tr>
<tr>
<td>2</td>
<td>According to LA stakeholders, educational LA aspects are more important than the economical LA aspects</td>
</tr>
<tr>
<td>3</td>
<td>There is consensus among LA stakeholders regarding important LA change topics.</td>
</tr>
</tbody>
</table>

Three claims are identified in Drachsler et al. (2014) on the importance of strategic LA change themes: (1) there is consensus on LA change themes among stakeholders; (2) LA stakeholders value educational LA aspects as more important and feasible than the economical LA aspects; and (3) LA stakeholders show consensus regarding important LA change topics. Claim (3) is included in claim (1). Therefore, two distinct claims remain: (1) there is consensus on LA change themes among stakeholders on the importance of strategic LA change themes; and (2) LA stakeholders value educational LA aspects as more important than the economical LA aspects.

Table 6 presents the integrative literature review on Learning Analytics. The first column covers the publications; the second and third columns denote if the claims by Drachsler et al. (2014) are supported by Siemens (2013), Greller & Drachsler (2012) and Chatti et al. (2012), respectively. The systematic analysis of the integrative literature review on Learning Analytics is presented in Appendix A2.

Table 6 Summary of Integrative literature review on Learning Analytics.

<table>
<thead>
<tr>
<th>Publication</th>
<th>There is consensus among Dutch LA stakeholders on importance of strategic LA change themes</th>
<th>According to LA stakeholders, educational LA aspects are more important than economical LA aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drachsler et al. (2014)</td>
<td>Supported</td>
<td>Supported</td>
</tr>
<tr>
<td>Siemens (2013)</td>
<td>-</td>
<td>Supported</td>
</tr>
<tr>
<td>Greller &amp; Drachsler (2012)</td>
<td>-</td>
<td>Supported</td>
</tr>
<tr>
<td>Chatti et al. (2012)</td>
<td>-</td>
<td>Supported</td>
</tr>
</tbody>
</table>

The claim by Drachsler et al. (2014) that LA stakeholders perceive educational LA aspects as more important than the economical LA aspects is supported by Siemens (2013), Greller & Drachsler (2012) and Chatti et al. (2012). The claim by Drachsler et al. (2014) that there is consensus among Dutch LA stakeholders on the importance of strategic LA change themes is not covered by these authors; therefore, it is neither supported nor rejected.
2.2.4 Theoretical literature review on Learning Analytics

The theoretical literature review analyzes the theories that account for the existence of the phenomenon (Moustakas, 1994, p. 112). The goal is to identify a theory of Learning Analytics and related theories. The challenge of bridging theory and practice mentioned in chapter one is recognized by several authors (Ali, Asadi, Gašević, Jovanović, & Hatala, 2012, p. 131; Siemens, 2012, p. 5; Siemens & Long, 2011, p. 32). Attempts have been made to overcome this challenge by defining reference models to aid the implementation of LA in practice (Chatti et al., 2012; Greller & Drachsler, 2012). This theoretical literature review focuses on the stakeholders of Learning Analytics. Table 7 presents the identified stakeholders in Drachsler et al. (2014), Siemens (2013), Greller & Drachsler (2012) and Chatti et al. (2012), and the number of references to these stakeholders within these publications.

Table 7 Stakeholders and number of references by Drachsler et al. (2014), Siemens (2013), Greller & Drachsler (2012) and Chatti et al. (2012)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Experts</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Novices</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Students</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Teachers</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Managers</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Researchers</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Governments</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Companies</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

Drachsler et al. (2014) distinguish two stakeholders: experts and novices. Greller & Drachsler (2012) differentiate six stakeholders (students, teachers, managers, researchers, governments and companies), Chatti et al. (2012) five (students, teachers, managers, researchers and companies), and Siemens (2013) none. Table 8 ranks these stakeholders within LA, based on the number of references.

Table 8 Stakeholders and their number of references in Drachsler et al. (2014), Siemens (2013), Greller & Drachsler (2012) and Chatti et al. (2012)

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Number of references</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>5</td>
</tr>
<tr>
<td>Companies</td>
<td>4</td>
</tr>
<tr>
<td>Teachers</td>
<td>3</td>
</tr>
<tr>
<td>Researchers</td>
<td>3</td>
</tr>
<tr>
<td>Managers</td>
<td>2</td>
</tr>
<tr>
<td>Government</td>
<td>1</td>
</tr>
<tr>
<td>Experts</td>
<td>1</td>
</tr>
<tr>
<td>Novices</td>
<td>1</td>
</tr>
</tbody>
</table>

The key literature distinguished six stakeholders: students (5), companies (4), teachers (3), researchers (3), companies (4), managers (2) and government (1). Thus, students can be seen as the most important stakeholder, followed by companies, teachers, researchers and managers.
3. Methodology

This chapter reports on the methodology applied in this investigation. Because this investigation uses secondary data, generated in an earlier study by Drachsler et al. (2014), it starts with an introduction describing the context of that study and its results (3.1). Then, the methodologies applied in this investigation are covered: Strategic Consensus Mapping (3.2) and Group Concept Mapping (3.2). The final section (3.4) explains how the findings from these two methods are compared.

3.1 Group Concept Mapping study Drachsler, Stoyanov, & Specht (2014)

This investigation uses data collected during a Group Concept Mapping study among Dutch LA stakeholders during LASI-Amsterdam 2013 (Drachsler et al., 2014, p. 159). Group Concept Mapping is a methodology that facilitates participants to develop consensus on a shared vision about a particular issue, e.g., the impact of LA on education (Drachsler et al., 2014, p. 2). For this, it employs brainstorming to generate stakeholder statements in reaction to a focus prompt, a starting phrase guiding the generation of the statements (Drachsler et al., 2014, p. 159). A statement is a short phrase expressing one idea only (Drachsler et al., 2014, p. 159). The focus prompt used by Drachsler et al. (2014, p. 159) is: “One specific change that Learning Analytics will trigger in Dutch education is...”. The participants in their study consist of both expert and novice LA stakeholders with a management, research or teaching role in education. The data makes up a list of 108 different statements.

The participants in Drachsler et al. (2014, p. 159) are involved in a sequence of four activities that most of them are used to: (1) idea generation, (2) sorting ideas, (3) rating ideas, (4) idea interpretation. They are assumed to have an informed opinion about the issue under discussion. They did not, however, needed to know anything about the statistical techniques applied in Group Concept Mapping such as Multidimensional Scaling and Hierarchical Cluster Analysis. In the, idea generation phase, the participants generated statements, based on a focus prompt to guide the statement generation process. These statements were then, in the sorting phase, sorted by other participants into groups of similarity in meaning and labelled subsequently. In the rating phase, each statement was rated on its importance and feasibility.

After the rating phase, Multidimensional Scaling was applied on the sorted data to identify similarities. Multidimensional Scaling is a statistical method to quantify estimates of similarities (Hout, Papesh, & Goldinger, 2013, p. 93). In Group Concept Mapping, application of Multidimensional Scaling results in a two-dimensional point map which shows a map of spatial distances between the statements based on the aggregate sorts of the sorters (Jackson & Trochim, 2002, p. 315). Thus, the point map indicates how the statements are related to each other. The two dimensions of this map are distance measures for these relationships. The statements spatially close to each other are strongly related, whereas statements that are positioned far away are weakly related.

Additionally, a Hierarchical Cluster Analysis is applied on the positioning of the statements in the point map to cluster the individual statements into groups that indicate the best spatial fit for the statements with regard to the total number clusters in the cluster map (Drachsler et al., 2014, p. 2). Hierarchical Cluster Analysis is a statistical method to cluster statements into cluster based on similarity. Thus, a new map is generated, a cluster map, that visualizes which statements the participants consider related to each other and therefore belong to the same cluster.
The final phase, idea interpretation, concerned deciding on an appropriate number of clusters for the research problem addressed and assigning labels to the clusters that best describe their context (Jackson & Trochim, 2002, pp. 316-327). Because there is no sensible mathematical criterion that can be used to select the ‘best’ number of clusters, a judgment based on the level of specificity and the research context was made. Drachsler et al (2014, p. 159) combines 3 available methods for this: (1) labels suggested by the Group Concept Mapping software, (2) looking at the statements that, according to the software, best represent each cluster and (3) capturing the overall theme while reading through all the statements.

### 3.2 Group Concept Mapping methodology

In the previous section, the methodology of the Group Concept Mapping study by Drachsler et al. (2014, pp. 160-162) is explained. This section reports on the application of Group Concept Mapping (GCM) within this study. It starts with a description of the procedure followed in this study select statements for a comparison of the subgroups on similarities and differences (3.2.1) and ends with the results of this selection (3.2.2).

#### 3.2.1 Comparing similarities and differences

Drachsler et al. (2014, p. 160) analyzed the relationships among the seven identified clusters in their study and compared the seven LA change themes and the importance ratings for these themes generated by the participants. This analysis can be regarded as an analysis on cluster level. They did not, however, compare individual statements within these clusters, which can be regarded as an analysis on statement level.

The similarities and differences among teachers, managers and researchers regarding the importance of the strategic LA change themes managing, researching and teaching are derived from the position of the statements in the go-zone diagrams for the three subgroups. A go-zone diagram is a two dimensional visualization that presents the rated statements within a particular cluster (Trochim & Kane, 2005, p. 188). An example of a go-zone graph is presented in Figure 4.

![Go zone diagram](image)

Figure 4 Go-zone diagram (Trochim & Kane, 2005, p. 188)
For each go-zone diagram, the GCM-Global software provides an option to extract the X- and Y-coordinates of each statement. The X-coordinate equals the importance value and the Y-coordinate the feasibility value of a statement. These coordinates are then used to select statements for the similarities and differences comparisons. A detailed description of this method is presented in the four steps below:

1. **Collection of the (X, Y)-coordinates of all statements in a go-zone plot (like the one in Figure 4) through GCM-Global.** Each (X,Y)-coordinate represents the importance (X) and feasibility (Y) ratings of a strategy statement for a subgroup and LA change theme.

2. **For each subgroup and LA change theme, the coordinate values are sorted from highest to lowest score, thus creating a ranking.**

3. **For each subgroup and LA change theme, the ranked coordinate values are compared case-by-case among all combinations of two subgroups and for each LA change theme, following the ranking order; thus, as an example, first the highest coordinate values on importance for a LA change theme are compared among all combinations of two subgroups, then the second highest, and so on until the lowest coordinate values are compared.**

4. **From these case-by-case comparisons, similarities and differences among the three subgroups are derived by analyzing for which comparison the subgroups show similarities and for which differences are shown.**

This investigation applies these four steps limited to the comparison of the highest and lowest ranked coordinate values only. It is assumed here that analyzing these extremes is a good way for determining similarities and differences. This comparison focuses on the importance aspect of the LA change themes. It further concentrates on the three clusters that, by their names, directly refer to these three subgroups: (4) Teacher Empowerment, (7) Management & Economics and (3) Research & Learning Design. These clusters are referred to in this thesis as ‘Teaching,’ ‘Managing,’ and ‘Researching,’ respectively. These three LA change themes are analyzed as a whole, treating the highest and lowest ranked coordinate values for each subgroup as the extremes for these subgroups. In Drachsler et al. (2014, p. 162), the cluster ‘Teaching’ belongs to the educational stance and the cluster ‘Managing’ to the economical view. Similarly, this investigation assumes that the statements in the cluster ‘Teaching’ refer to the educational dimension and the statements in the cluster ‘Managing’ resemble the economical dimension.

### 3.2.2 Go-zone coordinate values on importance

Table 9 shows the highest and lowest coordinate values on importance of LA change themes managing, researching and teaching for the subgroups teachers, managers and researchers. These values are extracted from the go-zone plots using the GCM Global software.

<table>
<thead>
<tr>
<th>Clusters / Rating score</th>
<th>Teachers</th>
<th>Managers</th>
<th>Researchers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highest</td>
<td>Lowest</td>
<td>Highest</td>
</tr>
<tr>
<td>Teaching</td>
<td>4.40</td>
<td>3.25</td>
<td>4.55</td>
</tr>
<tr>
<td>Managing</td>
<td>3.75</td>
<td>2.10</td>
<td>3.45</td>
</tr>
<tr>
<td>Researching</td>
<td>4.35</td>
<td>3.45</td>
<td>4.27</td>
</tr>
</tbody>
</table>
The highest coordinate values, marked in green, for teachers, managers and researchers are found in the LA change theme ‘Teaching’ (4.55, 4.33 and 4.40), whereas the lowest values, marked in purple, are found in the theme ‘Managing’ (2.36, 1.89 and 2.10). As the theme ‘Teaching’ refers to the educational dimension of LA and the theme managing resembles the economical view of LA, this is an indication that the subgroups perceive the educational stance as more important than the economical view, in line with Drachsler (2014, p. 162).

Derived from Table 9, the statements belonging to the highest and lowest coordinate values for the educational and economical dimensions are presented in Table 10. Thus, Table 10 shows the most important and least important statements within the clusters ‘Managing’, ‘Researching’ and ‘Teaching’, respectively regarding the educational and economical dimensions. The contents of these statements are presented in Table 92, Appendix A13 and represent the most and least important LA change statements.

### Table 10 Highest and lowest scored statements by teachers, managers and researchers

<table>
<thead>
<tr>
<th>Sub group / Rated statements</th>
<th>Dimension</th>
<th>Educational</th>
<th>Economical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highest</td>
<td>Lowest</td>
<td>Highest</td>
</tr>
<tr>
<td>Teachers</td>
<td>70</td>
<td>22</td>
<td>23 and 17</td>
</tr>
<tr>
<td>Managers</td>
<td>77</td>
<td>30</td>
<td>52 and 77</td>
</tr>
<tr>
<td>Researchers</td>
<td>68</td>
<td>69</td>
<td>105</td>
</tr>
</tbody>
</table>

#### 3.3 Strategic Consensus Mapping

In addition to Group Concept Mapping (GCM), other methods can also provide insight into the similarities and differences among subgroups. This section reports on the application of one of these methods, Strategic Consensus Mapping (SCM). It starts with an introduction explaining the methodology (3.3.1), followed the explanation of the Vector Model for Unfolding biplot (3.3.2) and it’s characteristics (3.3.3). Then, the procedure followed in this investigation is explained (3.3.4). Finally, the method followed to compare the subgroups on similarities and differences is presented (3.3.5).

##### 3.3.1 Strategic Consensus Mapping methodology

Next to GCM (Group Concept Mapping), SCM (Strategic Consensus Mapping) is additionally applied on the individual statements contained within the clusters ‘Managing’, ‘Researching’ and ‘Teaching’, generated during the sorting phase in Drachsler et al. (2014). SCM is a set of complementary procedures for probing strategic consensus multidimensionally, and testing the cross-sectional and longitudinal differences within and among groups (Tarakci et al., 2014, pp. 1057-1061). With SCM, it is possible to measure similarities and differences within and among groups at various points in time. In this investigation, SCM is used to identify similarities and differences regarding the importance of three strategic LA change themes among managers, researchers and teachers. SCM consists of five steps (Tarakci et al., 2014, pp. 1057-1061):

1. Visualizing the degree of within group consensus, using the ‘Vector Model for Unfolding’ method
2. Quantifying the degree of within group consensus using the results of this method
3. Quantifying the degree of among group consensus using a correlation analysis of the among group consensus derived from the degree of within group consensus quantification
4. Visualizing the degree and locus of consensus among groups, using Multidimensional Scaling and the quantified measures for within- and among group consensus
5. Assessing the statistical significance of the observed differences, both cross sectional and longitudinal, using permutation tests.
The SCM method relies on data that quantify how individuals, e.g. members of LA stakeholder subgroups, assess strategic priorities, for example by rating changes that LA might trigger in Dutch higher education generated in the GCM study. For this, SCM, like GCM, uses Multidimensional Scaling and similarity estimates act as input for this analysis. The output is a map, in this investigation a two-dimensional representation that shows, spatially, the relationships between the statements: similar statements are positioned close to each other, whereas dissimilar statements are positioned proportionally far away from each other (Hout et al., 2013, p. 94). This way, Multidimensional Scaling is used to visualize similarities and differences on these statements among subgroups. Additionally, the ‘Vector Model of Unfolding’ is used to measure the degree of within-subgroup strategic consensus and visualize its content (Tarakci et al., 2014, p. 1057). VMU is a statistical method which unfolds relations in a system to vectors in a two-dimensional space representing these relations (Borg & Groenen, 2005, p. 337).

### 3.3.2 Vector Model of Unfolding biplot

The results of the Vector Model of Unfolding (VMU) analysis can be visualized in a biplot, a two-dimensional graphical representation of rated data (Borg & Groenen, 2005, p. 337). VMU is a statistical method which transfers relationships to vectors in a biplot representing these relationships. This biplot shows both the rated data and the raters' scores on these data in a two-dimensional space. The rated data are visualized by object points, whereas the raters' scores on these data are pictured by vectors. The object points visualize the strategic statements that are rated by the participants and the vectors picture the individual preferences of these participants. The orthogonal projections of all object points on each vector correspond to the individual preferences of each participant regarding the strategic statements in the dataset (Tarakci et al., 2014, p. 1058). A further explanation of this is presented in Figure 25, section A9.1.3.

### 3.3.3 Characteristics VMU biplot

VMU biplots indicate five core consensus characteristics of a participant group under research (Tarakci et al., 2014, pp. 1058-1059):

1. The similarities and differences in preferences on the strategic statements are indicated by the angles between the vectors; a similar preference is indicated by a small angle and a different preference by a large angle; thus, an angle of zero degrees indicates similar preferences, an angle of 180 degrees refers to dissimilar preferences and an angle of 90 degrees, showing equally similar and dissimilar preferences, indicates moderate balanced preferences.
2. The length of a vector indicates how well a respondent represents his or her subgroup perception, because for that particular vector low variance is accounted for. A length close to 1 indicates a high level of consensus; a vector length close to zero indicates that a low level of consensus.
3. The degree of within-subgroup strategic consensus is indicated by the spread of the vectors in the biplot; vectors grouped in a tight cluster indicate a high degree of within-subgroup strategic consensus; A low degree of within-subgroup consensus is indicated by a wide distribution of vectors in opposing directions.
4. The VMU biplot both provides a comparison of individuals and indicates their preferences; the orthogonal projection of a strategic statement onto a respondent's vector indicates the respondent's preference for that particular strategic statement; when item is projected onto the end of a vector, the respondent has a high preference regarding the strategic statement, whereas the respondent has a low preference on the items that are projected in the opposite direction.
5. The VMU enables quantification of the preferences of the participants to determine similarities and differences among groups; the first dimension can be interpreted as the prototypical subgroup member: the member of the subgroup who best represents the subgroup's perception; therefore, the projections of the strategic statements onto the first axis represent the overall perception of the subgroup.
Figure 5 shows an example of a VMU biplot for the subgroup teachers regarding the importance of strategic LA change statements. The object points (objects) represent the strategic LA change statements whereas the vectors (component loadings) represent the individual teachers within the subgroup teachers. Thus, the VMU biplot visualizes the individual perceptions of each subgroup member regarding the strategic LA change statements.

Most of the 44 object points shown are positioned in a cluster centered around the origin whereas some object points (11, 17, 23, 27, 30 and 39) are positioned further away from this cluster of object points. This indicates that the subgroup teachers perceive these object points (11, 17, 27, 30 and 39) as less important on dimension 1. On dimension 2, however, these object points are perceived as more important (17, 27 and 39) or as less important (23 and 30). Thus, both dimensions, object points can be identified that are perceived as more important or less important. Note that visually identifying the more important object points from the VMU biplot is troubled by the position of the vectors.

The vectors are in majority tightly clustered with small angles between them. Exceptions are the vectors T7 and T13, which show larger angles compared to the remainder of the vectors. This indicates dissimilar perceptions regarding the importance of LA change statements by these teachers. No vectors are present that are positioned in opposing directions. Thus, the degree of within-group consensus is considered to be moderate.
It should be noted that the VMU biplot in Figure 5 shows 2 dimensions: dimension 1 and dimension 2. Tarakci et al. (2014, p. 1057) state that the first dimension represents the prototype subgroup member: the member of the subgroup who best represents the subgroup’s perception. Then, the orthogonal projections of the strategic statements onto this first dimension represent the overall perception of the subgroup based on this prototypical subgroup member (see: Figure 25, section A9.1.3). However, they are unclear on the meaning of the second dimension. As the VMU biplots in this investigation are two-dimensional plots, it is also important to understand the meaning of the second dimension.

To derive the meaning of both VMU biplot dimensions, a new approach is introduced in this investigation. A VMU biplot is the result of a VMU analysis using a combination of two data-sets: rated data, visualized by object points; and raters’ scores, pictured by vectors (see: A9.1.1). Tarakci’s (2014, p. 1057) method for defining the meaning of dimension one of a VMU biplot is vector-based. However, as the VMU biplot uses a combined data-set, the meaning of the dimensions can also be based on the object points. In a biplot, each of the two dimensions are defined by combinations of the plotted variables (Greenacre, 2012, p. 403). Thus, the new approach in SCM employed in this investigation is to consider the strategic LA change statements across the subgroups as an indication for each dimension, which are visualized by the object points and their coordinates.

Therefore, the method presented in this investigation derives the meaning of the two VMU biplot dimensions from the coordinates of the objects. These objects are represented in the biplots by their scores: a pair of coordinate values; one value for each of the two dimensions indicating the positions of the objects in the two-dimensional biplots (Tarakci et al., 2014, p. 1058). In this investigation, each object represents a strategic LA change statement belonging to one of the strategic LA change themes ‘Teaching’, ‘Managing’ or ‘Researching’. For each subgroup, the strategic LA change theme with the highest average object scores on the two dimensions are considered to be the best representation for those dimensions. The average coordinate values per strategic LA change theme on importance, for teachers, managers and researchers are shown in Table 11. The highest averages on each dimension per subgroup are marked in orange.

<table>
<thead>
<tr>
<th>Clusters / Dimensions</th>
<th>Teachers</th>
<th>Managers</th>
<th>Researchers</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Teaching’</td>
<td>.205</td>
<td>.005</td>
<td>.211</td>
</tr>
<tr>
<td>‘Managing’</td>
<td>.018</td>
<td>.088</td>
<td>.083</td>
</tr>
<tr>
<td>‘Researching’</td>
<td>-.342</td>
<td>-.160</td>
<td>-.474</td>
</tr>
</tbody>
</table>

For teachers, managers and researchers, dimension 1 is best represented by ‘Teaching’ (.211, .243 and .205) and dimension 2 by ‘Managing’ (scores: .087, .092 and .088). These findings resemble the educational-economical differentiation by Clow (2013, p. 684). Thus, dimension 1 represents the educational dimension regarding the importance of the strategic LA change statements and dimension 2 the economical dimension.
3.3.4 Procedure

As stated in the previous section, SCM enables to visualize and quantify the degree of consensus, both within and among groups (Tarakci et al., 2014, p. 1054). In this investigation, SCM is used to identify similarities and differences in the level of consensus regarding the importance of the strategic LA change statements. Similarities and differences for both within-group and among-group consensus are identified. For this, the statements belonging to the three clusters central in this investigation, ‘Teaching,’ ‘Managing,’ and ‘Researching’, are analyzed with SCM.

Following Tarakci’s (2014, pp. 1057-1061) methodology, the rated statement data on importance is analyzed in SPSS 19.0 to visualize the degree of within-group consensus in a VMU biplot. The SPSS code for this is presented in appendix A10. This analysis yields six VMU biplots: three on importance and three on feasibility (see: appendix A11). These plots show both vectors and objects. Each vector represents a LA stakeholder and each object represents a LA change statement. The visual spread of the vectors is an indication of the within-group consensus of the three stakeholder groups. Respondents with small angles between their vectors have a similar opinion of the statements in question (Tarakci et al., 2014, p. 1057). In contrast, wide angles between respondents’ vectors indicate different opinions. Thus, the spread of all the vectors in a biplot demonstrates the degree of within-group strategic consensus. When the vectors are grouped in a tight cluster, there is a high degree of within-group strategic consensus and a wide distribution of vectors of the respondents in opposing directions indicates a low degree of within-group consensus. This thesis focuses on characteristic item 5 of the VMU-biplot: qualifying the preferences of the participants to determine the key similarities and differences among subgroups. Tarakci et al. (2014, p. 1057) use this characteristic to determine the preference per subgroup.

3.3.5 Comparing similarities and differences

The similarities and differences among teachers, managers and researchers regarding the importance of the strategic LA change clusters ‘Teaching,’ ‘Managing,’ and ‘Researching’ are derived from the positions of the object points in the VMU biplots regarding dimension 1 and 2. For this, the orthogonal projections (see: Figure 25, section A9.1.3) of strategy statements onto these two dimensions are used. These projections are quantified by the object scores of the object points. Thus, the object score for dimension 1 represents the preference regarding the educational dimension for an object point and the object score for dimension 2 represents the preference regarding the economical dimension for an object point. This analysis is done in five steps:

1. Collecting the object scores, which are generated alongside with the VMU biplot; each set of object scores is assigned a case by SPSS 19.0 which represents a strategy statement
2. Sorting the object scores from highest to lowest score for each subgroup and dimension
3. Ranking the object scores case-by-case from highest to lowest scores
4. Comparing the highest and lowest ranked object scores, among all combinations of two subgroups and dimensions
5. Determining similarities and differences among the three subgroups by analyzing if the compared cases are similar or different.

This investigation applies these five steps limited to the comparison of the highest and lowest ranked object scores only. It is assumed here that analyzing these extremes is a good way for determining similarities and differences.
To support the understanding of the five steps above, Figure 6 shows an example of the VMU biplots of three subgroups: teachers, managers and researchers regarding the importance of strategic LA change statements. Note that the actual comparison in this thesis is done on the object scores only and not visually using the biplots.

A comparison of the three VMU biplots would yield that among teachers, managers and researchers the same object point (17) scores the lowest on the educational dimension (dimension 1). This indicates that teachers, managers and researchers perceive the same object points as least important on the educational dimension. On the economical dimension (dimension 2), however, different object points score the lowest among teachers, managers and researchers (23, 17 and 9 respectively). This indicates that teachers, managers and researchers perceive different object points as least important on the economical dimension.
3.4 Comparison between GCM and SCM

In this investigation, findings from the GCM and the SCM analysis are triangulated to yield insight into the supposed consensus among teachers, managers and researchers regarding the strategic LA change statements within the strategic LA change themes ‘Managing’, ‘Researching’ or ‘Teaching’. Consensus concerns insights into the level of key similarities and differences (Markóczy, 2001, p. 1022). Consensus is operationalized in this investigation as more key similarities than differences regarding the most and least important strategic LA change statements. Thus, this investigation compares the key similarities and differences among the subgroups teachers, managers and researchers regarding the most and least important strategic LA change statements.

These similarities and differences are compared for the three subgroups overall and per combination of two subgroups. This leads to four comparisons:

1. Similarities and differences among the three subgroups regarding the most or least important statements
2. Similarities between teachers and managers differing from researchers regarding the most or least important statements
3. Similarities between teachers and researchers differing from managers regarding the most or least important statements
4. Similarities between managers and researchers differing from teachers regarding the most or least important statements.

These four comparisons are employed to determine whether there are more similarities than differences, indicating consensus, or whether the differences outnumber the similarities, indicating no consensus.

Finally, similarities and differences regarding the most important strategic LA change statements identified through GCM and SCM are combined, resulting in very important similarities and differences. Thus, very important strategic LA change statements are perceived as most important by subgroups in either the GCM or the SCM analysis.
4. Findings

Section 4.1 presents the findings of the Group Concept Mapping analysis and section 0 of the Strategic Consensus Mapping analysis. Section 4.3 compares the findings of the two previous analyses.

4.1 Findings from Group Concept Mapping

The Group Concept Mapping findings of the similarities and differences are presented in Table 12 and Table 13; Table 12 on the educational dimension and Table 13 on the economical dimension.

Table 12 Group Concept Mapping similarities and differences among subgroups on educational dimension

<table>
<thead>
<tr>
<th></th>
<th>Applying Group Concept Mapping, what are the key similarities and differences among teachers, managers and researchers regarding the most and least important strategic LA change statements on the educational dimension?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Teachers and managers perceive Easing class management as the least important educational statement</td>
</tr>
<tr>
<td>2</td>
<td>Managers perceive Student progress tracking as the most important educational perception, researchers perceive Adaptive learning as the most important educational perception and teachers perceive Effectiveness of learning content and assessments as the most important educational statement</td>
</tr>
<tr>
<td>3</td>
<td>Teachers and managers perceive Easing class management as the least important educational statement whereas researchers perceive Developing teachers’ dashboard creating skills as the most important educational statement.</td>
</tr>
</tbody>
</table>

Applying Group Concept Mapping, on the educational dimension, teachers, managers and researchers differ regarding the most important strategic LA change statements. Managers perceive “student progress tracking” as the most important, researchers “adaptive learning” and teachers “effectiveness of learning content and assessments”. In addition, teachers and managers similarly perceive “easing class management” as the least important statement. They differ however from researchers on this aspect as this subgroup perceives “developing teachers’ dashboard creating skills” as the least important statement.

Table 13 Group Concept Mapping similarities and differences among subgroups on economical dimension

<table>
<thead>
<tr>
<th></th>
<th>Applying Group Concept Mapping, what are the key similarities and differences among teachers, managers and researchers regarding the most and least important strategic LA change statements on the economical dimension?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Teachers and managers perceive Increased teachers’ role complexity as the most important economical statement and Cutting costs as the least important economical statement</td>
</tr>
<tr>
<td>2</td>
<td>Teachers and managers perceive Increased teachers’ role complexity as the most important economical statement whereas researchers perceive Dramatic change of ICT’s role in education as the most important economical statement</td>
</tr>
<tr>
<td>3</td>
<td>Teachers and managers perceive Cutting costs as the least important economical statement whereas researchers perceive Resulting cost reduction as the least important economical statement.</td>
</tr>
</tbody>
</table>
Applying Group Concept Mapping, on the economical dimension, teachers and managers similarly perceive “increased teachers’ role complexity” as the most important strategic LA change statement and “cutting costs” as the least important. In contrast, researchers perceive “dramatic change of ICT’s role in education” as most important and “resulting cost reduction” as least important.

4.2 Findings from Strategic Consensus Mapping

The findings in this section cover the biplots employing the ‘Vector Model for Unfolding’ (VMU) (4.2.1) and the consensus findings on the strategic LA change statements among the sub groups teachers, managers and researchers, differentiated to the most important similarities and differences, applying Strategic Consensus Mapping (4.2.2).

4.2.1 VMU biplots

To support the understanding of the findings in the next sub section, Figure 7 presents the VMU biplots of the three sub groups (teachers, managers and researchers) regarding the importance of strategic LA change statements, applying Strategic Consensus Mapping. Note that the actual comparison in this thesis is conducted on the object scores.

VMU biplot: the object points (blue) represent rated strategic LA change statements; the vectors (black) represent individual importance preferences for the sub groups teachers (top-left), managers (top-right) and researchers (bottom-left).

Dimension 1 represents the educational dimension and dimension 2 the economical dimension.

Each object point is accompanied by a number, representing cases. Each case, in turn, represents a statement. Cases and statements are presented in Table 93, Appendix A13.

Figure 7 VMU biplots on importance of LA change statements for subgroups teachers, managers and researchers
Both similarities and differences among the three subgroups emerge when the most and least important object points are compared. For instance: on the educational dimension, object point 17 (statement 13) is similarly perceived as the least important statement by all three subgroups; the least important object points on the economical dimension (23, 17 and 9), however, differ among these subgroups.

The vectors in the three VMU biplots demonstrate a different spread. For instance, in the top-left biplot (teachers) the vectors are bundled tighter together than in the bottom-left biplot (researchers). This indicates a higher degree of consensus within the subgroup ‘teachers’. Differences among the three subgroups are also visible regarding the position and the spread of the object points. This reveals different perceptions on the importance of the strategic LA change statements among the three subgroups.

### 4.2.2 SCM similarities and differences among subgroups

Table 14 presents the similarities and differences among subgroups regarding the most and least important strategic LA change statements on the educational dimension applying Strategic Consensus Mapping.

<table>
<thead>
<tr>
<th>Applying Strategic Consensus Mapping, what are the key similarities and differences among teachers, managers and researchers regarding the most and least important strategic LA change statements on the educational dimension?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Teachers and managers perceive Identifying patterns in data as the most important educational statement.</td>
</tr>
<tr>
<td>2 Teachers, managers and researchers perceive Insight into course progress as the least important educational statement.</td>
</tr>
<tr>
<td>3 Teachers and managers perceive Identifying patterns in data as the most important educational statement whereas researchers perceive Identification of effective activities for the students’ learning process as the most important educational statement.</td>
</tr>
</tbody>
</table>

Applying Strategic Consensus Mapping, on the educational dimension, teachers and managers perceive “the identification of patterns in the data” as the most important LA change statement, whereas researchers perceive “the identification of effective activities for the students’ learning process” as the most important LA change statement. On the educational dimension, teachers, managers and researchers perceive “insight into course progress” as the least important LA change statement.

Table 15 presents the similarities and differences among subgroups regarding the most and least important strategic LA change statements on the economical dimension applying Strategic Consensus Mapping.

<table>
<thead>
<tr>
<th>Applying Strategic Consensus Mapping, what are the key similarities and differences among teachers, managers and researchers regarding the most and least important strategic LA change statements on the economical dimensions?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Teachers, managers and researchers do not perceive similar strategic LA change statement as the most and least important economical statement.</td>
</tr>
<tr>
<td>2 Teachers perceive Insight into the quality of a course for teachers as the most important economical statement, managers perceive Course problem identification by teachers as the most important economical statement and researchers perceive Promise of adaptive learning as the most important economical statement.</td>
</tr>
<tr>
<td>3 Teachers perceive Insight into the course difficulties of students as the least important economical statement, managers perceive Insight into the quality of a course for teachers as the least important economical statement and researchers perceive Increased diversity of digital educational tools as the least important economical statement.</td>
</tr>
</tbody>
</table>

Applying Strategic Consensus Mapping, on the economical dimension, teachers and researchers perceive “insight into the course difficulties of students” as the least important LA change statement.
On the economical dimension, teachers, managers and researchers have no similar perceptions regarding the most and least important LA change statements. Teachers perceive “insight into the quality of a course for teachers” as most important, managers “course problem identification by teachers” and researchers “course problem identification by teachers”. In addition, teachers perceive “insight into the course difficulties of students” as least important, managers “insight into the quality of a course for teachers” and researchers “increased diversity of digital educational tools”.

4.3 Comparison

A summary of the findings from the Group Concept Mapping (GCM) and Strategic Consensus Mapping (SCM) and is presented below on the educational dimension (similarities: Table 15 and differences: Table 16) and the economical dimension (similarities: Table 17 and differences: Table 18). First, Table 15 presents a summary of the similarities findings applying GCM and SCM on the educational dimension.

Table 15 Similarities findings from GCM and SCM among subgroups on educational dimension

<table>
<thead>
<tr>
<th>Subgroups</th>
<th>Most important strategic LA change statements</th>
<th>Least important strategic LA change statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers - Managers</td>
<td>- Identify patterns in data</td>
<td>Easing class management</td>
</tr>
<tr>
<td>Managers - Researchers</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Teachers - Researchers</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Applying GCM, on the educational dimension, there are no similarities on the most important statements. Applying SCM, teachers and managers similarly perceive “Identifying patterns in data” as most important. Applying GCM, teachers and managers similarly perceive the theme “Easing class management” as least important. Applying SCM, teachers, managers and researchers similarly perceive the perception “Insight into course progress” as least important.
Table 16 presents a summary of the differences findings regarding GCM and SCM on the educational dimension.

Table 16 Differences findings from GCM and SCM among subgroups on educational dimension

<table>
<thead>
<tr>
<th>Subgroups</th>
<th>Most important strategic LA change statements</th>
<th>Least important strategic LA change statements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GCM</td>
<td>GCM</td>
</tr>
<tr>
<td></td>
<td>SCM</td>
<td>SCM</td>
</tr>
<tr>
<td>Teachers - Managers</td>
<td>Managers: Student progress tracking Researchers: Adaptive learning</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Managers: Student progress tracking Researchers: Adaptive learning</td>
<td>Managers: Easing class management Researchers: Developing teachers’ dashboard creating skills</td>
</tr>
<tr>
<td>Managers - Researchers</td>
<td>Managers: Student progress tracking Researchers: Adaptive learning</td>
<td>Managers: Identifying patterns in data Researchers: Identification of effective activities for the students’ learning process</td>
</tr>
<tr>
<td></td>
<td>Managers: Identifying patterns in data Researchers: Identification of effective activities for the students’ learning process</td>
<td>Managers: Easing class management Researchers: Developing teachers’ dashboard creating skills</td>
</tr>
<tr>
<td>Teacher - Researchers</td>
<td>Researchers: Adaptive learning Teachers: Effectiveness of learning content and assessments</td>
<td>Researchers: Identifying patterns in data Researchers: Identifying patterns in data</td>
</tr>
<tr>
<td></td>
<td>Researchers: Developing teachers’ dashboard creating skills Teachers: Easing class management</td>
<td>Researchers: Developing teachers’ dashboard creating skills Teachers: Easing class management</td>
</tr>
</tbody>
</table>

Applying GCM, on the educational dimension, teachers, managers and researchers perceive different strategic LA change statements as most important: managers “Student progress tracking”, researchers “Adaptive learning” and teachers “Effectiveness of learning content and assessments”. Applying SCM, teachers and managers similarly perceive “Identifying patterns in data” as most important, while researchers perceive “Identification of effective activities for the students’ learning process” as most important. Applying GCM, teachers and managers similarly perceive “Easing class management” as least important; researchers “Developing teachers’ dashboard creating skills”. Applying SCM, there are no similarities on the least important statements.

Table 17 presents a summary of the similarities findings regarding GCM and SCM on the economical dimension.

Table 17 Similarities findings from GCM and SCM among subgroups on economical dimension

<table>
<thead>
<tr>
<th>Subgroups</th>
<th>Most important strategic LA change statements</th>
<th>Least important strategic LA change statements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GCM</td>
<td>GCM</td>
</tr>
<tr>
<td></td>
<td>SCM</td>
<td>SCM</td>
</tr>
<tr>
<td>Teachers - Managers</td>
<td>Increased teachers’ role complexity</td>
<td>Cutting costs</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Managers - Researchers</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Teacher - Researchers</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Applying GCM, on the economical dimension, teachers and managers similarly perceive the strategic LA change statements “increased teachers’ role complexity” as most important. Applying SCM, there are no similarities on the most important statements. Applying GCM, teachers and managers similarly perceive the theme “cutting costs” as least important. Applying SCM, there are no similarities on the least important statements.

Table 18 presents a summary of the differences findings regarding GCM and SCM on the economical dimension.

<table>
<thead>
<tr>
<th></th>
<th>Most important strategic LA change statements</th>
<th>Least important strategic LA change statements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GCM</td>
<td>SCM</td>
</tr>
<tr>
<td>Teachers - Managers</td>
<td>-</td>
<td>Managers: Course problem identification by teachers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teachers: Insight into the quality of a course for teachers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manag ers: Insight into the quality of a course for teachers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teachers: Insight into the course difficulties of students</td>
</tr>
<tr>
<td>Managers - Researchers</td>
<td>Managers: Increased teachers' role complexity Researchers: Dramatic change of ICT’s role in education</td>
<td>Managers: Course problem identification by teachers Researchers: Promise of adaptive learning</td>
</tr>
<tr>
<td></td>
<td>Manag ers: Cutting costs Researchers: Resulting cost reduction</td>
<td>Manag ers: Insight into the quality of a course for teachers Researchers: Increased diversity of digital educational tools</td>
</tr>
<tr>
<td>Teacher - Researchers</td>
<td>Teachers: increased teachers’ role complexity Researchers: Dramatic change of ICT’s role in education</td>
<td>Teachers: insight into the quality of a course for teachers Researchers: Promise of adaptive learning</td>
</tr>
<tr>
<td></td>
<td>Teachers: Cutting costs Researchers: Resulting cost reduction</td>
<td>Teachers: Insight into the quality of a course for teachers Researchers: Increased diversity of digital educational tools</td>
</tr>
</tbody>
</table>

Applying GCM, on the economical dimension, teachers and managers similarly perceive the theme “Increased teachers’ role complexity” as most important, and researchers “Dramatic change of ICT’s role in education”. Applying SCM, teachers, managers and researchers perceive different strategic LA change statements as most important: managers “Course problem identification by teachers”, researchers “the promise of adaptive learning” and teachers “insight into the quality of a course for teachers”.

Applying GCM, teachers and managers similarly perceive the statement “Cutting costs” as least important, and researchers “Resulting cost reduction”. Applying SCM, teachers, managers and researchers perceive different statements as least important: managers “Insight into the quality of a course for teachers”, researchers “increased diversity of digital educational tools” and teachers “insight into the course difficulties of students”.

In Chapter 5, the findings presented in this section will be evaluated in the light of consensus among teachers, managers and researchers, and compared to the claim by Drachsler et al. (2014).
5. Evaluation

This section reports on the evaluation of this investigation. First, the conclusions are presented in section 5.1. Then, the reliability (5.2), construct validity (5.3) and on relevance (5.4) of the conclusions are discussed. Section 5.5, finally, covers the recommendations, both theoretical and practical.

5.1 Conclusions

The aim of this investigation is to conclude whether a hidden aggregation problem underlies the claim of Drachsler et al. (2014) that there is consensus among Dutch LA stakeholders that the educational stance is more important than the economical view, when considering strategic LA change themes. For this, it identifies key similarities and differences among the subgroups teachers, managers and researchers regarding the most and least important strategic LA change statements within the themes managing, researching and teaching.

The main question in this investigation is:

Is there a hidden aggregation problem in Drachsler et al. (2014) concerning their consensus claim regarding the strategic LA change themes among teachers, managers and researchers?

Three sub questions (SQ) are derived from this main question:

SQ1. Applying Group Concept Mapping, what are the key similarities and differences among teachers, managers and researchers regarding the most and least important strategic LA change statements on the educational and economical dimensions?

SQ2. Applying Strategic Consensus Mapping, what are the key similarities and differences among teachers, managers and researchers regarding the most and least important strategic LA change statements on the educational and economical dimensions?

SQ3. How do these two findings compare to the consensus claim among teachers, managers and researchers regarding the strategic LA change themes by Drachsler et al. (2014)?

The Group Concept Mapping findings show that, on the educational dimension, the key similarity is that both teachers and managers perceive “easing class management” as the least important strategic LA change statement. Researchers perceive “developing teachers’ dashboard creating skills” as the least important statement. Teachers perceive “effectiveness of learning content and assessments” as most important, managers “student progress tracking” and researchers “adaptive learning”. Thus, (1) the three subgroups teachers, managers and researchers differ regarding the most and least important statements; (2) the subgroups teachers and managers differ regarding the most important statement, while they share the least important statement; (3) the subgroups teachers and researchers differ regarding the most and least important statements; and, (4) the subgroups managers and researchers differ regarding the most and least important statements. Hence, on all four comparisons the differences outnumber the similarities. Therefore, on the educational dimension there is a very low level of consensus among teachers, managers and researchers.
The Group Concept Mapping findings show that, on the economical dimension, teachers and managers both perceive “increased teachers’ role complexity” as the most important statement and “cutting costs” as the least important. Researchers perceive “dramatic change of ICT’s role in education” as most important and “resulting cost reduction” as least important. Thus, (1) the three subgroups teachers, managers and researchers differ regarding the most and least important statements; (2) the subgroups teachers and managers share the most and least important statement; (3) the subgroups teachers and researchers differ regarding the most and least important statements; and, (4) the subgroups managers and researchers differ regarding the most and least important statements. Hence, on three out of four comparisons the differences outnumber the similarities. Therefore, on the economical dimension there is a moderately low level of consensus among teachers, managers and researchers.

The Strategic Consensus Mapping findings indicate that, on the educational dimension, teachers and managers perceive “identifying patterns in data” as the most important statement. Researchers perceive “identification of effective activities for the students’ learning process” as the most important. Furthermore, teachers, managers and researchers similarly perceive “insight into course progress” as least important. Thus, (1) the three subgroups teachers, managers and researchers differ regarding the most important statement, while they share the least important statement; (2) the subgroups teachers and managers share the most and least important statement; (3) the subgroups teachers and researchers differ regarding the most important statement while they share the least important statement; and, (4) the subgroups managers and researchers differ regarding the most important statement while they share the least important statement. Hence, on all four comparisons the differences outnumber the similarities on the most important statement and the similarities outnumber the differences on the least important statement. Therefore, on the educational dimension there is a very low level of consensus among teachers, managers and researchers on the most important statement but a very high level of consensus on the least important statement.

The Strategic Consensus Mapping findings indicate that, on the economical dimension, teachers perceive “insight into the quality of a course for teachers” as the most important statement, managers “course problem identification by teachers” and researchers “promise of adaptive learning”. Teachers perceive “Insight into the quality of a course for teachers” as most important and managers as least important. Researchers perceive “increased diversity of digital educational tools” as least important and teachers “insight into the course difficulties of students”. Thus, (1) the three subgroups teachers, managers and researchers differ regarding the most and least important statements; (2) the subgroups teachers and managers differ regarding the most and least important statements; (3) the subgroups teachers and researchers differ regarding the most and least important statements; and, (4) the subgroups managers and researchers differ regarding the most and least important statements. Hence, on all four comparisons the differences outnumber the similarities. Therefore, on the economical dimension there is a very low level of consensus among teachers, managers and researchers.

Both the Group Concept Mapping and the Strategic Consensus Mapping findings indicate that there is a very low level of consensus regarding the importance of the strategic LA change statements among teachers, managers and researchers on both the educational and the economical dimensions; except for the subgroups teachers and managers, who perceive the same most and least important strategic LA change statements on the economical dimension: “increased teachers’ role complexity” and “Cutting costs”, respectively. This contrasts Drachsler et al. (2014) on a subgroup level, who claim that on a group level there is consensus among Dutch LA stakeholders regarding the strategic LA change themes. It is therefore concluded that this claim indeed contains a hidden aggregation problem.
5.2 Discussion on reliability

The discussion on reliability follows the theme structure, also presented by Schaap (2014). Reliability includes demonstrating that the operations of a study – such as the data collection procedures – can be repeated, with the same results (Yin, 2003, p. 34). The data collection procedures deal with the data collection and the data analysis (Jurg, 2010, p. 109). This section covers the reliability strengths and issues of the data collection and the data analysis of the conceptualizations (5.3.1), the operationalizations (5.3.2) and the measurements (5.3.3).

5.2.1 Reliability of conceptualization

The literature review in chapter 2 deals with the “Learning Analytics” conceptualizations. This subsection discusses the reliability of the literature review; first, the reliability strengths and issues of the literature collection followed by the strengths and issues of the literature analysis.

A reliability strength regarding the literature collection is the explicit description of the publication selection. Wolfswinkel et al. (2013, p. 44) argue that literature reviews should offer clarity about how and why literature is selected. This thesis provides in the define stage of the literature review clarity about the search criteria, and in search & select stage about the selected publications.

A reliability issue concerning the literature collection is the selection of the search terms. The search term ‘Learning Analytics’ is directly derived from the thesis problem, but additional search terms are not. Furthermore, the selection of the search term ‘model’ is not well founded. Future research should take this into account.

A reliability strength of the literature analysis is its extensive description in Appendix 2. The analyze stage is systematically built up by several steps, and explicitly expresses the methods of analysis that are employed. A literature review which takes this into account is more useful to the field and also more replicable (Wolfswinkel et al., 2013, p. 44).

A reliability issue about the literature analysis is the manual search and analysis within publications. Manual searches tend to produce a higher error rate than automatic procedures. Future research should therefore apply automatic literature analysis, like the Nvivo program. This program covers text search, word frequency tables and coding functions; features, that are well suited to aid in the literature review Di Gregorio (2000, p. 2).

5.2.2 Reliability of operationalizations

The methodology (Chapter 3) deals with the operationalizations of the concepts “Group Concept Mapping” (GCM) and “Strategic Concept Mapping” (SCM). Therefore, in this subsection the reliability of the methodology is discussed; first, the reliability strengths and issues of the data analysis in GCM are discussed, then strengths and issues in SCM.

A reliability strength regarding the GCM operationalization is the use of the features available in the GCM go-zone graphs to determine the most and least important LA change themes for the three subgroups teachers, managers and researchers. The go-zone graph is able to quantify the importance ratings for these subgroups (Trochim & Kane, 2005, p. 188). These ratings are then used to determine the highest and lowest rating values, which correspond to the most and least important themes, respectively.

A reliability issue concerning the GCM operationalization is the selection of the statements used to determine the most and least important LA change themes. By selecting only the most and least important statements,
other, almost equally rated statements are omitted. In Figure 5 in chapter 3.2.1, for example, four statements have approximately the same rating value; only one statement is selected though. It is therefore suggested that future research selects the most and least important themes based on the three highest and the three lowest rated themes. However, this would complicate the manual analysis adopted in this thesis. An automatic content analysis of the statements is suggested to overcome this issue.

A reliability strength of the SCM operationalization is the use of the features available in the SCM VMU-biplot graphs to determine the most and least important themes for the three subgroups. The VMU-biplot analysis generates object scores belonging to the object points in the graph (Tarakci et al., 2014, p.1058). As each object point resembles one theme, the systematical comparison of the highest and lowest ranked object scores, applied in this investigation, yields the most and least important themes. Another reliability strength of the SCM data analysis is the use of rated data generated in the GCM. This provides for both a practical and rigid method to determine strategic priorities not available in SCM. Tarakci et al. (2014) report on earlier consensus mapping studies which relied on pre-defined and standardized lists of strategic priorities. Although rigid, these strategic priorities might not always match the context of study. Tarakci therefore used strategic priorities generated by managers, accepting a loss of rigidity in creating these strategic priorities. Further, the meanings of the two dimensions in the VMU-biplot are derived from the LA change themes containing the highest average object scores on the two dimensions. This way, a meaning of the two dimensions is generated according to the nature of the analyzed data instead of by interpretation by the researcher. A reliability strength regarding the data and its analysis is the availability of the code for generating VMU biplots; this code is presented in Appendix A10. The data and analysis are freely available to the reader which adds to the reliability strength. Researchers are encouraged to use this data for further analysis.

A reliability issue about the SCM operationalization is the selection of the statements used to determine the most and least important LA change themes. By selecting only the most and least important statements, other, almost equally rated statements are omitted. As can be seen in Figure 29-31 for example, many object points reside especially in the area where the highest object scores are found. It is therefore suggested that future research selects the most and least important themes based on more object points, for example the three highest and the three lowest scores. Again, as with the GCM analysis, this would complicate the manual analysis adopted in this thesis and an automatic content analysis of the statement is therefore suggested. Last, the determination of the meaning of the two dimensions is a new approach in SCM and thus has not been validated yet. It is therefore suggested that future research is conducted on the validation of the VMU-biplot dimensions determining the method adopted in this investigation.

5.2.3 Reliability of analysis

The findings (Chapter 4) deals with the analysis of the similarities and differences on strategic LA change themes among the subgroups teachers, managers and researchers. This subsection therefore discusses the reliability of the analysis; first, the reliability strengths and issues of the data analysis in GCM is discussed, then strengths and issues in SCM. A discussion on the chain of evidence (Yin, 2003, p. 105) closes this subsection.

A reliability strength of both the GCM and SCM data analysis is the systematic comparison of similarities and differences. Systematically comparing both similarities and differences among the subgroups yields a complete comparison among the subgroups. Moreover, important aspects are consequently marked (bold, italic, red or underlined) to improve readability and comparison. This eases the comparison between the findings of the two methods.
A reliability issue of SCM concerns the SCM data analysis. Tarakci et al. (2014, p. 1061) provide a method for quantifying among group consensus. However, this analysis, presented in Appendix A12 for the three subgroups teachers, managers and researchers, yields no significant differences. In this analysis, permutation tests are used as significance testing statistics. **Permutation tests are non-parametric significance testing statistics based on randomization** (Wood, 2005). In the case of SCM, non-parametric hypothesis testing is more suitable than parametric tests, like T-tests (Tarakci et al., 2014, p. 1061). Further research is therefore suggested on the significance of differences among the three subgroups.

Another reliability issue concerning both the GCM and SCM data analysis concerns the interpretation of the comparisons by the researchers leading to the findings. Although the findings were reviewed by experienced LA researchers (Drachsler and Stoyanov), additional reviews from LA stakeholders, especially teachers, researchers and managers, on the findings would lead to more reliable findings. It is therefore suggested that future thesis research contains systematic reviewing of its findings and conclusions.

Continuing on this last issue, a discussion at the chain of evidence closes this subsection. A **chain of evidence** refers to allowing an external observer to follow the derivation of any evidence, ranging from initial research questions to ultimate case study conclusions (Yin, 2003, p. 105). This summary of thesis is reviewed in two rounds by six reviewers. In the first round, three theme-peer group members (Luchies, Van der Zwan and Diepenbrock) and one external reviewer (Mulders) provided feedback on the summary. The second round consisted of feedback on the summary by two current theme-peer group members (Bent and Rosema). An overview of these review rounds is provided on the memory card as feedback files. General feedback is that the summary is thorough but extensive. The concept thesis was adapted on the feedback provided and the summary was reduced in length.

### 5.3 Discussion on construct validity

The discussion on construct validity follows the theme structure also presented by Schaap (2014). **Construct validity** is the establishment of correct operational measures for the concepts being studied (Yin, 2003, p. 34). Thus, this section focuses on the construct validity of the data operationalizations in chapter 3 and the data analysis in chapter 4, regarding similarities and differences among the subgroups teachers, managers and researchers on strategic LA change themes.

#### 5.3.1 Construct validity of operationalizations

This subsection discusses the construct validity of the operationalization choices that are made in chapter 3. First, the construct validity strengths and issues of GCM; then, the strengths and issues of SCM are discussed.

A construct validity strength regarding the GCM operationalizations is the method for analyzing the most and least important LA change themes for the three subgroups teachers, managers and researchers, in section 3.2.2. This analysis method shows that the highest rated themes reside in the cluster “teaching” and the lowest in cluster “managing”. As teaching resembles the educational perspective and managing the economical perspective (Drachsler et al., 2014), this indicates that the subgroups perceive the educational perspective as more important than the economical perspective. This result is in agreement with the claim of Drachsler et al. (2014) on this aspect.
Another strength regards the consensus claim of Drachsler et al. (2014), other comparisons yield similar findings as the comparison of similarities and differences among the subgroups. A comparison of the 7-cluster map of each subgroup among teachers, managers and researchers, shown in Appendix A6, reveals yet other similarities and differences among these three subgroups. For each subgroup teachers, managers and researchers all have different subgroup cluster maps, emphasizing rather the differences than the similarities among them. This is a strong indication that consensus among these subgroups is lacking.

A construct validity issue concerning the GCM operationalizations is that only the clusters teaching, managing and researching are investigated and only regarding the most and least important theme. Extending the investigation to more clusters or determining the most and least important theme based on averages, e.g. using the averages of the three highest and lowest rated scores per team, the highest rated themes could be found in different themes and thus the identification of the perspectives differs. The selection of different clusters also bears an issue: the identification of the optimum number of clusters in GCM is based on the judgment and interpretation of the analyst (Börner, Glahn, Stoyanov, Kalz, & Specht, 2010, p. 244). Determining the best fit, i.e. the optimum number of clusters for the desired study focus, depends on the level of specificity desired and the context at hand, factors that can only be judged subjectively (Jackson & Trochim, 2002, p. 316). This implies that there is no sensible mathematical criterion that can be used to select the number of clusters. It is therefore suggested that other methods should support the cluster selection phase in the GCM method. Systems constellations is one of these methods. It can aid the selection of the best number of clusters for a research problem by visualizing the researchers’ subconscious knowledge of this problem (Jurg, 2010).

Another issue refers to the comparison of similarities and differences among subgroups. In this investigation, the rating data of the GCM study was used to investigate similarities and differences among subgroups. The individually compared statements in this analysis originate from GCM go-zone graphs (Trochim & Kane, 2005, p. 190). With these graphs, statements within a cluster can be compared and, as applied in this investigation, between clusters. However, other comparisons of similarities and differences among subgroups comparing individual statements show different findings. Appendix A8 presents a new analysis which compares statements between clusters. In particular, statements on the boundary of clusters are of interest to the relationships between clusters. This is a direct consequence of the positional dependence of individual points within a MDS point map, as the distance between two points is a measure for their similarity: points close to each other are very similar, whereas points far away from each other are very dissimilar. Thus, two statements close to each other are very similar, whereas statements far away from each other are very dissimilar. The novel idea is that statements on the boundaries of two nearby clusters are a good indication of how to overcome, i.e. bridge, the differences between these clusters on the statement level. This idea is derived from the Bridging Cluster (Drachsler et al., 2014, p. 161; Jackson & Trochim, 2002, p. 328), a cluster in between two other clusters that indicates how to bridge the differences between these two clusters on the cluster level. Thus, statements on the boundary of the clusters ‘teaching’, ‘managing, and ‘researching’ are compared in Appendix A8, because those clusters are representative for the three stakeholders under investigation. This comparison yields different similarities and differences among teachers, managers and researchers.

In addition, this investigation has focused on similarities and differences among the subgroups teachers, managers and researchers. In the definition of LA adopted in this thesis however (Siemens, 2013), there is also a clear role for the student. This role is confirmed in the theoretical literature review; recent LA frameworks (Chatti et al., 2012, p. 324; Greller & Drachsler, 2012, p. 44) confirm the student as a major stakeholder. Thus, an evident stakeholder has been omitted in this investigation. Also taking the student into account as LA stakeholder, would generate different sets of strategic LA Change themes and subsequent analysis.
Regarding the three subgroups, four participants were characterized as both teachers and researchers. Thus, in the analysis, these participants are included in the analysis for teachers and researchers. However, an analysis excluding these four participants is not conducted. Such an analysis would have provided insight into the effect of the inclusion through an analysis of the differences between inclusion and exclusion. It is therefore suggested that future research takes this comparison into account.

A construct validity strength of the SCM operationalizations is the method for determining the meaning of the two VMU biplot dimensions from the coordinates of the objects, in section 3.3.4. This analysis method shows that on the importance dimension of LA change themes, dimension one represents the educational perspective and dimension two the economical perspective.

A construct validity issue about the SCM operationalizations is that the previously described method does not hold for the feasibility dimension of LA change themes, as is shown in Appendix A11.1. Teachers and researchers perceive dimension 2 also as the educational dimension, instead of the economical. It is suggested here that the subgroups teachers and researchers, contrary to managers, lack focus on and experience in the economic field. They may therefore be unable to make valid estimations of the economic feasibility of LA change perceptions, and therefore perceive ‘teaching’ as the most feasible. Further research on the identification of the two VMU-biplot dimensions applying this method is therefore suggested.

5.3.2 Construct validity of analysis

This subsection discusses the construct validity of the analysis choices that are made in chapter. The construct validity strengths and issues of GCM and SCM are discussed.

A construct validity strength of both the GCM and SCM data analysis is the systematical comparison of similarities and differences. Systematically comparing both similarities and differences between the subgroups yields a complete comparison between the subgroups. Moreover, important aspects are consequently marked (bold, italic, red or underlined) to improve readability and comparison. This eases the comparison between the findings of the two methods.

A construct validity issue of both the GCM and SCM data analysis concerns the interpretation of the comparisons by the researchers leading to the findings. Application of automatic content analysis on the clusters teaching, managing and researching or on the statements within these clusters yields different results. An analysis employing the Linguistic Inquiry and Word Count (LIWC) is presented here as an example. The computer program LIWC is developed in the U.S. to analyze written or spoken text (Pennebaker, Francis, & Booth, 2001, p. 1). LIWC counts words in 66 psychologically meaningful categories (Tausczik & Pennebaker, 2010, p. 24) divided over five dimensions. Tausczik & Pennebaker (2010, p. 33) argue that increased use of assents (e.g., agree, OK, yes) could signal increased group consensus and agreement. Leshed et al. (2007, p. 217) additionally argue that consensus leads to fewer self-pronouns and cognitive process terms. An LIWC analysis, presented in Appendix A14, shows differences among the three subgroups. This indicates a lack of consensus.

A final remark on the construct validity of the GCM and SCM data analysis concerns the differences noticed in the findings of the two studies. Further research should be conducted, both theoretical and quantitative, to address and validate these observed differences.
5.4 Discussion on relevance

In this section, the relevance of the conclusions of the thesis is discussed. Relevance refers to the fit of the produced knowledge with the knowledge need from the literature (De Leeuw, 2005, p. 23).31

In this investigation, SCM was used to quantify observed consensus differences in the GCM study, adding a new and promising analysis to the GCM methodology. It helps further understanding of phenomena encountered in the GCM and, even more important, generates the possibility to quantify implementation success of a LA tool, as SCM can be applied before and after an implementation (Tarakci et al., 2014, p. 1066).

GCM, in its turn, can be of value for SCM as well. Tarakci (2014, p. 1059) reported on earlier consensus mapping studies which relied on pre-defined and standardized lists of strategic priorities. Although rigid, these strategic priorities might not always match the context of study. Strategic priorities generated by managers were used instead, accepting a loss of rigidity in creating these strategic priorities. GCM are proposed here as a third method for determining the strategic priorities, allowing both rigid and Discussion on practical relevance

This investigation has revealed strategic LA change themes which are perceived as very important by teachers, managers and researchers. This knowledge can act as a focus for future LA research and as a guide the implementation of LA outcomes in Dutch higher education. This will help teachers, managers and researchers to recognize the added value of LA for their education.

5.5 Recommendations

This section presents the theoretical recommendations (5.5.1) and practical recommendations (5.5.2).

5.5.1 Theoretical recommendations

This investigation compares the importance aspect of consensus among teachers, managers and researchers regarding the strategic LA change themes on the educational and economical dimensions. The feasibility aspect of consensus among these subgroups regarding these themes is not part of this investigation. To further extend the pioneering work of Drachsler et al. (2014), it is therefore suggested that future research also investigates the feasibility aspect, applying GCM and SCM in line with this investigation.

Further, as this investigation resembles a qualitative research, each statement presented in the conclusions should be theoretically validated. However, this investigation does not do this but focusses on a discussion on reliability, validity and relevance. It is therefore suggested that future research should theoretically validate the statements presented in the conclusions.

When analyzing how different stakeholder groups perceive aspects of a topic, the overall GCM cluster solution depends heavily on the number of participants in each of these groups, as is shown in Appendix A6. In particular, as teachers covered approximately 70% of the population, the overall cluster solution resembled the cluster solution of the teacher group. It is therefore suggested that in the case of comparing different stakeholder groups, their sizes should be approximately equal.

As stated before, there is no sensible mathematical criterion that can be used to select the number of clusters in the GCM study. Other methods should therefore support the objectivation of the interpretation phase in the GCM method. Systems constellations is one of these methods. It can aid the selection of the best number of clusters for a research problem by visualizing the researchers’ subconscious knowledge of this problem (Jurg, 2010).
This investigation has also shown how SCM has complementary value to GCM by providing a method to analyze and quantify consensus among subgroups, not available yet in this methodology. Further research on jointly applying GCM and SCM is therefore suggested. The joint application of GCM and SCM is in this investigation is conducted in a single case in the Dutch Higher Education. To add to its rigidity, additional research applying both GCM and SCM should be compared to the findings in this investigation. The joint application of GCM and SCM also has potential in cases outside of the field of LA. In particular, it could be of use in the case of ICT implementation projects, which tend to have a high failure rate (Wopereis et al., 2005, p. 683). Insight into similarities and differences among stakeholders can add to the success of these implementation projects, thus decreasing their failure rate.

In addition, the application of strategic themes generated through GCM as base for the SCM analysis can provide a more robust method for determining stakeholders’ strategic priorities, which is highly needed according to (Tarakci et al., 2014, p. 1059). Earlier consensus mapping studies relied on pre-defined and standardized lists of strategic priorities. Although rigid, these strategic priorities might not always match the context of study. Strategic priorities of managers were used instead, accepting a loss of rigidity in creating these strategic priorities. GCM are proposed here as a third method for determining the strategic priorities, allowing both rigid and contextual sound strategic priorities. Future SCM studies using GCM for defining the strategic priorities are suggested for further research.

5.5.2 Practical recommendations

This investigation focuses on recommendations for the subgroup researchers. Their perceptions differ from those of teachers and managers on two important themes: (1) on the educational dimension, while researchers focus on identification of specific LA outcomes, like identifying effective activities for the students’ learning process, teachers and managers focus on general LA outcomes; (2) on the economical dimension, while researchers consider the importance of ICT in education in general, teachers and managers regard the importance of ICT for the teacher’s work specifically. Thus, researchers should realize the differences between themselves and the practitioners in order to successfully bridge the theory practice gap. It is suggested that researchers connect their LA expertise to practice, as Siemens (2012, p. 7) suggests. In particular, researchers need to connect the educational and the economical perspectives by addressing the differences teachers and managers show on these aspects, especially regarding application of LA to provide insight into educational quality. Further, they need to make more clear how adaptive learning can be of value to educational change from both the educational and the economical perspectives.

When designing and implementing LA tools, researchers can use GCM and SCM to design LA tools that will appeal to both teachers and managers, thus building a consensus on LA change themes. This aids the successful implementation of LA in everyday practice because it appeals to the LA needs of both stakeholders. Besides this, SCM provides an opportunity to quantify the level of consensus before and after the implementation of the LA tool, enabling the possibility to determine whether the implementation has been successful or not.
Table 19 summarizes the very important strategic LA change statements for the subgroups on the educational and economical dimension.

### Table 19 Very important strategic LA change statements for subgroups on educational and economical dimensions

<table>
<thead>
<tr>
<th>#</th>
<th>Dimensions</th>
<th>Stakeholders</th>
<th>Very important strategic LA change statement</th>
</tr>
</thead>
</table>
| 1 | Educational | Teachers | Effectiveness of learning content and assessments  
Identifying patterns in data |
| 2 | Managers | | Student progress tracking  
Identifying patterns in data |
| 3 | Researchers | | Adaptive learning  
Identification of effective activities for the students’ learning process |
| 4 | Economical | Teachers | Increased teachers’ role complexity  
Insight into the quality of a course for teachers |
| 5 | Managers | | Increased teachers’ role complexity  
Course problem identification by teachers |
| 6 | Researchers | | Dramatic change of ICT’s role in education  
Promise of adaptive learning. |

Learning Analytics is about the empowerment of educational organizations and their stakeholders, and through these, education itself. Its potential as a driver for educational change is clear (Siemens, 2013, p. 1395), but its success is unclear if LA research is unable to bridge the research-practice gap, manifested in the disconnection between the educational stance and the economical view on LA. This study provides a road ahead, empowering LA researchers to be where they should be: at the heart of educational change where East meets West.
References


Tables and Figures

Tables

TABLE 1 DEFINE STAGE STEPS AND CRITERIA OF THE LITERATURE REVIEW ........................................... 5
TABLE 2 PUBLICATIONS, TITLES, PUBLICATION TYPES, IMPACT FACTORS AND EXPLANATIONS .......... 6
TABLE 3 CONCEPTUALIZATIONS OF LEARNING ANALYTICS ........................................................................ 7
TABLE 4: METHODOLOGICAL LITERATURE REVIEW ON LEARNING ANALYTICS .......................................................... 7
TABLE 5 CLAIMS BY DRACHSLER ET AL. (2014) ON THE IMPORTANCE OF STRATEGIC LA CHANGE THEMES .......................................................... 8
TABLE 6 SUMMARY OF INTEGRATIVE LITERATURE REVIEW ON LEARNING ANALYTICS ....................... 8
TABLE 9 HIGHEST AND LOWEST COORDINATE VALUES ON IMPORTANCE OF LA CHANGE THEMES ‘MANAGING’, ‘RESEARCHING’ AND ‘TEACHING’ FOR THE SUBGROUPS TEACHERS, MANAGERS AND RESEARCHERS ............................................................................................................. 13
TABLE 10 HIGHEST AND LOWEST SCORED STATEMENTS BY TEACHERS, MANAGERS AND RESEARCHERS ................................................................................................................................. 14
TABLE 11: AVERAGE OBJECT SCORES FOR CLUSTERS ‘MANAGING’, ‘RESEARCHING’ AND ‘TEACHING’ ON IMPORTANCE OF STRATEGIC LA CHANGE THEMES FOR TEACHERS, MANAGERS AND RESEARCHERS ON DIMENSIONS 1 AND 2 ............................................................................................................. 17
TABLE 12 GROUP CONCEPT MAPPING SIMILARITIES AND DIFFERENCES AMONG SUBGROUPS ON EDUCATIONAL DIMENSION .......................................................................................................................... 21
TABLE 13 GROUP CONCEPT MAPPING SIMILARITIES AND DIFFERENCES AMONG SUBGROUPS ON ECONOMICAL DIMENSION ..................................................................................................................... 21
TABLE 14 SCM SIMILARITIES AND DIFFERENCES AMONG SUBGROUPS ON EDUCATIONAL DIMENSION. 23
TABLE 15 SIMILARITIES FINDINGS FROM GCM AND SCM AMONG SUBGROUPS ON EDUCATIONAL DIMENSION .......................................................................................................................... 24
TABLE 16 DIFFERENCES FINDINGS FROM GCM AND SCM AMONG SUBGROUPS ON EDUCATIONAL DIMENSION .......................................................................................................................... 25
TABLE 17 SIMILARITIES FINDINGS FROM GCM AND SCM AMONG SUBGROUPS ON ECONOMICAL DIMENSION .......................................................................................................................... 25
TABLE 18 DIFFERENCES FINDINGS FROM GCM AND SCM AMONG SUBGROUPS ON ECONOMICAL DIMENSION

TABLE 19 VERY IMPORTANT STRATEGIC LA CHANGE STATEMENTS FOR SUBGROUPS ON EDUCATIONAL AND ECONOMICAL DIMENSIONS

Figures

FIGURE 1 CLUSTER MAP OF RELATED STRATEGIC CHANGE STATEMENTS ON LEARNING ANALYTICS (DRACHSLER, STOYANOV, & SPECHT, 2014, P. 160)

FIGURE 2 CLUSTER MAP OF RELATED STRATEGIC LA CHANGE STATEMENTS ON LEARNING ANALYTICS (DRACHSLER ET AL., 2014)

FIGURE 3 CLUSTER MAP OF RELATED LA CHANGE STATEMENTS ON LEARNING ANALYTICS (DRACHSLER ET AL., 2014, P. 160)

FIGURE 4 GO-ZONE DIAGRAM (TROCHIM & KANE, 2005, P. 188)

FIGURE 5 VMU BIPLOT ON IMPORTANCE OF LA CHANGE STATEMENTS FOR TEACHERS

FIGURE 6 VMU BIPLOTS ON IMPORTANCE OF LA CHANGE STATEMENTS FOR SUBGROUPS TEACHERS, MANAGERS AND RESEARCHERS

FIGURE 7 VMU BIPLOTS ON IMPORTANCE OF LA CHANGE STATEMENTS FOR SUBGROUPS TEACHERS, MANAGERS AND RESEARCHERS
Content memory card

This thesis is accompanied by a memory card labeled “East versus West”. It contains the following sources:

   1.1 Thesis
   1.2 Appendices
   1.3 References
   1.4 Feedback documents
2. Data
   2.1 Raw data from Drachsler et al. (2014)
   2.2 GCM statement analysis
   2.3 SCM statement analysis
3. Miscellaneous
   3.1 Randomization software (Wood, 2005)
   3.2 Recorded video of Systems Constellation (2013-11-08)
Endnotes

1 To improve the readability of the figure, the original figure in Drachsler, Stoyanov, & Specht (2014) has been adapted so the cluster labels fit within the corresponding clusters.

2 Siemens (2012, p. 5) uses the word ‘research’. However, the word ‘theory’ fits the context of this investigation better.

3 Drachsler et al. (2014, p. 2) mention 39 participants in their study. This number refers to the participants who finished the sorting phase. These participants have either a managing (13), researching (6) of teaching role (16) in education or an equal role in both researching and teaching (4). However, the number of participants finishing the rating phase were 36 (importance) and 34 (feasibility). As this investigation uses the data from Drachsler’s importance rating phase, the number of participants analyzed here is 36. Of these, 13 were classified as manager, 9 as researcher and 19 as teacher, treating the 4 participants with an equal role in both researching and teaching as both researcher and teacher. Thus, the total sample here is 41.

4 To improve the readability of the figure, the original figure in Drachsler et al. (2014) has been adapted so the cluster labels fit within the corresponding clusters.

5 Drachsler et al. (2014, p. 162): “We can see this result as an indication for a consensus between different participants involved in the LA community in the Netherlands. The community seems to highly agree on topics that are of importance to change the educational system with LA.”

6 Phenomena at the aggregate level or mean effects are often crucial for policy recommendations. However, for explaining and understanding a phenomenon in the aggregate, it is important to link them to patterns on the individual level (Baetschmann, 2014, p. 398).

7 Markóczy (2001, p. 1022) implicitly identifies both similarities and differences between groups when defining the level of consensus between these groups. However, similarities and differences are not explicated. The original text in Markóczy (2001, p. 1022) is: “The distance between causal maps was measured as a number between 0 and 1 inclusive, where 0 indicates identical maps and 1 total dissimilarity. The primary measure for degree of consensus for any group was the average distance (and standard deviation) between all pairs of CMs from that group. The greater the average distance between CMs, the smaller the level of consensus between the people the CMs were elicited from, and the smaller the average distance the greater the consensus level.”

8 The definition used by Drachsler et al. (2014, p. 158) is in line with the most commonly cited definition of Learning Analytics: Learning Analytics covers the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs (SoLAR, 2014).

9 Siemens (2012, p. 5) uses the word ‘research’. However, the word ‘theory’ fits the context of this investigation better.

10 Drachsler et al. (2014, p. 159) mention 39 participants in their study. This number refers to the participants who finished the sorting phase. These participants have either a managing (13), researching (6) of teaching role (16) in education or an equal role in both researching and teaching (4). However, the number of participants finishing the rating phase were 36 (importance) and 34 (feasibility). As this investigation uses the data from Drachsler’s importance rating phase, the number of participants analyzed here is 36. Of these, 13 were classified as manager, 9 as researcher and 19 as teacher, treating the 4 participants with an equal role in both researching and teaching as both researcher and teacher. Thus, the total sample here is 41.

11 To improve the readability of the figure, the original figure in Drachsler et al. (2014) has been adapted so the cluster labels fit within the corresponding clusters.

12 Drachsler et al. (2014): “We can see this result as an indication for a consensus between different participants involved in the LA community in the Netherlands. The community seems to highly agree on topics that are of importance to change the educational system with LA.”
Greller & Drachsler (2012, p. 44) use the four stakeholders 1) Institutions, 2) Teachers, 3) Learners and 4) Service providers. Within educational organizations, these four stakeholders refer to 1) Managers, 2) Teachers, 3) Students and 4) Researchers.

Phenomena at the aggregate level or mean effects are often crucial for policy recommendations. However, for explaining and understanding a phenomenon in the aggregate, it is important to link them to patterns on the individual level (Baetschmann, 2014, p. 398).

Markóczy (2001, p. 1022) implicitly identifies both similarities and differences between groups when defining the level of consensus between these groups. However, similarities and differences are not explicated. The original text in Markóczy (2001, p. 1022) is: “The distance between causal maps was measured as a number between 0 and 1 inclusive, where 0 indicates identical maps and 1 total dissimilarity. The primary measure for degree of consensus for any group was the average distance (and standard deviation) between all pairs of CMs from that group. The greater the average distance between CMs, the smaller the level of consensus between the people the CMs were elicited from, and the smaller the average distance the greater the consensus level.”

Acknowledgments: this thesis follows the OD-MP theme’s standard methodology for a systematic literature review (Jurg, 2014), also applied by Schaap (2014).

Markóczy (2001, p. 1022) implicitly identifies both similarities and differences between groups when defining the level of consensus between these groups. However, similarities and differences are not explicated. The original text in Markóczy (2001, p. 1022) is: “The distance between causal maps was measured as a number between 0 and 1 inclusive, where 0 indicates identical maps and 1 total dissimilarity. The primary measure for degree of consensus for any group was the average distance (and standard deviation) between all pairs of CMs from that group. The greater the average distance between CMs, the smaller the level of consensus between the people the CMs were elicited from, and the smaller the average distance the greater the consensus level.”

Importance and feasibility are two common rating parameters (Rosas & Kane, 2012, p. 243)

Concept System Global: http://www.conceptsystemsglobal.com

The ‘go-zone’ graph is a bivariate plot of two patterns of ratings at the statement level. The bivariate space is divided into quadrants based on the average x and y values. For example, when comparing an importance and feasibility rating of the statements, the go-zone is the quadrant showing the statements simultaneously rated above average in both importance and feasibility. While pattern matching is especially useful for high-level pattern assessment, go-zones are particularly valuable for detailed use of the maps for planning or evaluation at the statement level (Trochim & Kane, 2005, p. 188).

Concept System Global: http://www.conceptsystemsglobal.com

Borg & Groenen (2005) define a VMU biplot as a graphical representation of ordered or ranked data based on the ‘Vector Model of Unfolding’. In this investigation, rated is used instead, because it fits to the rating phase.

Greenacre (2012, p. 403): in a regular biplot the axes are defined by (linear) combinations of all the variables

Markóczy (2001, p. 1022) implicitly identifies both similarities and differences between groups when defining the level of consensus between these groups. However, similarities and differences are not explicated. The original text in Markóczy (2001, p. 1022) is: “The distance between causal maps was measured as a number between 0 and 1 inclusive, where 0 indicates identical maps and 1 total dissimilarity. The primary measure for degree of consensus for any group was the average distance (and standard deviation) between all pairs of CMs from that group. The greater the average distance between CMs, the smaller the level of consensus between the people the CMs were elicited from, and the smaller the average distance the greater the consensus level.”

http://www.qsrinternational.com/products_nvivo.aspx