

Advances in Analytics for Learning and Teaching

Series Editors

Dirk Ifenthaler, Learning, Design and Technology, University of Mannheim,
Mannheim, Baden-Württemberg, Germany

David Gibson, Teaching and Learning, Curtin University, Bentley, WA, Australia

This book series highlights the latest developments of analytics for learning and teaching as well as providing an arena for the further development of this rapidly developing field.

It provides insight into the emerging paradigms, frameworks, methods, and processes of managing change to better facilitate organizational transformation toward implementation of educational data mining and learning analytics. The series accepts monographs and edited volumes focusing on the above-mentioned scope, and covers a number of subjects. Titles in the series *Advances in Analytics for Learning and Teaching* look at education from K-12 through higher education, as well as vocational, business, and health education. The series also is interested in teaching, learning, and instructional design and organization as well as data analytics and technology adoption.

More information about this series at <http://www.springer.com/series/16338>

Srinivasa K G • Muralidhar Kurni

A Beginner's Guide to Learning Analytics

 Springer

Srinivasa K G
National Institute of Technical Teachers
Training and Research
Chandigarh, India

Muralidhar Kurni
Anantha Lakshmi Institute of Technology
and Sciences
Ananthapuram, India

ISSN 2662-2122

ISSN 2662-2130 (electronic)

Advances in Analytics for Learning and Teaching

ISBN 978-3-030-70257-1

ISBN 978-3-030-70258-8 (eBook)

<https://doi.org/10.1007/978-3-030-70258-8>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2021

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

Generally speaking, learning analytics refers to the collection and analysis of learner data and their environments to understand and improve learning outcomes. The most cited definition of *learning analytics* comes from the very first Learning Analytics and Knowledge Conference in 2011, where George Siemens and colleagues defined learning analytics as: “*the measurement, collection, analysis and reporting of data for learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs.*”

A key turning point in the field was imperative to concentrate learning analytics on learning as a core element in its use and application. Since then, more has been done in research and practice in learning and teaching, improved our understanding of the student learning methods and performances, the effect and redesign of design in terms of learning, research, and implementation methodologies.

Learning analytics is where big data in education meets conventional quantitative approaches. Governments, colleges, testing organizations, and MOOC providers capture student data and their learning. However, until recently, when the methods and tools were built, all these data were largely unused. Many of the current data are not available in well-ordered, tidy, and collected formats. It occurs in various forms across networks and places. Analysts need the opportunity to access and process these data now, so we can better understand what students know and how they know it. Translating these data into information and eventually contributing to a better education are learning analytics and educational data mining.

The emphasis on “*understanding and optimizing learning*” where learning analytics departs from the educational data mining and more data-driven practice, a methodology with more important relations with learning theory, the learning design, and a more empirical, evidence-informed practice. A vital, ethical mindset is central to this process of integrating data into teaching and learning practice.

The book, *A Beginner’s Guide to Learning Analytics*, is the culmination of decades of experience written by expert thought leaders to help educational institutions develop the culture of sustainable measurement and data-informed decision-making.

Organization of the Book

Chapter 1 provides an overview of learning analytics' evolving field, followed by a short overview of learning analytics' benefits and drawbacks. This chapter also discusses the various ethical and privacy problems involved.

Chapter 2 explores the connection between the two classes, namely LA and EDM. This chapter explores further the improved and official cooperation and collaboration between these two groups to share techniques, research, knowledge mining, and analytical tools to develop EDM and LA areas.

Chapter 3 focuses primarily on how organizations should prepare for learning analytics. How can they organize themselves to advance learning analytics and see the sustainable impacts of learning analytics across traditional services?

Chapter 4 presents and analyzes various data and data usage formats in the learning analytics context to select the best data model for use. This chapter also provides a report on data privacy problems in the learning analytics functions.

Chapter 5 is intended to provide an overview of popular learning analytics tools, including the criteria for selecting the appropriate tool and strategies to effectively develop a learning analytics tool. Eventually, this chapter also presents case studies on learning analytics tools in various educational institutions.

Chapter 6 presents various technologies, viz. big data analytics, data science, AI, ML, and DL, and how can these techniques be used to expand educational system capabilities. This chapter highlights how each technology advances learning analytics' capabilities for reforming higher education practices and helping instructors improve teaching and learning.

Chapter 7 focuses on integrating learning analytics into Massive Open Online Courses (MOOCs), addresses the major challenges of this integration, and examines its potential benefits and limitations.

Chapter 8 highlights the value of pedagogical systems focused on learning analytics and pedagogical intervention design for students to use learning analytics.

Chapter 9 adds remarkable contributions to learning analytics' research by furnishing a substantial and forward-looking view of learning analytics and its related developments and provides a promising path for the twenty-first century in this emerging field.

Chapter 10 explores the usage of learning analytics as recommender systems and in higher education. Additionally, it provides evidence for the use of learning analytics at various educational institutions.

Chapter 11 provides some practice problems to enhance your knowledge and further understand the concepts guided by this book.

The book is well researched and written comprehensively and compellingly, making this book a must-read for all learners, professionals, and teachers. It serves as a practical guide to sound learning analytics practice based on technology and real-world success stories.

Key Features of the Book:

- Clearly provides a basic understanding of the evolving field of learning analytics.
- Provides excellent content on establishing and maintaining learning analytics alignment with various emerging technologies, viz. big data analytics, data science, artificial intelligence, machine learning, and deep learning.
- Gives practical advice for building a solid foundation for your measurement strategy by providing an overview of popular learning analytics tools.
- Analyses various data and data usage formats to ensure that you use the data you gather to improve learning outcomes.
- The content applies not only to readers but also to trainers and practitioners who want to build analytics capability beyond learning, too.

This book is really intended for readers who have no prior knowledge in learning analytics. The book functions as an introductory text to learning analytics for those who want to do more with evaluation/assessment in their organizations. It is useful to all who need to evaluate their learning and teaching strategies. It covers the key concepts linked to learning analytics for researchers and practitioners interested in learning analytics. This book helps those who want to apply analytics to learning and development programs. This book helps educational institutions to identify learners who require support and provide a more personalized learning experience.

Chandigarh, India

Srinivasa K. G.

Ananthapuram, India

Muralidhar Kurni

Acknowledgements

Srinivasa would like to thank Prof. S S Pattnaik, Director, NITTTR Chandigarh, for his kind encouragement for publishing this book. He also would like to thank Prof. Maitryee Dutta, Prof. S S Gill, Prof. C Rama Krishna, and all other faculty members of NITTTR, Chandigarh, for their whole hearted support for publishing this book.

Muralidhar would like to thank the following for all their advice during manuscript preparation: Dr. K. Saritha, P. Sanjeevamma, K. Manushri, Ilayaraja, Thanooj, and K. Somasena Reddy.

Contents

1	Introduction to Learning Analytics	1
1.1	Introduction to Learning Analytics	1
1.2	Learning Analytics: A New and Rapidly Developing Field.	8
1.3	Benefits and Challenges of Learning Analytics	11
1.4	Ethical Concerns with Learning Analytics	18
1.5	Use of Learning Analytics	20
1.6	Conclusion	25
1.7	Review Questions.	26
	References.	26
2	Educational Data Mining & Learning Analytics	29
2.1	Introduction	29
2.2	Educational Data Mining (EDM).	30
2.3	Educational Data Mining & Learning Analytics	36
2.4	Educational Data Mining & Learning Analytics Applications	42
2.5	Conclusion	56
2.6	Review Questions.	57
	References.	57
3	Preparing for Learning Analytics	61
3.1	Introduction	61
3.2	Role of Psychology in Learning Analytics	62
3.3	Architecting the Learning Analytics Environment	64
3.4	Major Barriers to Adopting Learning Analytics	76
3.5	Case Studies: Adopting/Implementing Learning Analytics at Institutions	82
3.6	Conclusion	90
3.7	Review Questions.	90
	References.	90

4	Data Requirements for Learning Analytics	93
4.1	Introduction	93
4.2	Types of Data Used for Learning Analytics.....	94
4.3	Data Models Used to Represent Usage Data for Learning Analytics	100
4.4	Data Privacy Maintenance in Learning Analytics	108
4.5	Case Studies.....	114
4.6	Conclusion.....	118
4.7	Review Questions.....	119
	References.....	119
5	Tools for Learning Analytics	121
5.1	Introduction	121
5.2	Popular Learning Analytics Tools	122
5.3	Choosing a Tool.....	126
5.4	Strategies to Successfully Deploy a Tool.....	130
5.5	Exploring Learning Analytics Tools	135
5.6	Case Study: Initiation of Learning Analytics Tools Usage at Various Institutions/Organizations	135
5.7	Developing a Learning Analytics Tool.....	155
5.8	Conclusion.....	158
5.9	Review Questions.....	159
	References.....	159
6	Other Technology Approaches to Learning Analytics	161
6.1	Introduction	161
6.2	Big Data & Learning Analytics	179
6.3	Data Science & Learning Analytics.....	188
6.4	AI & Learning Analytics	192
6.5	Machine Learning & Learning Analytics	196
6.6	Deep Learning & Learning Analytics	197
6.7	Case Studies.....	197
6.8	Conclusion.....	199
6.9	Review Questions.....	199
	References.....	199
7	Learning Analytics in Massive Open Online Courses	203
7.1	Introduction to MOOCs.....	203
7.2	From MOOCs to Learning Analytics.....	211
7.3	Integrating Learning Analytics with MOOCs	214
7.4	Benefits of Applying Learning Analytics in MOOCs	220
7.5	Major Concerns of Implementing Learning Analytics in MOOCs	222
7.6	Limitation of Applying Learning Analytics in MOOCs	223
7.7	Tools that Support Learning Analytics in MOOCs	224

7.8	Cast Study: Online Learners and their Persistence Within Online Courses Offered on the Coursera Platform	225
7.9	Conclusion	227
7.10	Review Questions.	227
	References.	228
8	The Pedagogical Perspective of Learning Analytics	231
8.1	Introduction to Pedagogy.	231
8.2	Learning Analytics Based Pedagogical Framework	240
8.3	Pedagogical Interventions	243
8.4	A Preliminary Model of Pedagogical Learning Analytics Intervention Design	252
8.5	Case Study: Newman University Birmingham’s ‘Collaborative Development of Pedagogic Interventions Based on Learning Analytics’.	253
8.6	Conclusion	258
8.7	Review Questions.	258
	References.	258
9	Moving Forward	261
9.1	Self-Learning and Learning Analytics.	261
9.2	Life-Long Learning and Learning Analytics	265
9.3	Present and Future Trends of Learning Analytics in the World.	269
9.4	Measuring Twenty-First Century Skills Using Learning Analytics	273
9.5	Moving Forward	274
9.6	Smart Learning Analytics (Smart LA).	275
9.7	Case Study. Learning Analytics to Support Self-Regulated Learning in Asynchronous Online Courses: A Case Study at a women’s University in South Korea	279
9.8	Conclusion	281
9.9	Review Questions.	281
	References.	282
10	Case Studies.	285
10.1	Recommender Systems Using Learning Analytics	285
10.2	Learning Analytics in Higher Education	289
10.3	Other Evidence on the Use of Learning Analytics.	304
10.4	Conclusion	316
10.5	Review Questions.	316
	References.	317
11	Problems	319