Intelligent Textbooks

Sergey Sosnovsky[1], Peter Brusilovsky[2], Andrew S. Lan[3], Richard G. Baraniuk [4]

[1] Utrecht University, Princetonplein 5, Utrecht 3584 CC, the Netherlands
s.a.sosnovsky@uu.nl
[2] University of Pittsburgh, 135 North Bellefield Ave., Pittsburgh, PA. 15260, USA
peterb@pitt.edu
[3] University of Massachutsetts Amherst, 140 Governors Dr., Amherst, MA 01003, USA
andrewlan@cs.umass.edu
[4] Rice University, 6100 Main Street, Houston, TX 77005, USA
richb@rice.edu

Textbooks remain one of the main methods of instruction, but – just like other educational tools – they have been evolving over the last several decades in many aspects (how they are created, published, formatted, accessed, and maintained). Most textbooks these days have digital versions and can be accessed online. Plenty of textbooks (and similar instructional texts, such as tutorials) are freely available as open educational resources (OERs). Many commercial textbooks come with libraries of supplementary educational resources or even distributed as parts of online educational services built on top of them. The transition of textbooks from printed copies to digital and online formats has facilitated numerous attempts to enrich them with various kinds of interactive functionalities including search and annotation, interactive content modules, automated assessments and more.

As a result of these enrichments, new research challenges and opportunities emerge that call for the application of *artificial intelligence* (AI) methods to enhance digital textbooks and learners' interaction with them. Intelligent digital textbooks have the potential to significantly enhance the online learning experience, the importance of which is highlighted by the COVID-19 pandemic. There are many research questions associated with this new area of research; examples include:

- How can one facilitate the access to textbooks and improve the reading process?
- How can one process textbook content to infer knowledge underlying the text and use it to improve learning support?
- How can one process increasingly more detailed logs of students interacting with digital textbooks and extract insights on learning?
- How can one find and retrieve relevant content "in the wild", i.e., on the web, that can enrich the textbooks?
- How can one better understand both textbooks and student behaviors as they learn within the textbook and create personalized learner experiences?

Our workshop series seeks research contributions addressing these and other research questions related to the idea of intelligent textbooks. While the pioneer work on various kinds of intelligent textbook technologies has already begun, research in this area is still rare and spread over several different fields, including AI, human-computer

interaction, information retrieval, intelligent tutoring systems, and user modeling. We hope that this workshop brings together researchers working on different aspects of intelligent textbook technologies in these fields and beyond to establish intelligent textbooks as a new, interdisciplinary research field.

The 2021 version of the workshop will build upon the success of the 1st and 2nd workshops on Intelligent Textbooks that we organized in conjunction with AIED'2019 in Chicago and AIED'2020 online. We intend to further develop this series. Therefore, we aim at gathering researchers from a wide range of communities that are interested in all aspects of intelligent textbooks. The 2021 workshop themes include but are not limited to:

a) Modelling and representation of textbooks: examining the prerequisite and semantic structure of textbooks to enhance their readability;
b) Analysis and mining of textbook usage logs: analyzing the patterns of learners' use of textbooks to obtain insights on learning and the pedagogical value of textbook content;
c) Collaborative technologies: building and deploying social components of digital textbooks that enable learners to interact with not only content but other learners;
d) Generation, manipulation, and presentation: exploring and testing different formats and forms of textbook content to find the most effective means of presenting different knowledge;
e) Assessment and personalization: developing methods that can generate assessments and enhance textbooks with adaptive support to meet the needs of every learner using the textbook;
f) Content curation and enrichment: sorting through external resources on the web and finding the relevant resources to augment the textbook and provide additional information for learners.

While we did not receive submissions addressing all of these topics, the number of submitted papers was sufficiently large and the diversity of topics was more than enough to represent the emerging field as a whole. After a thorough reviewing, where each submission was reviewed by two to four members of the reviewing committee, which included workshop organizers and PC members, we selected seven papers for long presentation and two papers for the short presentations. Additionally, we selected four papers for interactive demo presentations at the workshop. In the workshop program, we combined the papers (not including the demos) into three sessions.

Overall, the focus of the workshop was slightly different from the previous year. The program of the 2019 workshop focused more on such HCI issues as adaptation, and interactivity. The program of the 2020 workshop focused more on (semi)automated analysis of textbook content and structure, extraction of knowledge, and integration of textbooks with other educational systems. This year, the presented papers and demos covered a broad range of topics related to intelligent textbooks - from approaches to construct intelligent textbooks to studies based on data collected from modern textbook platforms. The most popular group of topics this year was related to "smart"

use of textbook content to provide additional functionalities, such as automatic generation of questions and contextual definitions or a textbook-driven chatbot. The most popular domains were medical textbooks (including dental) and computer science textbooks.

We want to thank the program committee members that helped us in preparation of the workshop program:

- Brendan Flanagan
- Atsushi Shimada
- Roger Nkambou
- Vinay Chaudhri
- Paulo Carvalho,
- Noboru Matsuda,
- Cliff Shaffer,
- Erin Walker,
- Elena Glassman,
- Reva Freedman,
- Julio Guerra,
- Ilaria Torre,
- Benjamin Paaßen,
- Paul Denny,
- Zichao Wang,
- Andrew Olney,
- Isaac Alpizar Chacon,
- Debshila Basu Malick.