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# Analysis of Existing Technological Platforms for the Collaborative Production of Open Textbooks

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**Abstract**: The production of high-quality open textbooks requires the collaboration of different contributors. This work conducts a comparative analysis of the six different collaborative platforms for the production of books. To be able to compare the platforms, several dimensions extracted from literature of collaborative writing and the requirements associated with open textbooks are described and used. As conclusion of the study, it is clear that Connexions is currently the best option for the collaborative production of open textbooks although it lacks some basic functionality. This work recommend the creation of a new breed of platforms that better support the producers of open textbooks that inherit all the successful capabilities of the current generation.

## Introduction

Describing what Open Textbooks are presents a double problem. First, the term "Open" could be understood in several ways, from being free of cost to being possible to adapt, mix and distribute. Second, the term "Textbook" is rapidly changing its meaning according to the technological progress from the traditional printed book to a collection of online content purposefully curated in a website or an interactive multimedia experience published by digital means. Due to this difficulty to state a simple definition of Open Textbooks, Frydenberg and Matkin (2007) propose the use of the continuum concept. The traditional physical textbook is on one side of this continuum. If distributed for free or low cost and covered with open licenses could be considered an Open Textbook. On the other side of this continuum they propose to have a highly interactive multimedia Open Online Course. They suggest that any point in this continuum could be considered an Open Textbook. To move in this continuum, from the traditional physical book to the multimedia online course, features should be added, but at the same time, barriers for its production are increased. The more features the open textbook provides, such as dynamic content, interactivity, collaboration; increases the perceived value of the textbook. However, it requires more work to produce and a more complex infrastructure to support its creation and distribution.

In order to move forward in this continuum, the production barriers should be lowered. The first intuitive approach to reduce the complexity of the task for any individual producer is to distribute the workload among several producers (Benkler, 2005). This would lead to a collaborative production of open textbooks. The study of how to organize such task falls into the realm of Computer-Supported Collaborative Writing (CSCW) and

more specifically to Collaborative Writing tools. After a review of the academic literature, Casalis et al. (2012) found that most of the discussion about collaborative writing has been around the methodologies followed by different groups, but not about how well existing collaborative writing tools adapt to those methodologies. While collaborative writing is a well-understood concept, each group involved in the task has to re-discover their own methodology. This repetition could be avoided if collaborative writing tools provide the framework for groups to select from supported methodologies to guide them during the production of the textbook. According to the authors of this work such tools currently do not exist.

This work presents a comparative analysis of technological platforms for collaborative production of open textbooks. The structure of the papers is as follows: The next section describes the most relevant platforms for the collaborative production of books. The following section presents a comparative analysis of the platforms based on a set of dimension extracted related to the collaborative methodologies for collaborative writing. The platforms are also compared in a technical dimension containing the requirements to support the production and use of such textbooks. The paper closes with conclusions about the study and recommendations to close the existing gaps in order to create a more supportive collaborative tool for the production of open textbooks.

## Existing Platforms for the Collaborative Production of Books

In this Section we analyze the most relevant platforms that support the collaborative writing of books. The analysis was done by reviewing literature that explain their characteristics and, in some cases, by testing them. A brief description of the main characteristics of each platform is presented.

### *Wikibooks*

Wikibooks[1] is a project started by the Wikimedia Foundation in 2003. The aim of the project is to provide a platform of open-content textbooks where many authors can work together. It has the same interface as Wikipedia, allowing any user (registered or not) to edit a book. The book may include several chapters that include pages with text, images, videos or articles available from Wikipedia and other Wikimedia projects. A study made by to Frith (2009) revealed that Wikibooks has some problems. One of the key problems is the *accuracy*, since any user can edit a book created by a different user and then write content that could be incorrect. Although Wikibooks has a community of editors, they are a small group and don't have enough time to do a quality control of the content of all existing books. The accuracy problem is also increased by the lack of *Authorial Attribution*; the authors of this platform have no control over their content or receive any credit for their contributions. The lack of a gratification system could reduce the interest of authors to invest significant time to develop long and valuable textbooks. This produces a problem as the creation of a book requires more specialized knowledge, considering that the length and content of the chapters should be more depth than a Wikipedia article. Another drawback of Wikibooks is that the platform does not have the same modular structure of Wikipedia, as a book is lengthier than an article. A casual user could find difficult to add a chapter or a section in the book. Frith's paper also mentions the end user functionality problem regarding printing on demand. It is not possible to print all the pages of a book in one step, as every page must be selected to print or export to PDF.

### *Connexions*

Connexions[2] provides a complete publishing platform for open textbook projects and it is also a repository where the user can store his/her own created books and can retrieve books created by other authors. Connexions repository provides an effective means for educators to create, modify, share, and disseminate open textbooks under the Creative Commons Attribution license. The use of content posted to Connexions is free for instructors or students to view, to remix or to download. This platform provides tools for authors to create content that ranges from single-topic treatments to complete textbooks. Instructors can create integrated textbooks from any of the modular content already in the repository and from any content created or imported by the instructor. Connexions can also be used to produce a PDF of the integrated textbook that can be read off-line, sent to a local printer, or to Connexions' print-on-demand partner, QOOP, producing a printed copy of the

[1] Wikibooks (http://en.wikibooks.org)
[2] Connexions (http://www.cnx.org)

textbook at a fraction of the cost of a traditional textbook. Based on tests performed on the Connexions platform we can highlight certain features:

- In Connexions, a user must be registered in order to create or modify content. Due to this requirement, it is able to manage the attribution of authorship. When an author reused content from another user, a sentence is added automatically identifying the original work and its authors. In addition, to editing a module from another author, a user needs to have permission to do this.
- The different roles have permissions and attributions to a module or collection. The roles that can be defined within a module are: Author, Maintainer and Copyright Holder. Other optional roles are: Editor and Translator.
- Respect to the interface, to edit a module the user must have some knowledge of programming in general. For example, the *mean* and *figure* elements are not covered by the Edit-in-Place (WYSIWYG) editor. Due to that reason, these elements must be edited manually, which create a steep learning curve.
- One of the interesting features of this platform is the ability to work with a variety of media objects, allowing the creation of interactive books and multimedia. It manages videos (MPEG, AVI, MOV, 3GP), images (BMP, JPG, GIF, PNG), audio (MP3, WAV, AIFF), among others.
- It also has the ability to import and export different types of files. It can import Word / Open Office / Latex / CNXML plain files, taking into account the corresponding templates. It allows uploading multiple files into a module. The content of a module can be exported as CNXML, plain text or a ZIP file. Moreover, the modules can be downloaded in the following formats: PDF, EPUB, XML, and ZIP.
- Concurrence was evaluated when two users accessed the same module. Currenlty Connexions does not block the module or display any warning to avoid inconsistencies in writing.
- The Lens System and the community accredit the quality of contents.
- When a user reads he is able to provide feedback to the authors via mail. Also he can share it through different social networks.

### *Booktype*

Booktype[3] is an open source collaborative e-book editor. It makes it easier for people and organizations to collate, organize, edit and publish books. Booktype allows the creation of books in several formats to be printed or to be integrated into catalogs, like Amazon, iBooks or any other digital reader. It is web-based and must be installed in a Linux or OSX server. Booktype is a young product, introduced mid 2012. It was developed using the following Programming language: HTML, CSS, Python, JSON, XML and being supported by a PostgreSQL database. Based on tests performed on this platform, we can highlight certain features that we develop below:

- The platform has easy edition tools for writing and inserting tables and images.
- The books are divided in chapters that can be edited in a wiki style.
- It was observed that it lacks the ability to work with different multimedia objects.
- Users must be registered and the platform keeps a record of every transaction that takes place.
- It has a chat for communication, where, in addition to messages, it will report every action performed by all users on that book. Also it is possible to message other people in Booktype using the message services. That means that users can send messages by text snippets or images to others collaborators. To share more extended notes, authors can use the tool Notes tab.
- User roles can be Administrator or Editor. The user can assign different editing permissions to a book, so it can only be edited by the owner, the administrators, the administrators and editors or anyone.
- Respect to concurrency, when more than one user are editing the book, Booktype indicates which chapter is currently being edited and blocks it. Other parts of the book or another chapter can be edited.
- Booktype has groups to bring people together to create books that share a common theme or interest.
- The book can be published, in four different formats: Book (a PDF document which contains a general index), Ebook (a EPUB document, which can be set for iPad, Kindle or general), Screen PDF and Open Text Document (an ODT document).
- The books can be licensed in several variants of creative commons, GNU, MIT or public domain. Booktype can create new versions, but only the last one will be visible or editable by other authors.

[3] Booktype (http://www.sourcefabric.org/es/booktype/)

## *Pressbooks*

PressBooks[4] is a book publishing platform, built on WordPress, that makes it easy to collaborate with an editorial team, and to generate clean, well-formatted books in multiple outputs: EPUB, print-ready PDF, InDesign-ready XML, and HTML. It considers that a website is a book, so it has all the powerful features that WordPress have like user management, revision system, comments, WYSIWYG editor, media insertion, etc. The authors can edit book information metadata, manage authors, export the book in several formats, track the analytics of the book with Google Analytics and ecommerce URLs of the book (Amazon, Oreilly, Kobo, iBooks, Barnes & Noble, etc.). PressBooks allows the creation of multi-author projects with online workflows for distributed teams. You can invite many collaborators within the same project. This platform uses CMS Wordpress, which is developed in PHP and MySQL, under GPL license. Based on tests performed on this platform, we can highlight certain features:

- Users must be registered. The different Roles in the platform are: Administrator, Author, Editor, Contributor and Subscriber. The Author and Contributor roles allow creating new chapters, new front matter, but not edit those already created by other authors. Instead, the Editor and Administrator can do it. The Contributor cannot organize or publish the book. The Subscriber role can only comment. The Administrator is the only one who can add users, assign roles and edit the book information.
- No books or modules can be reused by other users. Pressbooks do not provide a search repository. The author can invite other users to edit the book, but it cannot be reused.
- It can be configured to make books public, and thus the book can be accessed by any person (whether or not that person is a registered user of pressbooks) who knows the URL of the site.
- It has a toolbar with basic editing functions (character formatting, bullets, numbering, paragraph formatting, etc.). The user also has the option to edit HTML code directly.
- The user can work with multiple media files, such as images, video or audio.
- With respect to managing concurrency, when an author is editing a book and another wants to edit it too, a warning alerts that someone else is editing. But it does not block it, meaning that the last edit is the one considered final.
- The authorship of the book should be manually entered.
- Respect to social accreditation, the platform allows users to insert comments on the books and also, to share them through social networks.

## *Widbook*

Widbook[5] is an online platform for writing, reading and sharing digital books, available since May 2012. The service provides a social network where a user can register and use it free of charge. After a user has signed up for the site, he can complete his profile with network information like school or university name and also can pick favorite genres of books. This information could be used by Widbook to recommend friends or books based on their preferences. Also a user can contact friends that are using Widbook using other social networks like Facebook, Twitter or Google+ accounts. The following characteristics could be highlighted:

- When a user creates a new e-book, the interaction level with the readers must be specified, for example whether collaborations of content or comments will be accepted. If collaborations are allowed and the owner of the book revises and accepts the content, the user who made the collaboration will become co-author of the book.
- Writing of the book is very simple. The author can choose a book cover, define a table of contents, add chapters, write text content using the tools available which are easy to use and also can add multimedia content like images or videos (only from YouTube). The way the book looks when it is written is how it will be visualized when it is published for reading.
- There is no simultaneous writing; contributions of different users must be authorized to be included in the book. When the book is saved it becomes part of the profile in the section “My books”.
- The author can publish the book, even when it is not finished., and gets a unique URL that can be shared. In this way, the book is available for reading and can be rated and shared using Facebook, Twitter and Pinterest.

[4] Pressbooks (http://pressbooks.org/)
[5] Widbook (http://www.widbook.com/)

- A user can find a book using some filters available like author or book title, language, rating, number of pages or number of views. If a user finds a book that is interesting, it can be added to their bookshelf, the area where favorite books are saved for quick access.
- The social network of Widbook provides following functionality and private messages.
- The current version of Widbook is in beta stage, so it is not possible to export or download e-books, they can only be viewed on the site with an authenticated user.

### *Sophie 2.0*

Sophie[6] is a multiplatform software to write, read and share books in a easy way. Its goal is to allow users to use rich multimedia content to create sophisticated books without employing complex tools. The first version of Sophie was released under the Smalltalk platform in 2008 and few years later it was rewritten in Java to be accessible for the open source community. Since then, Sophie has been developed considering all the new devices available in the market, such as tablets or mobile phones, to reach as many users as possible. As presented in Georgiev et al. (2011) a survey was conducted to analyze the importance of Sophie development to support reading of books in mobile devices. Based on the results of the survey and the analysis of means to add multimedia content in an e-book, the feature to export to HTML5 was added in Sophie, allowing books be read on any device just using a modern web browser without installing additional plugins or applications. The following characteristics could be highlighted:

- Sophie provides three modules to support writing, reading and sharing of books. With ***Sophie Author*** a user can create interactive books with rich multimedia content like videos, images, sounds, PDF files, web pages, and even another Sophie book. These elements and text can be located with different styles (size, rotation) and the timelines feature can be applied to them to create animations. Then books can be read using ***Sophie Reader***. The ***Sophie Server*** allows to share Sophie books, providing a web interface where a user can upload, download, search and read book details.
- To share a book the user must have an account to connect to the server and must establish the actions (read/write) that a different user can perform on the uploaded book.
- There is no statistical information about user actions on the web interface to know how many users uploaded, downloaded or liked a book. For the collaborative writing of a book, the resource must be share using the Sophie Server with read and write permissions to be available for different users via the Sophie Author.
- It is not possible to assign roles and planning activities when writing a book. All users can write at the same time, any place, and there is no way to block a section to avoid conflicts when writing nor it's possible to know which section of the book was written by a particular user.
- Communication between authors and readers can be performed by using comments frames, a feature that allows to add comments in any place of the book promoting discussion and conversation.
- The page of a book, its elements and even the entire book can be saved as a template so it can be reused in a different section or book, reducing the amount of work to complete the desired material.
- In addition to HTML5 support, the book can also be exported to PDF and to an own extension called Sophie package. The exported book has a unique version with no defined license.
- Sophie is released under Educational Community License, Version 2.0 (ECL).

## Comparative Analysis Platforms for the Collaborative Production of Open Textbooks

The process of collaboratively producing open textbooks incorporates four different methodological dimensions, first identified by Poesner and Baker (1993) and later expanded by Adkins (1999). These dimensions: roles, process, document control and writing strategy, reflect the different decisions and strategies that collaborative writing groups should follow in order to produce a book. The dimensions are presented and described in the following subsections and are used to compare the studied platforms. In addition, a fifth dimension is introduced to include the technical aspects that are not part of the collaboration methodology, but support the whole production and distribution process.

[6] Sophie 2 (http://www.sophieproject.org/)

## *Roles*

People involved in the production of a collaborative book may take several roles. Traditional roles identified by Poesner and Baker (1993) have been expanded to consider the open nature of the work (not just producing but also reusing and remixing) and also to account for multimedia content instead of just text. The roles that users could have in the collaborative writing of open textbooks are:

- **Content producer:** This is the basic role, the person who actually creates content of the Open Educational Textbooks. The original name "writer" given by Poesner and Baker (1993) has been changed to reflect that the created content could be in different formats, such as audio or video.
- **Idea Generator:** People on this role give their advice on the content. They do not produce it, but provide ideas to do it. Their contribution should also be recorded and recognized by the tool.
  **Reviewer:** They provide advice and eventually additional content based on already produced material. According to the type of advice that they generate they could be classified in: 1) ***Content Reviewer*****:** this role is in charge of reviewing the contents about a subject. Then, this person (or group) must work in close relation with the Content Organizer, proposing the appropriate modifications. 2) ***Technical Reviewer:*** this role has the function of checking all the technical aspects of the book or content. For example, it checks the consistency of the links, revise the formulas edition, etc. 3) ***Pedagogical Reviewer*****:** this person reassures that the organization of the content (see below) makes sense from a pedagogical point of view. Hence, the reviewer works closely to the content organizer in order to notify missing content, or to point out some elements that must be deeper/lighter investigated. And 4) ***Language Reviewer:*** a native speaker has to review the book in order to ensure that its spelling, syntax and grammar conform to the target audience language.
- **Organizer:** they take final decisions on the work and how it is done. Depending if they are in charge of how the group works or the content of the book, two sub-roles could be identified: 1) ***Content Organizer:*** a person (or group) able to guide the creation of a book, who has clear insights into the curriculum that needs to be covered. This person could provide swift feedback on all aspects of the contents. This role has the final decision on what is included or not in the book. And 2*)* ***Group Organizer:*** this role is vital in order to organize the team working in the book. The person in charge of this role should be characterized by various competencies: project management, good social relationships, experience within the field, and basic knowledge regarding the topic of the book. One full-time coordinator per book is recommended since managing all the team can be time consuming.
- **Template** Designer: this role is in charge of creating basic formats that could guide different aspects of one or more books. Depending on the types of templates it would be possible to classify them in: 1) ***Interface:*** this designer develops and maintains the template of each book to make sure that the content produced by the various collaborators (content producers) follows the same look-and-feel. And 2) ***Pedagogical:*** the pedagogical template designer offers a uniform way to fill the table of contents established by the content organizer, and ensures that the content of the various chapters are organized according to a common structure and following a pedagogical strategy.
- **Accreditor:** is a person or an organization that validates each book against a given level of quality assurance. The quality of the books is validated according to the content, technical, pedagogical, and language points of view. Once the accreditation has been established, the books can be disseminated to the target audience.
- **Translator:** when the native language of the content producer does not match the language of the intended audience, the translator ensures the translation of the content towards the target language. On a final step, the translation has to be validated by the language reviewer.

Table 1 presents the comparison of the different platforms against the Roles dimension. From the group of platforms, Connexions has the wider spectrum of roles, while Wikibooks has the only content producers and idea generators.

## *Processes Dimension*

More than just a simple aggregation of rich media content, books involve a wider spectrum of processes; which come from group-related activities (group formation, task and roles assignation), to publishing and accreditation, and the creative processes themselves. There are two sub-dimensions to consider, one that leads

to the creation of a complete book (book-driven processes) and the other that leads to the creation of atomic or small pieces of content (content-driven processes).

**Table 1.** Platforms according to Role dimension

| Characteristic | Wikibooks | Connexions | Booktype | Pressbooks | Widbooks | Sopie 2 |
|---|---|---|---|---|---|---|
| **Content Producer** | **Y** | **Y** | **Y** | **Y** | **Y** | **Y** |
| **Idea Generator** | **Y** | **Y** | **Y** | **Y** | **Y** | **N** |
| **Reviewer** | **N** | **Y** | **Y** | **N** | **N** | **Y** |
| Content Reviewer | N | N | Y | N | N | Y |
| Technical Reviewer | N | Y | N | N | N | N |
| Pedagogical Reviewer | N | N | N | N | N | N |
| Language Reviewer | N | N | N | N | N | N |
| **Organizer** | **N** | **Y** | **Y** | **N** | **N** | **N** |
| Content Organizer | N | Y | Y | N | N | N |
| Group Organizer | N | N | N | N | N | N |
| **Template Designer** | **N** | **N** | **N** | **N** | **N** | **N** |
| Interface | N | N | N | N | N | N |
| Pedagogical | N | N | N | N | N | N |
| **Accreditor** | **N** | **Y** | **N** | **N** | **N** | **N** |
| **Translator** | **N** | **Y** | **N** | **N** | **N** | **N** |

The so-called Book-driven processes include:

- **Group-related activities:** which include group formation strategies (by invitation, auto-invitation, or open groups) and the assignment of tasks and roles (which could be auto-assigned or assigned by the persons with coordinating roles). Roles, tasks and the group itself could be changeable during the book production process.
- **Publishing:** with the meaning of creating "frozen" versions of the books and dealing with its distribution.
- **Accreditation:** referring to the process of certifying and approval of a version of the book. This process could be held by a person or an organization and being done in a manual way, which means that each book version must be under a dedicate accreditation process; or (semi) automatic, when accreditations are given according to the author's profile and previous accreditation.

Content-driven activities are enclosed in book-driven ones, and they include:

- **Brainstorming:** more than a group dynamics technique, is a process that must be taken to explore the creativity of a person or a group. Even fine-granular content could optionally be planned through brainstorming, despite more complex content that will require this process.
- **Planning:** is one of the most important processes, since it is essential to decide some characteristics of the content that will be covered, such as: aspects, approach, information that is vital for the purpose of the book, etc.
- **Research and finding content:** once the planning process is done, the person (or group) involved in this task has to conduct a research on the content, taking into account what was previously decided. If previous reusable content exists, it should be found and adapted.
- **Content producing:** could be realized in different ways: writing a whole new content based on a person (or group) previous knowledge and/or research that took place, reusing some content that matches the objective of the book or remixing it with extra information, or changing the structure in which the content was originally created.
- **Content organization:** gives cohesion to the content produced for the book and organize it following a pattern, since people with different writing styles collaboratively wrote the content.
- **Reviewing:** can be done in different levels: content, when it is analyzed whether the content covers the objectives and provides feedback to improve the text quality; technical, when consistency, format, and images are reviewed; pedagogical, when it is taken into consideration if the structure of content follows a pedagogical approach; language, when it is checked the spelling, grammar, collocation in a text that was written in a different language from the people involved.

- **Versioning:** refers to the process of "freezing" the content and organization of a book to release it. Professors will be able to establish their own book versions in order to use them in their syllabus.
- **Templating:** this process covers the creation, reusing and remixing of interface templates applied to individual content or the entire book. This process is related to a specific role, the Template Designer, and this task can be accomplished in two different ways: the Interface templating, which deals with aesthetic features of text and rich media presentation; and the Pedagogical templating, referring to the ways the content is organized and exposed to readers.

Table 2 present the comparison based on the Process dimension. While most of the platforms provide basic Book-driven processes, they support for more detailed Content-drive process is very weak. Most of them only provide tools to produce, organize and versioning content. The important activities of brainstorming and planning should be executed outside the tools. The only exception is Wikibooks that provide a discussion page with such activities could take place. None of the platforms provide tools for researching, reviewing or templating.

**Table 2.** Platforms according to Processes dimension

| Characteristic | Wikibooks | Connexions | Booktype | Pressbooks | Widbooks | Sopie 2 |
|---|---|---|---|---|---|---|
| **Book-driven Processes** | | | | | | |
| Group | N | Y | Y | Y | Y | N |
| Publication | N | Y | Y | Y | Y | N |
| Accreditation | N | Y | N | N | N | N |
| **Content-driven Processes** | | | | | | |
| Brainstorming | Y | N | N | N | N | N |
| Planning | Y | N | N | N | N | N |
| Researching | N | N | N | N | N | N |
| Content Producing | Y | Y | Y | Y | Y | Y |
| Content Organization | Y | Y | Y | Y | Y | Y |
| Reviewing | N | N | N | N | N | N |
| Versioning | Y | Y | Y | Y | Y | Y |
| Templating | N | N | N | N | N | N |

## *Document Control Dimension*

This dimension determines who manages the processes related to collaborative writing of open textbooks. Posner and Baecker (1993) have proposed a classification of four types of control for the writing process. We have extended that classification to a general process related to collaborative writing of open textbooks, as follow:

- **Centralized:** one person controls the process during the whole project;
- **Relay:** one person at a time controls the open book but it is not always the same person, the controlling relay was planned in the initial phase;
- **Independent:** each person controls the section on which he or she is working;
- **Shared:** every role has equal access to the open textbook.

These methods usually change at different stages of the writing process (Noel and Robert, 2004). In the different types of controls (Centralized, Relay, Independent and Shared), different roles could be assumed on the phases of the collaborative writing process, where according to the established control, it is possible to realize different activities, such as: Writing, Editing, Researching, Brainstorming or Reviewing. Table 3 presents the comparison of the platforms according to this dimension. It can be seen that Connexions, Booktype and PressBooks support all the control modes. Wikibooks and Sophie 2, due to their nature, only support Independent and Shared modes. On the other hand, Widbook only work in a Centralized way.

**Table 3.** Platforms according to Document Control dimension

| Characteristic | Wikibooks | Connexions | Booktype | Pressbooks | Widbooks | Sopie 2 |
|---|---|---|---|---|---|---|
| **Centralized** | **N** | **Y** | **Y** | **Y** | **Y** | **N** |
| **Relay** | **N** | **Y** | **Y** | **Y** | **N** | **N** |
| **Independent** | **Y** | **Y** | **Y** | **Y** | **N** | **Y** |
| **Shared** | **Y** | **Y** | **Y** | **Y** | **N** | **Y** |

## *Writing Strategy Dimension*

The writing strategies are the different ways in which the members of the group cooperate in the writing process. There are three types of strategies:

- **Single writer:** this strategy covers the case of one team member writing the document, while the others assist. In terms of roles, there is only one content producer.
- **Separate writers:** if the document is divided into parts and different individuals work on them, we have several content producers. In this case, the separate writers strategy is being used.
- **Joint writing:** several group members compose the text together, and even small components of the text are decided by a group effort.

The writing strategy is closely related with the document control dimension. The use of the single writer strategy usually implies the use of the centralized process control method. Table 4 presents the support of each platform for the different Writing Strategies. Most of the tools are designed for Single or Separate writing, due to the lack of good concurrency mechanisms. Sophie 2, on the other hand, was designed with synchronous collaboration in mind and support all the strategies.

**Table 4.** Platforms according to Writing Strategy dimension

| Characteristic | Wikibooks | Connexions | Booktype | Pressbooks | Widbooks | Sopie 2 |
|---|---|---|---|---|---|---|
| **Single writer** | Y | Y | Y | Y | Y | Y |
| **Separate writers** | Y | Y | Y | Y | N | Y |
| **Join writing** | N | N | N | N | N | Y |

## *Technological Dimension*

There are a number of additional capabilities that a collaborative writing tool should provide in order to facilitate the production and distribution of open textbooks.

- **Usability:** a tool should be user friendly for the intended target. In this case experts in different areas interested in producing a collaborative open textbook.
- **Rich media support:** it allows the inclusion of images, video, interactive programs, among others types of media.
- **Embedded communication:** there is a channel to provide synchronous and asynchronous communication between roles (chats, video/audio-conferences, mail lists, etc.)
- **Distribution:** there is a way to publish the final/frozen versions of the text, and distribute it to third parties (send announces of publication, publish the link to the book on a website or social network, etc.)
- **Personalization:** the tool provides a way to customize the content, by using both interface and pedagogical templates.
- **Track of authorship:** the tool is able to inform about the authors of a text or a piece of it. It eventually ranks authors according to their contribution, and tracks authorship through derivative works.
- **Accessibility:** the tool should provide accessibility to large diversity users; for example users with visual impairments (test-to-speech, increasing font size, increasing contrast).
- **Licensing:** The tool clearly establishes a license to texts produced within, or let the author establish a specific license to their work. In the last case, it is able to track licensing through derivative works
- **Analytics of use:** the tool provides statistics about users accessing the work, such as the number of downloads or comments, in order to measure social impact of the work.
- **Social evaluation:** The tool provides a mean to catch public opinion about the book (likes, comments, polls, scores, blogs where users can give their advice, etc.)
- **Accreditation:** The tool provides a way to store and present expert advice about the book, such as customer reviews and book score.

Table 5 present how well the platforms adhere to the technical requirements described above. Connexions lead the group with the only downsides that it does not provide communication embedded in the tool and it is not as easy to use as other platforms.

**Table 5.** Platforms according to Technical dimension

| Characteristic | Wikibooks | Connexions | Booktype | Pressbooks | Widbooks | Sopie 2 |
|---|---|---|---|---|---|---|
| **Usability** | Medium | Medium | High | High | High | High |
| **Rich Media Support** | Y | Y | Y | Y | Y | Y |
| **Embedded Communication** | Y | N | Y | N | Y | Y |
| **Distribution** | Y | Y | Y | Y | Y | Y |
| **Personalization** | N | Y | N | N | N | Y |
| **Track of authorship** | N | Y | Y | Y | N | N |
| **Accessibility** | Y | Y | N | N | Y | Y |
| **Licensing** | Y | Y | Y | Y | N | N |
| **Analytics of use** | N | N | Y | Y | Y | N |
| **Social evaluation** | N | Y | N | Y | N | N |
| **Accreditation** | N | Y | N | N | N | N |

## Conclusions

The main conclusions that could be extracted from this comparative study are: 1) The existing platforms are not mere copies of each other, each one of them provide a different set of useful functionality. 2) Connexions is by far the most complete platform for the collaborative production of open textbooks, but lack basic collaborative features such as embedded communications that could enable the brainstorming and planning of the book in the same platform. Also, Connexions has a much more steep learning curve that other platforms reviewed. 3) There is a lack of support for the important process that take place during book production such as researching and reviewing. The producer group usually has to use external tools to complete these activities. And finally, 4) None of the platforms cover the whole book lifecycle from start to end, that is from group formation to publication, distribution and accreditation. Most of them only focus on the actual writing/production of the book

From these results an conclusions, it is clear that there is space for the creation of a new breed of platforms that copy the successful features from current tools and, while being easy to use, cover the whole life-cycle of the book creation, consumption, reuse and repurposing needed for a digital ecosystem of open textbooks.

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