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Wikipedia as a platform for impactful learning: A new course model in higher education

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Abstract In January 2014, 62 students graduated from the first for-credit course dedicated to Wikipedia. Learning focused on improved consumption of information, and collaborative construction of knowledge using the Wikipedia platform. This paper investigates the design and implementation of this course model, while highlighting the benefits and challenges to students & faculty. In addition to 128 medical articles in Hebrew Wikipedia, already viewed over 1.4 million times, students reported a unique learning experience that sharpened their collaborative skills as well as academic skills. This paper also presents the findings of a related study that focused on students' learning experience, long-term impact and productive teaching practices. The study results helped fine-tune the pedagogical and administrative aspects of the course, influencing both teaching practices and the learning experience. Finally, the course is discussed in a wider educational perspective, presenting insights regarding reuse of the model, scaling possibilities and suggestions for further research.

Keywords Wikipedia in higher education · Active learning · Collaborative learning · Literacies

1 Introduction

"Imagine a world in which every single person on the planet is given free access to the sum of all human knowledge", said Jimmy Wales, founder of Wikipedia, in 2004.

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Wikipedia, a free multi-lingual encyclopedia that everyone can edit, serves over 500 million users monthly. Being the largest open and free source of information comes with a huge responsibility, one that Wikipedia volunteers take seriously: Wikipedians strive for quality, up-to-date, well referenced articles that are written from a neutral point of view. It is especially important when considering that Wikipedia has become "the most viewed medical resource globally" (Heilman and West 2015), providing health-related information for both healthcare professionals and the general public (Boulos et al. 2006; Herbert et al. 2015). However, recent research reveals alarming results – there are "shortcomings in handling erroneous entries" (Herbert et al. 2015); the number of medical-related editors is declining (Heilman and West 2015); and even students who know how to edit do not correct mistakes they find (Heilman and West 2015). Keeping these challenges in mind, this paper describes the design, implementation and evaluation of a new academic course model that focuses on creating quality medical-related information in Wikipedia. As will be discussed, the course offers an innovative way of harnessing Wikipedia in higher education - not only as a platform for consuming knowledge, but also as one that allows a collaborative construction of information and provides an educational opportunity to both teachers and learners (Herbert et al. 2015; Konieczny 2007).

Being a Web 2.0 tool, Wikipedia's pedagogical potential has long been investigated (Calhoun 2014; Konieczny 2014; Bayliss 2013; Seitzinger 2006; Bruns and Humphreys 2005; McMullin 2005). Researchers and educators have explored Wikis, and specifically Wikipedia, as a collaborative learning platform - one that can be used to actively involve learners in the construction of knowledge, while sharpening learner's digital literacy, academic literacy and critical thinking (Zheng et al. 2015; Calhoun 2014; Eteokleous et al. 2014; Konieczny 2007, 2014; Parker and Chao 2007; De Pedro et al. 2006; Boulos et al. 2006). No wonder, then, that a growing number of educators are experimenting with Wikipedia in their classrooms (Aibar et al. 2013, 2015; Dooley 2010). This is evident not only from the number of academic papers exploring Wikipedia uses in education, but also from data revealed by the Wikimedia Foundation (WMF), the non-profit organization that supports Wikipedia. In 2015, the education team at WMF started a campaign to collect and map historic data regarding the Wikipedia Education Program (WEP) and the use of Wikipedia in the classroom, since its inception in 2005 (Wikimedia Outreach Portal, Education, Historic Data). The campaign revealed that as of April 2016, 938 educational institutions (56% in higher education) from 91 countries, in 539 different cities, have engaged with the WEP, a number that keeps rising. The program includes 300 volunteers, 4600 educators, and 47,000 students, who wrote 150,000 new articles and improved 40,000 articles in 50 languages. While these numbers paint a better picture of the scope of WEP globally, they do not provide insight on these collaborations in terms of quality content creation and impact on learners and faculty. No doubt, these questions require further research as the WEP continues to spread globally and more academic research becomes available.

What could be stated with certainty is that the exact manner of incorporating Wikipedia-based assignments into a curriculum depends on a variety of factors. These include the students' age, the course learning objectives, the time allocated for the task, the level of support received from the Wikipedia community, the instructor's familiarity with Wikipedia and its community, and the support of faculty and academic peers (Konieczny 2007). As a result of these varying factors, different ways of

incorporating Wikipedia into the curriculum have been practiced around the world. Thus far, the two most common types of collaborations in higher education are: 1) Expanding existing articles - by adding missing content or correcting bias; and 2) Creating new articles. In both cases, students may translate articles that exist in another language, use other sources, or a combination of the two (Case studies on WEP Portal). Additional versions of academic assignments include collaborations with Wikipedia's sister projects, such as Wikimedia Commons, a repository of freely usable media files, Wiktionary, Wikisource or Wikispecies.

That said, despite its pedagogical potential, "the wiki phenomenon, by and large, has not yet made it to the classroom, either as a research topic or as a teaching method" (Evans 2006) and its use is still relatively new in higher education (Evans 2006; Schaffert et al. 2006; Franklin and Van Harmelen 2007; Chao 2007; Konieczny 2007). Instructors are still uncertain on how to integrate Wikis in the classroom and facilitate effective collaboration (Elgort et al. 2008; Ramanau and Geng 2009; Allwardt 2011; Naismith et al. 2011). In that sense, the case of Wikipedia is no different than other Wikis; it seems that even a decade after these accounts of the use of Wikis, and despite the growing numbers of educators experimenting with Wikipedia in the classroom, not much has changed. Wikipedia is still mainly used by students as "an introductory and/or supplementary source of information — providing initial orientation and occasional clarification on study topics" (Selwyn and Gorard 2016). In other words, Wikipedia is still mainly used to consume knowledge, less so as a pedagogical tool for the creation of knowledge. It seems that academia has only started exploring the potential of implementing Wikipedia into the curriculum and has yet to formalize the means that would promote "deeper learning and integration of learning experiences from both inside the classroom and out" (Chen et al. 2005).

Two practical needs have been revealed, then – one draws on Heilman & West's conclusions regarding the shrinking size of the medical editing community and the need to make Wikipedia a better source of medical information; the other draws on Herbert and his fellow researchers' appeal "to see Wikipedia as what it is: an educational opportunity" (Herbert et al. 2015), a platform that can be wisely harnessed as a pedagogical tool to enhance active and meaningful learning in the twenty-first century. In order for these two needs to be fulfilled and for a meaningful learning process to take place, there is one more requirement to consider – time. Though Konieczny's claim that writing assignments "are and likely will be the most popular" (Konieczny 2007), considering the *exact manner* and *scope* of practically incorporating writing assignments is crucial to the success of such process. As Zheng et al. rightly assert, engaging with Wikipedia effectively requires meticulous planning (Zheng et al. 2015), which in turn requires time. Not only that, but Wikipedia is a world in itself, with its own culture, language and codes of conduct. In order for students to *constructively* contribute to Wikipedia, they need to not only research their topic, but also familiarize themselves with the platform. In practicality, this means that in order to harness the full potential of the platform and allow for a meaningful learning experience, both faculty and students need sufficient time for the process to be successful.

Considering these requirements, a new course model for using Wikipedia in higher education has been designed. The semester-long elective course opened in the 2013 fall semester at the Sackler school of Medicine, Tel Aviv University. The course was developed with four main goals in mind:

- To create quality medical-related content in Wikipedia by medical students in an academic, for-credit setting.
- To give students practical tools to become better consumers of online information, while sharpening their digital and academic literacy skills.
- To guide students on how to become active members of the "information culture" (Curry and Moore 2003) by taking part in a collaborative construction of knowledge.
- To explore a new model of bringing Wikipedia into higher education, while providing an innovative, positive and active learning experience.

This paper investigates the design and implementation of this course model, while highlighting the benefits and challenges to students & faculty. In addition to 128 medical articles in Hebrew Wikipedia, already viewed over 1.4 million times, students reported a unique learning experience that sharpened their collaborative skills as well as academic skills. This paper also presents the findings of a related study that focused on students' learning experience, long-term impact and productive teaching practices. The study results helped fine-tune the pedagogical and administrative aspects of the course, influencing both teaching practices and the learning experience. Finally, the course is discussed in a wider educational perspective, presenting insights regarding reuse of the model, scaling possibilities and suggestions for further research.

2 The course

2.1 Rationale & goals

In 2013, a new course model that focuses on Wikipedia contribution was designed, with the goal of creating high quality medical content in Wikipedia, while improving students' consumption of information, as well as skills for collaborative construction of knowledge. The design and implementation of a new course model turned out to be a complex and continuous process. This complexity stemmed from several reasons that will be discussed hereafter, the first of which is the fact that there has been no precedent for such a course worldwide. While there was experience of using Wikipedia in the classroom, there has been no consistent effort in academia to regulate working with Wikipedia via a semester-long course. Drawing from existing academic research (to name a few: Heilman and West 2015; Herbert et al. 2015; Calhoun 2014; Bayliss 2013; Konieczny 2007) and from the accumulated experience of this author using Wikipedia as a learning tool, it soon became clear that designing an academic course that focuses on Wikipedia contribution raises new questions. Such a course also requires addressing various pedagogical aspects that were not dealt with outside the setting of academia. Simply put, for the course to be productive, successful and well-received, its design would have had to address the sometimes conflicting agendas and different needs of three main stakeholders: faculty, students and the wiki community. Considering that, the course had 6 main goals –

- Creating an innovative academic course that focuses on contributing to Wikipedia, where students not only consume knowledge, but also participate in its construction

- Increasing the number of quality medical articles on Wikipedia
- Making sure sessions encourage active learning and collaborative work
- Striving for a positive learning experience
- Making sure the course model is adaptable for other academic disciplines and institutions, and scalable for larger classrooms
- Monitoring & documenting the process, so that the model could be perfected

2.2 Design guidelines

Several guiding principles were used while designing the course:

- *Re-use* - creating a model that could be adopted and applied by other educators, faculties and academic institutions worldwide. Sessions focused on medical content could be easily replaced for other disciplines by specific topics in Wikipedia, or by a more general review.
- *Active learning* - In today's world the classroom has been declared "dead", students refrain from attending lectures and educators call for a shift in teaching patterns (Boulos et al. 2006; Galway et al. 2014), Therefore, most core sessions were accompanied by interactive sessions and online exercises. Working in small groups allowed students to practice teamwork, provide constructive feedback and claim responsibility for knowledge constructed by a community of learners.
- *Deep Understanding* – Wiki projects form a complex, community-run universe, with unique language, culture and rules. After initial enthusiasm, this complexity causes most workshop attendees to stop editing. Such a course, then, allows students a longer and deeper learning process, enhancing their knowledge, literacies and skills.
- *Embracing Diversity & Collaborative Work* - many Wikipedians contributed to the course's success acting as guest-lecturers, mentors, and other assistants. Working closely with the community further exposed students to its diverse nature.
- *Numbers & Impact on the community* - Hebrew Wikipedia is a small community, with 150–200 editors. With 62 simultaneous online participants, students had to conduct themselves in a way that would not create additional work for volunteers by respecting guidelines and working in "sandboxes" before moving approved articles to Wikipedia.

2.3 General structure

The course was divided into three main parts. The introductory sessions aimed to provide a general sense of the Wiki-world as a collaborative knowledge construction platform on a global scale. The core sessions touched on the main subjects one needs to master in order to contribute to Wikipedia such as basic wiki syntax, references and notes. They also dealt with community-related issues, such as constructive feedback and peer review. The final sessions gave students a stage to share the insights gained throughout the course –allowing students to critically reflect on the process they went through and actively participate in the course. The final stage also allowed instructors to

gain insight on students' experience, helping improve and re-shape future iterations. The course was designed so that most work would be completed throughout the semester. Strict submission deadlines were set allowing time for peer review and making corrections before faculty evaluations.

2.4 Technological tools

Two main tools were used to manage the course and monitor students' progress - a course page on the university LMS system (Moodle) and a course page on Hebrew Wikipedia's Education Extension. The course page on Moodle was used to curate the various resources created throughout the course, such as the syllabus, lecturers' presentations and online exercises. It also contained a forum, serving as a communication channel between instructors and students. The course page on Hebrew Wikipedia helped curate and monitor the students' work for faculty, other students, and the Wikipedia community. The page also allowed assigning reviewers, which increased transparency and minimized reviewing duplicity.

2.5 Course requirements & assessment

Evaluating students' work was based on four components:

1. Attendance & active participation (10% of final grade) –

Unlike other elective courses, this course required mandatory attendance. Participation included taking part in class workshops and working collaboratively in small groups, participating in online discussions -, and filling a feedback e-form at course end.

2. Completing five preparatory, minor, assignments throughout the semester (25%) –

These included signing up for the course page, choosing an existing short article (a.k.a. "stub") to expanded and registering it, choosing a new article to write and registering it, peer reviewing and final presentation at the end of the semester. Timely completion of these assignments greatly contributed to the success of the course - it required finishing most of the work before the semester ends, thus allowing students to peer-review and present the results in class.

3. The third, and one of the two main assignments, was expanding a medical-related "stub" – an existing article, which is short in nature (30%) –

For this assignment, students were asked to choose an article to work on from an existing list of stubs in Hebrew Wikipedia.

4. Finally, the main assignment was writing a new medical-related article (35%) –

For this assignment students were given a list of missing / wanted articles in Hebrew Wikipedia. Students were also free to choose other topics provided the subject was first

approved by the instructor to confirm its encyclopedic value or notability. The articles were evaluated against both academic and wiki requirements - they had to not only include accurate, verifiable, quality content, but also be fluent, well structured and comply with the community rules and standards of contributing to Wikipedia.

3 Research goals & questions

Since contributing to Wikipedia in a dedicated academic course is a new concept, there is a lack of research regarding positive learning experiences (Zepke and Leach 2010; Garrison and Kanuka 2004; van Dinther et al. 2011; Paechter et al. 2010; Lea et al. 2003; Ames and Archer 1988), as well as effective teaching practices (Lee et al. 2015; Carbone et al. 2015; Jordan et al. 2010; Devlin and Samarawickrema 2010; Sajjad 2010; Biggs 1999) with Wikipedia. Therefore, the goal of the research described herein is to provide insight into these inter-connected aspects of the course. In order to gain understanding regarding the former, the study aims to examine the course design process and structure and their effect on students' learning experience, their perception of contributing to Wikipedia in a semester-long academic setting, and their self-perceived knowledge after the course. As for effective teaching practices, these need to be examined considering four main parameters – first, that the learning outcomes, i.e. the overall performance of students in the course as assessed by faculty, was satisfactory; second, that the students learning experience was a positive one; third, that the course staff had a positive teaching experience; and finally, that the course's overall flow reflected the design guidelines. Accordingly, the research questions are:

1. What were the course outcomes and to what extent have they been affected by gender, mother tongue and program of studies?
2. To what extent was the students' perception of the learning experience and course outcomes a positive one?
3. In what ways did students' feedback, learning outcomes and overall experience in the course influence teaching practices and course structure?
4. To what extent did the course have a lasting impact on students' perception of working with Wikipedia?
5. To what extent did the course have impact on academia beyond the course itself?

4 Methodology

4.1 Participants

Study participants included 62 Wiki-Med students who enrolled in the 2013 fall semester and completed the course requirements. These included 35 (56%) medical students, and 24 (38%) dentistry students. The course hosted 3 non-student participants: a faculty member, a PhD student from the Life Sciences faculty, and an administrative staff member. Out of 62 participants, 29 (47%) were female. Finally, 33 students were Hebrew native speakers, 26 Arabic native speakers and 3 Russian native speakers.

4.2 Data collection and analysis

A mixed-method approach was used to collect and analyze data from four main sources: 1) the course grades, which where comprised mostly from an evaluation of students' written articles; 2) a post-course questionnaire followed by meetings with a selection of students; 3) recordings of students' course-end presentations discussing their learning experience; and 4) a questionnaire followed by a limited number of semi-structured interviews, conducted 2 years after the end of the course.

4.2.1 Analysis of articles' quality and overall performance evaluation

A quality analysis of students' articles and an evaluation of overall performance were conducted at the end of the course. Unlike English Wikipedia, Hebrew Wikipedia does not employ a ranking system for articles' quality. Considering the numerous factors required for quality ranking, it was outside the scope and available resources of this study to perform a comprehensive qualitative analysis of the articles.

It is important to note that for students whose mother tongue was non-Hebrew, more weight was given to their overall effort and following encyclopedic article guidelines, rather than to article fluency and grammar.

4.2.2 Post-course questionnaire

The post-course questionnaire focused on students' learning experience, perception of contributing to Wikipedia, self-perceived knowledge after the course and overall assessment of the course and its staff. 56 students (about 90% of participants) filled out the questionnaire. In the first section students were asked to numerically rank (from 1 to 5) various aspects of the course. Adding optional free text comments on each aspect of the course was encouraged. In the second section, students ranked the lecturers and their sessions, again using quantitative evaluation ranking adding optional free text.

4.2.3 Students' presentations

In order to gain a deeper understanding of the learning experience in the course, video recordings of students' final presentations were analyzed. Students were asked to share their experience in the course, including reasons for choosing their topics, sessions they enjoyed, challenges they had and anecdotes from their learning process. The analysis began with transcribing important issues raised into short sentences. Then, the sentences were cataloged into main themed categories. Finally, the categories were used to check whether teaching or learning patterns that influenced the learning experience (either contributing or disrupting) could be recognized. Highlighting repeating patterns helped identify factors that have influenced the effectiveness of the learning experience.

4.2.4 Lasting impact questionnaire & personal interviews

Two years after the end of the first course, a second online questionnaire was sent out to participants. Six students responded (10% of the class) and four of them participated in

follow-up, semi-structured, personal interviews. Both the questionnaires and interviews were analyzed, with the goal of examining students' perception of their learning experience in retrospect and determining whether the course had a lasting impact. This questionnaire included four parts. The first evaluated changes in students' perception of Wikipedia as a reliable, neutral and collaborative platform, before and after the course. Most questions were quantitative, asking students to rate change from 1 (very weak), to 5 (very strong). Optional, free text comments allowed students to further express their thoughts. The second part was dedicated to evaluating changes in literacies and skills before and after the course. Again, students ranked the change and could add free text comments. The third part dealt with students' learning experience in retrospect, with a mixture of rating questions, multiple choice questions and optional textual comments. Finally, in the fourth part, students were asked to reflect on the course's importance and preferable format, using a mixture of rating questions and free-text comments. The personal interviews discussed the open-ended questions, asking students to share more details and reasoning behind their answers. The four interviews were recorded and key statements were transcribe and categorized.

5 Results

5.1 Course outcomes

Most students completed the course very successfully. The grades reflected an evaluation of students' overall performance, including a quality analysis of their written articles. Grades ranged from 80 to 100, with a class average of 93, and a standard deviation of 3.27. Since grade distribution is so narrow, when comparing grading statistics even minor differences of several percentage points can be significant. Since participants varied in gender, mother tongue and program, grades were analyzed according to these variables.

Grades' analysis found no significant impact of gender or program of studies. The only significant factor was mother tongue which reflected a clear advantage to native speakers – at 94.4 as compared to 91.08 for Arabic speakers and a 91.75 for Russian speakers. Highlighting the fact that non-Hebrew native speakers had to work harder and overcome challenges. However, these students compensated with enthusiasm, higher involvement and more effort put into assignments, including final class presentations. Without taking into account 'effort' as an integral part of the grading mechanism, the language-induced grading gap would have been significantly larger.

In terms of content generation, the course resulted in 64 new articles in Hebrew Wikipedia and 64 expanded stubs, most of which had previously less than a paragraph of content and were missing crucial information. Many of these 128 medical-related articles focused on basic and common medical phenomena: the top 10 mostly viewed course articles includes basic topics such as "blood test", "white blood cell", "hematology", "pathology", "endocrinology", "neurology", "edema", "urology", "cell tissue", "albumin" and "cardiac arrest". A Wiki tool was used to monitor total page views for each article created or expanded in the course from November 2013 to April 2016. The graph in Fig. 1 below shows aggregated page views per month, clearly demonstrating that articles continue to be viewed consistently over the 30 months

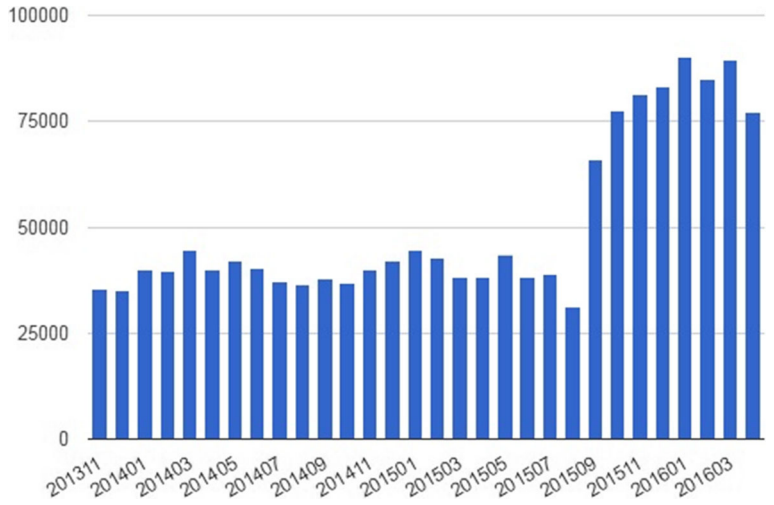

Fig. 1 Number of page views per month

period. The increase in page views from September 2015 is attributed to an update of the monitoring tool to include views from mobile devices. As of April 2016, the articles were viewed a total of 1,349,296 times. However, if mobile device views are taken into account and extrapolated back for the entire time period, it is estimated that articles had been viewed over 2.5 million times.

The data indicates that the total number of views is steadily growing (rather than having a peak of views that drops over time), attesting to a positive course impact - making sought-after medical information readily available.

5.2 Students' learning experience and perception of the course's outcomes

Both questionnaires and student presentations were used to gain insight into the students' learning experience and perception of the course's outcomes. The students were asked to rank the course's various elements between 1, being the lowest, to 5, being the highest. The quantitative part of the questionnaire shown in Fig. 2 below reveals that the students ranked the course's structure, organization, and overall quality at 4.1–4.2 out of 5. The students assessed their own learning outcomes at 4.4, indicating a very high level of self-perceived knowledge.

Most of the insights regarding students' learning experience stemmed from the qualitative comments. The three main groups of comments dealt with the following topics:

- Course's structure and assignments (21 comments)
- Learning outcomes and overall assessment (23 comments)
- Course coordinator & her influence on the learning experience (16 comments)

The first general comment was that despite its labor pains, the course was interesting, unusual and innovative. It allowed students to expand their horizons and learn more about a platform they use almost daily. Various students stated that the course

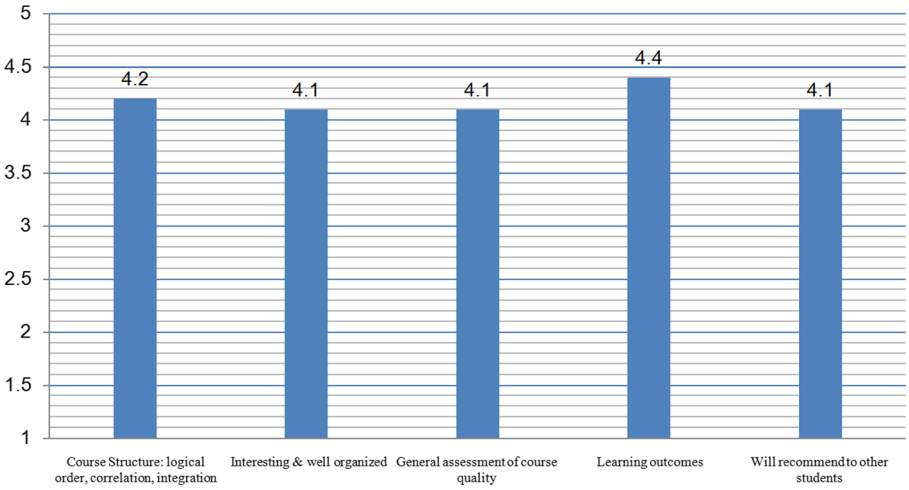

Fig. 2 Course evaluation: quantitative assessment from1 (lowest) to 5 (highest)

helped them sharpen their academic skills, specifically finding and assessing academic sources and merging them into a coherent text. Another aspect mentioned was the good atmosphere in class. Students appreciated the enthusiasm and passion of their lecturers, as well as the support, encouragement, and rapid assistance they received, most notably from the course coordinator. The majority of students noted that a key aspect of the course was being able to give back to their community.

An aspect reported to hinder a productive learning experience was the structure of the core sessions. Two-thirds of the core sessions (approximately 60–70 min), were allocated to learning a specific aspect of editing in the format of a lecture and discussion. The remaining 15–20 min were used for Moodle practice in small groups. Students were divided regarding the group activity format; some found it extremely useful, while others found it unproductive. Most agreed that the length of the group activity was not sufficient to be productive, and would rather have a dedicated workshop session. Some comments focused on the exercises, helping to map which were helpful and which require revision. A small number of comments suggested that some lectures were too technical, stating that technical issues are better learned individually, while class sessions should be dedicated to more in-depth discussions and practice. Finally, some mentioned that timely feedback on the first main assignment would have helped them better write their article. A translated sample of students' comments is presented in Table 1 below.

These issues, as well as others, have been considered while revising the syllabus for the consecutive years, and would be discussed later in this section.

Student presentations at the end of the course allowed a deeper understanding of their learning experience. Instructions were purposely vague, to allow students to express themselves freely and help expose issues. Presentations' analysis revealed that students mainly addressed three themes that were later internally categorized, focusing on inhibiting or supporting patterns – reasons for choosing their subject, sources and anecdotal information regarding their experience in the course. The first theme, reasons for choosing their subject, was an aided question. The reasons for choosing a subject

Table 1 Sample of Students' comments

"It's a shame this course is only an elective. All students should take it, as they are missing out on something very important and fascinating."
"A very significant course that should become a flagship at the Faculty. It encourages the doctors of the future to be able to explain complex medical issues in simple and understandable language… I'll be happy to be in a group of students that help perfect it for the future."
"I believe the main idea of the course is great, and it's really important that the course coordinator is committed and enthusiastic, but there are a few things that could be done differently, like the group work and making some of the lectures more interesting."
"The course has very good potential. Some lectures were a bit too technical… but all in all I really enjoyed it! Thank you!"
"… It was one of the most helpful courses this semester and really allowed us to give back to the community. Although I would change a few small things, I think the course should continue because its contribution is simply tremendous."

(multiple replies allowed) are depicted in the Fig. 3 below and reveals that most students (28) chose a topic they found interesting, while some worked on topics that they found important (23 students) or personally relevant to them (20 students).

The second main theme was article sources and the number of students mentioning each source type appears in Fig. 4 below. Analysis revealed that some (26 students) translated articles from other languages (mainly English), while others (23 students) relied on external sources or conducted personal research and interviewed experts on their subject (8 students). Some students, especially non-native Hebrew speakers, mentioned difficulties using sources in other languages.

Finally, students shared anecdotal information regarding their experience in the course and the breakdown each sub-category appears in Fig. 5 below. The first sub-category was the positive learning experience mentioned by 24 students, which was enabled by contributing to the greater good, the good atmosphere in class, support from

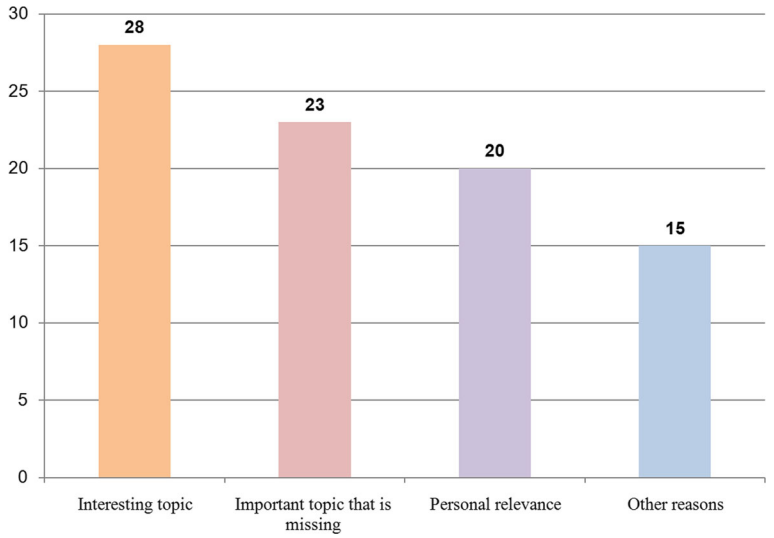

Fig. 3 Reasons for choosing articles summary

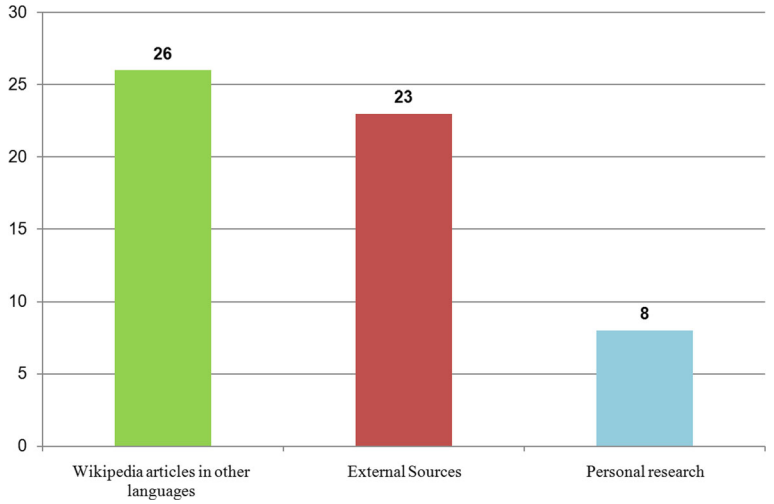

Fig. 4 Sources summary

course staff, and using the learning of this course in other courses. Some students (13) referred to various challenges in the course, most of which focused on technical issues and language barriers. Finally, 9 students commented on community input - both peer-evaluations and input via talk pages was another sub-category mentioned.

In summary, the most important factors that were revealed from the analysis of the presentations were the inhibiting and prohibiting factors of a good learning experience, which are summarized in Table 2 below. Analysis of both the written comments and presentations highlighted patterns that contributed to a positive learning experience, such as working on interesting or important topics, expanding horizons, studying in a positive atmosphere, overcoming obstacles, sharpening skills, being supported by staff and giving back to the community. Analysis of both the written comments and presentations also highlighted patterns that inhibited students' learning experience,

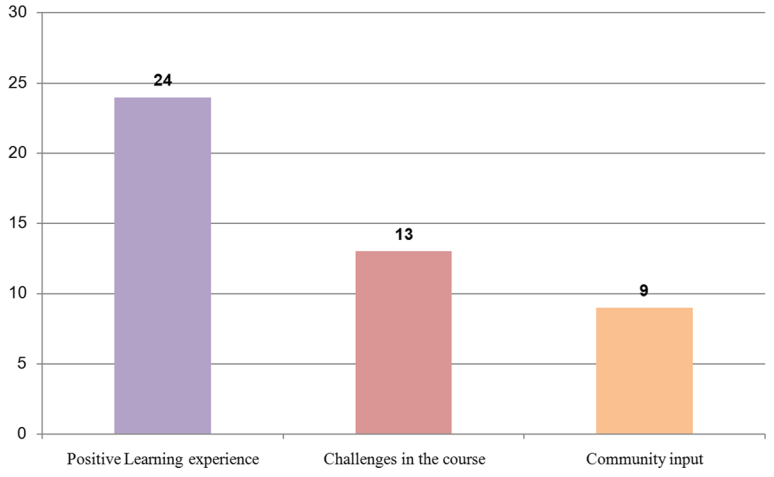

Fig. 5 Anecdote summary

Table 2 Contributing and inhibiting patterns

Contributing patterns	Inhibiting patterns
Working on topics that matter / interest	Mixed structure of core sessions
Sharpening academic skills	Not enough time for group sessions
Expanding horizons	Not being able to choose what to work on
Learning in a positive atmosphere	Technical difficulties
Overcoming obstacles	Lack of sources
Enthusiasm of course staff	Language barriers
Receiving support and encouragement from course coordinator and others	Missing timely feedback
Receiving feedback	
Giving back to the community	

such as mixed structure of core sessions, lack of time in group work, technical difficulties, missing timely feedback and language barriers.

5.3 Effects on teaching practices and course structure

Reviewing the course's results indicates that specific changes to the course syllabus and organization, both academically and administratively, could improve the learning experience and teaching practices. These changes stem from considering two main factors: conclusions from designing and moderating the course; and the practical feedback received from students. The challenges faced while designing the course included designing sessions that familiarize students with the necessary wiki lingo and toolset in an interesting, not too-technical way. It was also essential to address students' varying levels of computer skills, and encourage students to work collaboratively. Another challenge was making sure students do not copy-paste existing content, which is especially critical in Wikipedia, where copyrights violations are not tolerated. Finally, the biggest challenge was a timely evaluation of students' work, reviewed both from an academic as well as from a Wikipedian point of view. This is a well-known issue when scaling and increasing the number of participants (Palomo-Duarte et al. 2014). Naturally, the amount of articles correlates with the number of participants. Therefore, unless a new evaluating method is used, the number of students per semester limits scaling possibilities.

These challenges, together with students, feedback, resulted in changes to the course's structure in the consecutive academic year. First, three whole sessions were dedicated to practical editing workshops. The other sessions focused on specific topics while reducing the number of guest lecturers and adding discussion topics. Moodle online exercises were abandoned and content was reviewed during the discussion part of each session. A new mini-assignment focusing on copyrights violations resulted in a drastic decline in copy-paste issues. A new session on Wikidata was added, exposing students to its importance and its possible implications on future research. In addition, added emphasis on peer

evaluation resulted in meticulously timed assignments and better understanding of giving and receiving constructive feedback. A special session was partly dedicated to highlighting frequent questions and mistakes using examples from students' own work. This timely feedback assisted students in perfecting their articles and having an overall better learning experience. The course coordinator's feedback combined with peer review allowed students to move forward with their full-length articles during the semester. It also alleviated pressure from the course staff, allowing the postponement of comprehensive feedback to after the course end. Finally, the number of course participants was limited. This decision helped manage the severe strain on faculty during assessment "peaks", and enabled a more a personal atmosphere in class. However, it also naturally reduced the course's overall impact on Hebrew Wikipedia, as will be discussed in the concluding section of this article.

5.4 Students' perception of lasting impact

Two years after the course ended, a second questionnaire was sent to students. Six students replied, − two females; five Hebrew natives and one Arabic native speaker; five medical students and one dentistry student. Four respondents also participated in follow-up interviews to explain and elaborate on questionnaire answers. Although a reasonable representation of the original class composition, it is a small sample size, which cannot be used to be inferred from on the class as a whole. However, the replies allowed some insight into the students' perceptions of the course in retrospect.

5.4.1 Changes in students' self-perception of Wikipedia

Results showed a strong change of perception of Wikipedia as a reliable source (average = 4) as before the course most students questioned Wikipedia's reliability. Interestingly, before the course, students less questioned Wikipedia's neutrality (neutral point of view average = 2.8). Finally, the perception of Wikipedia as a collaborative environment showed a slightly stronger change, with an average of 3.5. Interviews revealed that some students did not know that articles are being edited collaboratively. In summary, the majority of replies indicated a strong change in Wikipedia's perception two years after the course.

5.4.2 Changes in course-related literacies and skills

Change in literacies averaged about the same, with of 2.7 for digital literacies, 3.3 for academic literacies and 3.0 for collaborative skills. Most students' felt they had possessed a good digital literacy base that the course further enhanced. There was a somewhat stronger enhancement of academic skills. And finally there was a consensus that the course contributed to collaborative work skills.

In summary, most students felt the course positively contributed to their digital literacy, academic literacy and collaborative skills. Depending on background and experience each student found different parts of the course to be meaningful and useful - even two years later.

5.4.3 Students' learning experience in retrospect

Results revealed that all students remembered certain sessions, lecturers and topics positively even two years later. All students remembered the learning experience as highly positive (average of 4.7), interesting (4.3) and inspiring (4.3). While some students had constructive criticism, as will be further discussed, they still found the overall experience positive. As a consensus, students were satisfied and proud when their articles became available on Wikipedia with an average of 4.7. All Students shared their experience with friends and family (average of 4.5). And all would recommend the course to others.

Four students kept editing Wikipedia after the course and the other two believed they will edit in the future. The fact students mentioned future editing as an option, indicates that they understood the importance of contributing to Wikipedia, and have both the will and the skills to do so. In summary, results indicate that even two years down the road, students' perception of the learning experience remained a positive one and that some of the themes and ideas were still vivid in students' minds.

5.5 Impact beyond the course

The course had a number of unexpected results, the most imperative of which is the overall reception by its various stakeholders, including the Hebrew Wikipedia community, students, academic staff, and the Academic Affairs Committee that has approved the continuation of the course in the coming years. The course also received a surprising level of media coverage. After the course third iteration, and based in part on students' own suggestions to expand the course to related fields, the curricular committee at the Life Sciences faculty at TAU has also approved the course. Thus, as of the 2016 fall semester, Wiki-Med will be also offered to life sciences students.

Moreover, building on this course, the author has developed a similar elective course, available to all undergraduate students at Tel Aviv University. The new course, opened in the fall 2015 semester, allows students from all disciplines to contribute to Wikipedia. Finally, other education institutions have expressed interest in offering similar courses to their students and exploring other ways of implementing Wikipedia into their programs and curricula. These new horizons will be explored in the coming academic years.

6 Conclusions & discussion

6.1 Conclusions

In his famous play "Man and Superman", George Bernard Shaw writes, "The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore, all progress depends on the unreasonable man" (George Bernard Shaw, *Man and Superman).* According to Shaw, then, one has to be a tad unreasonable to command progress. Such "unreason" is also reflected in the last of the five pillars of editing Wikipedia, calling contributors to "ignore all rules" and "be bold" when needed. This last pillar follows the first four: Neutral Point of View,

Verifiability, No original research and Notability. These rules need to be taught and practiced for Wikipedia to endure and remain one of the most visited websites. In that sense, it appears that despite its "boldness" and labor pains, the Wiki-Med course results indicate that it has been successful. Its main goals were achieved - have a positive impact on the general public and the learners; equip students with tools to become productive contributors to the free knowledge community; sharpen students' academic and twenty-first century skill; and finally, offer a new pedagogical model that could be adopted and further explored. However, as can be expected from any initiative practiced for the first time, there has been room for improvement. As Boulos and his fellow researchers put it, new technologies should continue to be "systematically evaluated to ascertain their benefits and limitations in a number of learning contexts, and to determine and document their proper use for higher education" (Boulos et al. 2006).

The accumulated experience of designing and implementing the course, as well as the related research have been used to fine-tune the course model, which influenced both the teaching practices and the learning experience. Beyond perfecting the course, this research could be used in a wider educational perspective. It is the hope of these authors that despite its limited scale, this study will encourage further adoption of the Wikipedia platform for academic purposes, and that the presented course model will be reused in a variety of disciplines and academic institutions. It is also hoped that insights gained from this innovative and unique experience, will help perfect and scale future academic endeavors, for the benefit of educators, learners and the general public.

6.2 Discussion & future research

Clearly, in such a course model the number of participants directly impacts the overall class contribution to open knowledge. The extent of contribution per course is important mainly since it affects the morale, good will and support of all stakeholders – faculty, students, and the Wiki community. It is therefore necessary to find new, innovative ways of scaling, allowing more students to participate in the course per semester, while keeping it manageable for academic staff and the wiki community. One such possibility is using a more elaborate peer-evaluating methodology, in which each article is strictly reviewed at least 3 times before being finally submitted - a self-evaluation and two additional peer evaluations. This methodology has been reported to give the same end results as a teacher's evaluation (Sadler and Good 2006), and has been adopted as a credible evaluation methodology in Massive Open Online Courses (MOOCs) run by Coursera (Piech et al. 2013). This method has been successfully incorporated into the course in the academic year 2015–2016. However, further research is needed in order to explore the efficacy of this method, as well as other scaling possibilities and their impact on teaching practices and students' learning experience and outcomes.

It is important to note that scaling would become increasingly viable as technological tools develop. During 2014–2015, three online wiki tools have been developed, deployed and integrated into the course. The first is a Hebrew online Wikipedia editing tutorial for newcomers developed by Wikimedia Israel.

The second is a wiki translation tool, which allows easy translation of existing Wikipedia articles from one language to another. The third is a wiki tool that is meant to check copyright violations, i.e. copy-pasting from other online sources. These tools have the potential to revolutionize the way Wikipedia is being taught and used in educational and cultural institutions (GLAMs), as well as within the community. Using these new tools, and developing missing ones, is already in progress. However, further research should be conducted to evaluate their effectiveness and impact on teaching practices, learning experience and user retention. Moreover, further research is needed not only regarding new tools, but also regarding Wikipedia's latest sister-project, Wikidata, launched during 2012–2013. Wikidata is "a free and open knowledge base that can be read and edited by both humans and machines" (Wikidata). As such, it has a potential to revolutionize the way research is conducted, as well as the way medicine is being practiced, for example by using Wikidata quarries during a medical diagnosis process. It is therefore critical to not only expose students to its existence, but also examine it as a teaching tool worthy of academic research.

Since Wiki-Med was a thematic course, focusing on Wikipedia contribution in a specific academic discipline, future research efforts should include the effectiveness of adopting this course model into other thematic disciplines. Such research should also include adoption of the model into courses with audiences from varying academic backgrounds, as well as into other wiki projects, such as Wiktionary and WikiSource. Research should also examine the efficacy of adopting the course model in advanced studies, working with M.A. and PhD students, who represent higher levels of academic maturity. It is also extremely important to explore new and productive ways to include more academic staff as active collaborators and contributors. Finally, further research is needed to explore the long-term effects of this course and its future variations. Such research should examine the course's effect on learners' academic development, level of creativity, self-perception of collaborative knowledge construction, and long-term contributions to the free knowledge movement beyond the scope of the course and its academic surrounding.

6.2.1 Limitations

Only 62 students participated in the course and research and only 6 in the final questionnaire, mostly first year students of medical professions studying at Tel Aviv University. Variables such as background, mother tongue, age, length of studies, academic experience, academic discipline and affiliation with a specific educational institution could affect learning outcomes. This relatively small sample, as well as its thematic academic focus, did not provide an opportunity to look into how these variables might affect the course and induce different results. The fact that not all students were able to contribute to Wikipedia in their native language is also a limiting factor, which has affected the outcomes of the course, students' learning experience and self-perception of knowledge. Finally, the fact that the author of this paper and its main researcher, was also the course initiator and coordinator, could be limiting. However, since this paper reports on various practical matters, this limitation could, in effect, be found as an advantage.

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Compliance with ethical standards

Conflict of interest The main author works at the American Medical Program at Sackler School of Medicine, Tel Aviv University, focusing on curriculum development & E-learning strategies. In her capacity as a volunteer, she is also an active contributor to Wikipedia and other Open Source and Open Knowledge initiatives. The course described in this paper has been part of the Israeli Medical Program at Sackler and there has been no financial or ethical conflict of interest related to the subject matter of the article.

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