

Wikipedia in university courses: teaching practices and educational benefits

Corrado Petrucco

University of Padova, Italy, corrado.petrucco@unipd.it

Abstract

The academic world initially regarded Wikipedia with misgivings for a number of reasons, including the uncertainty concerning the reliability of its content, its anonymous authorship and the fact that students often use it as an easy way to cut and paste material for their coursework. In recent years, however, university instructors' perception of Wikipedia has changed significantly: it is seen as a useful teaching resource, as well as a promising environment for learning and collaborative knowledge building. It can be used for teaching purposes by assigning students to create and edit encyclopaedia articles. Such assignments can have many benefits: in addition to improving students' understanding of content, the assignments have been shown to increase their intrinsic motivation to learn, develop digital competences and build cross-cutting skills in online communication and interaction. Lastly, in connection with universities' institutional role, editing Wikipedia can be an interesting channel for the public communication of science.

Keywords: *Wikipedia, learning environment, teaching practices, teaching strategies*

Introduction

One of the most important educational challenges that universities must face in the coming years is that of providing students and faculty with effective tools and methods for learning to build and share knowledge openly and cooperatively. The world is becoming increasingly complex, and solving problems in every field of human inquiry calls for gaining or developing cross-cutting skills that encompass communication, finding and selecting information, and mutual collaboration. At the same time, it calls for online environments where knowledge is free, broadly accessible and codifiable (Scardamalia et al., 2012). From this standpoint, Wikipedia can be particularly interesting for use in the university setting, both as an active environment for building and disseminating knowledge in society, as well as for providing encyclopaedic support for disciplinary content.

With its 48 million articles in 298 different languages,¹ Wikipedia is one of the most successful examples of online collaboration, as it fulfils the need for readily accessible encyclopaedia articles from verifiable sources. Moreover, all published content is freely licensed and can be quoted or copied. As a result of the daily contributions of thousands of editors, Wikipedia is checked constantly, with the editors correcting any errors and improving content by following a working protocol that puts particular emphasis on a rigorous approach to selecting and citing the online and hardcopy sources for each article. Indeed, Wikipedia has very precise policies for drafting articles, especially regarding the use of reliable sources and maintaining a neutral point of view (NPOV), i.e. writing articles from a fair and balanced standpoint without political, religious, gender or social bias.

This paper presents a study based on a literature review and an analysis carried out in order to identify the best teaching strategies to be used with Wikipedia in a university course, as well as highlighting its potential advantages in terms of improving students' learning performance and enabling them to gain specific skills.

¹ https://en.wikipedia.org/wiki/Wikipedia:Size_of_Wikipedia

1. Changing perceptions of Wikipedia at the university

Students use Wikipedia (Selwyn & Gorard, 2016) both informally in their daily lives and as an academic resource, precisely because it provides them with a fast, flexible and easy-to-use source of knowledge (Blikstad-Balas, 2016): Wikipedia is readily accessible to students and its content is generally written in a clear, straightforward style, which students appreciate for the support it offers in gaining an overview of specific subjects, which can then be followed up through the sources cited in the entries. In this connection, it has been found that university students' use of Wikipedia rises steadily throughout the semester and peaks during examinations, although the mean Wikipedia session length is <2 minutes. This would appear to suggest that students use Wikipedia to meet their needs for immediate clarification concerning a topic or to find a specific bibliography, rather than as a study material per se (Trotman & Alexander, 2009). University instructors, and teachers in general, initially viewed their students' use of the online encyclopaedia unfavourably, while admitting that they frequently used it themselves (Head & Eisenberg, 2010). In addition, many databases and indicators of the quality of research do not currently acknowledge contributions to Wikipedia, which may explain some of the lack of motivation to participate in writing encyclopaedia articles. This negative attitude was due to a number of misconceptions that cast doubt on the effectiveness of Wikipedia's revision, oversight and control process, given the lack of an editorial board. In particular, criticisms have concerned the following:

- 1) Reliability of content, as anyone can create and edit it;
- 2) Shared authorship, or in other words, the possibility that the author of an article may not be identifiable;
- 3) The risk of plagiarism, i.e. the fear that students will use Wikipedia as a quick way to cut and paste material.

In attempting to analyse these criticisms, we can say a number of studies seem to have demonstrated that they are unfounded, and that Wikipedia's major problem does not lie in its poor reliability or lack of recognised authors, but in the low level of accuracy and completeness of some articles, especially those dealing with domains of specialised knowledge (Giles, 2005; Magnus, 2009; Kim et al., 2010). Though the problem of anonymity and the fact that a given article may have been edited by dozens – or even hundreds – of people over time has been viewed as critical, since it runs counter to academia's traditional model of scientific production, other studies have found shared authorship to be reliable. As for the risk of plagiarism, though it certainly exists for Wikipedia, this is no less true for any other documentary resource that can be found online. In any case, instructors should at least be familiar with what Wikipedia contains in the subject they teach, as students will doubtless consult it and, if the content proves to be satisfactory, it can be included among the teaching resources as an entry point that enables students to get started on specific topics. Conversely, if the content has shortcomings or the topics at hand are not covered, this can provide instructors with an opportunity to engage their students in a Wikipedia editing project, adding and/or revising encyclopaedia articles.

Over the years, however, the academic world's perception of the online encyclopaedia has changed, as is indicated by a recent quantitative study that found that Wikipedia even appears to be having a significant impact on academics' language usage: indeed, words and phrases that have previously appeared in the encyclopaedia's articles are also more frequently used in scientific papers (Thompson & Hanley, 2017). This change in attitude has undoubtedly been influenced by the fact that many academics, once their early scepticism had been overcome, have begun to use the encyclopaedia more frequently in their research as well as in everyday contexts, learning its rules and methods of interaction. Courageously, some academics have become authors themselves by creating and editing entries in their own disciplines, though their contributions are generally limited to articles that are already considered reliable (Occhipinti, 2015). Colleagues' opinions about Wikipedia also appear to be an important factor: the more a faculty member thinks that colleagues have a positive attitude towards Wikipedia, the higher is the perceived quality of the encyclopaedia's articles and the higher the perceived usefulness of Wikipedia on the whole will be (Meseguer-Artola, Aibar, Lladós, Minguillón & Lerga, 2016). Faculty members' participation in online open collaborative environments also has a significant influence on the perceived usefulness of Wikipedia and the intention to use it for teaching purposes.

2. Potential educational benefits with Wikipedia

Assigning students to edit Wikipedia articles can have many educational benefits: it can enhance students' digital literacy and critical research skills, promote collaboration and motivate students more than traditional assignments (McDowell, 2017). The most important benefits include the following:

- 1) Developing digital competences: DigComp 2.1, the European Commission's Digital Competence Framework (Carretero, Vuorikari & Punie, 2017) presents a complete, recent taxonomy for developing digital competences. Editing encyclopaedia articles makes it possible to develop at least the first three competence areas contemplated by the framework, viz., Information Literacy, Communication and Collaboration, and Digital Content Creation. Information

Literacy competences consist, for instance, of knowing how to find documentary resources online using search engines and the university libraries' online public access catalogues (OPACs) and of assessing the quality of the sources to be cited in the encyclopaedia article. Communication and Collaboration competences can be acquired in the group assignments and in following the rules for interacting and negotiating with the encyclopaedia's other editors. Lastly, Digital Content Creation competences also include understanding the concept of copyright, and, in particular, the concept of the Creative Commons (CC) licensing system used for Wikipedia articles. All Wikipedia texts are released openly under a Creative Commons Attribution-Share Alike (CC-BY-SA) licence, which permits them to be freely reused and adapted provided that the final text is then released under the same licence as the original and that appropriate credit (attribution) is given to the author or licensor, at least by proving a link to the licence. Wikipedia can thus be considered a true Open Educational Resource (OER) and can provide many of the impacts typical of such materials as defined by the OER Research Hub, a project at the UK Open University (Weller, 2015). In particular, using OERs can have an impact on the following: on performance, as it leads to improvement in student performance and satisfaction; on transition, as open education acts as a bridge to formal education and is complementary, not competitive, with it; on policy, as participation in OER pilots and programmes leads to policy change at an institutional level; and lastly, as we see herein, on assessment, as informal means of assessment are motivators to learning with OERs.

2) Increasing intrinsic motivation: in many initiatives involving Wikipedia, students have reported a high level of motivation, both to complete the assignment and to find out more about the topics concerned, and regard the work as having far more value than any other written exercise or assignment (Roth et al., 2013). This perception is especially apparent when students begin to consider themselves not only as users but also as creators of high-quality information and knowledge. In particular, the fact that the encyclopaedia article is made public and could then be read by thousands of people always has an empowering effect (Rafaeli & Ariel, 2008), which also provides a sense of satisfaction in producing something that is useful for the community: it is no coincidence that a small but significant percentage of students continue to monitor and edit the entry – which they regard as their own by now – even after the assignment has ended. Indeed, a survey of almost 180,000 Wikipedia editors around the world (Rudiger, Schmidt & Rishab, 2010) found that the idea of sharing knowledge was important or very important to >73% of the participants.

3) New forms of formative assessment: teaching assignments with Wikipedia can make it possible to test interesting new forms of assessment that complement traditional methods. During assessment, the instructor usually checks the quality of the content of the encyclopaedia entries and the bibliographic references cited by the individual student and/or by the work group as a whole. Specific grading rubrics can be used for this purpose.² But students can also be assessed on the basis of, for instance, their skills in Information Literacy and collaborative writing, or their skills in dialogue and communication when responding to feedback from other Wikipedia editors: such feedback generally consists of modifications or deletions in the encyclopaedia entry, which, if not accepted, necessarily require that the students interact with whoever made the changes. This process is extremely educational for the students, as they must learn to substantiate their choices with sound arguments and reach a consensus on the content.

Essentially, this is a co-participatory formative assessment, no longer carried out only by the instructor but open to actors from outside the university, who – in general – are Wikipedia users with a knowledge of the discipline concerned. Feedback from users as a whole can reach levels of quality that are very close to those of actual experts (Cope, Kalantzis, Abd-El-Khalick & Bagley, 2013), and the process is a good example of crowdsourcing (Surowiecki, 2005; Zheng, Niiya & Warschauer, 2015). These kinds of formative assessments have been shown to be extremely effective, especially in improving student performance, with an effect size of 0.90 (Hattie, 2009); moreover, they are oriented equally towards the process and the product. Indeed, formative assessment takes place alongside the teaching/learning processes and provides immediate, targeted feedback to the students, thus triggering forms of self-directed learning (Scardamalia et al., 2012; Cope & Kalantzis, 2015).

4) Participating in an online community outside the university: in editing or creating Wikipedia articles, instructors and students inevitably come into contact with the online community of Wikipedians, who interact with them in revising entries and checking that the rules are followed. This experience is extremely educational and can subsequently lead students to become active members of the community (Farzan & Kraut, 2013). However, it should be stressed that there is an important distinction between the practical community that collaborates spontaneously on the one hand and those who are 'forced' to do so as part of academic or university learning on the other. This could entail significant differences in attitude and motivation (Wannemacher, 2009). Participating in a community such as Wikipedia, in fact, makes it possible to develop two aspects of the collaborative process: interaction between peers, which encourages negotiation and the co-construction of artefacts, as well as an apprentice–master relationship, typical of 'legitimate peripheral participation' (Lave & Wenger, 2002; Baytiyeh & Pfaffman, 2010). However, it must be borne in mind that this collaborative process takes place outside of the 'protected' university environment and involves unmediated social interactions, in which students may often have to deal with people who do not always abide by netiquette rules. In addition, they have to bring all of their skill in dialectics and argumentation into play in order to 'defend' the entries they have added from changes or deletion by other Wikipedians (Brailas et al., 2015). From this standpoint, it is a form of 'meaningful' learning to build knowledge through dialogue (Hernandez-Serrano, Choi & Jonassen 2000), as

² https://commons.wikimedia.org/wiki/File:Wiki_Education_Classroom_Program_example_grading_rubric.pdf

participants must formulate questions and provide answers in turn and are, thus, exposed to many interpretive perspectives and, therefore, are required to articulate and explain the concepts or information they express.

5) Social benefits and the university's 'third mission': Wikipedia can have an important role as a means for the public communication of science (Brossard and Scheufele, 2013; Halfaker and Taraborelli, 2015): every day, millions of people turn to it for information on an enormous range of topics, including such topical social or medical issues as the recent controversies over the need for vaccinations or for an authoritative source to counteract fake news. People look for information written in simple, understandable language, but which is – at the same time – scientifically accurate, reliable and comes from verifiable sources. In this connection, the university is not only a centre of education and research: it also pursues a third mission, viz., working to ensure that knowledge contributes to society's cultural, social and economic development. Accordingly, editing and improving Wikipedia articles can be an important service that the university provides to society.

3. Teaching strategies for using Wikipedia in education

Wikipedia is not a simple cognitive place: it is a singularly complex environment. If used as an educational resource, it cannot be treated in the same way as a book or an ordinary encyclopaedia; rather, it must be used together with specific educational strategies to ensure that it is as effective as possible in each teaching–learning process. Far from being a traditional encyclopaedia, Wikipedia is an innovative social process of collaborative knowledge building, whereby a community of millions of people has, over time, created not only the content but also software tools based on Wiki technology and the precise rules for using them. The literature confirms that the use of advanced technologies does not in itself guarantee a significant difference in improving learning processes (Rushby & Seabrook, 2008): they have a small-to-moderate or neutral effect size (Hattie, 2009; Tamim et al., 2011), or even, in some cases, negative effects, derived, in particular, from cognitive tasks that exceed the capacity of working memory, a problem that is well explained by the Cognitive Load Theory (Sweller et al, 1998). What makes the difference is a well-informed choice of teaching models and strategies capable of informing practice: the literature also indicates that outcomes improve significantly if, for instance, advanced technologies are used together with teaching strategies that support collaborative-constructive learning processes (Higgins, 2014).

A simple theoretical framework such as Technological Pedagogical Content Knowledge (TPACK) can help us clarify the skills that instructors need to effectively integrate technology tools in their teaching practices. TPACK is a blending of three types of 'knowledge', viz., 1) Content Knowledge (CK), or knowledge about the actual subject matter to be learned or taught; 2) Pedagogical Knowledge (PK), or knowledge about the teaching methods and practices; and 3) Technology Knowledge (TK), which involves the knowledge related to technologies to be used in teaching and learning activities. As Mishra and Koehler (2006) note, 'how to use technology is not the same as knowing how to teach with it'. In our case, the instructor should, for instance, show a mastery of the following: 1) Content Knowledge (CK) of the topic to be covered in the Wikipedia article; 2) Pedagogical Knowledge (PK) of collaborative and cooperative learning strategies, given that in most of the initiatives involving the use of Wikipedia in teaching described in the literature, students work collaboratively and cooperatively in groups to create new articles or edit existing ones; 3) Technology Knowledge (TK) concerning Wikipedia editing procedures and the advanced use of search engines and OPACs in efficiently retrieving content and bibliographic references.

Using Wikipedia in teaching calls for attention during the initial stage and throughout the project. At the beginning, it can be very useful to arrange a meeting between the students and an expert Wikipediaian who can explain the rules for editing Wikipedia articles: otherwise, as we will see, there is a risk that students' entries will be deleted by the community. This is one of the reasons that it is advisable from the outset to have one or more sufficiently expert mentors who follow the project together with the instructor to provide students with support and monitor their work. Lastly, when designing teaching assignments in a specific discipline, it can be useful to read some of the current projects that can be found in Wikipedia under the heading 'School and University Projects'.

4. Possible difficulties with Wikipedia assignments

As mentioned earlier, the literature indicates that teaching with Wikipedia can entail a particular set of problems. It is interesting to analyse them on the basis of Activity Theory (Engeström, 1999), as illustrated in Figure 1. This theory suggests that each individual's activities are situated and distributed among the subject, the available tools and the community concerned. The relationships between the subject and the object of the activity are thus always mediated by *tools* (physical or conceptual), by *rules*, by the interactions with the *community* and by *collaborative* procedures. It is important to point out that every Wikipedia article is a shared digital artefact, and revision methods are codified in rules. These rules must be followed to avoid the risk of being excluded from the community. The elements of an activity system frequently exhibit contradictions. Accordingly, if we try to adapt this theory to students' activity with Wikipedia (Bryant, Forte & Bruckman, 2005), we see that it can aid in interpreting the interactions between all of the elements involved: the subjects, the community of Wikipediaian, the software tools used, the editing rules and the

cooperative/collaborative distribution of work. In order of increasing importance, the contradictions involved here arise from the following:

- 1) In students' participation in the work group creating the article;
- 2) In using Wiki software to edit articles;
- 3) In following the rules for editing and creating Wikipedia articles;
- 4) In **the dialectical relationship** with the community of Wikipedians.

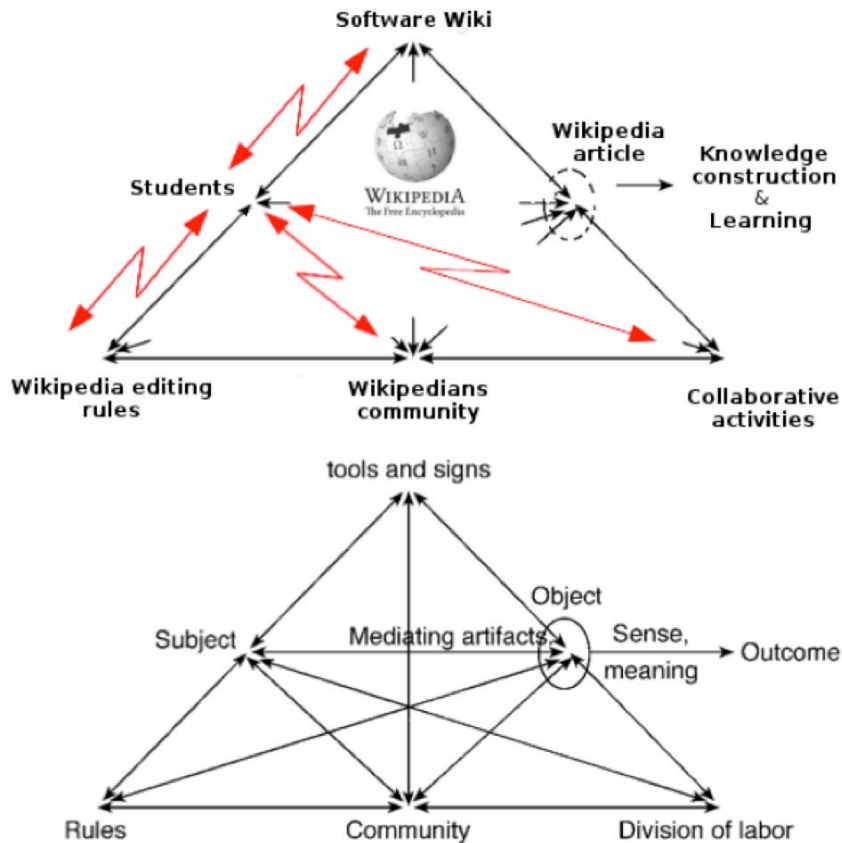


Fig. 1 The Wikipedia editing process as interpreted with the Activity Theory. The contradictions that can interfere with students' work are indicated by broken arrows.

As for the group activities, the most frequently reported problem – aside from the conflicts that can arise between group members – occurs when one or more students contribute little or nothing to the editing work, which can slow down article production and detract from quality. To avoid this problem, it is advisable that each group work in its own forum and that the instructor or mentor monitor the forum continually, contacting the students who interact infrequently. Another problem that is frequently encountered is the difficulty in using Wikipedia's editing software, although the MediaWiki Visual Editor was recently (2017) introduced with the goal of removing avoidable technical impediments associated with the old Wikimedia's editing interface.

Failure to follow the rules in creating encyclopaedia articles and the consequent dialectical conflicts with the Wikipedian community are the most critical problems: if unresolved, they can – in many cases – result in the entry being deleted within a few days or in an immediate request for changes. In general, problems involve insufficient notability, copying and pasting (plagiarising) texts from other sources or not taking an NPOV towards facts or people. Fortunately, when there are disagreements or divergent interpretations of the content of an article, the Wikipedian community urges users not to engage in an 'edit war', i.e. stubbornly continuing to override deletions or additions for the same content, but to use the 'talk page' provided on the Wikipedia editing interface to discuss the question and reach a consensus concerning the content. Wikipedia's editing structure itself encourages this process in the talk page associated with each article. Thus, examining a number of talk pages together with the students can be an extremely useful preliminary exercise, as it can provide a grasp of how difficult it can be to reach a consensus, to cite reliable sources and to maintain an objective NPOV, which are the essential pillars on which Wikipedia is based.

Conclusions

Not As we have seen, Wikipedia can be a promising learning environment for collaborative knowledge building, as well as offering a teaching strategy that complements traditional approaches. The effectiveness of this activity is not measured only in terms of increasing the intrinsic motivation to learn and arrive at a better understanding of content but also in helping gain cross-cutting skills in community participation, online dialogue and Information Literacy. From the institutional standpoint, it is also an important socially oriented service learning activity that the university can conduct as part of its third mission by editing high-quality encyclopaedia articles couched in simple but rigorous language on a wide range of scientific topics. In this connection, we can concur with Darwin, who, in 1865, wrote: *'I sometimes think that general and popular treatises are almost as important for the progress of science as original work'*.

References

- Baytiyeh, H., & Pfaffman, J. (2010). Volunteers in Wikipedia: Why the community matters. In *Educational Technology & Society*, 13 (2), pp. 128-140.
- Brailas, A., Koskinas, K., Dafermos, M., & Alexias, G. (2015). Wikipedia in education: Acculturation and learning in virtual communities. *Learning, Culture and Social Interaction*, 7, 59-70.
- Blikstad-Balas, M. (2016). "You get what you need": A study of students' attitudes towards using Wikipedia when doing school assignments. *Scandinavian Journal of Educational Research*, 60(6), 594-608.
- Brossard, D., & Scheufele, D. (2013). Science, new media, and the public. *Science*, 339(6115), 40-41.
- Bryant, S. L., Forte, A. and Bruckman, A. (2005), *Becoming Wikipedian: Transformation of participation in a collaborative online encyclopedia*, Proceedings of GROUP International Conference on Supporting Group Work, Sanibel Island, FL, pp. 1-10.
- Carretero, S., Vuorikari, R., & Punie, Y. (2017). DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use (No. JRC106281). [http://publications.jrc.ec.europa.eu/repository/bitstream/JRC106281/web-digcomp2.1pdf_\(online\).pdf](http://publications.jrc.ec.europa.eu/repository/bitstream/JRC106281/web-digcomp2.1pdf_(online).pdf)
- Cope, B., Kalantzis, M., Abd-El-Khalick, F., & Bagley, E. (2013). Science in writing: Learning scientific argument in principle and practice. *e-Learning and Digital Media*, 10(4), 420-441
- Cope, B., & Kalantzis, M. (2015). Assessment and pedagogy in the era of machine-mediated learning. *Education as Social Construction*, 350.
- Engeström, Y. (1999). Activity theory and individual and social transformation. In Y. Engeström, R. Miettinen & R.-L. Punamäki (Eds.), *Perspectives on Activity Theory*. New York, NY: Cambridge University Press, pp. 19-38.
- Farzan, R., & Kraut, R. E. (2013). Wikipedia classroom experiment: bidirectional benefits of students' engagement in online production communities. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 783-792. ACM.
- Halfaker, A. & Taraborelli, D. (2015). Scholarly article citations in Wikipedia. Figshare. <http://dx.doi.org/10.6084/m9.figshare.1299540>.
- Giles, J. (2005), *Internet Encyclopaedias Go Head to Head*. *Nature*, 438:900.
- Hattie, J. (2009). *Visible learning: a synthesis of over 800 meta-analyses relating to achievement*, London and New York: Routledge
- Head, A. J., & Eisenberg, M. B. (2010). How today's college students use Wikipedia for course-related research. *First Monday*, 15(3).
- Hernandez-Serrano, J., Choi, I., & Jonassen, D. (2000). Integrating constructivism and learning technologies. In J. M. Spector & T.M. Anderson (Eds.), *Integrated and holistic perspectives on learning, instruction and technology* (pp. 103-128). Dordrecht, Boston: Kluwer Academic Publishers.
- Higgins, S. (2014). Critical thinking for 21st-century education: A cyber-tooth curriculum? *Prospects*, 44(4), 559-574.
- Kim, J. Y., Gudewicz, T. M., Dighe, A. S., & Gilbertson, J. R. (2010). The pathology informatics curriculum wiki: Harnessing the power of user-generated content. *Journal of Pathology Informatics*, 1.
- Lave, J. & Wenger, E. (2002). Legitimate peripheral participation in communities of practice. In R. Harrison, F. Reeve, A. Hanson & J. Clark (Eds.). *Supporting lifelong learning: Perspectives on learning*, (pp. 1111-1126). London: Routledge Farmer.
- Magnus, P. D. (2009). On trusting Wikipedia. *Episteme*, 6(01), 74-90.
- Meseguer Artola, A., Aibar, E., Lladós, J., Minguillón, J., & Lerga, M. (2016). Factors that influence the teaching use of Wikipedia in higher education. *Journal of the Association for Information Science and Technology*, 67(5), 1224-1232.
- McDowell, Z. (2017). Student learning outcomes using Wikipedia-based assignments: Fall 2016 research report. Wikimedia Commons.
- Mishra P., Koehler M (2006). Technological pedagogical content knowledge: A framework for integrating technology in teachers' knowledge. *Teachers College Record*, 108(6): 1017-1054.

- Occhipinti, R. (2015). "La partecipazione degli esperti alla produzione collettiva di conoscenza: il caso Wikipedia". Master thesis. Trieste: Scuola Internazionale Superiore di Studi Avanzati. <http://preprints.sissa.it/xmlui/handle/1963/34783>
- Rafaeli, S., & Ariel, Y. (2008). Online motivational factors: Incentives for participation and contribution in Wikipedia. *Psychological Aspects of Cyberspace: Theory, Research, Applications*, 243-267.
- Roth, A., Davis, R., & Carver, B. (2013). Assigning Wikipedia editing: Triangulation toward understanding university student engagement. *First Monday*, 18(6).
- Rudiger, G., Schmidt, P., & Ghosh, R. (2010). Wikipedia Survey—Overview of Results. Report. United Nations University, UNU-Merit, Collaborative Creativity Group. http://www.ris.org/uploadi/editor/1305050082Wikipedia_Overview_15March2010-FINAL.pdf
- Rushby, N., & Seabrook, J. (2008). Understanding the past—illuminating the future. *British Journal of Educational Technology*, 39(2), 198-233.
- Scardamalia, M., Bransford, J., Kozma, B., & Quellmalz, E. (2012). New assessments and environments for knowledge building. In *Assessment and teaching of 21st century skills* (pp. 231-300). Springer Netherlands.
- Selwyn, N., & Gorard, S. (2016). Students' use of Wikipedia as an academic resource—Patterns of use and perceptions of usefulness. *The Internet and Higher Education*, 28, 28-34.
- Surowiecki, J. (2005). *The Wisdom of crowds: Why the many are smarter than the few and how collective wisdom shapes business, economics, societies and nations*. London. Abacus: New Edition, 39.
- Sweller, J., Van Merriënboer, J., & Paas, F. (1998). Cognitive architecture and instructional design. *Educational Psychology Review*. 10 (3): 251–296.
- Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: a second-order meta-analysis and validation study. *Review of Educational Research*, 81(1), 4-28.
- Trotman, A. and Alexander, D. (2009). University Student Use of the Wikipedia. url: <http://www.cs.otago.ac.nz/homepages/andrew/papers/2009-11.pdf>
- Thompson, N., & Hanley, D. (2017). Science is shaped by Wikipedia: Evidence from a randomized control trial. Unreviewed preprint article on Social Science Research Network (SSRN) online archive/database.
- Wannemacher, K. (2009). Articles as assignments – Modalities and experiences of Wikipedia use in university courses. In M. Spaniol, Q. Li, R. Klamma, & R.W.H. Lau (Eds.), *Advances in Web Based Learning – ICWL 2009*, pp. 434-443.
- Weller, M., De Los Arcos, B., Farrow, R., Pitt, B., & McAndrew, P. (2015). The impact of OER on teaching and learning practice. *Open Praxis*, 7(4), 351-361.
- Zheng, B., Niiya, M., & Warschauer, M. (2015). Wikis and collaborative learning in higher education. *Technology, Pedagogy and Education*, 24(3), 357-374.