R&E-SOURCE http://journal.ph-noe.ac.at
Open Online Journal for Research and Education
Special Issue #6, March 2017, ISSN: 2313-1640

Addressing Quality Aspects of Dynamic Mathematics Materials

TSG 42: Uses of technology in lower secondary mathematics education (age 10 to 14)

Barbara Kimeswenger[*]

Abstract

This paper describes a PhD research project which addresses the issue of quality aspects of dynamic materials. Platforms with user-generated educational resources for mathematics teaching show a wide variety in terms of quality of materials. The presented project investigates possible quality criteria for dynamic materials based on the opinion of experts who describe their views on educationally valuable use of dynamic materials. The results of this study should give new inputs and ideas for designing manual and/or automatic review systems for dynamic material platforms such as GeoGebraTube.

Keywords:
Educational research
Technology
High-quality GeoGebra materials
User-generated educational resources
Online platform

1 Quantity vs. quality – "user-generated" educational resources

Various online platforms provide a large number of open educational resources (OER) for teaching mathematics (for instance, GeoGebraTube, 2015; LearningApps, 2015). This makes it difficult for users to quickly find appropriate resources for their teaching (Trgalova, Jahn, & Soury-Lavergne, 2009). The problem of inconsistent quality particularly appears on platforms with user-generated educational resources, which aren't supported by an editorial team. They are often free or low cost materials, which are created and shared by different types of users (Camilleri, Ehlers, & Pawlowski 2014; Ott & Hielscher, 2014).

An example of a large repository of dynamic mathematics materials – GeoGebraTube

One example of such a platform is GeoGebraTube (2015), which provides more than 250 000 public dynamic materials (as of September 2015). Since dynamic worksheets – which are created by the dynamic mathematics software GeoGebra – can be uploaded, copied, edited and organized into collections by every user, this platform is subject to the mentioned problem of inconsistent quality (Kimeswenger & Hohenwarter, 2014, 2015). According to interviews with GeoGebraTube users, it isn't always easy to find high-quality resources on GeoGebraTube which comply with users' own quality standards. Thus, reconsidering the review and ranking systems of such a platform which influences the search results, the appearance and ranking of the shown materials might be desirable.

[*] Private Pädagogische Hochschule der Diözese Linz, Salesianumweg 3, 4020 Linz.
Corresponding author. E-mail: E-mail: barbara.kimeswenger@ph-linz.at

2 Quality and assessment on platforms

Several platforms with materials for mathematics teaching have different implementations for assessing quality of their resources with a similar aim: influencing the search results and ranking the high-quality materials first (Libbrecht et al., 2008; Ott & Hielscher, 2014). For instance, under the project Intergeo, Trgalova et al. (2009, p. 1163) characterize nine "relevant indicators" of quality of dynamic geometry resources on their platform I2Geo: "metadata, technical aspect, mathematical dimension of the content, instrumental dimension of the content, potentialities of DG, didactical implementation, pedagogical implementation, integration of the resource into a teaching sequence, usage reports." E.g., one criterion according to the indicator "content" is "validity" with the question "Are the activities in this resource correct from the mathematical point of view?"

Intentional vs. non-intentional reviews

To be able to develop a new review system for GeoGebraTube I consider combining an intentional and non-intentional review system. Under the project Intergeo a questionnaire was developed based on the mentioned quality indicators. For assessing quality of a particular resource on the platform I2Geo users can answer questions – 9 broad statements, which can be extended optionally to 59 questions – using a scale from 'I agree' to 'I disagree' (Kortenkamp et al., 2009; I2Geo, 2015; Trgalova et al., 2011). Other ways to contribute intentionally as a user to an evaluation of a resource are likes, comments or star ratings, which are also often implemented on platforms with a large number of resources for teaching mathematics – for instance, on CK-12 (2015), Curriki (2015) or LearningApps (2015). These possibilities of reviewing depend a lot on the willingness of individual users to contribute to the reviewing process of certain materials, for instance, by answering a questionnaire, clicking on likes, writing comments or giving a star rating.

But not every viewed material has always been reviewed by a user: On average, only 0.22% of viewed resources on the video-sharing website YouTube have been reviewed using likes or comments (Siersdorfer et al., 2010). Therefore, Ott and Hielscher (2014) – who investigate the issue of quality of interactive exercise on the platform LearningApps – consider to assess quality in an automatic way. For instance, one quality criterion is related to the communication with other users. E.g., it turns out that authors of exercises of LearningApps with an average well-rated content (4-5 stars of maximum 5 stars) communicate more than the average authors. The absolute number of messages of the author can thus be used as an evaluation criterion for their created content.

In summary, different parts of both forms – where users assess quality intentionally or non-intentionally/automatically – might come together in a new conception of a review system for dynamic materials on GeoGebraTube, which leads us to the research questions of this project.

3 Research questions

- What quality criteria for dynamic materials exist according to experts?
- How do experts describe the educationally valuable use of dynamic materials?
- How could the conclusions from research questions 1 and 2 affect the conceptual design of a new review system and further development of GeoGebraTube?

4 Research design

Before designing a new conception of a review system for GeoGebraTube, the complexity of quality aspects of dynamic materials should be investigated using qualitative research based on Grounded Theory (Strauss & Corbin, 1996). Experts – in particular mathematics teachers and mathematics educators – are interviewed according to their perspective on quality aspects of dynamic materials. After analyzing those interviews a list of quality criteria for dynamic materials will be expressed in a "theoretical and detailed quality catalog" according to the experts. These considerations about quality criteria and educationally valuable use of dynamic materials should provide new ideas for a conceptual design of a review system for platforms like GeoGebraTube, which might combine different parts of already existing review systems of other platforms. Then, after confronting key experts with the results of the developed quality criteria catalog and ideas for a review system, these will be

adapted again. Based on the results of this project stage I will develop a new review system and evaluate it with further interviews to continue the improvement of its design.

5 Examples of quality criteria

The following example will give a first idea of what quality aspects are mentioned by an expert – in this case by a very experienced teacher and user of GeoGebraTube – concerning to a specific dynamic material on GeoGebraTube about the orthocenter of a triangle (see Fig. 1).

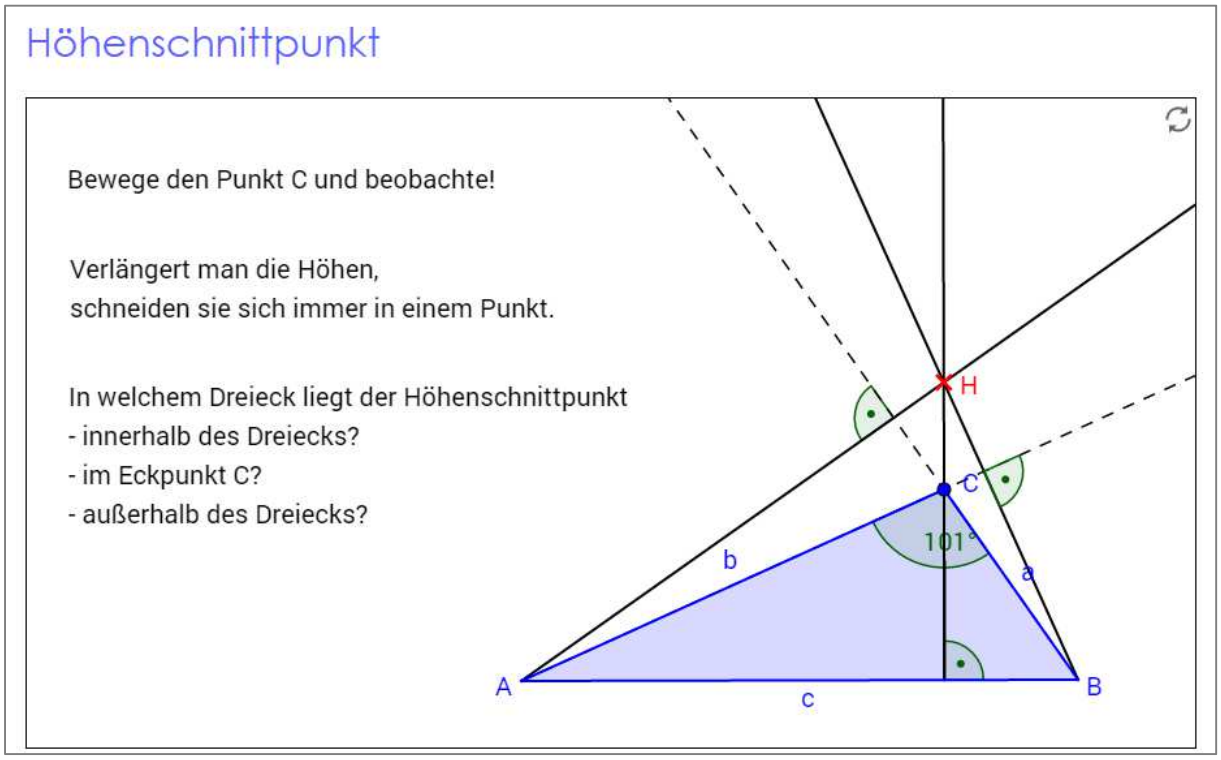

Fig. 1: Dynamic worksheet, Interview 2014-12-11, http://ggbtu.be/m16822

According to the interview with the expert one quality criterion of many possible criteria for a dynamic material is "supporting the learning of mathematics". The related question could be asked "Does the dynamic material support the learning of mathematics?" and be answered as following from perspective of the expert: According to the instruction next to the construction, students should move the point C. The potential of the material is from the expert's view that the dynamic worksheet allows students to explore with the dynamic construction. Depending on the location of the vertices of the triangle, the position of the orthocenter changes. E.g., students should discover that the orthocenter is inside an acute triangle and outside of an obtuse triangle. Such materials are intended to encourage students to conduct their own assumptions and formulate insights. This small example shows that often many different quality aspects come together that indicate the quality of a particular material. Therefore, experts are asked about their opinion and perspective on this topic in order to investigate the complexity and different facets of the issue of quality of dynamic materials.

6 Possible quality indicators – ideas for a conceptual design of a review system

It seems impossible to decide in general, whether a specific resource is of "high quality": "A given resource can be 'good' in one context and 'poor' in another." (Trgalova et al., 2009, p. 1162). Nevertheless, there seem to be certain strategies for searching for "good" dynamic materials on GeoGebraTube, for example one common

"quality indicator" was often mentioned by experts in interviews: "Steve Phelps materials are brilliant and if you see something of Steve Phelps then it is a guarantee of quality." (Interview 2015-07-15). Expert users of GeoGebraTube seem to search especially on profile pages of already known "high-quality authors", which they expect to produce "good" dynamic materials according to their own standards of quality:

"If you get to know people who produce quality materials, they don't tend to produce quality materials by accident. Once, you find one or two things by somebody which is good, you can expect pretty much more materials with high quality." (Interview 2015-07-15)

As mentioned at the beginning, inconsistent quality especially occurs, because users with different quality standards share their dynamic materials online. However, this can be regarded not only as a disadvantage, but also as an advantage. It seems important that a review system of a platform enables users to quickly find materials of specific authors who have similar quality standards. It should also allow to follow these authors and possibly allow searching for dynamic materials by giving resources of followed authors higher priority.

Further analysis of different expert interviews will examine the complexity of quality of dynamic materials in greater detail to come to a detailed catalog of quality criteria. With this background knowledge additional suggestions for intentional and non-intentional review systems for dynamic material platforms like GeoGebraTube should be devised.

References

Camilleri, A. F., Ehlers, U. D., & Pawlowski, J. (2014). *State of the Art Review of Quality Issues related to Open Educational Resources (OER)*. Luxembourg: Publications Office of the European Union.

CK-12 (2015). Platform. http://www.ck12.org/, retrieved on 2015-09-01.

Curriki (2015). Platform. http://www.curriki.org/, retrieved on 2015-09-01.

GeoGebraTube (2015). Platform. http://www.geogebratube.org/, retrieved on 2015-09-01.

I2Geo (2015). Platform. http://i2geo.net/, retrieved on 2015-09-01.

Kortenkamp, U., Dohrmann, C., Kreis, Y., Dording, C., Libbrecht, P., & Mercat, C. (2009). Using the Intergeo Platform for Teaching and Research. In *Proceedings of the 9th international conference on Technology in Mathematics Teaching* (pp. 1–5). Metz, France.

Kimeswenger, B. & Hohenwarter, M. (2014). GeoGebraBooks für Tablets. In *Proceedings of the 48th conference of Gesellschaft für Didaktik der Mathematik* (pp. 611–614). Koblenz, Germany.

Kimeswenger, B. & Hohenwarter, M. (2015). GeoGebraBooks – Dynamische Materialien und ihre Qualitätssicherung. *IMST-Newsletter*, 14(43), 11–14.

LearningApps (2015). Platform. http://learningapps.org/, retrieved on 2015-09-01.

Libbrecht, P., Desmoulins, C., Mercat, C., Laborde, C., Dietrich, M., & Hendriks, M. (2008). Cross-Curriculum Search for Intergeo. In *Proceedings of the 7th conference on Mathematical Knowledge Management* (Vol. 5144, pp. 520–535). Birmingham, UK.

Ott, M. & Hielscher, M. (2014). Kriterien für die automatisierte Bewertung von user-generated educational Microcontent. In *E-Learning Fachtagung Informatik. Proceedings Series of the Gesellschaft für Informatik* (Vol. P-233, pp. 73–84). Freiburg, Germany.

Siersdorfer, S., Chelaru, S., Nejdl, W., & San Pedro, J. (2010). How useful are your comments? In *Proceedings of the 19th international conference on World Wide Web* (Vol. 15, pp. 891–900). Raleigh, USA.

Strauss, A. & Corbin, J. (1996). *Grounded Theory: Grundlagen Qualitativer Sozialforschung*. Weinheim: Beltz Psychologie Verlags Union.

Trgalova, J., Jahn, A. P., & Soury-Lavergne, S. (2009). Quality process for dynamic geometry resources: the Intergeo project. In *Proceedings of CERME* (Vol. 1, pp. 1161–1170). Lyon, France.

Trgalova, J., Soury-Lavergne, S., & Jahn, A. P. (2011). Quality assessment process for dynamic geometry resources in Intergeo project. *ZDM - International Journal on Mathematics Education*, 43, 337–351.