Using E-Comics Based on Realistic Mathematics Education in Transformation Geometry

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Abstract: The very rapid development of technology in the era of Society 5.0, requires lecturers to package learning that is interesting for students, one of which is with media and learning approaches from abstract material to concrete material. The purpose of this research is to produce e-comic products with a realistic approach. mathematics education in geometry transformation courses that can be used in online tutorials for 4th semester mathematics education study program students at Universitas Terbuka. This research method uses the Dick & Carey development design by including eight steps. Based on the results of student questionnaire responses using e-comic media with a realistic mathematics education approach, namely based on the results of student assessment responses, an average value of 86% was obtained, which means that e-comic media is classified as good as a learning medium. Meanwhile, based on the test of the effectiveness of the use of media on students, it is obtained t_{count} 3.285 > t_{table} 2.002 from the two results from the t-test through comparison it can be concluded that H_0 is rejected and H_a is accepted, which means that it means that there is a difference in the average learning outcomes between tutor class scores and the class media score. This means that the e-comic media learning outcomes with the RME approach to this transformation geometry material is effectively used for students of mathematics education program at the Universitas Terbuka.

Keywords: research & development, e-comics, realistic mathematics education.

Abstrak: *Perkembangan teknologi yang sangat pesat di era Society 5.0, menuntut dosen mengemas pembelajaran yang menarik bagi mahasiswa, salah satunya dengan media dan pendekatan pembelajaran dari materi abstrak ke materi konkret. Tujuan dari penelitian ini adalah untuk menghasilkan produk e-comic dengan pendekatan yang realistis. pendidikan matematika pada mata kuliah transformasi geometri yang dapat digunakan dalam tutorial online bagi mahasiswa program studi pendidikan matematika semester 4 di universitas terbuka. Metode penelitian ini menggunakan desain pengembangan Dick & Carey dengan memasukkan delapan langkah. Berdasarkan hasil respon angket mahasiswa penggunaan media e-comic dengan pendekatan realistic mathematics education yaitu berdasarkan hasil respon penilaian mahasiswa diperoleh nilai rata-rata sebesar 86% yang artinya media e-comic tergolong baik sebagai media pembelajaran. Sedangkan berdasarkan uji keefektifan penggunaan media pada siswa diperoleh t_{hitung} 3,285 > t_{tabel} 2,002 dari kedua hasil uji t melalui perbandingan dapat disimpulkan bahwa H_0 ditolak dan H_a diterima, dimana artinya ada perbedaan rata-rata hasil belajar antara nilai kelas tutor dengan nilai kelas media. Artinya media hasil belajar e-comic dengan pendekatan RME pada materi geometri transformasi ini efektif digunakan untuk mahasiswa program pendidikan matematika di Universitas Terbuka.*

Kata kunci: *penelitian dan pengembangan, e-comics, pendidikan matematika realistic.*

▪ **INTRODUCTION**

In the era of society 5.0, as it is today, it is mandatory for lecturers to be able to produce qualified students in global challenges, in accordance with the Universitas terbukaStrategic Plan which stipulates that lecturers must be able to create interesting learning based on ICT, therefore it is required for lecturers to conduct research IT-based, namely technology to teach and learn mathematics. In connection with the number of media used in the learning process, it must be adapted to the character of the students and the characteristics of the subjects being studied. One of the subjects that is difficult to understand for students of the universitas terbuka at mathematics education study program is the subject of transformation geometry. Transformation geometry is a two- or three-dimensional object that can be expressed as a mapping of a geometric object in a flat plane from one position to another with certain rules (Hardiyanti, 2015). Transformational geometry is an important knowledge in geometry to build spatial abilities, geometric reasoning abilities, and strengthen mathematical proofs (Edward, 1997). Some of these abilities are proven to be able to support achievement in mathematics, especially reasoning related to transformation geometry. So far, transformational geometry learning at open universities has not produced any e-learning-based research breakthroughs that can construct student thinking, transformational geometry learning should be made interesting and constructive so that it can build students' spatial abilities.

The use of e-learning can improve the quality of learning. The results of research by Anwas (2006) on the use of learning videos show that students are attracted to visual objects that are relatively unique and rarely found, as well as abstract objects so that the learning process is more conducive. Therefore innovations in electronic-based learning services continue to be developed. One of them is the creation of electronic-based learning media, in the form of e-Comics. Meanwhile, according to Saniya (2011) Japanese comics such as Manga have flooded Indonesian fans targeting teenagers since the 1990s. The results of a survey conducted by Kompas Research and Development yielded data indicating that the majority of Manga enthusiasts were teenagers aged less than 25 years. Comics which are interpreted as cartoon images with text are able to convey a message in a light and fun style. Adopting comic media styles with video-based digital packaging to convey learning messages is an alternative to developing learning media.

Realistic Mathematics Education (RME) is a human activity and must be related to reality. RME has characteristics, among others, that in the learning process students must be given the opportunity to reinvent mathematics through teacher guidance (Gravemeijer, 1994), and that the reinvention of mathematical ideas and concepts must start from exploring various situations and "real world" problems (Lange, 1995). Furthermore, it is said, if we (teachers) are diligent in paying attention to the environment and linking learning with the environment, it is likely that students' scientific thinking will grow. Therefore, the material must be selected and adapted to the environment related to everyday life (contextual) and the cognitive level of students, starting with informal methods through modeling before formal methods. This is in accordance with the characteristics of RME. The main idea of RME is that students must be given the opportunity to reinvent mathematical ideas and concepts with adult guidance through exploring various situations and real world problems (Astuti, 2018).

Based on the background description above, the article discusses analysis of student responses using media e-comics based on realistic mathematics education in transformation geometry for distance learning. Because distance learning is necessary, additional media is online and make it easier for students to access learning resources anywhere and anytime.

▪ **METHOD**

This study uses a population of all students of the mathematics education study program at universitas terbuka while the subject of this study is the 4 semester student of the mathematics education study program as many as 30 students. As for the technique of returning the sample using purposive sampling. This research belongs to the type of R & D (research and development) namely developing a learning media product. The research model uses the development of the Dick & Carey. The steps of this research and development model are 1) identifying instructional objectives, 2) conducting instructional analysis, 3) analyzing student characteristics and context, 4) formulating specific instructional objectives, 5) developing assessment instruments, 6) developing instructional strategies, 7) developing and selecting appropriate instructional materials, 8) designing and conducting formative evaluations, 9) revising learning, and 10) designing and conducting summative evaluations. This research was carried out for 7 months, from March to October 2022.

The research instrument used a questionnaire distributed to students. The questions tested used validity and reliability techniques. Media e-comics based on realistic mathematics education were used to test learning motivation, this was done to determine the magnitude of the effect of student learning outcomes of mathematics study program on transformation geometry material. The method of data collection is by conducting tests to get student learning outcomes by using essay questions. The test is carried out by giving questions to students and then students send back the results of their work via google form. After being collected, the results of the work are processed and analyzed using the SPSS application.

The data statistical technique used is using 3 statistical tests namely normality test, homogeneity test and t-test. The Normality test is carried out to assess the distribution of data in a data group or variable, whether the data distribution is normally distributed between the tutor class and the media class. Then a homogeneity test was carried out, namely observing the differences in data from the two classes between the tutor class and the media class. While the last step examines the average difference between the two samples from the class between the tutor class and the media class.

▪ **RESULT AND DISSCUSSION**

The result of this research is that an e-comic with approach realistic mathematics education video has been produced which used by students is done by using google form. From the questionnaire responses from 19 students has been get some information. The e-comic with approach realistic mathematics education video as shown in figure 2, figure 3, and figure 4. Follow are some displays of e-comic with approach realistic mathematics education video.
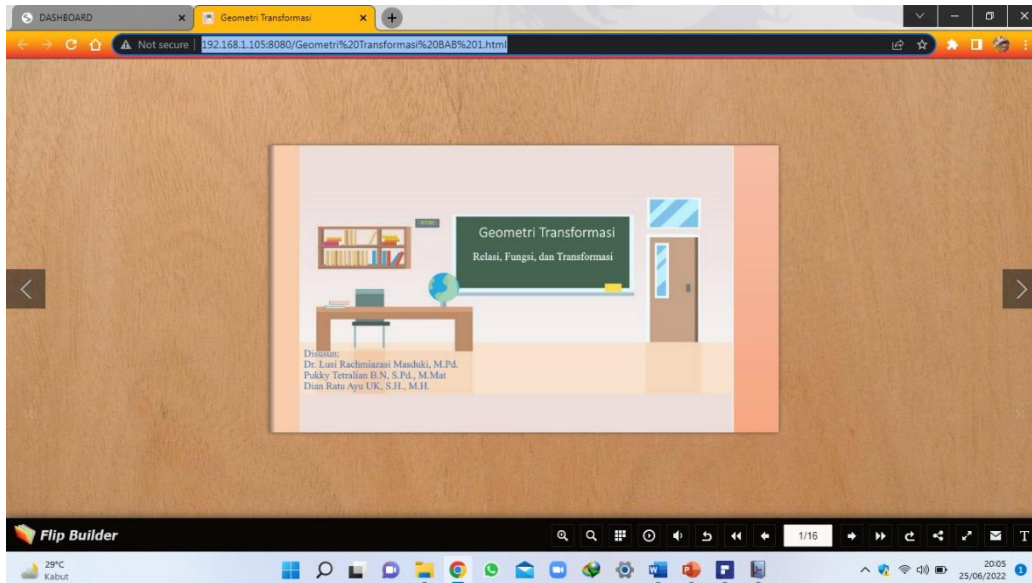
Figure 1. Display of e-comic cover

Based figure 1 display begining from media with e-comic with approach realistic mathematics education video model and can be accessed at https://online.flipbuilder.com/gtnvk/teyz/. Furthermore, on the cover there is the identity of the author and there are several buttons that can be operated to view the contents of the e-comic. Figure 2 display e-comic contens there are six characters who each have a story telling role to make the storyline contained in the e-comic.
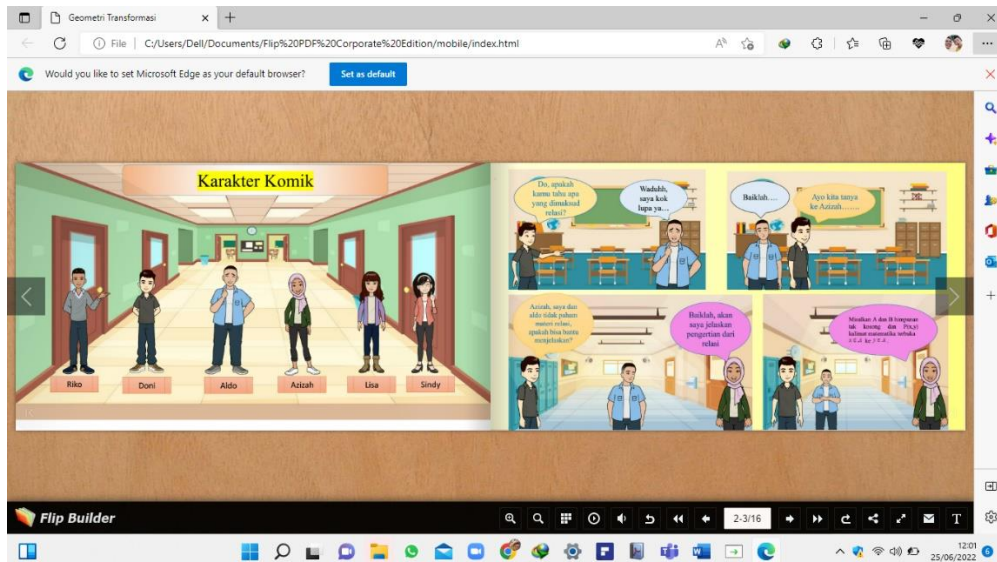

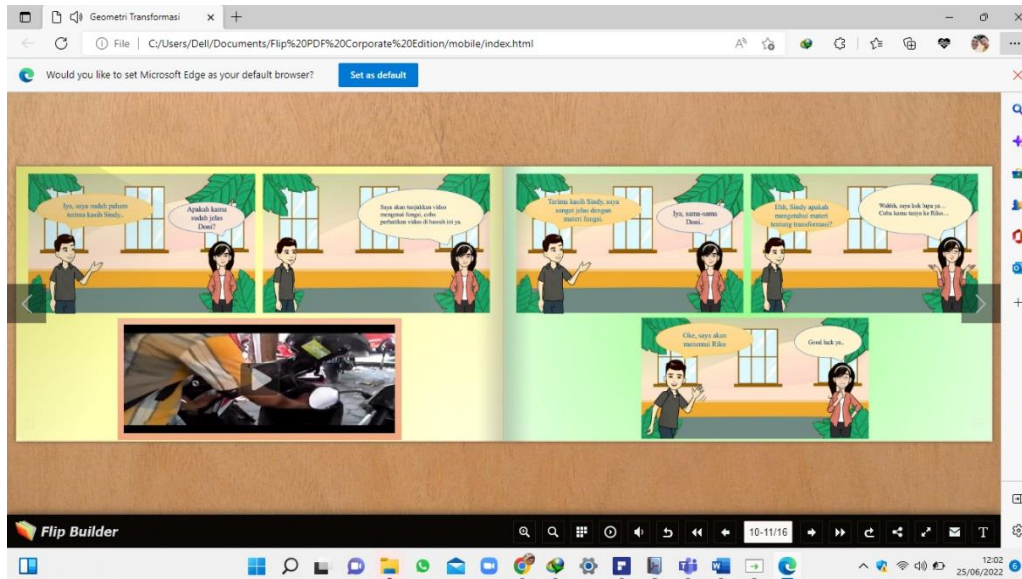**Figure 2.** Display of e-comic contens

Figure 3. Display of e-comic with realistic mathematics education video

Figure 3 display of e-comic with realistic mathematics education video. There are three videos in the e-comic that can add to the understanding of realistic mathematical material. First video material relation with realistic mathematics, second video material function with realistic mathematics, Third video material transformation with realistic mathematics. Meanwhile, based on student responses to e-comic media with a realistic mathematical approach that has been analyzed by percentage of student questionnaires in the figure above, student assessments related to e-comics with a realistic mathematics education video approach, namely the media aspect of 84%, means that the e-comic media used is easy enough for students to learn, aspects of learning material 86% means the material teaching e-comic in terms of material is quite complete. The language aspect is 89%, meaning that the use of language in this teaching material is in accordance with the language used by students, the variety of questions is 86%, meaning that the sentences and pictures in the transformation geometry material are quite clear. While the last aspect of media design is 86%, meaning that the media presented is a unique design and can be studied well.

Based on the results of the questionnaire, it can be concluded that the average of the results of the assessment of the use of e-comic media with a realistic mathematics education approach by students is 86%, so it can be interpreted that e-comic media with a realistic mathematics education approach in relation, function and transformation material can be used as a source of student learning. Meanwhile based on student responses related to e-comic media that have been recapitulated via google form. First respon the material in the module and in the e-comic, the sentences are the same, so that I still can't easily understand the material, while in terms of media, this e-comic it's good to help make the learning process more enjoyable, with the note that the sentences can use sentences that are easily understood by ordinary people, not just from the perspective of math educators.

According to other respondents, the ve-com media with the RME approach is quite good and easy to understand, it's just that instructions must be given to read the

next section so that the reader is not confused because if the reader is not used to reading comics, it will be difficult to read it. Then for the results of other respondents the tutor is very good and active and very clear when explaining, if i may give a suggestion, hopefully in the future the tutor can convey the material with vidio so that it can be more easily understood. As for the other respondents providing feedback, namely in e-comic media with the RME approach to this transformation geometry material there are clear, concise, and complete instructions for activities. Meanwhile, based on the effectiveness test of e-comic media learning outcomes with the RME approach to this transformation geometry material using SPPS, several calculation results were obtained. First, using the normality test, the results are obtained in the table below:

Table 1. Tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Tutor Class	.148	30	.093	.964	30	.392
Media Class	.145	30	.108	.960	30	.314
a. Lilliefors Significance Correction						

Based the normality test, it can be seen that the df value for tutor class value is 30 and the df value for the media class value is 30, so the number of samples is 30 and it can be concluded that the number of data samples for each group is more than 50 so using Kolmogorov-Smirnov. It can be seen that the significance of tutor class value is 0,093 and the significance of the media class value is 0,108. Because the significance value of the two groups is greater than 0,05 it can be concluded that the data on tutor class and media class learning outcomes are normally distributed. Next steps is using a homogeneity test, the results are shown in the table below:

Table 2. Test of homogeneity of variances

		Levene Statistic	**df1**	**df2**	**Sig.**
Learning outcomes	Based on Mean	3.880	1	58	.054
	Based on Median	3.932	1	58	.052
	Based on Median and with adjusted df	3.932	1	50.622	.053
	Based on trimmed mean	3.847	1	58	.055

Furthermore, based on the homogeneity variances with the means test using SPSS, the significance value is 0,054. This means that 0,054 > 0,05 so it can be concluded that the variance of on tutor class and media class is homogeneous.

Table 3. Independent samples test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Learning outcomes	Equal variances assumed	3.880	.054	-3.285	58	.002	-10.833	3.298
	Equal variances not assumed			-3.285	49.225	.002	-10.833	3.298

Based on the independent samples test table, it can be seen that the t-count is 3.285 with a df of 58, the t-table is 2.002 and the t-test value is significant (2-tailed) of 0.02. By using the significance value of the t-test significance (2-tailed) obtained $0.02 < 0.05$ and t_{count} $3.285 > t_{table}$ 2.002 from the two results from the t-test through comparison it can be concluded that H0 is rejected and Ha is accepted, which means that it means that there is a difference in the average learning outcomes between tutor class scores and the class media score. This means that the e-comic media learning outcomes with the RME approach to this transformation geometry material is effectively used for students of mathematics education program at the universitas terbuka.

This is in line with research (Siregar, et al. 2019) that classes that get problem-solving abilities with learning treatment using mathematical e-comic media are better (effective) than classes that receive treatment with the lecture method (not using learning media).

▪ **CONCLUSION**

Based on the results of the research and discussion of the problem, it can be concluded as follows, student responses related to e-comic media with the RME approach to this transformation geometry based on the results of the student assessment questionnaire obtained a value of 86%, which means e-media Comics are classified as good learning media. Meanwhile, based on the results of the student response questionnaire using e-comic media, the advantages and disadvantages were obtained. One of the advantages that has been summarized is that in terms of media, this e-comic it's good to help make the learning process more enjoyable. As for one of the shortcomings that has been summarized, it's just that instructions must be given to read the next section so that the reader is not confused because if the reader is not used to reading comics, it will be difficult to read. Based on the assessment responses and responses to suggestions that have been submitted by students, it can be concluded that e-comic media still needs to be improved in terms of material, but e-comic media is appropriate for use as a learning medium for students at Universitas Terbuka. Meanwhile, based on the test of the effectiveness of the use of media on students, t_{count} 3.285 is higher than t_{table} 2.002 from the two results from the t-test through comparison it can be concluded that Ho is rejected and Ha is accepted, which means that it means that there is a difference in the average learning outcomes between tutor class scores

and the class media score. This means that the e-comic media learning outcomes with the RME approach to this transformation geometry material is effectively used for students of mathematics education program at the Universitas Terbuka.

▪ **REFERENCES**

Aggleton, J. (2019). Defining digital comics: a British Library perspective. *Journal of Graphic Novels and Comics*, *10*(4), 393–409.

Albab, I. U., Hartono, Y., & Darmawijoyo. (2014). *Kemajuan belajar siswa pada geometri transformasi menggunakan aktivitas refleksi geometri* [student learning progress in transformational geometry using geometry reflection activities]. *Jurnal Ilmiah Cakrawala Pendidikan*, *1*(3), 338-348.

Al-Emran, M., Mezhuyev, V., & Kamaludin, A. (2018). Technology acceptance model in m-learning context: a systematic review. *Computers & Education*, *125*, 389–412.

Dimitris, K., & Nikolaos, K. (2014). Electronic textbooks advantages and challenges for the Hellenic higher education and publishing community. *Library Review*, *63*(6), 531-543.

Ebied, M. A., & Rahman, S. A. A. (2015). The effect of interactive e-book on students' achievement at Najran University in computer in education course. *Journal of Education and Practice*, *6*(19), 71-82.

Edwards, L. D. (1997). "Explore Ring the terrority before proof: students' generalization in a computer microworld for transformation geometry". *International Journal of Computers for Mathematical Learning*, *1*(1), 187-215.

Enteria, O., & Casumpang, P. F. H. (2019). Effectiveness of developed comic strips as instructional materials in teaching specific science concepts. *International Journal for Innovation Education and Research*, *7*(10), 876–882.

Herbst, P., Chazan, D., Chen, C. L., Chieu, V. M., & Weiss, M. (2011). Using comics-based representations of teaching, and technology, to bring practice to teacher education courses. *International Journal on Mathematics Education*, *43*(1), 91–103.

Hosler, J., & Boomer, K. . (2011). Are comic books an effective way to engage nonmajors in learning and appreciating science?. *CBE Life Science Education*, *10*(3), 309–317.

Hollebrands, K. F. (2003). High School students understanding of geometric transformations in the context of a technological environment. *Journal of Mathematical Behavio*r, *1*(22), 55-72.

Joo, Y. J., Park, S., & Shin, E. K. (2017). Students' expectation, satisfaction, and continuance intention to use digital textbooks. *Computers in Human Behavior*, *69*, 83-90.

Khalid, A. (2014). Text Books: ebook vs. Print. *Journal of Education and Human Development*, *3*(2), 243-258.

Khayriah, M., Bshouty D., Verner., I. M. (2010). An ethnomathematics exercise in analyzing and constructing ornaments in a geometry class. *Journal of Mathematics & Culture*, *5*(1), 1-20.

Khor, E. T. (2014). An analysis of ODL student perception and adoption behavior using the technology acceptance model. *International Review of Research in Open and Distributed Learning*, *15*(6), 275-288

Lazarinis, F., Mazaraki, A., Verykios, V. S., & Panagiotakopoulos, C. (2015). E-comics in teaching: Evaluating and using comic strip creator tools for educational purposes. *In 2015 10th International Conference on Computer Science & Education (ICCSE),* 305-309.

Leontyeva, I. A. (2018). Modern distance learning technologies in higher education: introduction problems. *Eurasia Journal of Mathematics Science and Technology Education*, *14*(10), 1-8.

Martha, Z. D., Adi, E. P., & Soepriyanto, Y. (2018). E-book berbasis Mobile learning [E-book based Mobile learning]. *Jurnal Kajian Teknologi Pendidikan*, *1*(2), 109-114.

Mamolo, L. (2019). Analysis of senior high school students' competency in general mathematics. *Universal Journal of Educational Research*, *7*(9), 1938-1944.

Morris, T., & Paulsen, R. (2011). Using tracing paper to teach transformation geometry, Johannensberg: Amesa.

Naidoo, J. (2010). Strategies used by grade 12 mathematics learners in transformation geometry, Natal: University of Kwazulu.

Özdemir, E. (2017). Humor in elementary science: Development and evaluation of comic strips about sound. *International Electronic Journal of Elementary Education*, *9*(4), 837-850.

Prastowo, A. (2015). *Panduan kreatif membuat bahan ajar inovatif*, Yogyakarta: Diva Pres.

Rossa, B., Pechenkinab, E., Aeschlimanb, C., & Chasec, A. M. (2017). Print versus digital texts: understanding the experimental research and challenging the dichotomies. *Research in Learning Technology*, *1*(25), 1-12.

Schultz, K. A., & Austin, J. D. (1983). Directional effects in transformation tasks. *Journal for Research in Mathematics Education*, *14*(2), 95-101.

Siregar, N., Suherman, Masykur, R., Sari, R. N. (2019). Pengembangan media pembelajaran e-comic dalam pembelajaran matematika [development of e-comic learning media in mathematics learning]. *Journal of Mathematics Education and Science*. *2*(1), 11-19.

Sugiyono. (2013). *Metode penelitian pendidikan pendekatan kuantitatif, kualitatif, dan R&D*. Bandung: Alfabeta

Sri, G. (2019). Research and development (r&d) method as a model design in educational research and its alternatives, Holistics. *Journal Hospitality And Linguistics, 11*(2), 12-22.

Tafiardi. (2005). Meningkatkan mutu pendidikan melalui e-learning [improving the quality of education through e-learning]. *Jurnal Pendidikan Penabur*, *4*(4), 85-97.

Wu, B., & Zhang, C. (2014). Empirical study on continuance intentions towards E-Learning 2.0 systems. *Behaviour & Information Technology*, *33*(10), 1027-1038.