A Review of Gamification in Technological Pedagogical Content Knowledge

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Abstract. This paper review 10 papers that relating to gamification adoption in developing technological pedagogical content knowledge (TPACK) framework. Technological developments lately led to the trend of increased use of ICT in the learning process, one of which is gamification. Gamification is the concept of applying game mechanics and game design techniques to engage and motivate people to achieve their goals. Gamification in education as an intersection of learning and fun. The problem is that not all game’s attributes suitable for use in presents a teaching material. TPACK is a framework for the teacher that described a complex interaction among three bodies of knowledge: content, pedagogy and technology. TPACK engagement has an impact on the teacher mastery in dimension of teaching material content, in addition to improve teachers skill in developing technology in classroom learning.

1. Introduction
The rapid development of technology clearly had a significant impact in the world of education. One of which is with commonly Information and Communication Technology (ICT) used as a learning resource (in the form of instructional media, or just a repository of material) and even the management of learning activities (eg e-learning, distance learning, etc). Student interaction with ICT was certainly increasing, due to the demands of the learning process (other than the reasons related the devices ownership, need for self-actualization, etc). Therefore, ICT becomes important to be a concern for educators [1].

This condition raises the interesting issues about the importance of mastering ICT for teachers. Integrating ICT into classroom has always been a challenging task for many teachers [2]. Teacher feel not quite ready prearing learning using ICT, partly caused by the mastery of the theoretical framework that relate to the development of ICT for learning is lacking [3]. Research conducted by the Son, Robb and Charismiaji [4] regarding the Computer Literacy and Competency revealed that teachers in Indonesia generally have basic computing skills are quite high, but the frequency of utilization of these capabilities are limited only to a few applications only (one quite dominant is a word processing application). It's obvious impact on the ability of computing and computer skills of students.

The gap between the potential of technology and its implementation in learning gave rise to various related questions about the reason involvement of technology in classroom learning. In many cases the use of technology in education, teacher impressed only play the role of gatekeepers [5] [6], which makes decisions on the selection of appropriate technology to be used in learning and make decisions on exactly when the students allowed to use these technologies [7].
Gamification is using elements of game mechanics to provide practical solutions by way of building interest (engagement) certain groups [8]. Gamification not only use the game elements and game design techniques in non-game contexts [9], but also to empower and engage learners with the ability of motivation on learning approach and maintains a relaxed atmosphere.

In understanding technology as an integral partner for education, a conceptual framework called Technological Pedagogical Content Knowledge (TPACK) deserves to become the reference. The TPACK was first proposed by Mishra and Koehler [10] to describe an integrated connection between content knowledge, pedagogical knowledge, and technological knowledge. The framework illustrates essential knowledge of how teachers could integrate technological tools into their teaching of specific content in their school practice [11]. Figure 1 shows a complex interaction among three bodies of knowledge: content, pedagogy and technology.

![Figure 1. Technological Pedagogical Content Knowledge (TPACK) framework.](image)

2. Method

The literature were identified by exploring the google search engine with keyword “gamification”. As a result, total 10 articles were located. This paper review using three main categories were employed the researchers to make sense of the articles, they are: basic data (authors, year of publication, journal/conference); content analysis (pedagogy, content area), and gamification element. Table 1 shown the taxonomy which will be used in analyzing the elements of gamification that are used in developing instructional learning object base on the TPACK.

| Element               | Type                                                                 |
|-----------------------|----------------------------------------------------------------------|
| Game based rules      | rules, interactivity and feedback to produce measurable results      |
| Game mechanics level  | level, earnings badge, point system, score and time challenge       |
| Game thinking competition, cooperation, exploration and storytelling |

*Games based elements are intended to create a system in which learners or players involved in the abstract challenge, defined by rules, interactivity and feedback to produce measurable results ideally bring out the emotional reactions; Game mechanics can be interpreted as level, earnings badge, point system, score and time challenge is the element used in the gamification; Game thinking is the idea of*
thinking about everyday experiences such as jogging turn it into an activity that has elements of
competition, cooperation, exploration and storytelling [12].

3. Result and discussion

Table 2. Gamification in technological pedagogical content knowledge.

| Reference | Pedagogical Approach | Content Area | Gamification Element |
|-----------|----------------------|--------------|----------------------|
| Cook, Smith, Maglaras, Janicke (2016) – The 4th International Symposium for ICS & SCADA Cyber Security Research 2016 [13] | Role Playing | Network Security | **Game mechanics**: points system, level, leaderboards, badges, challenges. **Game thinking**: Collaborative to competitive, intrinsic to extrinsic, multilayer to solitary, campaign to endless, emergent to scripted. |
| Prambayun, Farozi (2015) – Proceeding Seminar Nasional Teknologi Informasi dan Multimedia [14] | Communicative Language Teaching (CLT), including Task Based Language Teaching (TBLT) and Content Based Instruction | Nature Science for Primary School | **Game mechanics**: points system, level, leaderboards, badges, challenges. |
| Figueroa (2015) - Digital Education Review, Number 27, June 2015 [15] | Second Language Learning | | **Game based**: progress bar, reward system. **Game thinking**: social element. |
| Lister, West, Cannon, Sax, Brodegard (2014) – Journal of Medical Internet Research (JMIR) Serious Games, Vol.2, Issue 2 [16] | Health and Fitness | | **Game based**: digital reward, real world prizes, rank of achievement. **Game mechanics**: level, leaderboards, badges, time pressure. **Game thinking**: social or peer pressure, competitions. |
| Brewer, Anthony, Brown, Irwin, Nias, Tate (2013) – Proceedings of the 12th International Conference on Interaction Design and Children [17] | Touch and Gesture interactions | | **Game based**: reward. |

4. Conclusion

It should be understood that the gamification not mean to make a game, make a special application to apply the concept of gamification would be better, but if resources owned is not possible to make a special application for gamification then gamification can use simple tools to implement gamification in the learning process in class. The most important thing is the right concept, clear goals and be able to build for student engagement in learning. TPACK engagement has an impact on the teacher mastery in dimension of teaching material content, in addition to improve teachers skill in using and developing technology in classroom learning.
5. References

[1] Polly D, Mims C E, Shepherd and Inan F 2010 An International Journal of Research and Studies 26 863-70

[2] So H J and Kim B 2009 Australasian Journal of Educational Technology 25 101-16

[3] Kramarski B and Michalsky T 2010 Learning and Instruction 20 434-47

[4] Son J B, Robb T and Charismiadji I 2011 Computer-Assisted Language Learning - Electronic Journal 12 26-42

[5] Ertmer P A 2005 Educational Technology Research & Development 53 25-39

[6] Zhao Y, Pugh K, Sheldon S and Byers J L 2002 Teachers College Record 104 482-515

[7] Forssell K S 2011 Technological Pedagogical Content Knowledge : Relationship to Learning Ecologies and Social Learning Networks (Standford: A Dissertation Submitted to The School of Education and The Committee on Graduate Studies of Standford University)

[8] Vianna Y, Vianna M and Medina B 2014 Recreating Companies Through Games 1st edition vol 3 (Rio de Janeiro: MPV Press)

[9] Werbach K and Hunter D 2012 For the Win: How Game Thinking can Revolutionize Your Business (Philadelphia: Wharton Digital Press)

[10] Koehler M J and Mishra P 2005 Journal Educational Computing Research 32 131-52

[11] Srisawasdi N 2012 Procedia - Social and Behavioral Sciences 46 4031–38

[12] Kapp K M 2012 The Gamification of Learning and Instruction: Game-based Methods and Strategies for Training and Education 1 edition (San Francisco: Pfeiffer & Company)

[13] Cook A, Smith R, Maglaras L and Janicke H 2016 The 4th International Symposium for ICS & SCADA Cyber Security Research 2016 (Belfast) (Swindon: BCS Learning & Development Ltd.)

[14] Prambayun and Farozi M 2015 Pola perancangan gamifikasi untuk membangun engangement siswa dalam belajar Seminar Nasional Teknologi Informasi dan Multimedia 2015 Yogyakarta

[15] Figueroa J F 2015 Digital Education Review 27 32 – 54

[16] Lister, West J H, Cannon B, Sax T and Brodegard D 2014 Just a fad? gamification in health and fitness apps JMIR Serious Games 2(2014)2

[17] Brewer R, Anthony L, Brown Q, Irwin G, Nias J and Tate B 2013 The 12th International Conference on Interaction Design and Children (New York) (New York: ACM Digital Library, The Association for Computing Machinery)

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