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Future Prospect of Gamification-Based Mobile in Physics Learning

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ABSTRACT
The development of gamification in the world of education today continues to grow. This study aims to find trends, distributions, contributions, and effects of gamification research in various sectors, especially in education, in the last ten years. The Research uses quantitative Research in the form of bibliometric analysis using the Scopus database with the help of visualization from VOSViewer. The results of this analysis show that in 2012-2021 (the last ten years), gamification increased yearly. In addition, the distribution and contribution of gamification are very beneficial for the world of education, with the note that it must be prepared carefully to produce positive outputs. For further Research, it is expected to continue to develop the field of gamification-based mobile in physics learning so that it can be an alternative to various educational levels included in physics learning.

INTRODUCTION

In recent years, technological developments have been very rapid, one of which is the concept of gamification. This is evidenced by the increasing number of publications related to gamification (Surendeleg et al., 2014; Fadhli et al., 2020; Sailer & Homner, 2020). Gamification is the introduction of game design elements into non-game applications to make them more fun and attract people's attention (Dichev & Dicheva, 2017; Hamari et al., 2014; Shane et al., 2020). Currently, the concept of gamification is not only focused on the world of games but also can attract attention and interest in the field of education. Based on the results of the research, Seaborn & Fels et al. (2017) and Huotari & Hamari et al. (2017) stated that the academic field received attention and interest, especially in Research related to gamification. In the world of education, a gamification is an approach to learning by using elements to motivate students in learning with feelings that they enjoy and can build particular interest in certain groups (Treiblmaier et al., 2018).

Great expectations so that developments in gamification in the world of education can have a good impact on students' learning outcomes instead of having a negative impact. The application of gamification is currently one of the trends in the world of education. Thanks to the development of gamification can have an impact on learning. This can be seen through the results of Research conducted by Martens & Mueller (2016), which states that gamification has positive learning. By involving gamification in learning, students can support and improve their learning outcomes (Huang et al., 2020; Ahmad et al., 2020; Nurtanto et al., 2021). According to Lister (2015), Val Gaealen et al. (2021), and Toda et al. (2019), gamification can use electronic concepts. However, it is enough to apply the right concepts related to learning or the elements that exist in gamification. They are already representative. In this case, the most important thing is building engagement for students to make learning more fun and meaningful. On the

other hand, gamification is currently known for using software (Buckley & Doyle, 2014; Poondej & Lerdpornkulrat, 2019; Saleem et al., 2021). This is supported by technological developments that continuously bring up something Innovative, especially in the field of education.

There are several examples of gamification applications that have succeeded in increasing user interest, namely angry birds (for physics lessons), Pokemon (for language lessons, art, science, and maps), and Minecraft (for architecture lessons) (Dichev et al., 2014). Furthermore, learning that uses the average gamification approach must use software to access it. This is in line with several previous studies by Pedreira et al. (2015) and Arruza & Chau (2021), which discussed gamification in the world of must-have education software. In addition, the gamification developed has different characteristics where there is a need to use a data package. There is also enough to install applications used. However, this does not become an obstacle for students or teachers who want to use gamification for learning because game-based learning can be accessed using smartphones anywhere and anytime.

Moreover, most of the school currently has a computer laboratory with internet access that can be used as a study room. The importance of gamification is discussed, especially in physics education, because it has excellent potential to provide meaningful learning to students. This is proven by the number of young people interested in the internet and the field of gamification Zicherm & Cunningham (2015). This can be used for the prospects of gamification in physics education in the future

In addition, the presence of COVID-19 is one of the causes of the development of the internet and technology in schools, which has a relationship with the feelings, administration, and social media of students in their use. Besides that, one of the negative impacts of online learning during the pandemic of COVID-19 was the increase in the number of students from elementary schools to high schools who are addicted to playing online games, so a solution is needed to find a solution. one solution is to manipulate these online games into exciting learning games. That way, we will provide contextual examples because they have a more attractive appearance to look at and observe. This is based on the suggestions of his sebum research. To realize gamification in education requires ICT and media that are easy to carry and use everywhere. This follows the results of Research from Erenli (2013) and Hariadi et al. (2022), which state that the most straightforward media to carry everywhere is a mobile phone (mobile learning) because it is by the current state of technological development.

Based on the description previously discussed, we have our weaknesses and advantages in the world of education. This is something interesting to be discussed and studied in the future (Kalogiannakis et al., 2021; Cardinot & Fairfield, 2022). Besides that, it also examines the future prospects for gamification in physics education. The study aims to determine the impact of gamification on education in the last ten years (2012-2021). To facilitate the analysis in this study, several questions can help, such as the following:

Q1: What is the trend of Gamification development during 2012 - 2021?
Q2: What is the distribution pattern of gamification during 2012 - 2021?
Q3: Which authors contributed the most to gamification research during 2012 - 2021?
Q4: Which countries discussed gamification the most during 2012 - 2021?
Q5: How does gamification contribute to the education sector?
Q6: How does the prospect of gamification-based mobile in physics learning?

RESEARCH METHOD

Study uses bibliometric analysis to answer questions from the Research conducted. Analysis Bibliometric was chosen because it could find the latest in the studies conducted based on the data obtained (Prahani et al., 2022a; Prahani et al., 2022b; Goyal & Kumar, 2021). This Research requires four stages to perform bibliometrics. These stages refer to the Research that has been done. The following stages can be seen in Figure 1.

Figure 1. Flowchart research.

Identification

This study uses the Scopus database as the primary data source. The Scopus database is used because it is a source that provides various indexed international (Julia et al., 2020; Halevi et al., 2017). After that, the existing data are identified according to the needs of research that will be focused on using keywords through a search during 2012-2021 (last ten years).

Filtering

After identifying according to needs, data filtering is carried out so that the research focus is more in-depth and sharper. With the keyword "Gamification," data is obtained from as many as 4.318 documents for all time. Then delimited by the string TITLE (gamification) AND (LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR) , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012)) obtained 4055 documents. The Scopus database takes on June 20, 2022.

Analysis

This study uses analytical analysis bibliometrics focused on aspects of gamification research that have been carried out from 2010 – 2021 based on the database Scopus. The analysis was carried out by the objectives of this study, namely related; (1) trend, (2) country, (3) keyword, (4) authors, (5) pattern, (6) distribution, and (7) impact of gamification based mobile learning to STEM. Furthermore, the stored data is analyzed with the help of several applications and the web, such as VOSViewer, MS-excel, and Word Cloud, to help visualize the analysis (Aksnes & Sirvertsen, 2019; Zabin & González, 2022). In addition, the researcher reviewed six articles related to prospects related to gamification in physics education. This is done because it sees the immense opportunity for gamification's contribution to physics education. In addition, with the presence of gamification, it can be one of the media that shows accurate visualization in everyday life.

Conclusion

After the results of the Research are conducted and analyzed, conclusions will be drawn according to the results obtained in the field of gamification during 2012 – 2021. On the other hand, there will be added limitations and several suggestions for researchers so that Research related to the field of gamification continues to develop in line with technological developments in the current.

RESULTS AND DISCUSSION

Publication Trend Gamification

During 2012 – 2021 there were 4055 documents indexed in Scopus in gamification. Documents in the form of articles can have their own every year. The Figure 1 shows the trend of gamification during 2012 – 2012.

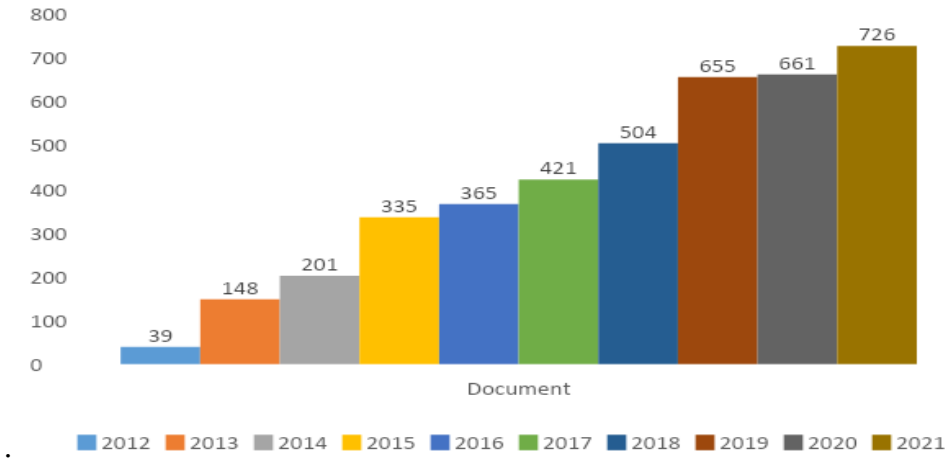

Figure 2. Publication trends of gamification 2012 – 2021.

Figure 2 shows trend development in gamification during the last ten years, 2012 – 2021. The graph in Figure 2 shows an increase in publications from 2012, as much as (39 docs) to (726 docs) in 2021. This gives information that Research and publications indexed in Scopus become an improvement from year to year in gamification. In recent years, technological developments have continued to increase and provide innovation to the community to continue to be creative, one of which is in gamification. In line with several studies that discuss gamification top distribution 100 cited of gamification 2012 - 2021 in several fields, including education (Sood et al., 2021), economy (Kalogiannakis et al., 2021), tourism (Heksarini & Putri, 2022), and agriculture (Bravo et al., 2021). It is known that gamification has a significant impact on several sectors. That way, predictions in the field of gamification will continue to increase along with the development of technology.

Top Distribution 100 Cited of Gamification 2012-2021

Throughout 2012 – 2021 there were so many publications occurred. However, some articles have better quality than others articles. This can be seen through the number of citations in each article. Table 1 shows the distribution of the top 100 citations from field gamification.

Table 1. Top distribution 100 cited.

Year	Paper	Cited	ACPP	ACPPY	Citable Years
2012	4	1192	298.0*	29.8	10
2013	14	2858	204.1	22.7	9
2014	19*	5604*	294.9	36.9	8
2015	16	5251	328.2	46.9	7
2016	18	3037	168.7	28.1	6
2017	17	3734	219.6	43.9	5
2018	5	423	84.6	21.2	4
2019	5	944	188.8	62.9	3
2020	2	256	128.0	64.0*	2
2021	-	-	-	-	0
Total	100	23299	1915.0	356.4	-

Note: ACPP = Average Citation Per Paper, ACPPY= Average Citation Per Paper Per Year, *= the highest number.

Table 1 shows the distribution of gamification fields based on the top 100 cited during ten years. Based on the data above, it can be concluded that the highest distribution for ten years last one occurred in 2014 (19 docs) with 5604 citations. Meanwhile, in 2021, based on the top 100 citations, there were no entries at all. This could happen because the publications that occur are still new, which is still a year apart from the current one. By the results of Research from Koleva (2021), Martín-Martín et al. (2021), and Correia et al. (2020), it is stated that one of the effects that occur on the number of citations is the length of publication carried out. In this case, the year of publication is one indication of the many side article journals.

Visualization of Distribution Top 100 Cited Gamification 2012-2021

One way that can be done is to identify clearly. In this case, Figure 3 shows the items with their respective clusters in the gamification field.

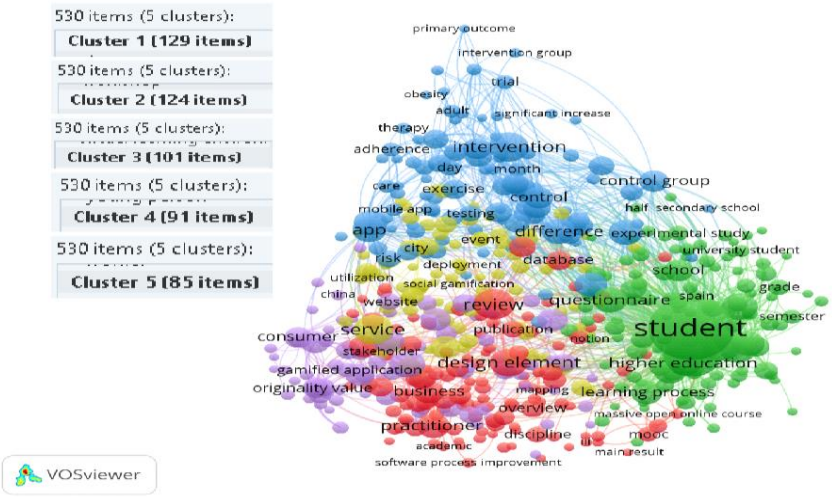

Figure 3. Network visualization.

Figure 3 shows 5 clusters with 530 items; cluster first (red) has the highest (129 items) connected. The second cluster (green) has a total of 124 items. The third cluster (blue) has a total of 101 items, and the fourth has several items (91 items). The fifth cluster

(purple) has several (85 items). Items visible in Figure 3 are the most abundant used in Research related to gamification. This can be supported by visualization in addition to Figure 4.

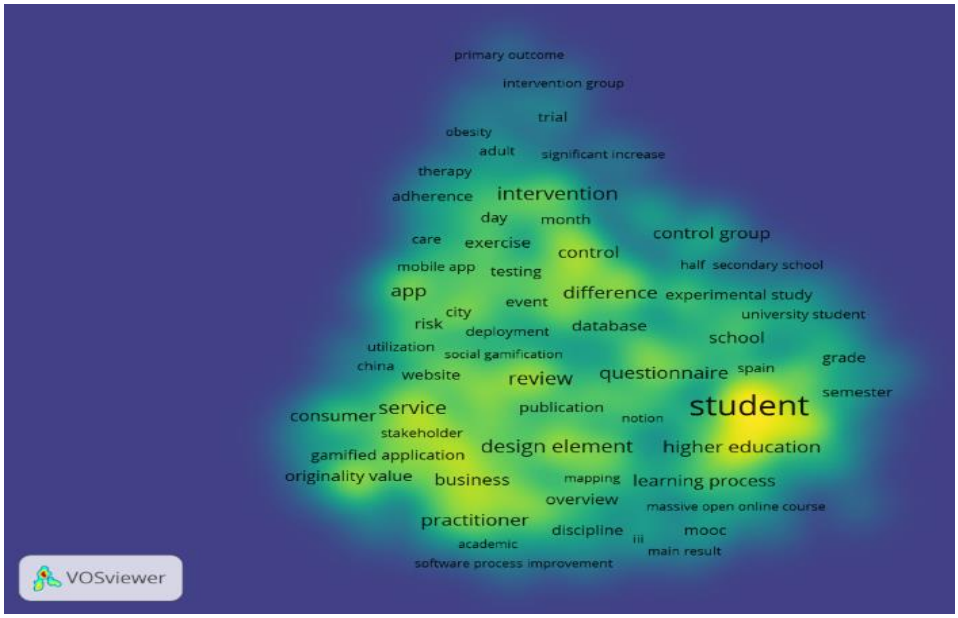

Figure 4. Density visualization.

Words/items used in research gamification are based on the color of the cluster and the number of items; several items are interconnected. All clusters appear starting from the keywords used in the data search, namely "Gamification ."After analyzing more in-depth, there is a relationship between all clusters with gamification. Figure 5 shows the number of items related to gamification in each cluster.

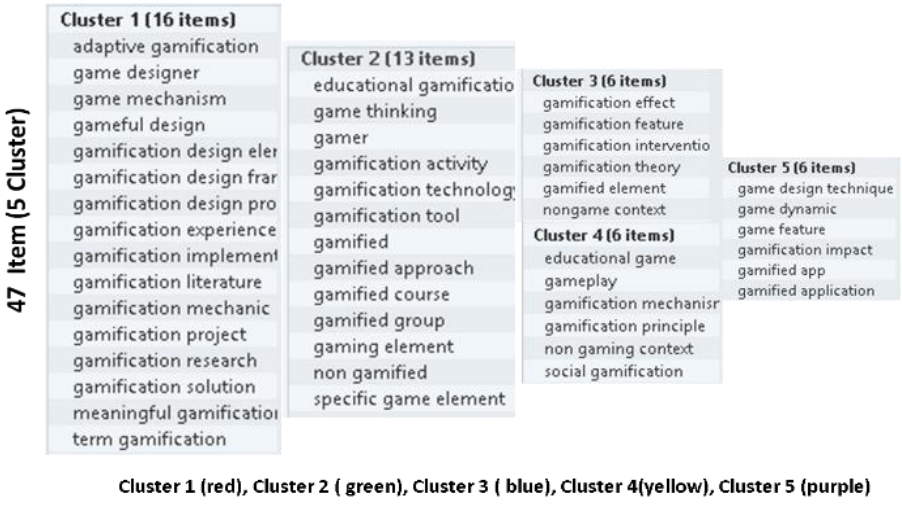

Figure 5. Items with gamification relationship.

From 530 items for a total of 5 clusters, 47 discuss the topic of games in gamification. This can be seen in Figure 5. In cluster 1 (16 items), cluster 2 (13 items), cluster 3 (6 items), cluster 4 (6 items), cluster 5 (6 items), and cluster 5 (6 items). Based on these items, it turns out that they have a relationship with one another. However, they have different focus areas, and the clusters are different. That way, this can be information related to novelty for further Research.

Top Language

In a study, of course, using different types of language. This can be known through Scopus-indexed journals and not only journals that use English or from countries. However, all journals originating from various countries have potential and quality by the stages that have been adjusted to the indicators from Scopus. Table 2 shows the top 10 types of languages used in gamification from 2012 – 2021.

Table 2. Top language.

Language	Document	Language	Document
English	3863	French	7
Spanish	107	Chinese	4
Portuguese	45	Hungarian	3
German	33	Turkish	3
Russian	11	Italian	2

Table 2 shows the most widely spoken document database, which is dominated by English (3863 doc), Spanish (107 doc), and Portuguese (45 doc). English dominates the language most widely used because English is a language of international communication between countries. This is in line with Mc Cabe et al. (2014) and Contreras-Soto et al. (2019), who states that English is the language used to communicate with the world. In addition, English is one of the subjects that must be studied. Good English is a particular skill possessed by people from countries that do not use English as their daily language (Fu & Wang, 2021; Gomes, 2020). On the other hand, Spanish has several particles, as many as (107 docs). This is obtained based on local journals in Spain and then indexed by Scopus to appear in the Scopus database. Likewise, with other types of languages such as German, Russian, etc.

Top 10 Authors

In every field of Research, there will undoubtedly be writers who have their respective advantages. Table 3 shows the top 10 authors in the field of gamification based on the database Scopus.

Table 3. Top author.

Author	Doc.	Cited	Author	Doc.	Cited
Hamari, J	54	29783	Koivisto, J	16	10633
Isotani, S	27	5691	Today, AM	15	898
Nacke, LE	25	24740	Korn, O.	14	1284
Gasca-Hurtado, GP	19	418	Fonseca, D	13	2900
Gasparini, I.	17	1803	Johnson, D	13	6432

In one particular field, there is so much competition going on in it. This is not negative because an article will go through previous research studies. On the other hand, it can be an update from the previous to become a reference source and the field is more comprehensive. Based on Table 3, it can be seen the names, documents, and number of citations of the authors. If it is explored more deeply based on the data above, it is not appropriate that many documents will have a large number of citations as well. It can also depend on the quality of the articles that have been published. That way, the top 10 authors above are based on the documents they publish in the field of gamification based on the amount.

Top Country

Anywhere will certainly be a country that dominates over something. The Figure 6 presents the top 10 countries in the field of gamification.

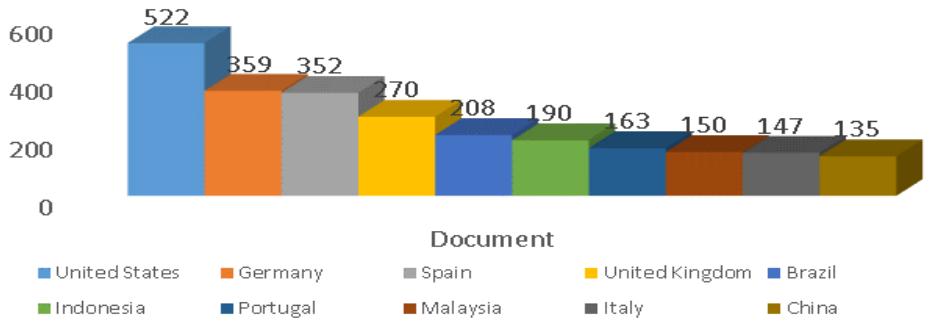

Figure 6. Top 10 countries.

Top Contribution of Gamification on Education

The developments in the field of gamification, also contributes to various factors, one of which is the education sector. This is shown based on the results of Research conducted Aguiar-Castilloet al. (2021), Dindar et al. (2021), and Özhan & Kocadere (2020) which says that gamification has a very positive effect on increasing graduation achievement, participating in completing assignments challengingly, encouraging students to focus more on paying attention to learning high-level motivation for students, and providing experiences for students in learning. On the other hand, gamification in the form of applications can provide deep learning (meaningful learning). It is in line with the findings of Research Katsaris & Vidakis (2021) and Aguiar-Castillo et al. (2020) which states, with the help of gamified applications in learning, it can make more contributions related to learning deep learning, strategies deep, motivational and lessons through the applications used.

According to Research Ahmed & Asiksoy (2021) that has been carried out using backward gamification in it by comparing the control class and the experimental, get different results between the two. Classes that implement gamification elements in it have a higher value than classes that do not use element gasification. From this, it can be seen that gamification has a contribution to students in learning physics. Gamification uses elements of design such as providing the context problems by involving environment learning of students, providing motivation, and providing stimulation so that it can improve student performance in learning. In addition, Research by Fan & Wang (2020) and Junaidi et al. (2022) that focuses on the time of the COVID-19 pandemic is related to physics education laboratory courses. This Research has a purpose, namely to find out the skills of students in the laboratory which are carried out virtually study. They used two sample groups, namely the control group and the experimental. The GFL (Gamified Flipped Learning) was used in the experimental while the CFL (Classical Flipped Learning) was used in the control group. After that, data was collected using efficacy questionnaires and interviews that focused on the innovative skills of students. The impact was positive on the innovation skills of students, although it was not very significant. On the other hand, the interview

revealed that the presence of gamification in learning provides a more meaningful learning process compared to learning classical.

The Future Prospect of Gamification based Mobile in Physics Learning

Innovation in the world of education will certainly have its own effect, whether it is positive or negative. The positive effects related to gamification based on mobile learning in the world of education are: (1) Increase students' learning motivation, (2) Improve IT skills, (3) Attract individual students' interest, (4) experience learning students, and (5) Increase collaboration in learning. The negative effects related to gamification based on mobile learning in the world of education are: (1) Methodology education becomes less efficient, (2) The required cost is relatively high, (3) It can cause disorientation to students, (4) It can be abused in learning, and (5) Can reduce students' attention to teachers.

There are positive and negative effects in the application of gamification-based mobile learning. This is in accordance with the expression of the Research (Toda et al., 2017), namely the use of gamification-based technology in learning certainly has positive and negative impacts. However, this can be anticipated by preparing everything carefully in terms of students and the gamification technology that will be used. That way, learning will be more effective and efficient and produce a positive image. Table 5 describes the results of a review of six articles related to gamification in physics education.

Table 5. Review of six articles related to gamification based mobile in physics learning.

Title/ Author	Results	Recommendations
A Gamified Mobile-Based Virtual Reality Laboratory for Physics Education: Results of a Mixed Approach / Iquira et al. (2019)	Research provides useful application results. It has a low cost for use in learning distance. In addition, an application has been tested on 86 students who have a very positive on learning for distance learning.	This study gives some emphasis in which virtual applications that are created are used to conduct experiments, but not to replace teachers. In addition, it is hoped that future Research will develop this application for other materials.
Design on 'FunPhy: Fun Physics' Educational Game Apps using Agile EXtreme Programming / Nada et al. (2019)	This Research only focuses on producing FunPhy that only focuses on learning physics level school high. Inside the application has various features that can be accessed when using the application.	For the future, the expected application can be tested to see whether this application is effective or not. In addition, this application can be developed for high school and university level.
Overview of game and content design for a mobile game that will prepare students in calculus and physics prerequisites to the engineering curriculum /Smith et al. (2017)	The results of this Research are in the form application which focuses on calculus and physics. In addition, the created application can be accessed by users using mobile software so that it can be played anywhere.	In the future, this Research will add chemical material in it. Furthermore, a trial will be conducted to determine and determine the efficacy of the game and its effectiveness in helping students.
Collaborative game model for teaching	This Research uses smartphone sensors which	Based on the existing results, it is hoped that this Research will

Title/ Author	Results	Recommendations
physics using smartphone sensors / Córdova & Alfonte (2020)	connect it to gamification and school curriculum. The results of trials conducted on two different groups resulted in better scores when using the treatment learning with smartphone sensors compared to learning.	continue to be carried out and developed so that it is truly effective. In addition, the trial is not only carried out in one school so that it can produce data that is truly valid and can assume that this smartphone sensor is effective and efficient,
"Cake Frenzy"- A physics game that implements puzzle mechanics with Indonesian cultures theme / Wibowo et al. (2018)	The results study resulted in an application called Cake Frenzy. Cake Frenzy is a game that is integrated into game that contains elements of culture in Indonesia to introduce and preserve it for foreign tourists visiting Indonesia.	The Research conducted is still focused on analyzing the application that is to be developed and seeing the opportunities for the development of social media. However, the Cake Frenzy Application cannot be said to be effective because it has not been tested evenly. Thus, in the future, trials should be carried out on tourists foreign
Game-based APP in teaching newton's three laws of motion for high schools students / Shyu & Chou (2019)	This Research resulted in a game-based interactive application on Newton's third law material. This Research has been tested on school high with these results are the available difference between the pretest and posttest after using the application. On the other hand, the teacher gives a positive response about the app which was used after conducting interviews with 6 teachers.	Suggestions for the future to be revised based on input from students and teachers so that according to what shortcomings have been assessed from the application. In of materials wider and not only focus on third Newton Law

Table 5 shows that the function of gamification in physics education is miscellaneous. This can be seen based on the review of the article above where there are applications made based on physics education for learning, introducing Indonesian culture, and as alternative media in distance learning. On the other hand, there are several applications that have been made, but have not been tried. In addition, there are also applications that have been tested and received positive learning outcomes and responses from students and teachers. Seeing it all, there are several recommendations from each application which in essence is to develop this application in further Research.

Based on the analysis that has been done, it is found that the development of gamification is very rapid and this has a great opportunity that has an impact on physics learning. In addition, this paper presents trends that can be used as a reference for further Research related to the prospect of gamification-based physics education. In addition, through the review papers that have been carried out, all of them have provided positive results or responses from each Research with suggestions for future Research.

CONCLUSION

Gamification is a growing trend in the era of rapid technological development. In addition, driven by the COVID-19 pandemic. Especially in the education sector, gamification makes a real contribution through mobile learning-based learning innovations. This can be known through the results of Research conducted by researchers. Based on the results above, it can be seen that gamification has had a tremendous impact on several sectors, especially in the education sector. It is hoped that developments in the field of gamification will continue to develop and can contribute positively to future education. There are several implications of this Research: 1) Gamification based mobile for now, cannot be considered only to have a negative impact on users, 2) Gamification based mobile makes a major contribution to physics education with careful preparation for implementation, 3) Gamification based mobile can be an innovation trend for schools, institutions, and government in conducting learning more meaningful.

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