A Robust Framework using Gamification to Increase Scientific Publication Productivity

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***Abstract*— This research focuses on the scientific publication productivity of higher learning institutions in Indonesia. The scientific publication productivity at Indonesia's higher learning institutions is still not ideal. Based on this issue, this study aims for a contribution in the form of a mechanism used as the main solution in optimizing scientific publication productivity. This mechanism is in the form of a framework based on gamification. This framework model consists of nine independent variables and 4 dependent variables. The independent variables used are networks, teamwork, competition, scores, leveling up, points, goals, inventory, and teammate. The dependent variable used is good sharing behavior, motivations, competence, and scientific publication enhancement. Researchers also make improvements to the Score variable, so that the calculation and ranking results become more accurate. Based on the preliminary test of the proposed framework, it shows that each construct of the framework has a positive impact on increasing motivations, except Leveling Up, while High Motivation had a positive impact of 0.807 on scientific publication enhancement. For reliability testing, done using AVE, CR, and CA shows all constructs have good reliability.**

Keywords*— framework, scientific publication, higher learning institution

I. INTRODUCTION

The scientific publication productivity at Indonesia's higher learning institutions (HLI) is still not ideal. High motivation is needed to optimize the number of research publications. The motivation can emerge from the lecturers themselves with support from government regulations. The number of lecturers vs. the number of publications and the publication's ratio in several HLI in Indonesia shown from the data collected by the Ministry of Research and Technology through the Sinta online database (Science and Technology Index) [1] in Table 1.

TABLE I. NUMBER OF LECTURERS VS. NUMBER OF PUBLICATIONS (FEB 2020), AND THE PUBLICATIONS RATIO FROM SEVERAL HLI IN INDONESIA

Higher learning institution	Number of Lecturers	Overall Number of Publications (Scopus)	Publications Ratio per Year (2006-2020)
Universitas Brawijaya	2,039	5,347	0.18
Universitas Diponegoro	1,663	5,196	0.22
Universitas Sebelas Maret	1,616	5,023	0.22
Universitas Hasanuddin	1,789	4,766	0.18
Universitas Sumatera Utara	1,264	4,198	0.23
Universitas Indonesia	1,682	14,561	0.61
Institut Teknologi Bandung	1,349	14,393	0.76
Universitas Gadjah Mada	2,300	10,421	0.32
IT Sepuluh Nopember	957	6,984	0.52
Institut Pertanian Bogor	1,339	6,894	0.36

Data published on the Sinta database was collected from 2006-2020. This applies to the assumption that each lecturer has become lecturers since 2006, but if these assumptions are not met, the ratio of publications obtained can be even lower. Over the past three years, the publication's ratio has increased, it can be understood because there are regulations that require lecturers, especially senior lecturers (full professors), to publish their research in reputable international journals indexed by a reputable database such as Scopus or Web of Science (WoS). But overall, if measured from 2006, it is clear that the publication's ratio per year is not optimal. Arisen from this problem, this study aims for a contribution in the form of a framework used as the main solution to increase scientific publication productivity, including the number of publications in higher learning institutions.

But before go any further, this research would like to present a related publication that discusses the method to increase scientific publication productivity (Table 2).

TABLE II. THE RELATED PUBLICATION DISCUSSES THE METHOD TO INCREASE SCIENTIFIC PUBLICATION

No	Article	Author(s)
1	Knowledge sharing: Role of academics towards scientific publication productivity in higher learning education	Fauzi, *et al* [2]

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No	Article	Author(s)
2	Motivation for Research and Publication: Experience as a Researcher and an Academic	Zain, *et al* [3]
3	Enhancing research publications and advancing scientific writing in health research collaborations: sharing lessons learnt from the trenches	Li, *et al* [4]
4	Examining scientific publication productivity of faculty in selected leading public universities in Kenya	Nafukho, Wekullo, and Muyia [5]
5	Scientific Publication Productivity of Emergency Physicians: A Bibliometric Analysis of The Last Decade	Kokulu, Mutlu, and Sert [6]
6	Some ideas on enhancing scientific publication productivity	Silver [7]
7	What Can Be Done to Enhance the Scientific publication productivity of Junior Staff?	Uncles [8]
8	Mentoring Through Predoctoral Fellowships to Enhance Scientific publication productivity	Olson and Connelly [9]
9	Increasing Faculty Scientific publication productivity via a Triple-Helix Modeled University Outreach Project: Empirical Evidence from Thailand	Chanthes [10]
10	How To Increase Scientific publication productivity In Higher Education Institutions – Sims Model	Aithal [11]
11	Increasing Scientific publication productivity in Undergraduate Research Experiences: Exploring Predictors of Collaborative Faculty-Student Publications	Morales, Grineski, and Collins [12]
12	A gamification framework for scientific publication productivity enhancement on the higher education institution	Sanmorino, Marnisah, and Sunardi [13]

Table 3 shows the comparison of the source of data, the type of article, and the results obtained by each researcher. The results of the comparison show that topics related to increasing scientific publication productivity are still very relevant and discussed by many researchers. The type of article is distributed equally in research papers, review papers, and essay papers. For the source of data, the method of observation, questionnaire, and survey still dominates. Some take data from secondary sources, such as online databases.

TABLE III. THE COMPARISON OF THE SOURCE OF DATA

Author	Source of Data		
	Interview	*Obser. /QNR/survey*	*Online Database*
[2]		√	
[3]	√		
[4]		√	
[5]			√
[6]			√
[7]		√	
[8]		√	
[9]	√	√	
[10]	√	√	
[11]			√
[12]		√	
[13]		√	

After the study about the method to increase scientific publication productivity in related articles, the next step is to build a mechanism used as the main solution in optimizing scientific publication productivity. This mechanism is a continuation of an initial study develop from previous studies [13][14]. In increasing the productivity of lecturers' scientific publications, also requires high motivation from within the lecturer. To increase the motivation of lecturers, other triggers are needed that can make lecturers remain consistent and enthusiastic in publicizing the results of their research[15][16]. Some elements of gamification can be an alternative increase the motivation of lecturers in publicizing the results of their research.

The concept of gamification has been used by several researchers for various purposes, including increasing students' interest in participating a massive open online course. Gamification is also used to increase employee motivation in increasing work productivity in a company. The term use of element games as a solution to the issue of non-games context is called gamification [17]. Gamification has been used by some researchers as motivation boasters or solutions to issues of non-games context [18]-[20]. Saputro, et al [21] used the game's design in a framework to increasing students' intrinsic motivation on massive open online courses (MOOC). Table 4 shows some game's element:

TABLE IV. THE GAMES ELEMENT AS CONSTRUCTS

No	Games Design	References
1	Teamwork, Competition, Network	[21][22][23]
2	Virality, Mission, Countdowns, Goals	[21][24][25]
3	Skill, Ability, Status	[21][26]
4	Level, Points, Badges, Progress Bar	[27][28][29]

One of the game design that can be used to determine lecturer rankings is Score. In the Sinta online Database published by the Ministry of Research and Technology also provides scores or assessments of the performance of the publications of each lecturer and overall college performance scores. The displayed score is used as a reference by the Ministry of Research and Technology in ranking lecturers. This ranking is also very influential on the cluster of higher learning institutions which has an impact on the amount of research funding that can be obtained. This ranking is also related to the rewards given to lecturers, both on a national and regional scale. The mechanism for calculating the performance scores of scientific publications used is still not relevant in terms of accuracy. The process of calculating the performance of scientific publications does not pay attention to important things such as the contribution of each author which is usually based on the order of author names, then whether an author actively interacts with reviewers, editors, or answers questions from other researchers via email or scientific forums. Based on this reason, the researcher wants to make improvements to the mechanism of calculating the scores of lecturers' scientific publication productivity. The score will be a construct in the framework that the researcher proposes.

II. RESEARCH METHOD

The study begins by identifying the problem, followed by determining the construct that will be used in the framework (Fig. 1). The process of problem identification and construct determination is based on the study of research literature related to the problem to be examined. In the literature-study conducted a review of related publications in the last few years (past publication). The review focuses on the data sources used, the proposed mechanism, the testing and analysis methods, and the contributions made. So that the advantages and disadvantages of each mechanism proposed by each researcher are known. Through this review, it is also known that there are gaps or research opportunities from several

previous studies that can be utilized for research to be conducted.

The sample data used were collected from lecturers from higher learning institutions in Palembang, Indonesia. The data were obtained through an online questionnaire, which began in early 2020. PLS-SEM (Partial Least Square-Structure Equation Modeling) used to evaluate and analyze the proposed framework [30]. The reason why the SEM method is chosen is that it supports complex modeling constructs with minor correspondents, which very relevant to this study. SEM is effective in modeling latent variables, measuring error correction, and estimating parameters for all hypotheses simultaneously. PLS-SEM is an alternative method of modeling equation structure used to explain the construct relationships, emphasizing the theory of the value of these relationships with a limited sample data size.

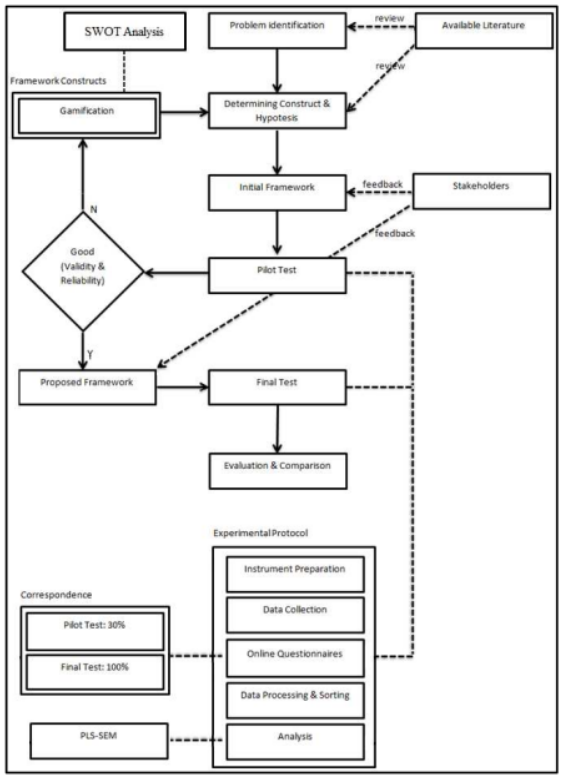

Fig. 1. The research design

In selecting and compiling the constructs used in the framework, the researcher determines three main components. However, the constructs taken from these three components are not last yet, adjustments can still be made based on the pilot test. The main part of the framework came from the gamification element. Pilot tests used to find out whether the construct and its indicators can still be used or maintained in the proposed framework. At the pilot test stage, correspondents involved were only 30 percent of the total correspondents. The sub-stage in the pilot test stage systematically includes instrument preparation, data collection using an online questionnaire.

Then the data collected according to the predetermined criteria, further analysis doing using the SEM-PLS method. If the results of the analysis show that all constructs valid, they can do it to the next stage. The indicators of a construct that accepted or can still be used are valid and have good reliability. The next stage is to test the proposed framework built by the construct and its indicators. The testing phase of the proposed framework is not much different from the pilot test stage, but this time the number of correspondents used is 100 percent, all correspondents involved in assessing the proposed framework. The last stage is to check the results of the test and to compare the mechanisms proposed by other researchers.

III. Results and Analysis

The next move is to choose the construct that will be used in the proposed framework. But before determining the construct, the next step is to formulate the research hypothesis (H) as the initial step in building the framework (Table 5).

TABLE V. Research Hypothesis

	Hypothesis
H1	Competition has a positive impact on the Good Sharing Behavior of academics in higher learning institutions.
H2	A Teamwork has a positive impact on the Good Sharing Behavior of academics in higher learning institutions.
H3	Networks have a positive impact on the Good Sharing Behavior of academics in higher learning institutions.
H4	Points have a positive impact on academic Competence in higher learning institutions.
H5	Goals have a positive impact on academic Competence in higher learning institutions.
H6	Inventory has a positive impact on academic Competence in higher learning institutions.
H7	Teammate has a positive impact on academic Competence in higher learning institutions.
H8	The Score has a positive impact on academics' High Motivation to Scientific publication enhancement in higher learning institutions.
H9	Leveling up has a positive impact on academics' High Motivation to Scientific publication enhancements in higher education institutions.
H10	Good sharing behavior among academics has a positive impact on High Motivation to Scientific publication enhancement in higher learning institutions.
H11	Academic Competence has a positive impact on High Motivation to increase Scientific publications in higher learning institutions.
H12	Academic High Motivation has a positive impact on Scientific publication enhancement in higher learning institutions.

Based on the hypotheses explained, the proposed framework is (Figure 2):

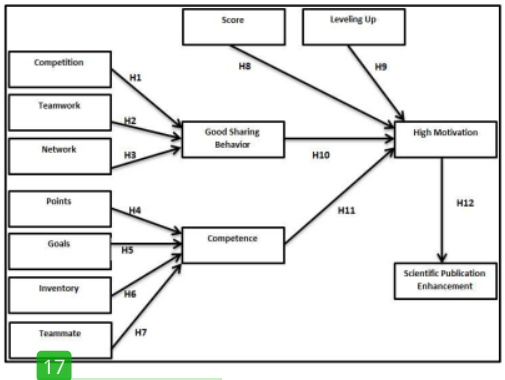

Fig. 2. The proposed framework

Based on the hypotheses and constructs that have been determined in the previous stage, the initial construction of the

framework will be proposed and tested in this study. This initial framework is a combination of preexisting models. This initial framework is also an adaptation of the model that we have previously proposed [13][14]. This framework model consists of nine independent variables and four dependent variables. The independent variables used are networks, teamwork, competition, scores, leveling up, points, goals, inventory, and teammate. The dependent variable used is good sharing behavior, high motivation, competence, and scientific publication enhancement. This initial framework can be seen in Fig. 2.

Furthermore, researchers try to contribute to the calculation method of lecturer publication productivity scores. This needs to be done because the process of calculating the performance of scientific publications by the current method does not pay attention to important things such as the contribution of each author which is usually based on the order of author names, then whether an author actively interacts with reviewers, editors, or answers questions from other researchers via email or scientific forums. The purpose of this modification is so that the score obtained is more accurate and in accordance with the contributions of each author. This calculation method can accommodate different assessments of the first author, co-author, and correspondent author. Each role is given a different rating weight, according to the contribution of each author. For fist authors as correspondent author-weight by 100 percent, the first author is not as a correspondent author or vice versa by 80 percent, while the co-author is only 60 percent of the total weight. Each component of the calculation will be used as an indicator of the construct score in the proposed Framework.

The outer model or loading factor value shows the validity of the indicator to a construct. For example, the outer model values for each indicator i1X3, i2X3, and i3X3 are 0.948, 0.923, and 0.914 then these three indicators are declared valid. Overall, there is no indicator with a value below 0.5, the minimum allowable threshold value. Furthermore, the Regression coefficient between constructs shows whether a construct has a positive effect. Such as the variable coefficient value of 0.499 shows that The Competition has a positive effect on academics' Knowledge Sharing Behavior. A value of 0.290 shows that Knowledge Sharing Behavior among academics' has a positive effect on increasing scientific publication productivity. The only construct has a negative effect is Leveling Up. For more details, the effect of each construct on other constructs shown in Table 6:

TABLE VI. THE EFFECT OF EACH CONSTRUCT USED IN PROPOSED FRAMEWORK

No	Construct	Toward	Value	Effect
1	Network	Good Sharing Behavior	0.368	Positive
2	Teamwork	Good Sharing Behavior	0.030	Positive
3	Competition	Good Sharing Behavior	0.499	Positive
4	Score	High Motivation	0.257	Positive
5	Leveling Up	High Motivation	-0.525	*Negative*
6	Points	Competence	0.293	Positive
7	Goals	Competence	0.260	Positive
8	Inventory	Competence	0.349	Positive
9	Teammate	Competence	0.031	Positive
10	Good Sharing Behavior	High Motivation	0.068	Positive
11	Competence	High Motivation	1.122	Positive
12	High Motivation	Scientific Publication Enhancement	0.807	Positive

CR, CA, and AVE values for all constructs show good reliability. This is shown in Table 7; the reliability values for each construct are above the minimum allowable threshold. With good reliability, every construct is feasible to be used in the proposed framework. The results of this preliminary study are a good step for the next research phase.

TABLE VII. RELIABILITY TESTING USING CR, CA, AND AVE

No	Construct	CR	CA	AVE
1	Network	0.855	0.770	0.603
2	Teamwork	0.911	0.869	0.720
3	Competition	0.949	0.920	0.862
4	Score	0.845	0.732	0.646
5	Leveling Up	0.918	0.866	0.788
6	Points	0.898	0.845	0.692
7	Goals	0.849	0.732	0.653
8	Inventory	0.958	0.946	0.791
9	Teammate	0.957	0.940	0.848
10	Good Sharing Behavior	0.949	0.928	0.822
11	High Motivation	0.950	0.929	0.826
12	Competence	0.968	0.956	0.883
13	Scientific Publication Enhancement	0.945	0.926	0.775

IV. CONCLUSION

Based on the preliminary testing of the proposed framework, it shows that each construct of the framework has a positive impact, except Leveling Up. This will affect on scientific publication productivity as the final goal to be achieved. Researchers will carry out adjustment of the indicators that will be used. The AVE value of each variable used to have good discriminant validity. Also, for the reliability test, Composite reliability (CR) shows that all variables have good reliability. Same with CR and AVE, the Cronbach Alpha (CA) test results also show all variables have reliable to be used as constructs in the proposed framework. This pilot test result indicates several variables can be used for future research with more comprehensive analysis and use 100% respondent.

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