Evaluation and Challenges of Research Groups in Higher Education: A Study in Faculty of Mathematics and Natural Sciences, Sebelas Maret University

Ahmad Ainurofiq
Sebelas Maret University

This article presents evaluations and challenges in managing Research Groups in Higher Education: Studies at the Mathematics and Natural Sciences Faculty, Sebelas Maret University (FMIPA UNS). Data were collected by an online survey conducted on FMIPA UNS lecturers included in the research group by filling a survey. The survey questions include 44 items classified into four groups, i.e. strength, weakness, opportunity, and threat. The questions were measured using the 5-point Likert scale. The obtained survey data were assessed using the Strengths, Weakness, Oppotunities and Threats (SWOT) analysis. SWOT analysis was conducted by determining the position of the quadrants. Analysis result was in the second quadrant, which showed that the research group required a diversification strategy to grow. These data could provide information on the management needed. There should be a policy on the performance improvement of the research group, and the obtained data could aid in making a decision and changing management to be used for further investigations.

Keywords: research group, Faculty of Mathematics and Natural Sciences, Sebelas Maret University, SWOT analysis, higher education

INTRODUCTION

The performance results of the UNS research and community service (P2M) under the management of LPPM UNS developed rapidly. Based on the clustering made by the Ministry of Research, Technology, and High Education, UNS is categorized as independent in research and superior in community service. This success cannot be separated from the internal management system of P2M UNS. To achieve the Key Performance Indicator (KPI) of UNS, LPPM created research groups as the cutting edge of P2M activity to obtain the increased achievement of the involvement of researchers and devotees in various schemes of P2M and increased publication outcome achievement as targeted by the KPI. The research group is a strategy to increase the quality and quantity of P2M. The formation of the research group had several benefits, include: as an analysis of the lecturer resource power in UNS, reinforcement of UNS strategic synergy as an impact of research and community service on the quality of teaching and reinforcement of innovation growth, increased lecturer participation, reinforcement of academic integration, and determination of development scope and strategic research innovation target, identification of research power, display of research collaboration, analysis of research trend, and identification of lecturer expertise in UNS, and a more focused research development strategies (LPPM UNS, 2020). The Faculty Coordinator of Research and Community Service (KPPMF) has an important role to guarantee the implementation of

P2M. The development of a research group coordinated by KPPMF is expected to lead to the fusion of unidirectional scientific studies in the process of innovation. Therefore, research groups can grow with their characteristic superiority to produce research products in the form of publications or quality innovative products. These survey data are beneficial as information in learning about strength, weakness, opportunity, and threat patterns in the research group. The analyzed data provided the most important criteria for the development of a research group, which can be used for intervention strategies to improve the performance of a research group and develop a more adaptive policy. This information is beneficial for all related parties, especially researchers, practicians, university management, ministry of higher education, or state authorities in the development of research climate and management of a research group. These data can be used by other researchers to find a model for the performance evaluation of a research group in different universities. This instrument can be used as an adapted platform for similar studies by other researchers.

MATERIALS AND METHODS

The data for this study were obtained through the survey using structured and validated questions with items adjusted to conditions in the research group. Samples were taken by filling in survey forms during September 2020. Data were collected using online questions through the provided link. Samples were specific for FMIPA UNS lecturers included in a research group. For data collection, 44 participants from 141 FMIPA UNS lecturers included in research groups from 8 study programs filled the survey. The total participants represented all research groups in FMIPA, which consisted of 30 as shown in Table 1. Each participant provided consent to fill the only survey directly. The identity of the participants was maintained but kept secret by the authors to determine that the participant is in a research group. The sampling technique was done randomly from the lecturer population to represent each research group and study program. There should not be a "mysterious" participant filling the survey. Therefore, participants must include their identity and the name of their research group. If the data input was incompatible with the system, then the data would not be included in the analysis.

The participants choose to agree with the statements and instruments used. The questionnaire was measured with a 5-point Likert scale. There are 5-point choices of the Likert scale based on the appointed typicality (Bowling and Hammond, 2008). The answers for the scale was designed with five choices, i.e. 1 (Strongly Disagree), 2 (Disagree), 3 (Uncertain), 4 (Agree), and 5 (Strongly Agree) (Mulyono and Saskia, 2020). The question system was assessed using the SWOT analysis, i.e. strength, weakness, opportunity, and threat. The questions included 44 items classified into four groups, consisted of 16 strength questions, 14 weaknesses, 6 opportunities, and 8 threats. Each SWOT group had the same total weight of 1 even though they have a different number of items. The weight of 1 was divided by the number of questions. Therefore, the weight of each item in one group is the same. The SWOT analysis model adopted the pattern from LPPM UNS as the parent of the research group. Although, the components of statements used in this SWOT analysis are a different design from LPPM UNS (LPPM UNS, 2020). The SWOT analysis was conducted by determining the quadrant position (Fardani et al., 2020). Certain quadrants can describe the condition of the research group during the survey. Based on the SWOT analysis results, the authors provided a solution of measures to improve the performance of the research group (Forleo and Palmieri, 2019; Kolomiets et al., 2019).

RESULTS AND DISCUSSION

The provided data consisted of information on the performance of the FMIPA UNS research group in 2020. Data were obtained according to the SWOT analysis to explore the strength, weaknesses, opportunities, and threats of the research group (Kaushik, 2018). The participants were FMIPA UNS lecturers, who consisted of 44 people, i.e. 31.2% of the total lecturer population in FMIPA UNS of 141 people. The participants were representative because they were spread in 8 study programs (Mathematics, Physics, Chemistry, Biology, Informatics, Pharmacy, Statistics, and Environmental Science) and were

included in 30 research groups presented in Table 1. Table 1 lists the research groups in FMIPA UNS in 2020-2021 based on the Dean's Decree.

TABLE 1
LIST OF RESEARCH GROUPS IN FMIPA UNS IN 2020-2021

NO	RESEARCH GROUPS	STUDY PROGRAMS
1	Combinatorial Mathematics	Mathematics
2	Mathematical Soft Computing	Mathematics
3	Pure Mathematics and Application	Mathematics
4	Applied and Mathematical Analysis	Mathematics
5	Magnetic Sensor and Materials	Physics
6	Optics and Photonics	Physics
7	Electronic Materials and Energy	Physics
8	Advanced Materials	Physics
9	Theoritical and Computational Physics	Physics
10	Accoustics and Geophysics	Physics
11	Electronics and Instrumentation	Physics
12	Natural Products and Synthetic Organic Chemistry	Chemistry
13	Solid State Chemistry and Catalysis	Chemistry
14	Inorganic Materials	Chemistry
15	Analytical and Environmental Chemistry	Chemistry
16	Plasma Science and Technology	Chemistry
17	Animal Biomaterials	Biology
18	Plant Biomaterials	Biology
19	Microbial Biomaterials	Biology
20	Biodiversity	Biology
21	Intelligence Systems and Humanized Computing (ISHC)	Informatics
22	Computational Science and Engineering (CSE)	Informatics
23	Data, Information and Knowledge Engineering (DIKE)	Informatics
24	Computer Networks and Security (CNS)	Informatics
25	Active Pharmaceutical Discovery and Development (APDD)	Pharmacy
26	Metabolic Disorders	Pharmacy
27	Statistics and Data Science in Industry and Economics	Statistics
28	Statistics and Data Science in Environmental and Health	Statistics
29	Environment And Climate Change	Environmental Science
30	Ecology	Environmental Science

The information in Table 2 represented a group of SWOT analysis questions with the characteristics of responses and the number of participants' percentage based on the Likert scale. The participants received adequate and correct information and questions on their research group condition. The composition of the questions varies considerably, such as the role of the research group, facilities, agenda, funding, the track record of achievement, management, and teamwork. The participants were given chances and freedom to choose and provide their opinions and their confidentiality is maintained. The participants answered the survey according to the condition of each research group based on the 5-point Likert scale lists to measure each research group. It should be noted that the chosen 5-point Likert scale is a representation of the participants' view on the research group, which affects the future development of the research group. Interpretation of the responses can provide a clear understanding of the participants' composition and can

be used for policymaking from the authorities in the Faculty of the University to improve the performance and effectiveness of research and community service and for further studies (Zhu and Mugenyi, 2015).

TABLE 2
COMPONENTS OF SWOT QUESTIONS AND PERCENTAGE OF PARTICIPANTS

No	Item components of Strength (S), Weakness (W), Opportunities (O), and Threats (T)	% of participants with Likert Scale:				
		Strongly disagree	Disagree	Uncertain	Agree	Strongly Agree
S1	The position of the research group is strong and strategic because there is a UNS Rector Regulation on the Implementation of Research Group-based Research and Community Service (P2M).	0	4,5	15,9	52,3	27,3
S2	The research group is the cutting edge of innovation in P2M as a more focused research development with characteristic superiority.	0	2,3	25	36,4	36,4
S3	The research group has a clear objective and job description.	0	2,3	22,7	47,7	27,3
S4	The research group has a structured and directed roadmap to improve the performance effectivity referring to the 13 (thirteen) themes of UNS research in line with *Rencana Induk Riset Nasional* (RIRN) 2017-2045 and *Prioritas Riset Nasional* (PRN) 2020-2024 (Permenristekdikti, 2019).	0	4,5	22,7	47,7	25
S5	The operational standard of the implementation of Research Group, P2M planning, and mechanism of performance measurement of a Research Group is described in the P2M Guide Funded from PNBP UNS.	0	2,3	29,5	56,8	11,4
S6	The management of Research Group membership is well structured and based on the regulation on the number of members, requirement of members, requirement for Research Group leader, and regulation on P2M proposal submission through the research group.	0	4,5	22,7	59,1	13,6
S7	The tiered coaching scheme started from becoming a researcher, entering the research group, center of study/center of research, to UNS center of excellence/Ipteks is a design to support achieving P2M performers.	2,3	9,1	15,9	54,5	18,2

S8	The suitable theme for researchers/devotees in achieving P2M grant according to the Research Group roadmap supported by various P2M schemes and appropriate funding is a strategy to improve the performance of UNS P2M.	0	0	20,5	56,8	22,7
S9	The research group development agenda is well-organized (research, service, publication, seminar/conference, workshop, training/short course, overseas visit plans of visiting scholar/researcher).	0	9,1	29,5	52,3	9,1
S10	Track record of P2M achievements from the research group is good and documented (competitive research, publication in scientific journals, publication in proceedings, the achievement of Intellectual Property Rights/patent and technological creations, book chapters, publication in magazines or the mass media).	2,3	2,3	25	54,5	15,9
S11	The research group has a high achievement of funding for research and community service from outside the university (domestic and foreign).	0	22,7	29,5	40,9	6,8
S12	The research group has a high publication spirit and good publication quality by choosing quality journals/proceedings by following indexing agencies such as Scopus/WOS.	0	4,5	20,5	50	25
S13	The research and community service achievement by the research group has reached a certain Technology Readiness Level (TRL) with the potential to be developed into a business unit (Permenristekdikti, 2016) .	2,3	6,8	45,5	36,4	9,1
S14	Good coordination and teamwork between members in a research group (in the aspect of research, service, and scientific publication).	0	6,8	18,2	50	25
S15	Research group members are skillful and have a synergistic field of studies to obtain a quality research group.	0	2,3	15,9	50	31,8
S16	The management of P2M administration and information system for the research group is supported by	0	11,4	20,5	54,5	13,6

	adequate information technology and computerization.					
W1	Lecturer participation in research and community service is still uneven. Therefore, the productivity, process quality, and outcome of P2M are not optimal.	4,5	20,5	29,5	38,6	6,8
W2	The ability of the research group in obtaining competitive research funding from outside the university by various national and international donor institutions is limited.	2,3	9,1	29,5	54,5	4,5
W3	There is a lack of ability of the research group to collaborate or joint research with researchers from other universities, both in and outside the country.	2,3	6,8	31,8	45,5	13,6
W4	There is a lack of teamwork in the research group to work together, grow, and develop together and provide a higher impact.	4,5	13,6	45,5	31,8	4,5
W5	The enforcement of Dean's Decree concerning the formation of a Research Group that is valid for two years leads to a limited duration of performance continuation of the research group.	4,5	13,6	43,2	29,5	9,1
W6	Low desire from the researchers in the research group to improve self-capacity.	11,4	29,5	43,2	15,9	0
W7	The research group did not represent the group of lecturers with unidirectional scientific studies. Therefore, an ideal research group is not yet formed, and a more focused research development target is not achieved.	4,5	18,2	43,2	25	9,1
W8	The research group has not been effective in improving overall P2M performance and publication, proven by uneven Research Group performance index with the majority of low. The role of personal fighters in the implementation of P2M in the research group is still high.	4,5	22,7	31,8	31,8	9,1
W9	Lower publication growth in FMIPA research group compared to research groups in other faculties in UNS and other universities.	9,1	31,8	40,9	15,9	2,3

W10	Lack of certified research-specialized laboratory facilities as research support facilities and services for the research group.	2,3	11,4	22,7	27,3	36,4
W11	Low quality of books, e-books, journals, and e-journals library collection for research support facilities and services for the research group.	9,1	25	34,1	20,5	11,4
W12	The database integration on personal or research group achievement (activities of university tri dharma) in MIPA is still lacking.	0	11,4	43,2	31,8	13,6
W13	Low awareness to report P2M teamwork activities of the research group with external parties.	2,3	11,4	50	25	11,4
W14	The process of proposal submission for P2M grant from lecturers as a research group member is relatively difficult.	13,6	22,7	34,1	25	4,5
O1	There are research grant/funding offers from various parties local, national, and international.	0	2,3	31,8	45,5	20,5
O2	The possibility of cooperative network development with research and community service partners and international seminar holdings from various parties local, national, and international.	0	2,3	20,5	59,1	18,2
O3	There is a network system, technology, information, and communication, especially through open-source platforms.	0	2,3	38,6	50	9,1
O4	Many chances for standardization, accreditation, and certification (acknowledgment).	2,3	11,4	29,5	50	6,8
O5	There are various publication media on many levels (regional-national-international).	0	6,8	11,4	50	31,8
O6	Many possibilities of cooperation and collaboration with industries, government, overseas universities, and overseas institutions.	2,3	9,1	25	50	13,6
T1	Demands of research outcome for the research group on articles published in accredited national journals, Scopus-indexed international journals, Scopus-indexed proceedings, textbooks, and book chapters.	0	9,1	34,1	43,2	13,6

T2	Demands of lecturer quality and quantity for article publications in Scopus-indexed international journals.	0	4,5	25	45,5	25
T3	Demands lecturer reinforcement and a broadminded research group with an international reputation.	0	2,3	27,3	47,7	22,7
T4	The need for adequate and certified research-specialized laboratory capacity.	0	4,5	20,5	34,1	40,9
T5	The need for quality books, e-books, journals, and e-journals library collection for reference sources.	2,3	0	15,9	38,6	43,2
T6	Demands of standardization needs, such as SNI, ASTM, JIS, ISO, etc.	0	0	29,5	45,5	25
T7	High demands of outcome quality and commercialization of research results and services.	0	4,5	31,8	47,7	15,9
T8	Demands good institutional management and governance.	0	0	20,5	52,3	27,3

The process of SWOT analysis results is shown in Table 3. The SWOT analysis results showed several points that needed more attention due to higher or lower Likert scale scores compared to other questions. For example, item S11 from the strength component had the lowest score compared to other items. For the solution, the research group should increase research and community service funding from outside the University, both from within and outside the country. The highest weakness component was W10. Therefore, there should be a research-specialized laboratory facility. Meanwhile, the highest threat was T5, which was the need for a library for books, e-books, journals, and e-journals collection as quality reference sources. Analysis data could aid the management of Faculty and University in considering the priority scale of measures taken in determining policy and decisions which help position the university within the world (Longhurst et al., 2020).

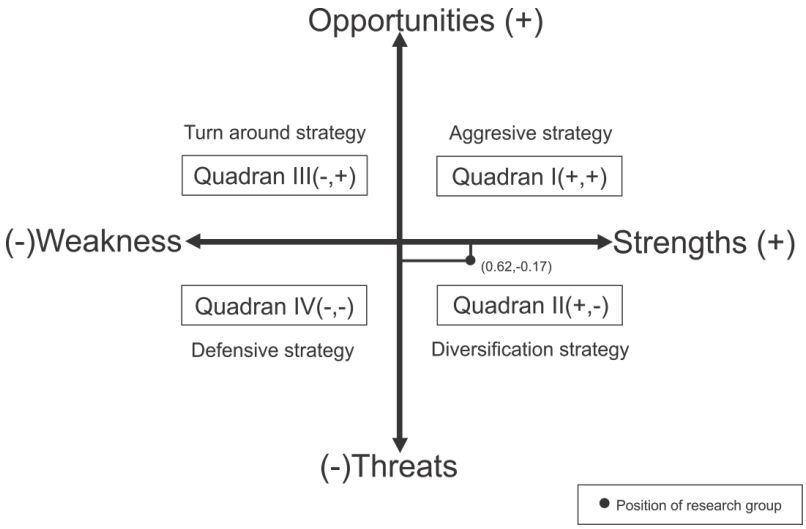
TABLE 3
SWOT ANALYSIS RESULTS OF THE RESEARCH GROUP

SWOT	Total Likert Scale Score	Mean Score	Weight	Value
S1	177	4.023	0.0625	0.251
S2	179	4.068	0.0625	0.254
S3	176	4.000	0.0625	0.250
S4	173	3.932	0.0625	0.246
S5	166	3.773	0.0625	0.236
S6	168	3.818	0.0625	0.239
S7	166	3.773	0.0625	0.236
S8	177	4.023	0.0625	0.251
S9	159	3.614	0.0625	0.226
S10	167	3.795	0.0625	0.237
S11	146	3.318	0.0625	0.207
S12	174	3.955	0.0625	0.247
S13	151	3.432	0.0625	0.214
S14	173	3.932	0.0625	0.246
S15	181	4.114	0.0625	0.257

S16	163	3.705	0.0625	0.232
TOTAL			1	3.830
W1	142	3.227	0.0714	0.231
W2	154	3.500	0.0714	0.250
W3	159	3.614	0.0714	0.258
W4	140	3.182	0.0714	0.227
W5	143	3.250	0.0714	0.232
W6	116	2.636	0.0714	0.188
W7	139	3.159	0.0714	0.226
W8	140	3.182	0.0714	0.227
W9	119	2.705	0.0714	0.193
W10	169	3.841	0.0714	0.274
W11	132	3.000	0.0714	0.214
W12	153	3.477	0.0714	0.248
W13	146	3.318	0.0714	0.237
W14	125	2.841	0.0714	0.203
TOTAL			1	3.209
O1	169	3.841	0.1667	0.640
O2	173	3.932	0.1667	0.655
O3	161	3.659	0.1667	0.610
O4	153	3.477	0.1667	0.580
O5	179	4.068	0.1667	0.678
O6	160	3.636	0.1667	0.606
TOTAL			1	3.769
T1	159	3.614	0.125	0.452
T2	172	3.909	0.125	0.489
T3	172	3.909	0.125	0.489
T4	181	4.114	0.125	0.514
T5	185	4.205	0.125	0.526
T6	174	3.955	0.125	0.494
T7	165	3.750	0.125	0.469
T8	179	4.068	0.125	0.509
TOTAL			1	3.940

SWOT analysis is used to determine the strength of correlation and results from the observed effects. The calculation results showed S = 3.830, W = 3.20, O = 3.769, and T = 3.940. This value was in the second quadrant (+,-), which was (0.62, -0,17). General research group condition mapping can be seen in Figure 1, which showed the research group position in a quadrant 2 graphic, which means a diversification strategy is needed. This analysis could provide different insights on what to manage. This requires commitment from all research group members to improve their task responsibilities, especially in a highly competitive P2M field.

FIGURE 1
THE QUADRANT POSITION OF SWOT ANALYSIS FROM THE RESEARCH GROUP



The correlation of the SWOT analysis results provides a solution of efforts in improving the performance of the research group using mapping as shown in Table 4, which showed an interactive matrix and SWOT strategy alternatives. The proposed improvements from the SWOT data analysis will help determine the prediction level of each construction which supports a more effective performance.

TABLE 4
INTERACTION MATRIX AND SWOT STRATEGY ALTERNATIVE

INTERNAL FACTOR **EXTERNAL FACTOR**	**STRENGTH (S)**	**WEAKNESS (W)**
OPPORTUNITY (O)	**S-O** • Improvement of quality and quantity of publication by choosing and utilizing quality journals/proceedings. • Improvement of cooperation network with research and community service partners. • Improvement of international seminar holdings. • Integration of group research data with units and institutions concerning P2M activity achievements. • Improvement of researchers and devotees' ability in compiling research/service activity roadmap related to funding.	**W-O** • Improvement of the capability to obtain research and service funding/grants from various parties (within and outside the country). • Improvement of coordination and synergy within the research group and with many parties. • Improvement of the network system, technology, information, communication, and database integration. • Perform standardization and process control of the programs and activities within the research group to fulfill quality assurance.

THREAT (T)	**T-S**	**T-W**
	• Improvement of downstream of research and service outcome to be developed into business commercialization. • Improvement of governance and management of administration and information. • Improvement of productivity and quality of research and international publication in the research group to support national and international rankings.	• Improvement of participation and research and service outcome in various journals, proceedings, textbooks, and book chapters. • Improvement of collaboration or joint research with researchers/devotees in other universities, both within and outside the country. • Improvement of lecturer quality and quantity for articles published in international journals to support national international rankings. • Improvement of facilities and adequate and certified research-specialized laboratory capacity. • Improvement of quality and library capacity as reference sources.

CONCLUSION

The SWOT analysis results provided benefits for the evaluation of the research group's performance and a breakthrough on improvement measures. The mapping of the research group condition showed a position in the second quadrant, which means the group required a diversification strategy. Based on the SWOT analysis results, the authors provided solutions to improve the performance of the research group which may help in determining the management policy in the faculty or the university level and changes in the management to be used in further studies.

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