JURNAL PENDIDIKAN TEKNIK SIPIL

Online (e-ISSN): e-ISSN 2715-0437 || Printed (p-ISSN): p-ISSN 2715-7601
2025, Volume 7, No 1, pp.1-13

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To cite this article:
Ardita R A, Sutarto, Adhikari B P. (2025). Triple Helix Partnership Model Between Universities, Industry, and Government for Implementing an Outcome-Based Curriculum in the Era of Disruption at PTSP UNY: An Internal University Review. *Jurnal Pendidikan Teknik Sipil*, 7 (1), Pp 1-13. doi: 10.21831/jpts.v7i1.83406

To link to this article:
http://doi.org/10.21831/jpts.v7i1.83406

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2025, Volume 7, No 1, pp.1-13, e-ISSN 2715-0437

Jurnal Pendidikan Teknik Sipil

Journal homepage: https://journal.uny.ac.id/index.php/jpts

Research paper

Triple Helix Partnership Model Between Universities, Industry, and Government for Implementing an Outcome-Based Curriculum in the Era of Disruption at PTSP UNY: An Internal University Review

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ARTICLE INFO

Article History:
Received: February 16, 2025
Accepted: June 29, 2025
Published: June 30, 2025

Keywords:
Triple helix model, outcome-based curriculum, era of disruption

How To Cite:
Ardita R A, Sutarto, Adhikari B P. (2025). Triple Helix Partnership Model Between Universities, Industry, and Government for Implementing an Outcome-Based Curriculum in the Era of Disruption at PTSP UNY: An Internal University Review. *Jurnal Pendidikan Teknik Sipil*, 7 (1), Pp 1-13. doi: 10.21831/jpts.v7i1.83406

ABSTRACT

Background: This study aims to describe: (1) the ideal triple helix model (THM) partnership for implementing an outcome-based curriculum (OBC) in the era of disruption from the university's perspective; (2) the level of THM implementation according to the university's perspective; (3) the THM ecosystem implemented by the university; (4) the level of university role implementation within the THM framework.
Method: This study employed both quantitative and qualitative descriptive research methods. Data collection techniques included a survey and a focus group discussion (FGD). The research subjects consisted of four active lecturers from PTSP FT UNY who provided survey responses, and seven PTSP lecturers participated in the FGD. Quantitative data were analyzed using descriptive statistical techniques, while qualitative data were examined through an interactive analytical model.
Results: (1) The balanced triple helix Model (BTM) was identified as the ideal framework for implementing OBC, rated highly suitable with a score of 3.50, as it ensures a balanced role among all parties. (2) The THM implementation was mostly realized (score 2.80), involving industry, professional associations, and certification bodies. (3) The THM ecosystem was mostly established (score 2.84), with additional support from unlimited research and partnership funding. (4) The university's role within THM was fully realized (score 3.02) through seminars, soft skill training, and certification programs.
Conclusion: Based on the research findings, BTM is the ideal model for implementing OBC in the era of disruption. Furthermore, the implementation of the triple helix partnership model, ecosystem, and university roles is largely accomplished.

INTRODUCTION

The 21st-century society is currently facing significant and drastic changes, resulting in an era of uncertainty known as disruption. The term "disruption" was first introduced by Clayton Christensen. It refers to a fundamental shift driven by technological evolution in human life (Lasmawan, 2019). This evolution replaces old technologies with newer digital technologies, emphasizing the integration of advancements such as the Internet of Things (IoT), artificial intelligence (AI), and others (Spoettl & Vidmantas, 2020). The disruption era is characterized by intense competition, where individuals, businesses, and even nations endeavor to remain competitive (Arif, 2021). As a result, managing human resources in this era requires innovation, creativity, and collaboration to develop superior strategies, methods, and products.

Education is essential in managing human resources. It equips individuals with the knowledge, skills, and attitudes necessary for sustainable contribution to society (Salsabila et al., 2020). Education in the disruption era is shaped by technological advancements and digital transformation, requiring educational institutions to adapt and reassess curricula (Panisha, 2022). According to Sutarto (2019), education must foster C4 competencies tailored to industry demands, which, as Prihadi (2019) notes, include critical thinking, communication, collaboration, and creativity.

Flynn and Schaefer (2017) argue that the current education system struggles to quickly adapt to evolving workforce demands. In Indonesia, the prevailing educational approach remains irrelevant, as it prioritizes knowledge acquisition without adequately addressing skills and attitudes, leaving graduates unable to compete with emerging technologies (Priatna, 2019). Curriculum misalignment can lead to graduates lacking essential workplace competencies (Warnandes et al., 2022). If unresolved, this issue may increase unemployment rates due to graduates' inability to integrate into the workforce.

Suryaman (2020) highlights the need for an outcome-based curriculum (OBC) in contemporary education. Initially introduced in the 1990s, OBC establishes a clear framework focused on student success upon course completion (Spady, 1994). This model integrates assessment and evaluation to achieve predetermined learning outcomes, encompassing knowledge, skills, and behavior (Prihantoro, 2020). OBC ensures that graduates acquire industry-relevant competencies, facilitating their entry into the workforce (Yumelking, 2023). Indonesian higher education institutions began adopting this approach in 2015 (Kushari, 2022). OBC enhances graduates' competitiveness for careers in industry or entrepreneurship through a triple helix partnership model, involving universities, industry, and government collaboration.

Triple helix is a theory popularized by Leydesdorff and Etzkowitz since the 1990s. This model involves three key actors: universities, industry, and government. The relationship among these three entities within the triple helix model is important for knowledge-based economic development (Leydesdorff & Etzkowitz, 2001). This aligns with the explanation of Hermansyah et al. (2019), who state that partnerships between universities, industry, and government contribute to the development of competencies and skills that enhance growth. Fitriani (2023) also notes that the triple helix concept serves as a platform for universities, industry, and government to interact and collaborate. It facilitates the creation of new spaces, policies, and innovations. Etzkowitz and Leydesdorff (2000) identify three configurations of the triple helix model: the statist model, the laissez-faire model, and the balanced helix model. Each of these

parties has its own role; however, the current situation reveals that the roles of universities, industry, and government remain ineffective, leading to suboptimal collaboration among the three entities.

The Department of Civil Engineering and Planning Education, Faculty of Engineering, Yogyakarta State University (PTSP FT UNY), representing the university sector, must address challenges in transferring knowledge and skills effectively to ensure graduates are directly absorbed into the industry. To tackle these challenges, universities need to implement an outcome-based curriculum (OBC) by fostering collaborations among universities, industry, and government within an ideal triple helix partnership model.

Based on this background, this study aims to describe: (1) the ideal triple helix partnership model for implementing an outcome-based curriculum in the era of disruption from the university's perspective; (2) the level of triple helix partnership model implementation according to the university's perspective; (3) the level of the triple helix partnership model ecosystem within the university; (4) the level of university role implementation within the triple helix partnership model.

METHOD

Type of Research

The research employed quantitative and qualitative descriptive approaches. Descriptive research aims to gather information regarding phenomena, symptoms, or conditions related to the studied variables as they exist at the time of the study (Arikunto, 2016). Hypothesis testing is not performed in descriptive research to prove specific assumptions. Therefore, the results of descriptive research reflect the actual conditions at the study site.

Research Location and Time

The research was carried out at the Department of Civil Engineering and Planning Education, Faculty of Engineering, Yogyakarta State University, from February to March 2023. It was also conducted online through Zoom meetings. The focus group discussion (FGD) session was held on Saturday, February 4, 2023.

Research Subjects

The research subjects, referred to as respondents, included active lecturers at PTSP FT UNY. The study involved four lecturers completing the questionnaire and seven lecturers participating in the FGD. The selection of research subjects followed a purposive sampling technique, which relies on predetermined criteria (Sugiyono, 2017). One of the selection criteria was that the lecturers had extensive knowledge of the teaching and curriculum system at PTSP FT UNY, facilitating the research process. In this study, representatives from PTSP FT UNY served as representatives of the university.

Data Collection Technique

The study employed both closed and open-ended questionnaires for data collection. A questionnaire consists of several questions that are presented to respondents for their responses (Sugiyono, 2017). Additionally, an FGD session was conducted to gain deeper insights into the triple helix partnership model among universities, industry, and government at PTSP FT UNY. The collected data were then analyzed using descriptive statistical analysis techniques.

Instrument Validity

Once the research instruments were developed, the next step was to test their validity. Instrument validity testing ensures that the instruments have an adequate validity level. An instrument is considered valid if it measures precisely what it is intended to measure. In this study, the validity test was conducted based on the opinions of judgment experts.

Data Analysis Technique

The study employed descriptive statistical techniques for quantitative data analysis. Descriptive statistical analysis aims to analyze data by describing or explaining it based on actual findings without generalizing conclusions (Sugiyono, 2017). In this study, descriptive statistics included central tendency calculations, such as mean ($\overline{x}$), maximum value (x_{max}), minimum value (x_{min}), and standard deviation (SD). The obtained data were interpreted according to established criteria.

Table 1.
Category of Average Score for the Ideal Triple Helix Model Concept Questionnaire

Interval	Category
$3.00 < \overline{x} \leq 4.00$	Highly Suitable
$2.00 < \overline{x} \leq 3.00$	Suitable
$1.00 < \overline{x} \leq 2.00$	Not Suitable
$\overline{x} \leq 1.00$	Highly Not Suitable

Meanwhile, the category of the average score for the implementation of the triple helix model questionnaire is presented in the table below.

Table 2.
Category of Average Score for the Implementation of the Triple Helix Model Questionnaire

Interval	Category
$3.00 < \overline{x} \leq 4.00$	Fully Implemented
$2.00 < \overline{x} \leq 3.00$	Mostly Implemented
$1.00 < \overline{x} \leq 2.00$	Partially Implemented
$\overline{x} \leq 1.00$	Not Implemented

This study employed a qualitative data analysis technique for data obtained from open-ended questionnaires and FGD sessions, using the interactive analysis model introduced by Miles and Huberman. The interactive analysis model can be applied either during field research or after data collection is complete (Saleh, 2017). The following is an overview of the qualitative data analysis flow using the Miles and Huberman interactive model.

Data collection involves gathering information through interviews, documentation, or observations. In this study, data were collected via an online FGD session conducted through a Zoom meeting, with recordings and meeting minutes prepared for documentation. Following data collection, the data reduction process was carried out, where relevant information was selected and organized to focus on problem-solving. The refined data were then presented in various formats, including text, images, tables, and graphs, ensuring they accurately reflected field conditions. Effective data presentation helps researchers manage and interpret information efficiently. After presenting the data, researchers formulated preliminary

conclusions, which remained speculative and required further validation. To ensure accuracy, additional supporting evidence was gathered to verify findings and establish conclusions.

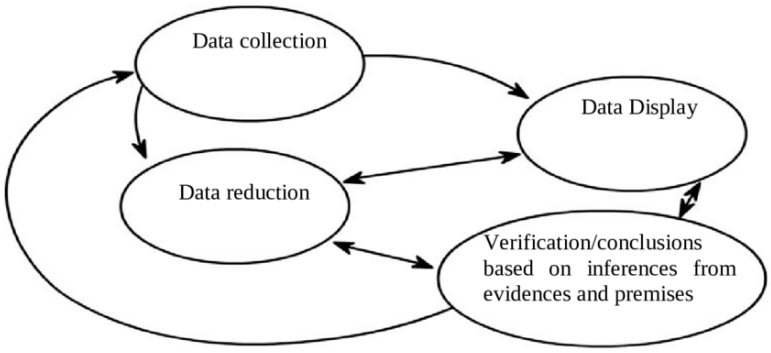

Figure 1. Miles & Huberman Interactive Analysis Model

RESULTS AND DISCUSSION

1. Ideal Triple Helix Partnership Model for Implementing an Outcome-Based Curriculum in the Era of Disruption from the University's Perspective

The above objective was measured using a questionnaire consisting of five closed-ended questions and one open-ended question. The collected data were analyzed to determine $\overline{x}$, x_{max}, x_{min}, and SD. The results of the data analysis are presented in the following table.

Table 3.
Results of Closed-Ended Questionnaire on the Ideal Triple Helix Partnership Model

No.	Statement	Average Score
1.	In the context of Indonesia, the selected model is the balanced triple helix model.	3.50
2.	The balanced triple helix model is selected as it provides an equal position among the three actors in the triple helix: the university, industry, and government.	3.25
3.	The balanced triple helix model supports a balanced role among the three triple helix actors.	3.75
4.	The balanced triple helix model is based on an equal distribution of benefits (added value) among the three triple helix actors.	3.50
5.	The balanced triple helix model promotes the establishment of a democratic work environment.	3.50
	Average Score ($\overline{x}$)	3.50
	Maximum Score (x_{max})	3.75
	Minimum Score (x_{min})	3.25
	Standard Deviation (SD)	0.17678

The results of the closed-ended questionnaire on the ideal triple helix partnership model for implementing an outcome-based curriculum in the era of disruption from the university's perspective indicate that the average score is 3.50. Referring to Table 1, this score falls under the highly suitable category. Furthermore, an SD of 0.17678 was recorded, indicating that the data distribution is relatively narrow, meaning that the values obtained for each aspect are closely aligned with the average score. Therefore, it can be concluded that the balanced triple helix model (BTM) is highly suitable as the ideal triple helix partnership model for implementing an outcome-based curriculum in the era of disruption at PTSP FT UNY.

The study also found that the maximum score (x_{max}) was 3.75, specifically in the aspect where BTM supports a balanced role among the three triple helix actors. The majority of respondents agreed that achieving an ideal triple helix partnership model requires a balanced role among universities, industry, and government. This aligns with the explanation of Etzkowitz and Leydesdorff (2000), who state that BTM is one type of triple helix partnership model in which each entity plays an equally important role, enabling collaboration to drive innovation.

Conversely, the minimum score (x_{min}) recorded was 3.25, appearing in the aspect where BTM was selected, since it provides an equal position among the three triple helix actors: universities, industry, and government. Several respondents disagreed with the notion of an equal position among these three entities. Unequal positioning is a characteristic of the statist model, a type of triple helix partnership in which the government holds the highest position as the leader of collaboration between universities and industry (Etzkowitz & Leydesdorff, 2000). Referring to research by Putri (2014), the statistical model is not considered an ideal partnership model, as it has not yet been able to resolve the challenges faced by industry and universities. Therefore, the statistical model is not suitable for implementing an outcome-based curriculum in the current era of disruption.

In addition to the closed-ended questionnaire, this study included supplementary data obtained from open-ended questionnaires and the focus group discussion (FGD), which are thematically presented in the following table.

Table 4.
Results of Open-Ended Questionnaire and FGD on the Ideal Triple Helix Partnership Model

No	Respondent	Theme	Feedback
1.	Slamet Widodo	Involved parties	Government, DUDI, universities
2.	Amat Jaedun	Roles of the involved parties	Balanced roles among all parties

Based on the data obtained, it can be concluded that the triple helix partnership model is an ideal framework that integrates a balanced role among universities, industry, and government. The university recognizes that active and equitable involvement of all parties is essential for the successful implementation of the outcome-based education (OBE) curriculum, ensuring improved graduate quality.

2. Implementation of Triple Helix Partnership Model from the University's Perspective

Data for measuring the above objective was obtained from a questionnaire consisting of five closed-ended questions and one open-ended question. The collected data were analyzed to determine $\overline{x}$, x_{max}, x_{min}, and SD. The results of the data analysis are presented in the following Table 5.

Quantitative research findings on the implementation of the triple helix partnership model from the university's perspective indicate an average score of 2.80. Based on Table 2, this score falls into the mostly implemented category. The standard deviation (SD) of 0.20917 suggests that the data distribution is relatively narrow, meaning the values for each aspect are closely aligned with the average score. Therefore, it can be concluded that the implementation of the triple helix partnership model at PTSP FT UNY has been mostly realized.

Table 5.
Results of Closed-Ended Questionnaire on the Implementation of Triple Helix Partnership Model

No.	Statement	Average Score
1.	To what extent has the balanced triple helix model been implemented in Indonesia?	2.50
2.	To what extent does the balanced triple helix model provide an equal position among the three actors in the triple helix: the university, industry, and government?	3.00
3.	To what extent does the balanced triple helix model assign balanced roles to the three triple helix actors (the university, industry, and government)?	2.75
4.	To what extent does the balanced triple helix model provide equal benefits (added value) to the three triple helix actors?	2.75
5.	To what extent does the balanced triple helix model establish a democratic work environment?	3.00
	Average Score ($\bar{x}$)	2.80
	Maximum Score (x_{max})	3.00
	Minimum Score (x_{min})	2.50
	Standard Deviation (SD)	0.20917

Based on the closed-ended questionnaire results, the maximum score (x_{max}) recorded for the ideal triple helix partnership model from the university's perspective is 3.00. This score corresponds to the aspect where the balanced triple helix model (BTM) provides an equal position among the three triple helix entities: universities, industry, and government. Respondents, representing the university sector, assessed that PTSP FT UNY has implemented BTM, ensuring that the university holds a balanced position alongside industry and government. As explained by Etzkowitz and Leydesdorff (2000), balanced positioning is a key characteristic of BTM, enabling effective collaboration among all stakeholders to foster innovation.

Another aspect that scored 3.00 is BTM's role in creating a democratic work environment. The majority of respondents agreed that BTM facilitates a workplace culture where all parties participate in decision-making. A democratic work environment is a collaborative setting where stakeholders engage in discussions and decision-making processes. According to Diana and Hakim (2020), university-led industry collaboration requires human resource involvement, ensuring all parties share experiences, including in aspects of workplace culture. Conversely, the minimum score (x_{min}) recorded in the closed-ended questionnaire is 2.50, corresponding to the aspect assessing BTM's implementation in Indonesia. Respondents indicated that BTM has not yet been widely adopted across the country.

In addition to the findings obtained from the closed-ended questionnaire, additional data were collected from the open-ended questionnaire and FGD regarding the implementation of the ideal triple helix partnership model from the university's perspective. The data are thematically presented in the following table.

Table 6.
Results of Open-Ended Questionnaire and FGD on the Implementation of Triple Helix Partnership Model

No	Respondent	Theme	Feedback
1.	Nuryadin Eko	Implementation	Collaboration with industry and certification bodies

Based on the thematic conclusions from the questionnaire and FGD, the university has implemented collaboration with industry and certification bodies. Certification bodies represent

a new form of partnership established by higher education institutions. Unlike industry, certification bodies do not serve as direct users or employers of graduates. Their role is solely to assess the competencies of students or graduates. Referring to the theory explained by Hermansyah et al. (2019), the triple helix partnership model consists of collaboration between universities, industry, and government, playing a vital role in shaping competencies and skills to enhance development. Therefore, it can be concluded that certification bodies are not considered part of the triple helix partnership model.

3. Ecosystem of Triple Helix Partnership Model within the University

The above objective was measured using a questionnaire consisting of 11 closed-ended questions and one open-ended question. The collected data were analyzed to determine $\overline{x}$, x_{max}, x_{min}, and SD. The results of the data analysis are presented in the following table.

Table 7.
Results of Closed-Ended Questionnaire on the Triple Helix Partnership Model Ecosystem

No.	Statement	Average Score
Tangible ecosystem supporting the triple helix		
1.	University competence in disseminating and transferring science and technology to the industrial community	3.25
2.	Positive industry response and capacity to apply science and technology, especially those developed by the university	3.00
3.	Supporting infrastructure, including fiscal policies for research and technological development from the university and other institutions, as well as technology transfer to industry	2.50
4.	Entrepreneurial institutions with a vision to develop knowledge-based technological innovations and unify leadership among the three key triple helix actors	2.50
Intangible ecosystem supporting the triple helix		
5.	Shared belief that science and technology are the key to economic growth	3.25
6.	Market-oriented organizational culture	2.75
7.	Effective intellectual property protection system	2.25
8.	Strong competitive spirit	3.00
9.	Emphasis on process management in science and technology development	3.25
10.	Social awareness	2.75
11.	Democratic decision-making process	2.75
	Average Score ($\overline{x}$)	2.84
	Maximum Score (x_{max})	3.25
	Minimum Score (x_{min})	2.25
	Standard Deviation (SD)	0.34045

The results of the closed-ended questionnaire on the triple helix partnership model ecosystem within the university indicate an average score of 2.84. Referring to Table 2, this score falls into the mostly implemented category. The standard deviation (SD) of 0.34045 suggests that the data distribution is relatively narrow, meaning the values for each aspect are closely aligned with the average score. Therefore, it can be concluded that the triple helix partnership model ecosystem has been mostly implemented or is already established within the university.

The first aspect with a maximum score (x_{max}) of 3.25 pertains to the tangible ecosystem, specifically the university's competence in disseminating and transferring scientific and technological knowledge to the industrial community. As an academic institution, the university has a responsibility to conduct research and development that contributes to technological

innovation. Within the triple helix framework, the dissemination of research findings serves as a means for universities to transfer knowledge among academia, industry, and government, ensuring societal benefits. These findings align with the theory presented by Kholis et al. (2021), which states that universities serve as the central academic sector for scientific and technological development.

Furthermore, the maximum score of 3.25 was also observed in the intangible ecosystem, specifically in the aspects of shared belief that science and technology are key to economic growth and the emphasis on process management in technological development. A shared belief among universities, industry, and government in cultivating technological advancements creates an ecosystem that supports the expansion of the triple helix partnership model, ultimately contributing to economic growth. Leydesdorff and Etzkowitz (2001) emphasize that collaboration among all parties within the triple helix model is fundamental to achieving knowledge-based economic development.

Meanwhile, the minimum score (x_{min}) recorded was 2.25, corresponding to the aspect of an effective intellectual property protection system. Respondents indicated that the lack of comprehensive intellectual property protection systems remains an issue. According to Kholis et al. (2021), one key factor supporting the development of the triple helix partnership model is the existence of regulations governing the use and protection of copyrights for produced works.

In addition to the closed-ended questionnaire data, this study included supplementary data obtained from the open-ended questionnaire and focus group discussion (FGD), which are thematically presented in the following table.

Table 8.
Results of Open-Ended Questionnaire and FGD on the Triple Helix Partnership Ecosystem

No	Respondent	Theme	Feedback
1.	Galeh Nur	Additional ecosystem components	Professional associations and society
2.	Satoto Endar	Additional ecosystem components	Non-government organizations
3.	Dian Eksana	Additional ecosystem components	Market
4.	Faqih Ma'arif	Supporting ecosystem	Unlimited funding for research and industry collaboration

Based on the thematic conclusions from the open-ended questionnaire, several additional ecosystem components suggested by the university include professional associations, society, NGOs, and the market. As previously explained, the triple helix partnership model involves three main entities: universities, industry, and government. According to Sujanto (2016), industry can be defined as the user or consumer of graduates. Therefore, the suggested additional ecosystem components, such as professional associations, society, NGOs, and the market, can be classified under industry, as they serve a similar role as graduate users.

In addition, recommendations were made regarding the supporting ecosystem for the triple helix partnership model, particularly unlimited funding for research and industry collaboration. This aligns with new policies introduced by UNY as a State University with Legal Entity (PTN-BH) status. These findings are consistent with Kholis et al. (2021), who emphasize that one of the key supporting ecosystems for the development of the triple helix partnership model is financial assistance for research and infrastructure support.

4. Implementation of University's Role in the Triple Helix Partnership Model

Data for measuring the above objective was obtained from a questionnaire consisting of eight closed-ended questions and one open-ended question. The collected data were analyzed to determine $\bar{x}$, x_{max}, x_{min}, and SD. The results of the data analysis are presented in the following table.

Table 9.
FGD Results on the Implementation of University's Role in the Triple Helix Partnership Model

No.	Statement	Average Score
1.	Conducting joint innovation research with industry	3.00
2.	Disseminating research findings to society	3.25
3.	Sharing human resources according to industry needs	3.00
4.	Sharing facilities, including laboratories, required by industry	3.25
5.	Conducting training and certification aligned with industry needs	3.50
6.	Developing interdisciplinary expertise according to industry requirements	2.50
7.	Recognition of work expertise, including RPL and innovations generated by industry	3.00
8.	Providing opportunities for faculty collaboration with industry, such as sabbatical leave	3.00
	Average Score ($\bar{x}$)	3.02
	Maximum Score (x_{max})	3.50
	Minimum Score (x_{min})	2.50
	Standard Deviation (SD)	0.30526

The quantitative research findings from the closed-ended questionnaire on the implementation of the university's role in the triple helix partnership model indicate an average score of 3.02. Referring to Table 2, this score falls under the fully implemented category. The standard deviation of 0.30526 suggests a relatively narrow data distribution, meaning the values for each aspect are closely aligned with the average score. Therefore, it can be concluded that the implementation of the university's role in the triple helix partnership model has been fully realized.

The highest score (x_{max}) recorded in Table 9 is 3.50, corresponding to the aspect of conducting training and certification aligned with industry needs. Respondents assessed that PTSP FT UNY, as the university entity, has successfully implemented this role. This finding is supported by Nuryadin in the FGD, who stated that PTSP FT UNY has collaborated with certification bodies to organize certification programs for graduates. These certification activities aim to assess whether graduates' competencies align with established standards.

Conversely, the lowest score (x_{min}) recorded is 2.50, corresponding to the aspect of developing interdisciplinary expertise according to industry requirements. Interdisciplinary expertise refers to an individual's ability to integrate knowledge and skills across multiple disciplines to solve problems. Respondents indicated that PTSP FT UNY has not yet implemented activities that effectively develop interdisciplinary expertise among students.

In addition to the eight closed-ended questions, this study also included one open-ended questionnaire question and an FGD session, thematically presented in the following Table 10.

Based on the thematic conclusions from the open-ended questionnaire and FGD, additional university roles that have been successfully implemented include resource sharing, direct research assignments, seminar organization, soft skill training, and certification activities.

Table 10.
Results of Open-Ended Questionnaire and FGD on the Implementation of University's Role in the Triple Helix Partnership Model

No	Respondent	Theme	Feedback
1.	Galeh Nur	University role	Conducting resource sharing
2.	Dian Eksana	University role	Conducting direct research assignment
3.	Faqih Ma'arif	University role	Conducting seminars and soft skill training
4.	Nuryadin Eko	University role	Conducting certification activities

Resource sharing is a practice where universities and industry share resources to enhance productivity. Research findings indicate that universities and industry currently engage in resource sharing, such as laboratory facilities and supporting infrastructure, as well as human resource sharing based on industry needs. Additionally, soft skill training in this study refers to orientation programs for new students, equipping them with essential soft skills for academic and professional success. Seminar programs allow students to gain direct insights from expert speakers.

These findings align with the theory explained by Fitriana (2017), which states that universities play multiple roles, including scientific research institutions, technology dissemination centers, training providers, and expert consultation institutions.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on the research findings, the balanced triple helix model (BTM) is identified as the ideal framework for implementing the outcome-based curriculum (OBC) from the university's perspective, with a high suitability score of 3.50. This model integrates a balanced role among all parties. The implementation of THM is mostly realized, scoring 2.80, with active involvement from industry, professional associations, and certification bodies. Additionally, the university's THM ecosystem is largely established, scoring 2.84, and supported by unlimited funding for research and industry collaboration. Furthermore, the university's role within the THM framework is fully implemented, with a score of 3.02, through initiatives such as resource sharing, direct research assignments, seminar organization, soft skill training, and certification programs.

Recommendations

Based on the research conclusions, universities should ensure a balanced positioning among academia, industry, and government within the BTM framework. Additionally, they need to further develop interdisciplinary expertise aligned with industry requirements to enhance graduates' competencies. Moreover, improving intellectual property protection systems for produced works is essential to safeguard innovations and encourage further research and development.

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