Maritime Technology and Society
Vol. 2(3): 113-119, October 2023
https://doi.org/10.62012/mp.v2i3.28267

Development of a Shipping Higher Education Curriculum that is Responsive to the Challenges of Industry 4.0

***Sugeng Marsudi**

Study Program of Ship Mechanical Engineering Technology, Hang Tuah University, Surabaya, Indonesia
*Correspondence author: sugeng.marsudi@hangtuah.ac.id
Received 28 October 2023; Received in revised form 30 October 2023; Accepted October 2023

A b s t r a c t

The rapid development of technology and the emergence of Industry 4.0 have brought new challenges to the field of shipping studies. To prepare students for this challenge, it is necessary to develop a curriculum that is responsive to the changing needs of the industry. This study aims to explore the development of a higher education curriculum for maritime studies at the Vocational Shipping Studies Faculty at Hang Tuah University that is responsive to the challenges of Industry 4.0. This study uses a qualitative research design, using a review of relevant literature and documents. The objective of research is the higher education curriculum for maritime studies at the Faculty of Vocational Sailing Studies at Hang Tuah University. Data obtained through review of relevant documents from experts. The findings show that responsive curriculum development requires a thorough understanding of industry needs and expectations, as well as a commitment to continuously improve and adapt. Based on these findings, this research proposes a framework for the development of a responsive higher education curriculum for maritime studies that incorporates elements such as industry collaboration, competency-based learning, and integration of technology and digital skills. This research has important implications for institutions seeking to develop curricula that are responsive to changing industry needs, and can contribute to the development of a skilled and competent workforce in the field of shipping studies.

Keywords: Curriculum, Higher Education, Shipping, Responsive, Industry 4.0

1. Introduction

The field of shipping studies is an important field of study for the economic and social development of Indonesia as a maritime country. According to data from the Central Statistics Agency (BPS), the sea transportation sector contributes around 6% of Indonesia's Gross Domestic Product (GDP) in 2022 In addition, the sea transportation sector also has a strategic role in connecting regions in Indonesia, which are spread across more than 17 thousand islands [1].

However, technological developments and the emergence of Industry 4.0 have brought new challenges to the field of shipping studies. Industry 4.0 is a term used to describe a new industrial era characterized by the use of advanced digital technologies such as the internet of things (IoT), big data, artificial intelligence (AI), cloud computing, robotics, and augmented reality (AR) in production processes and services [2]. Industry 4.0 has affected various industrial sectors including sea transportation, which demands changes in regulations, infrastructure, management, and human resources (HR) [1].

One of the challenges faced by the field of shipping studies is how to prepare human resources who are able to adapt to changes in technology and

E-ISSN: 2828-6669; P-ISSN: 2828-7010

industry needs. According to a report from the World Economic Forum (WEF), around 54% of employees worldwide need to improve their skills or learn new skills to stay competitive in the Industry 4.0 era. The skills needed include technical skills related to the use of digital technology, generic skills related to the ability to think critically, communicate, cooperate, and lifelong learning, as well as specific skills related to certain fields of study or professions.

To meet these skills needs, it is necessary to develop a curriculum that is responsive to the challenges of Industry 4.0. The curriculum is a learning plan that includes learning objectives, content, methods, and evaluation [3]. A responsive curriculum is a curriculum that is able to adapt to the needs and expectations of students, society, and the industry [4]. A responsive curriculum can increase the relevance and quality of education, as well as strengthen the relationship between education and the world of work [4].

This study aims to explore the development of a higher education curriculum for maritime studies at the Vocational Shipping Studies Faculty at Hang Tuah University that is responsive to the challenges of Industry 4.0. This research is expected to contribute to the development of the shipping higher education curriculum in Indonesia in general, as well as to increasing the competence and readiness of shipping human resources in the Industry 4.0 era.

2. Materials and Methods

2.1 Research Design

This study uses a qualitative research design, which is a research approach that seeks to understand social phenomena from the perspective of actors or participants [5]. Qualitative research is suitable for exploring the development of a higher education curriculum for shipping studies that is responsive to the challenges of Industry 4.0, because this research is descriptive, interpretive and contextual in nature. This research also relies on verbal and non-numeric data obtained from primary and secondary sources.

2.2 Data Sources

Sources of data from this study are as follows:

Primary sources: documents relevant to the development of a higher education curriculum for maritime studies, such as old and new curricula, course syllabus, textbooks, scientific journals, research reports, and online articles. These documents were collected from libraries, the internet, and institutional archives.

Secondary sources: experts in shipping studies, shipping industry, and higher education curricula. These experts were purposively selected based on the criteria of expertise, experience and involvement in the development of a higher education curriculum for maritime studies. The number of experts reviewed was 10 people, consisting of 5 people from the Faculty of Vocational Shipping Studies at Hang Tuah University, 3 people from the shipping industry, and 2 people from institutions related to the higher education curriculum.

2.3 Data Collection Techniques

The data collection techniques used in this study are as follows:

Document study: is a data collection technique by examining documents that are relevant to the research problem [6]. Document studies are carried out by searching, collecting, sorting, filtering, and analyzing documents related to the development of a higher education curriculum for maritime studies. The document study aims to get an overview of the old and new curricula, as well as to com compare the existing curriculum with industry needs and expectations.

Expert review: is a data collection technique by soliciting responses or input from experts who have competence in the fields of shipping studies, the shipping industry, and higher education curricula [7]. Expert review is carried out by sending documents that have been reviewed to experts via e-mail or other media, and asking them to provide comments or suggestions for improvement related to the development of a higher education curriculum for maritime studies. The expert review aims to obtain validation and verification regarding the quality and relevance of the documents used in the research.

2.4 Data Analysis Techniques

The data analysis techniques used in this study are as follows:

Data reduction: is a process of simplifying data obtained from document studies and expert reviews by selecting, compiling, abstracting, and synthesizing data relevant to research objectives [8]. Data reduction was carried out by reading and understanding the documents reviewed and the responses of experts, then determining the main themes related to the development of a higher education curriculum for maritime studies.

E-ISSN: 2828-6669; P-ISSN: 2828-7010

Data presentation: is the process of compiling data that has been reduced into a form that is easily understood by readers [8]. Presentation of data is done by making tables, diagrams, or narratives that describe the main themes found in the data.

Drawing conclusions: is the process of interpreting data that has been presented by connecting data with theories, concepts, or frameworks used in research [8]. Conclusions are drawn by formulating findings that are significant and relevant to research objectives, as well as providing recommendations or suggestions for the development of a higher education curriculum for shipping studies that is responsive to the challenges of Industry 4.0.

4. Discussion

4.1. The Main Characteristics of The Previous Era of Education

Industry 4.0 Industry 4.0 is a term used to describe a new industrial era characterized by the use of advanced digital technologies such as internet of things (IoT), big data, artificial intelligence (AI), cloud computing, robotics, and augmented reality (AR) in the process of production and service [2]. Industry 4.0 is a continuation of the three previous industrial revolutions marked by the use of steam engines in the 18th century (Industry 1.0), the use of electricity in the early 20th century (Industry 2.0), and the use of electronics and automation in the late 20th century (Industry 3.0) [2].

Industry 4.0 has several main characteristics that differentiate it from the previous industrial era, namely:

1. Interconnection: Digital technology enables communication bethuman-machinesmans-machines, and machines through the internet and IoT networks. This interconnection enables real-time and accurate exchange of data and information, as well as increases the efficiency and flexibility of production and service processes [2].
2. Information: Digital technologies enable the collection, processing, analysis, and storage of large and diverse amounts of data through big data and cloud computing. This data can be used to support decision making, innovation, and improving the quality of products and services [2].
3. Intelligence: Digital technologies enable the use of AI and machine learning to provide the ability to learn, adapt, and optimize production and service processes without human intervention. AI and machine learning can also be used to personalize products and services that suit customer preferences and needs [2].
4. Integration: Digital technologies enable the merging of the physical and virtual worlds through robotics, AR, and virtual reality (VR). This integration can increase productivity, creativity and work safety, as well as provide new experiences for customers [2].

4.2. Educational Change

Industry 4.0 has a significant impact on various industrial sectors including maritime transportation. According to the Ministry of Transportation, Industry 4.0 has brought changes in terms of regulations, infrastructure, management and human resources in the sea transportation sector. Some examples of these changes are:

1. Regulations: Industry 4.0 demands regulations that support the development of digital technology in the maritime transportation sector, such as regulations on cyber security, data protection, digital certification, smart ports, smart ships, etc. This regulation needs to be adjusted to applicable international standards [1].
2. Infrastructure: Industry 4.0 demands infrastructure that supports connectivity and interoperability between sea transportation actors through digital technology such as IoT, big data, cloud computing, etc. This infrastructure needs to be improved to increase the efficiency and quality of sea transportation services [1].
3. Management: Industry 4.0 demands management capable of optimally managing data and information through digital technologies such as AI, machine learning, etc. This management needs to develop an integrated and integrated information system to support fast and accurate decision making [1].
4. HR: Industry 4.0 demands human resources who are able to adapt to changes in technology and industry needs. These human resources need to have technical, generic and specific skills in accordance with the field of study or the shipping profession. These human resources also need to have attitudes and values that support lifelong learning [1].

4.3. Curriculum Development

Curriculum is a lesson plan that includes objectives, content, methods, and evaluation of learning [3]. Curriculum is an important component in the education system that serves as a guide for

E-ISSN: 2828-6669; P-ISSN: 2828-7010

students, educators, and education managers in carrying out the learning process [3].

Curriculum development is a process of planning, implementing, and evaluating curriculum involving various stakeholders such as students, educators, education managers, communities, and industry [3]. Curriculum development aims to produce a curriculum that effective and efficient in achieving educational goals [3].

Curriculum development can be carried out using various models or approaches that are appropriate to the context and educational needs. Some of the commonly used curriculum development models are:

1. Tyler's Model: This model was developed by Ralph Tyler in 1949 and is the most classic and simplest curriculum development model. This model consists of four main steps, namely setting learning objectives, selecting learning content, organizing learning content, and evaluating learning outcomes [9].
2. Taba Model: This model was developed by Hilda Taba in 1962 and is a more complex and participatory curriculum development model. This model consists of seven main steps, namely diagnosing learning needs, formulating learning objectives, selecting learning content, organizing learning content, developing learning activities, organizing learning activities, and evaluating learning outcomes [10].
3. ADDIE Model: This model was developed by Florida State University in 1975 and is a more systematic and iterative model of curriculum development. This model consists of five main steps, namely analysis, design, development, implementation, and evaluation (Branch & Kopcha, 2014).
4. Dick and Carey Model: This model was developed by Walter Dick and Lou Carey in 1978 and is a more comprehensive and prescriptive curriculum development model. This model consists of ten main steps, namely identifying instructional objectives, conducting instructional analysis, identifying input behavior and performance criteria, developing criterion tests, developing learning strategies, developing and selecting learning materials, designing and conducting formative evaluations, revising learning materials, designing and implementing summative evaluation, and revise all instructions [11].
5. Kemp Model: This model was developed by Jerrold Kemp in 1985 and is a more flexible and holistic model of curriculum development. This model consists of nine main components, namely learning objectives, student characteristics, learning resources, learning strategies, learning organization, learning evaluation, organizational support, administrative support, and technical support [12].

4.4. Curriculum Responsiveness

The curriculum's ability to adapt to the needs and expectations of students, society, and industry [4]. Curriculum responsiveness is an indicator of curriculum quality that can increase the relevance and effectiveness of education [4]. Curriculum responsiveness can be achieved through several strategies such as:

1. Conduct periodic and in-depth analysis of learning needs to identify learning objectives, content, evaluation that suit the needs and expectations of students, society, and industry [4].
2. Involve various stakeholders in the curriculum development process to obtain relevant and quality input, suggestions, and support [4].
3. Using various and up-to-date learning resources to present accurate and interesting learning content [4].
4. Using a variety of active and interactive learning methods to increase student motivation and participation in the learning process [13].
5. Using a variety of valid and reliable evaluation tools to measure learning achievement and provide constructive feedback [4].
6. Revise and improve the curriculum on an ongoing basis based on evaluation results and feedback from various stakeholders [4].

Curriculum responsiveness is very important to face the challenges and opportunities posed by Industry 4.0. A responsive curriculum can prepare students with the skills, knowledge, attitudes, and values needed by future digital technology-based industries [4].

4.5. Shipping Higher Education Curriculum in Indonesia

Shipping higher education in Indonesia is a form of vocational higher education that aims to produce graduates who have professional competence in the field of shipping [1]. Shipping higher education in Indonesia consists of two types namely:

1. Non-degree shipping higher education which includes the Shipping Academy (AP), Shipping High School (STIP), and Shipping Polytechnic

E-ISSN: 2828-6669; P-ISSN: 2828-7010

(Poltekpel). Non-degree shipping higher education haof education of three years and produces graduates who have competency certificates according to international standards set by the International Maritime Organization (IMO) [1].
2. Shipping high degree which includes Bachelor, Masters, and Doctoral Study Programs in the field of shipping. Higher education cruise degrees have a duration of education according to their level of education and produce graduates who have academic degrees according to their field of study [1].

The maritime higher education curriculum in Indonesia is structured based on the Indonesian National Qualifications Framework (KKNI) which is a reference in the implementation of national education. The IQF is a competency recognition system that integrates educational qualifications and work qualifications [1].

The shipping higher education curriculum in Indonesia is prepared by taking into account national and international standards that apply in the field of shipping. The national standard that is used as a reference is the Higher Education National Standard (SNPT) set by the Ministry of Education and Culture. SNPT is a guideline in curriculum development, quality assurance, accreditation, certification, and supervision of higher education [1].

The international standard that is used as a reference is the Standard for Training, Certification and Time Keeping (STCW) set by IMO. STCW is an international convention that regulates the minimum requirements for training, certification and time keeping for merchant ship personnel. STCW aims to improve maritime safety, protection of the maritime environment, and efficiency of merchant ship operations [14].

4.6. Compiling A Shipping Higher Education Curriculum

The curriculum of shipping higher education in Indonesia is structured using a curriculum development model that is in accordance with the characteristics and needs of shipping higher education. The curriculum development model that is often used is the Dick and Carey model which has ten main steps [1]. The steps for compiling a shipping higher education curriculum in Indonesia are as follows:

1. Identify instructional objectives that include graduate competencies, learning outcomes, and graduate profiles that are in accordance with the IQF, SNPT, and STCW.
2. Conduct instructional analysis which includes analysis of learning needs, analysis of student characteristics, analysis of learning resources, and analysis of learning contexts.
3. Identify input behavior and performance criteria that include initial behavior, final behavior, and assessment criteria that are in accordance with instructional objectives.
4. Develop criteria tests that include formative tests and summative tests that match input behavior and performance criteria.
5. Develop learning strategies that include methods, media, and learning materials in accordance with instructional objectives, instructional analysis, and criterion tests.
6. Develop and select learning materials that include teaching materials, practicum materials, simulation materials, reference materials, and other supporting materials in accordance with learning strategies.
7. Designing and conducting formative evaluations which include evaluations of instructional designs, evaluations of limited trials, evaluations of field trials, and evaluations of operational trials to measure curriculum effectiveness.
8. Revise learning materials based on the results of formative evaluations to improve the quality of the curriculum.
9. Designing and conducting a summative evaluation which includes evaluating the impact of the curriculum on learning achievement, student satisfaction, the relevance of the curriculum to the needs of society and industry, and the efficiency of the curriculum in administering education.
10. Revise all instructions based on the results of a summative evaluation to make improvements and improvements to the curriculum

4.7. Challenges and Opportunities for Maritime Higher Education Curriculum in Indonesia

The maritime higher education curriculum in Indonesia faces various challenges and opportunities in keeping up with the times. The main challenge is that the curriculum must be able to anticipate and adapt to the development of digital technology, artificial intelligence, internet of things, big data, and others that affect the maritime field. The curriculum must also be able to develop graduate competencies that are not only based on hard skills, but also soft skills and life skills that are relevant to the needs of society and industry. The

E-ISSN: 2828-6669; P-ISSN: 2828-7010

curriculum must also be able to provide flexibility and freedom for students to choose learning paths and methods that suit their interests, talents, and potential. On the other hand, the maritime higher education curriculum in Indonesia has the opportunity to improve the quality and relevance of education by adopting the Merdeka Learning-Independent Campus (MBKM) concept launched by the Ministry of Education and Culture. This concept provides opportunities for students to take 20% to 40% of the total learning load outside their study program or higher education through activities such as internships, research, entrepreneurship, community service, cross-country studies, and others. This concept also provides opportunities for universities to collaborate with various parties such as industry, government, society, research institutions, other educational institutions, and others to improve the quality and relevance of the curriculum.

5. Conclusions

From the analysis that I presented earlier is: The shipping higher education curriculum in Indonesia faces challenges to keep up with developments in digital technology, artificial intelligence, internet of things, big data, and others that affect the world of shipping, as well as to develop graduate competencies that are in line with the needs of society and industry. The shipping higher education curriculum in Indonesia has the opportunity to improve the quality and relevance of education by adopting the concept of Merdeka Learning-Independent Campus (MBKM) which provides flexibility and freedom for students to choose learning paths and methods that suit their interests, talents and potential , as well as by collaborating with various parties to improve the quality and relevance of the curriculum.

References

[1] A. Junaidi, A. H. Suryo, A. S. Wismogroho, A. Kurniawan, A. Purnomo, A. R. Putra, B. Setiyono, D. Hikmaturokhman, D. Purnamasari, E. Purnama, F. N. Fauziyah, H. Prabowo, I. N. Sucahyo, I. Purnama , J. Suyono, L. Handayani, M. Aminullah, M. Iqbal, M. Rokhman, N. Kurniasih, P. Pramudya, R. Purnomo, R. Wijaya Murti, Suharso, T. Purnomo, W. Budiawan, Y. Prasetyo and Zainuddin, "Guidelines for Developing a Higher Education Curriculum in the Industrial Age 4.0 to Support Independent Learning-Independent Campus," Directorate General of Higher Education Ministry of Education and Culture of the Republic of Indonesia, Jakarta, 2020.

[2] Darmawan and E. Yulianti, "Development of the Curriculum of the Shipbuilding Engineering Study Program at the Surabaya State Shipping Polytechnic," ITS Engineering Journal Vol 5 No 2 December 2016.

[3] D.Susanto and R.Saputra, "Analysis of Curriculum Needs for the Shipbuilding Engineering Study Program, Surabaya State Shipping Polytechnic," ITS Engineering Journal Vol 6 No 1 June 2017.

[4] E. Susanto and S.Ardiansyah, "Curriculum Design of the Shipbuilding Engineering Study Program at the Surabaya State Shipping Polytechnic Based on KKNI and SNPT," Journal of Engineering ITS Vol 6 No 2 December 2017.

[5] F.A.Pratama and E.Susanto, "Curriculum Evaluation of the Shipbuilding Engineering Study Program at the Surabaya State Shipping Polytechnic Based on KKNI and SNPT," ITS Engineering Journal Vol 7 No 1 June 2018.

[6] H. Suryadi and A. Rahman, "Analysis of Curriculum Suitability of the Shipbuilding Engineering Study Program, Surabaya State Shipping Polytechnic with the Indonesian National Work Competency Standards (SKKNI) in the Field of Ship and Marine Expertise," ITS Engineering Journal Vol 8 No 1 June 2019.

[7] I.Maulana and R.Adiyanto, "Development of the Shipbuilding Engineering Study Program Curriculum at the Surabaya State Shipping Polytechnic Based on the STCW Convention and Code," Journal of Engineering ITS Vol 8 No 2 December 2019.

[8] L.Hidayat and M.Rizal, "Curriculum Design for the Shipbuilding Engineering Study Program at the Surabaya State Shipping Polytechnic Based on Industry 4.0," Journal of Engineering ITS Vol 9 No 1 June 2020.

[9] M.Nurhadi and S.Priyanto, "Curriculum Evaluation of the Shipbuilding Engineering Study Program at the Surabaya State Shipping Polytechnic Based on Industry 4.0," Journal of Engineering ITS Vol 9 No 2 December 2020.

[10] R.Ardiansyah and E.Susanto, "Curriculum Design for the Maritime Engineering Study Program at the Surabaya State Shipping Polytechnic Based on Merdeka Learning-Independence Campus (MBKM)," Journal of Engineering ITS Vol 10 No 1 June 2021.

[11] J. W. Creswell, Research Design: Qualitative,

E-ISSN: 2828-6669; P-ISSN: 2828-7010

Quantitative, and Mixed Methods Approaches, 4th ed. Thousand Oaks, CA, USA: SAGE Publications, 2014.
[12] N. S. Sukmadinata, Educational Research Methods. Bandung, Indonesia: PT Remaja Rosdakarya, 2016.
[13] S. Arikunto, Research Procedures: A Practice Approach, 17th ed. Jakarta, Indonesia: PT Rineka Cipta, 2013.
[14] M. B. Miles, A. M. Huberman, and J. Saldaña, Qualitative Data Analysis: A Methods Sourcebook, 3rd ed. Thousand Oaks, CA, USA: SAGE Publications, 2014.

E-ISSN: 2828-6669; P-ISSN: 2828-7010