THE MAPPING AND IDENTIFICATION MODEL OF IT TECHNOPRENEURSHIPS STUDENT POTENTIAL USING DATA MINING AND ARTIFICIAL INTELLIGENCE

[1]WIJI LESTARI, [2]SINGGIH PURNOMO, [3]INDRA HASTUTI, [4]SRI SUMARLINDA

[1, 4] Faculty of Computer Science, University of Duta Bangsa Surakarta, Indonesia
[2] Management Department, University of Duta Bangsa Surakarta, Indonesia
[3] Accounting Department, University of Duta Bangsa Surakarta, Indonesia

Email : [1]wiji_lestari@udb.ac.id, [2]singgih_purnomo@udb.ac.id, [3]indra_hastuti@udb.ac.id, [4]sri_sumarlinda@udb.ac.id

ABSTRACT

The Information Technology (IT) Technopreneurships are growing very rapidly in line with technological increasing. This study aims to produce a model for mapping and identifying of student potential in IT (information technology) technopreneurships using intelligent computing. This mapping is based on the existence of 4 areas of IT technopreneurship, namely Software Application developer, Data Analyst, Computer System & Network engineer and Multinedia& Graphics Developer. The indicators used are: interesting, entrepreneurial values, learning styles (Solitary, Logical, Aural, Social, Verbal, visual and Physical) and multiple intelligences (Visual Spatial, Logical Mathematics, Body Kinesthetics, Naturalist, Musical, Linguistics, Interpersonal and Intrapersonal. This study used research and development and action research approach methods. The development of an intelligent computing system used the prototype method. The resulted of internal testing of running well models with cyclometic complexity was lower. The novel model that has been produced is a mapping based on students personal cognitive characteristics for IT technopreneurship based on intelligent computing. User acceptance Test resulted 96%, Expertise judgment Test (Computing / IT) yields 98% and Expertise Judgment Test (Entrepreneurships / Technopreneurships) yields 95%. The result of model validation of 20 IT technopreneurships was precise 85%. The resulted of the implementation of the model resulted in 60 students of Software Application developer, 65 students of Data Analysis, 56 students of Computer Systems & Network engineers, 50 students of Multinedia& Graphics Developer and 24 students not suitable to become IT technopreneurs.

Key words : *Mapping And Identification Model, Students Potential, IT Technopreneurships, Intelligent Computing, Personal Characteristics*

1. INTRODUCTION

The rapidly increasing of information technology and the pandemic has made the role of IT Technopreneurs bigger. The increasing rapidly of science and technology opens up various opportunities for entrepreneurship [1], [2]. The existence and development of entrepreneurship is very necessary for the economic development of a country [3]. The increasing of ntrepreneurships models and types from year to year has increased rapidly [4], [5]. These technological developments facilitate work and also change lifestyles [6]. The development of the era is supported by the development of information technology which also gives rise to new entrepreneurs in various fields [7], [8], [9]. Various fields of life become entrepreneurial fields. One of the developing fields in Indonesia is entrepreneurship in the field of information technology (IT Technopreneur) such as Software Application Development, Data Analysis, System analysis, Software Engineering, Computer Network Engineering, Graphics Design & Animation, Multimedia System development and Embedded & Computer System engineering [2].

Despite the opportunity for entrepreneurship is getting bigger, the problem of educated unemployment is still a problem facing Indonesia. Over the decades the educated unemployment rate

has increased [1]. Based on data from the Central Statistics Agency (BPS) in 2018, the number of unemployed university graduates reached 5.67 percent of the total workforce of around 13 million people. In order to reduce the number of educated unemployment, the government is trying to make efforts to implement entrepreneurship education in various universities. However, these efforts have not shown a significant success rate [1]. The phenomenon of low student interest and motivation to be entrepreneurial today has become a serious thought by various parties, including the government, education, industry, and society [10], [4], [11]. Various efforts have been made to foster an entrepreneurial spirit, especially changing the mindset of students who have only been interested in becoming job seekers. This is a challenge for the higher education institution as a graduate-producing institution [10], [12]. The number of entrepreneurs and technopreneurs in a country affects the economic condition of the country itself. In some countries, university graduates tend to be job seekers and very few are job creators. This has resulted in the low number of young entrepreneurs who have emerged so that it is necessary to develop an interest in becoming entrepreneurs in a student. Student interest in entrepreneurship is influenced by the environment and research [2], [13], [14].

The success of university or higher education graduates to become entrepreneurs will help the government reduce unemployment and improve people's welfare [15], [16]. Based on data from the Ministry of Industry in 2018, Indonesia still needs at least 4 million new entrepreneurs each year to improve people's welfare to become a middle-income country. Higher education must be able to prepare a curriculum that can prepare students to become technopreneurs [1], [17]. The students' interest in entrepreneurship is influenced by environmental and educational factors [2], [13], [14]. This means that the application of an appropriate curriculum accompanied by university assistance will accelerate the strategy for preparing university graduate entrepreneurs.

The Increasing of the ability to innovate and creativity of students in building entrepreneurship must be adjusted by their abilities and support from existing stakeholders. Some important aspects in business development and entrepreneurships that are related to the development of times and technology are infrastructure, information and human resources [1]. Universities have an indirect obligation to create technopreneurships [15], [8], [18]. This is in accordance with the 3 pillars of higher education, namely education, research, and community service [10], [19].

Many students who wish to become technopreneurs. Some are because of their family, motivated by seminars or invitations from friends, forced because they do not get a job, and so on [20], [15]. There are several critical success factors that must be considered by business people and those interested in becoming technopreneurs to achieve success. Most students and prospective entrepreneurs consider the main capital to start a business is money, and the most important thing in entrepreneurship is money. This opinion is not wrong, but there is more important capital, namely competence to do business and become an entrepreneur [2], [1],[21], [19].

The Students as technopreneurs candidates need to study various business opportunities in various fields of life [20], [15], [22]. The ease of getting information and consulting technopreneurships is very necessary. Bringing mentors or learning from practitioners certainly requires a lot of money and time. In this study, intelligent computing applications will be built that adopt the expertise of business practitioners and technopreneurships as a means of consultation and direction to students or prospective technopreneurs [23], [24].

The computing applications for identification or mapping of technopreneur potential have been widely implemented. Computing applications can be in the form of information systems, Decision support systems, expert systems, intelligent systems, instructional multimedia and the other applications [23], [2], [1], [25]. The application forms can also be various kinds such as desktop applications (standalone), web applications, mobile applications and responsive applications. The computing applications in general can increase the meaning of data so that information. The computing will help data related to one's potential or capital to be directed at choosing the type of entrepreneurships [23], [2]. This study developed a novel mapping and identification model based on personal personal cognitive consisting of interests, entrepreneurial values, learning styles and multiples intelligences in the field of IT technopreneurships based on intelligent computing. The contribution of this research is the study of intrinsic factors, especially personal cognitive characteristics for specialization and development of an

entrepreneurial spirit, especially IT technopreneurs. The problem limitation in this study is the identification of personal cognitive characteristics of modality in IT technopreursihps. The parameters on the personal cognitive characteristics used are Emtreprenurial Values, Learning Styles and Multiple Intelligences. These parameters will be mapped to IT Technopreneurships types.

3. RESEARCH METHODS

This study combined research and development with action research. This mapping was based on a person's potential approach based on interests & personal characteristics (entrepreneurial values), learning styles and multiple intelligents. The data for mapping came from questionnaires, observations, interviews, literature study and FGD (Forum Group Discussion) with technopreneurs and information technology business people, experts in the field of Computer / Information technology, experts in Management and Entrepreneurships, Psychology practitioners and students. The research stages are as shown below:
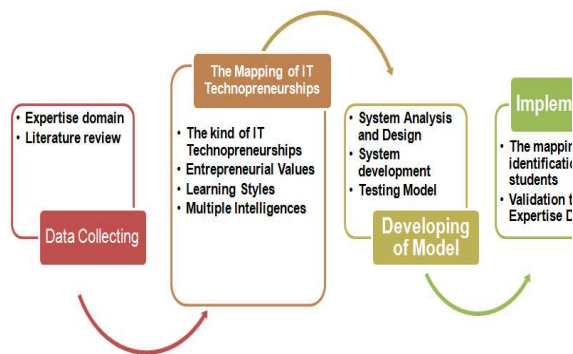

Figure 1: Research Stages

The first step of the research was Data Collecting. At this stage data related to the mapping and identification of IT technopreneurships were collected. Collecting data used interview methods, questionnaires, observation and literature review. The data collected was mapping of various types of IT Terchnopreneurships such as Software application Developers, Data Analysis, Computer systems & Network Engineers and Multimedia & Graphics Developers. The indicator attributes were Interesting, Entrepreneurial Values,

Learning Styles and Multiple Intelligences. The first step of the research was Data Collecting. At this stage data related to the mapping and identification of IT technopreneurships were collected. Collecting data used interview methods, questionnaires, observation and literature review. The data collected was mapping of various types of IT Terchnopreneurships such as Software application Developers, Data Analysis, Computer systems & Network Engineers and Multimedia & Graphics Developers. The indicator attributes were Interesting, Entrepreneurial Values, Learning Styles and Multiple Intelligences. The IT Technopreneurships mapping scheme shown in figure 2.
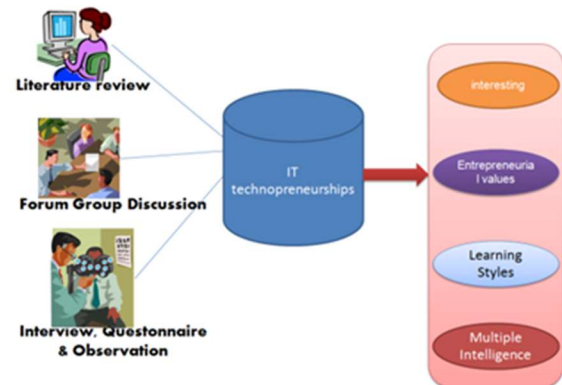

Figure 2: IT Technopreneurships Mapping Scheme

The indicators inventory of interest related to interest in IT technopreneurs and the development of related software, hardware and technology. The entrepreneurial Values were related to the behavior of entrepreneurs, namely: independent, creative, risk-taking, action-oriented, leadership, hard work, honest, innovative discipline, responsibility, cooperation, never giving up, commitment, realistic, curiosity, communicative and motivational for success. The learning styles indicator used the Memletics Learning Styles Inventory with learning styles: Solitary, Logical, Aural, Social, Verbal, visual and Physical [2]. The Multiple intelligences indicator based on the Gardner Multiple Intelligences Scale which includes multiple intelligences: Visual Spatial, Logical Mathematics, Body Kinesthetics, Naturalist, Musical, Linguistics, Interpersonal and Intrapersonal [2].

The next stage was the development of an intelligent computing model for mapping and identification of IT technopreurships. The system
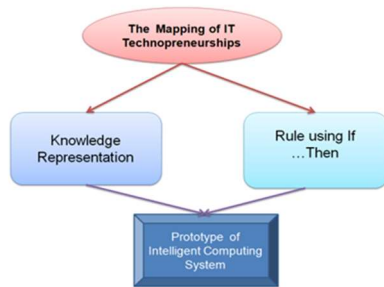
development stages are shown in Figure 3.

Figure 3: System Development Stages

The development of the Intelligent computing model used the Prototype method, the model will be used for mapping and identifying IT technopreneurships as shown in Figure 4.
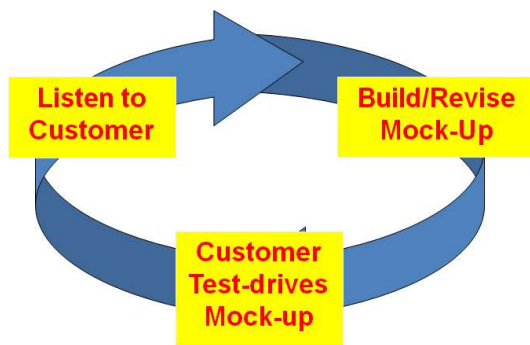

Figure 4:Prototype method

The next stage was model testing. Internal testing of the model used the black box test and white box test. External testing used the Expert Judgment Test and User Acceptance Test. Expert judgment test that used expert domain expertise in management / entrepreneurships and IT technopreneurships practitioners. User acceptance test involved IT / Computing lecturers and students. The model was then implemented to 100 Computing / IT students as a testbed. The model was also validated with training data for IT technopreneurs.

3. RESULT AND DISCUSSION

The results of the development of the Intelligent Computing model for mapping and identification of IT technopreneurships produced an architectural model, as shown in Figure 5.
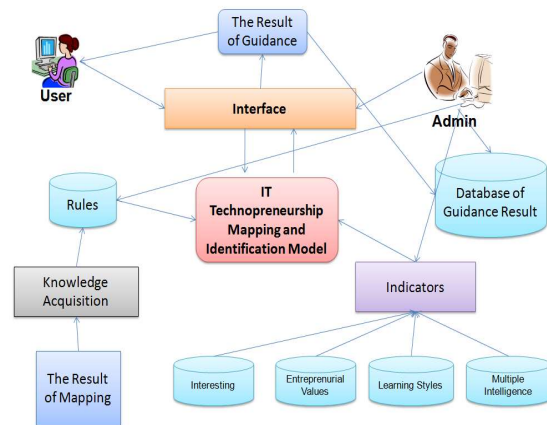

Figure 5: Model Architecture

The results of mapping various types of IT Technopreneurships associated with indicators of interest, entrepreneurial values, learning styles and multiple intelligences produce mappings such as Figure 6.
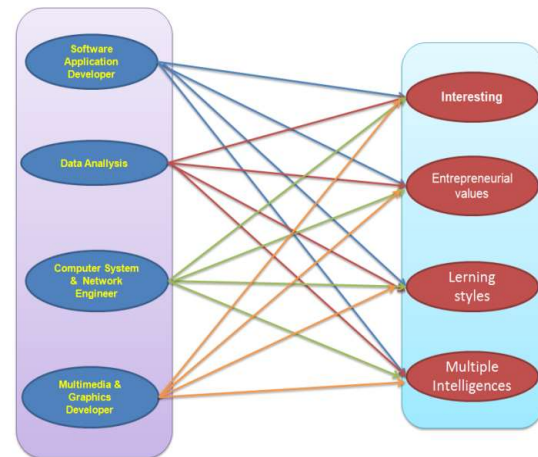

Figure 6: IT technopreneurships Mapping

The influence of Interesting, Entrepreneurial value, Learning Styles and Multiple Intelligences was validated to 30 experts and IT technopreneurs. Validation method by giving questionnaires and interviews to the 30 experts and technopreneurs. The results of the validation of the influence of personal characteristics factors on the potential of IT Technopreneurships are as follows in figure 7.
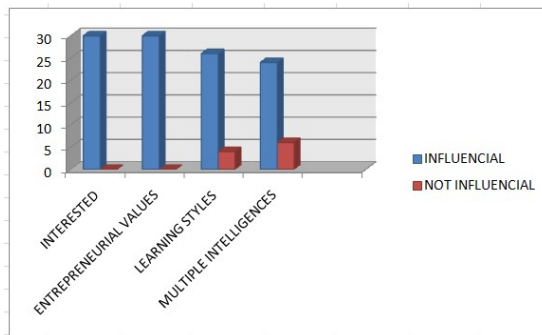
Figure 7: Validastion of Influenced Personal Characteristics to IT Technopreneurships

From the figure 8 shows the positive influence of 4 parameters of personal characteristics, namely Interest 100% (30 respondents), Entrepreneurial Value 100% (30 respondents), Learning Styles 87% (26 respondents) and Multiple Intelligences 80% (24 respondents).

The IT technopreneurships consist of 4 types, namely Software Application developer, Data Analysis, Computer System & Network engineer and Multinedia& Graphics Developer. The mapping process connected IT technopreneurs with indicators of interesting, entrepreneurial variables, learning styles and multiple intelligences. This relationship was made into rules in making intelligent computing systems. An example of a rule is as follows:

IF Interesting in Software Application Developer AND Entrepreneurial values is high AND visual learning styles isl Medium high AND Verbal learning styles is medium AND Logical learning styles is high AND Social learning styles is medium AND Linguistics Intelligece medium AND Logical-Mathematics Intelligence is high AND Visual-Spatial Intelligence ishigh AND Interpesonal Intelligence is medium AND Naturalist Intelligence is medium THEN *Software Application Developmer*

In this model, 64 rules are made that will be used for mapping and identifying IT technopreneurships based on the indicators. The results of the model testing before being used for mapping and identifying IT Technopreneurships are as shown in Table 1, below.

Table 1: Result of Model Testing

No	Model Testing	Indicators	Result of Testing
1	Internal testing	Black box test & white box test	System was running well and cyclometic complexity is lower
2	User Acceptance Test	Input processing, usefull, tombol and menu is matching, easily and clear, mapping and identification is running well	96%
3	Expertise Judgement Test (Computing/IT)	Efective and efisien, reliable, maintenable, usability, compatibility, documentation, reusable, communicative, creative, AI usage	98%
4	Expertise Judgement Test (Entrepreneurships/Technopreneurs hips)	Mapping and identification processing, similarity and macthing of IT tecnopreneurships and indicators, usability model, optimalization and accurazy processing.	95%

From table 1, it can be seen that the test results show that this model is useful and will then be implemented for mapping and identifying IT technopreneurship. Before implementing the model, the model needs to be validated by implementing model to 20 IT technopreneurship consisting of 6 Software Application developers, 6 Data Analysis people, 4 Computer Systems & Network engineers and 4 Multinedia& Graphics Developers. The validation results are measured by using confusion matrix which is measured by mapping scale and identification using precision:

$$Precision = \frac{True\ Positive\ (TP)}{True\ Positive\ (TP)\ +\ False\ positive\ (FP)}\ x\ 100\%$$

From 20 IT technopreneurs, 17 true identification and 3 false identification were obtained, so that the precision value is:

$$Precision = \frac{17}{17+3}\ x\ 100\% = \frac{17}{20}\ x100\% = 85\%$$

The model was then implemented for mapping and identification of IT technopreneurships with a testbed of 100 Computing / IT students. The results of the implementation are as shown in Figure 8.
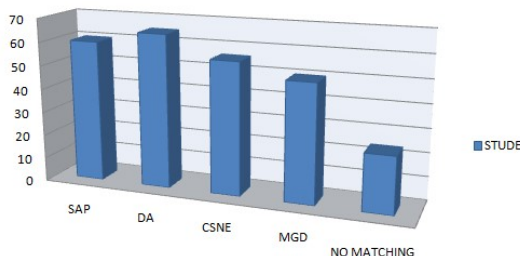

Figure 9:The Result of Mapping and Identification

From the 100 students who tested this model, it was found that a student could fit more than one type of IT Technopreneurships. The results of the mapping and identification showed that there are 60 students interested as Software Application developers (SAP), 65 students as Data Analysis (DA), 56 students interested in Computer Systems & Network engineers (CSNE), 50 students interested in Multinedia& Graphics Developer (MGD) and 24 students who are not suitable to be IT technopreneurs.

4. CONCLUSIONS

The mapping and identification model can work well to map the potential of students in the IT Technopreneurships field based on personal characteristics. The mapping and identification of the IT technoprenurships type from literature review and domain expertise resulted in 4 types, namely Software Application developer, Data Analysis, Computer System & Network engineer and Multinedia& Graphics Developer. The mapping and identification indicators used interesting, entrepreneurial values, learning styles (Solitary, Logical, Aural, Social, Verbal, visual and Physical) and multiple intelligences (Visual Spatial, Logical Mathematics, Body Kinesthetics, Naturalist, Musical, Linguistics, Interpersonal and Intrapersonal). The development of an intelligent computing system for this model used the prototype method. The tests through the black box test, white box test, user acceptance test and expertise judgment test showed high results (bigger than 90%). The validation of the implementation of the 20 IT technopreneurs is precise 85%. The results of the model implementation resulted in a Software Application developer of 60 students, Data Analysis 65 students, Computer System & Network engineer 56 students, Multinedia& Graphics Developer 50 students and 24 students not suitable to become IT technopreneurs.

REFERENCES

[1] I. Hastuti, S. Purnomo, and W. Lestari, "The Guidance of Technopreneurship Using Expert System Computing," *Int. J. Econ. Bus. Account. Res. (Ijebar), Vol. 2, Issue 3.*, vol. 2018, no. 3, pp. 27–35, 2018.

[2] S. Purnomo, W. Lestari, and I. Hastuti, "Expert System Design for Guidance of Information Technology (It) Technopreneurships Based on Students Personal Characteristics," *Int. J. Eng. Res. Technol.*, vol. 6, no. 11, pp. 237–242, 2017, [Online]. Available: https://www.ijert.org/research/expert-system-design-for-guidance-of-information-technology-it-technopreneurships-based-on-students-personal-characteristics-IJERTV6IS110125.pdf.

[3] H. S. Kamarudin and S. Sajilan, "Critical Success Factors of Technopreneurship in the Creative Industries : A Study of Animation Ventures," *Rev. Integr. Bus. Econ.Res*, vol.

2, no. 1, pp. 1–37, 2013, [Online]. Available: https://www.academia.edu/12569771/Critical_Success_Factors_of_Technopreneurship_in_the_Creative_Industries_A_Study_of_Animation_Ventures.

[4] Y. Chandra, "Mapping the evolution of entrepreneurship as a field of research (1990 – 2013): A scientometric analysis," *PLoS One*, vol. 13, no. 1, pp. 1–24, 2018, doi: 10.7910/DVN/CGDOHW.

[5] K. Anguelov, T. Stoyanova, and R. Tamošiūnienė, "Research of motivation of employees in the IT sector in Bulgaria," *Entrep. Sustain. Issues*, vol. 7, no. 3, pp. 2556–2567, 2020, doi: 10.9770/jesi.2020.7.3(73)CITATIONS.

[6] C. Trivedi and S. Misra, "Relevance of Systems Thinking and Scientific Holism to Social Entrepreneurship," *J. Entrep.*, vol. 24, no. 1, pp. 37–62, 2015, doi: 10.1177/0971355714560658.

[7] Y. Chandra, L. C. Jiang, and C. Wang, "Mining Social Entrepreneurship Strategies Using Topic Modeling," *PLoS One*, vol. 11, no. 3, pp. 1–28, 2016, doi: 10.7910/DVN/ATFL9A.

[8] B. de la Hoz-Rosales, J. Camacho, and I. Tamayo, "Effects of Innovative Entrepreneurship and The Information Society on SociaL Progress: An InternationaL Analysis," *Entrep. Sustain. Issues*, vol. 7, no. 2, pp. 782–813, 2019, [Online]. Available: http://doi.org/10.9770/jesi.2019.7.2(1).

[9] S. Wichitsathian and D. Nakruang, "Knowledge Integration Capability and Entrepreneurial Orientation: Case of Pakthongchai Silk Groups Residing," *Entrep. Sustain. Issues*, vol. 7, no. 2, pp. 977–989, 2019, doi: http://doi.org/10.9770/jesi.2019.7.2(13).

[10] A. D. Amante and T. A. Ronquillo, "Batangas State University Method of Technopreneurship as an Outcomes – Based Education Tool Applied in Some Engineering and Computing Science Programs BatStateU Method of Technopreneurship," in *AAEE2016 CONFERENCE Coffs Harbour, Australia Batangas*, 2016, pp. 1–10, [Online]. Available: http://aaee.net.au/wp-content/uploads/2018/10/AAEE2016-Amante_Ronquillo-Batangas_State_Uni_technopreneurship_method.pdf.

[11] A. Y. Dutse, S. I. Ningi, and S. Abubakar, "Technopreneurship and Enterprise Growth in Nigeria: An Exploration into the Latent Role of Microfinance Banks," *IOSR J. Bus. Manag.*, vol. 12, no. 2, pp. 25–32, 2013, doi: 10.9790/487x-1222532.

[12] R. V. Dolatabadi and M. R. Meigounpoory, "Effective Determinants of Corporate Nano-Technopreneurship Process in Active Technological Knowledge Base Firms," *Int. J. Acad. Res. Econ. Manag. Sci.*, vol. 2, no. 5, 2013, doi: 10.6007/ijarems/v2-i5/350.

[13] N. N. Okorie, D. Y. Kwa, S. O. O. Olusunle, A. O. Akinyanmi, and I. M. Momoh, "Technopreneurship: an Urgent Need in the Material World for Sustainability in Nigeria," *Eur. Sci. Journal, ESJ*, vol. 10, no. 30, pp. 59–73, 2014, [Online]. Available: https://callforpapers.uksw.edu/index.php/iceteach/2016/paper/viewFile/100/79.

[14] H. U. Rehman, "The Problem of Unemployment in Pakistan: (A case of study of Khyber Pakhtunkhwa)," *Int. J. Humanit. Soc. Sci.*, vol. 2, no. 8, pp. 237–243, 2012, [Online]. Available: www.ijhssnet.com.

[15] Y. Yang, M. Fabus, K. H. Bae, and M. Zhang, "A diamond model based analysis for improving the sustainable competitiveness in educational exports by Chinese colleges and universities," *Entrep. Sustain. Issues*, vol. 7, no. 3, pp. 1858–1871, 2020, doi: 10.9770/jesi.2020.7.3(28).

[16] S. Suradi, R. M. Yasin, and M. S. Rasul, "Increasing technopreneurs for a developing a nation: The majlis amanah rakyat (MARA) experience," *J. Tech. Educ. Train.*, vol. 9, no. 1, pp. 73–86, 2017, [Online]. Available: https://publisher.uthm.edu.my/ojs/index.php/JTET/article/view/1258/1107.

[17] R. Małgorzata, "Student entrepreneurship development," in *MATEC Web of Conferences 121, 12015 (2017)*, 2017, vol. 12015, pp. 1–8, doi: DOI: 10.1051/matecconf/20171211201.

[18] M. Mani, "Entrepreneurship education: A Students' Perspective," *Int. J. E-entrepreneursh. Innov.*, vol. 5, no. 1, pp. 1–14, 2015, doi: 10.4018/ijeei.2015010101.

[19] B. Mueller and J. Robert, "Two sides of the same coin ? Internationalisation and employability : S tudents ' perceptions of employability and career outcomes from International Studies," *J. Teach. Learn. Grad. Employab.*, vol. 12, no. 2, pp. 19–35, 2021.

[20] M. Harlanu and A. Nugroho, "The Importance of Technopreneurship Management Model for Vocational School," in *The 3rd UPI International Conference on Technical and Vocational Education and Training (TVET*, 2015, no., pp. 147–150, doi: 10.2991/ictvet-14.2015.33.

[21] M. Iqbal, S. Widiyanto, H. M. Fadlillah, and H. Susanto, "PAKAR-UKM - Expert System for SMES Using Dynamic," *ARPN J. Eng. Appl. Sci.*, vol. 9, no. 12, pp. 2441–2447, 2014, [Online]. Available: https://www.semanticscholar.org/paper/PA KAR-UKM-EXPERT-SYSTEM-FOR-SMES-USING-DYNAMIC-BASE-Iqbal-Widiyanto/887fc7c8b793310f9350bfbf169c 979a4968940b.

[22] A. Selvarani and K. Venusamy, "A Study of Technopreneurship in Small and Medium Industry . Technopreneurship AS A Firm Strategy : Links to Innovation , Creation and Performance," *Ina. J. Manag.*, vol. 6, no. 1, pp. 401–408, 2015, [Online]. Available: https://iaeme.com/MasterAdmin/Journal_u ploads/IJM/VOLUME_6_ISSUE_1/101201 40601041.pdf.

[23] M. L. Waghmode and P. P. Jamsandekar, "Expert system for Career Selection : A Classifier Model," *Int. J. Adv. Res. Comput. Sci. Manag. Stud.*, vol. 4, no. 1, pp. 174–179, 2016, [Online]. Available: http://citeseerx.ist.psu.edu/viewdoc/downlo ad?doi=10.1.1.1043.5599&rep=rep1&type =pdf.

[24] S. Purnomo, W. Lestari, and I. Hastuti, "The Mapping of Information Technology (IT) Technopreneurships Based of Learning Styles and Multiple Intelligences," in *Proceedings International Conference of Educational and Technology for Empowering Agents of Change*, 2016, pp. 1–11, [Online]. Available: https://callforpapers.uksw.edu/index.php/ic eteach/2016/paper/viewFile/100/79.

[25] E. E. L. Haji, A. Azmani, and M. E. L. Harzli, "Multi-expert system design for educational and career guidance : an approach based on a multi-agent system and ontology," vol. 11, no. 5, pp. 46–52, 2014, [Online]. Available: https://www.ijcsi.org/papers/IJCSI-11-5-2-46-52.pdf.