Games Knowledge Model Development Indonesia Traditional Approach On-To-Knowledge

Tukino[1(✉)], Baenil Huda[1], Agustia Hananto[1], Hendry[2], Eko Sediyono[2], and Saepul Aripiyanto[3]

[1] Faculty of Computer Science, Universitas Buana Perjuangan, Karawang, Indonesia
tukino@ubpkarawang.ac.id

[2] Faculty of Information Technology, Satya Wacana Christian University, Salatiga, Indonesia
[3] Faculty of Information Technology, University Islam Negeri Syarif Hidayatullah, Jakarta, Indonesia

Abstract. Traditional games are a form of play that reflects the customs of a tribe which are passed to the next generation. Traditional games have a philosophical meaning implied in each game and are also very fun. From the point of view of benefits, traditional games played by children are able to stimulate motoric, cognitive development and can build self-confidence, train concentration, build friendships and work together with others. In carrying out traditional games can be done without using tools or by using tools. The use of traditional game aids can be made from materials found in nature, such as wood, bamboo, paper, thread or objects found around them and without the high cost. Types of traditional games that use tools are kites, dakon, stilts and others, while types of games that do not use tools are applause, hompimpa, cublak-cublak suweng and others. Along with the development of technology, traditional games are slowly being abandoned and turning to modern games with information technology. In order to preserve traditional game culture so that it does not become extinct, information related to traditional games is digitized using the semantic web. Implementation of the semantic web is used to build a model capable of processing large data and making it easy to access information. Traditional games are spread throughout the archipelago in various forms and types. This requires knowledge to manage traditional Indonesian games in the form of OWL. Building traditional game ontology knowledge using the On-To-Knowledge methodology with 5 stages namely Feasibility study, kick off, refinement, evaluation, maintenance. The Ontology model can present information in a structured and systematic manner which can facilitate the search process more easily. The traditional game ontology model has six main classes, namely game type, game name, player type, toy material, toy form, how to play, winner. The evaluation results of the ontology model using the HermiT reasoner test on the protégé application, DL Query and completeness check have succeeded in answering the questions correctly. For the future, the traditional game ontology model.

Keywords: Traditional, Games, Stimulate motoric, Cognitive development

M. Setiyo et al. (eds.), *Proceedings of the 4th Borobudur International Symposium on Science and Technology 2022 (BIS-STE 2022)*, Advances in Engineering Research 225,
https://doi.org/10.2991/978-94-6463-284-2_55

1 Introduction

Indonesia consists of various tribes, cultures and customs that differ from Sabang to Merauke. Each region in Indonesia has different games, this reflects the characteristics of that area and can show the rich culture and works of each region in Indonesia. Games can be divided into two types, namely traditional games and modern games. Traditional games are works that come from an area in Indonesia. Traditional games are synonymous with equipment that is simple and easy to get around the house and easy to play [1]. Types of traditional games as shown in Fig. 1, including dakon, hompimpa, jumping rope, dragon snakes, stilts and slingshots. Traditional games have the values of skill, accuracy, thoroughness, cooperation and can train high patience [2][3]. Along with technological developments, traditional games are slowly being abandoned and turning to modern games using digital system platforms.

Information on traditional games can be accessed through guidebooks, journals, blogs or other media. Traditional game information has not been conveyed in detail and complete. Therefore, it is very important to introduce and document traditional games in Indonesian society.

Poor documentation and information dissemination systems have made the game less well-known to Indonesians. So, in this article an information infrastructure will be built to accommodate Indonesia's wealth and culture in the form of traditional games. The approach that can be applied to provide information about traditional games is using the semantic web. The Semantic Web is capable of managing a dynamic set of data and models so that it can provide open access to information [4]. To support the documentation of traditional Indonesian game objects based on Semantic Web, a modeling step is required for these objects. This modeling aims to produce a knowledge representation design that can later be applied in the Semantic Web application framework. Information on traditional games can be accessed through guidebooks, journals, blogs or other media. Traditional game information has not been conveyed in detail and complete. Therefore, it is very important to introduce and document traditional games in Indonesian society.

Poor documentation and information dissemination systems have made the game less well-known to Indonesians. So in this article an information infrastructure will be built to accommodate Indonesia's wealth and culture in the form of traditional games. The approach that can be applied to provide information about traditional games is using the semantic web. The Semantic Web is capable of managing a dynamic set of data and models so that it can provide open access to information [4]. To support the documentation of traditional Indonesian game objects based on Semantic Web, a modeling step is required for these objects. This modeling aims to produce a knowledge representation design that can later be applied in the Semantic Web application framework. Information on traditional games can be accessed through guidebooks, journals, blogs or other media. Traditional game information has not been conveyed in detail and complete. Therefore, it is very important to introduce and document traditional games in Indonesian society.

Poor documentation and information dissemination systems have made the game less well-known to Indonesians. So in this article an information infrastructure will be

built to accommodate Indonesia's wealth and culture in the form of traditional games. The approach that can be applied to provide information about traditional games is using the semantic web. The Semantic Web is capable of managing a dynamic set of data and models so that it can provide open access to information [4]. To support the documentation of traditional Indonesian game objects based on Semantic Web, a modeling step is required for these objects. This modeling aims to produce a knowledge representation design that can later be applied in the Semantic Web application framework.

This research will discuss the development of a traditional game knowledge model using the On-To-Knowledge method and modeled with Web Ontology Language (OWL). OWL is used to represent vocabulary meanings and relationships between words so that the meaning of information becomes explicit [5]. The On-To Knowledge method consists of several stages, namely the feasibility study, ontology kickoff, refinement, evaluation and maintenance [6]. The On-To-Knowledge method provides tools that can accelerate knowledge management on a large scale in processing semantic information and user access that is faster, selective and meaning-oriented [7]. The benefit of this research is that it makes it easier for people to obtain information related to objects in the form of games tradition in Indonesia. Effective and efficient dissemination of information [5] explains that by using the semantic web, information written on websites is not only useful as information that can be read by humans but also as a source of information that can be processed and understood by computers.

Semantic web offers an extraordinary solution for information processing on the website [8][7] explaining the use of the ontology method to represent knowledge in the ICT service domain in the Sipelantik application at the Ministry of Finance Pusyntek resulting in 6 classes of knowledge. The consistency test of the ontology model with Pellet Reasoner shows that the ontology model built is consistent because of the relationship between concepts.

Fig. 1. Traditional type of game: (a) dakon; (b) hompimpa; (c) lompat tali; (d) ular naga; (e) egrang; (f) ketapel.

2 Method

2.1 On-To-Knowledge

The ontology-based knowledge development methodology that is currently developing [9] is the On-to-Knowledge method. This method has 5 stages of the process [10][9] in building an ontology, namely feasibility study, ontology kickoff, refinement, evaluation and maintenance. Fig. 2 explains the 5 stages in the On-To-Knowledge methodology.

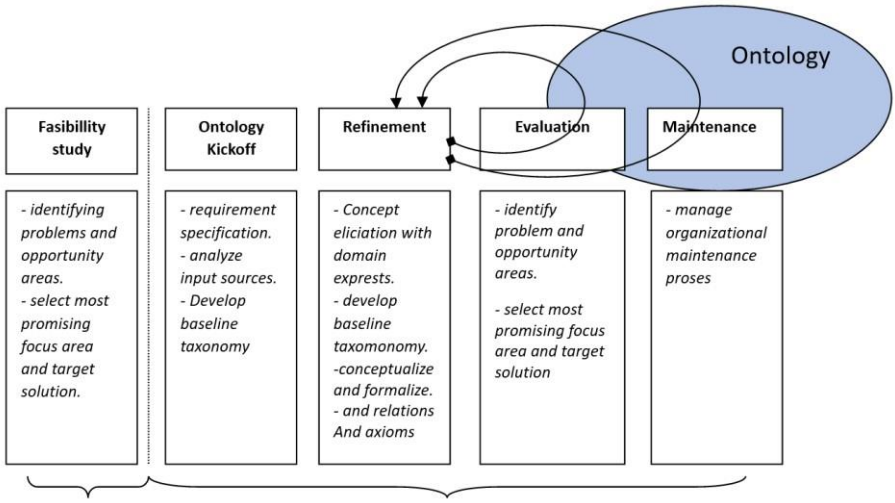

Fig. 2. Figure 2. On-To-Knowledge Process [9]

In detail, the 5 stages of the process are as follows:

1. Feasibility study is identifying problems and formulating the best solutions for each potential problem that arises.
2. Ontology kickoff is to determine and analyze the specifications required by the system which includes: system domain, system design guidelines, information knowledge sources.
3. Refinement is an activity that includes the process of knowledge extraction and formalization.
4. Evaluation is to evaluate the specification of system requirements and testing on the system.

2.2 SPARQL

Web semantics are able to manage data more efficiently by using RDF queries contained in SPARQL SPARQL's ability to express queries in a variety of different data sources, whether data is stored natively as RDF or viewed as RDF through middleware

[9]. SPARQL has 4 types of queries namely SELECT, ASK, CONSTRUCT, ASK and DESCRIBE.

2.3 Web Ontology Language (OWL)

Web Ontology Language (OWL) is a popular language used when creating ontologies. The purpose of the OWL is almost the same as the RDF Schema, which is to define an ontology including classes, properties, and relationships for each specific application. OWL can state more complex relations [11][7]. OWL is divided into three sub-languages namely OWL-Lite, OWL DL, and OWL Full. The OWL Vocabulary uses URIs in the RDF, RDFS, and OWL namespaces, and uses XML Schema literal definitions [12]. The following are important classes in ontology creation:

1. owl:Thing is a class of all things in OWL. All classes are subclasses of owl:Thing
2. owl:Class is a class of RDF resources and instances of rdfs:Class
3. owl:DatatypeProperty is a class of all properties that have ranges and instances of rdfs:Datatype
4. owl:ObjectProperty is a class of all properties that have a range that is an instance of owl:Class
5. rdf:XMLLiteral is the class of all XML literal values defined in the XML Schema specification.

2.4 Description Logics (DL)

Description logics (DL) is a knowledge-based language for representing knowledge about domains in a system in a structured way and can be understood easily [12]. Description logic provides precise and unambiguous understanding and meaning for domain descriptions. The knowledge base consists of two components, namely TBox and ABox. A TBox contains a vocabulary domain, where Vocabulary is a concept that shows a collection of individuals and roles that shows the relationship between individuals. ABox contains basic sentences that describe the relationships that occur between individuals and concepts. Every statement in ABox must have a model and be in accordance with the concept's description [6][13]. The concept description in the AL-language is formed according to the syntax rules can be seen in Fig 3.

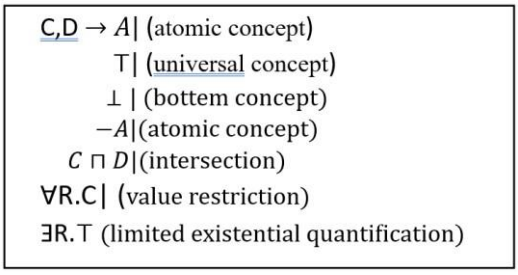

Fig. 3. Syntax for concept description [13]

2.5 Protégé

Protégé is a program with an OWL plugin concept that is used to edit ontologies and access description logic. Menus that can be used are reasoner HermiT, DL Query and other menus. Hermit is the first publicly available OWL reasoner. HermiT's goal is to determine ontology consistency and to identify hierarchical relationships between classes. With the concept of hyper table calculus, it can provide a faster process for classifying ontologies [14].

3 Result and Discussion

3.1 Formation of Traditional Game Ontology Model

The research method used in building a knowledge-based system about Indonesian traditional games (PeTra) is the On-To Knowledge Method. This method has 4 stages, namely: Feasibility Study, Formation of the Ontology Model and Refinement Stage.

At the feasibility study stage, an initial study was carried out by identifying problems with system development and system users. Furthermore, data collection related to information on traditional Indonesian games was carried out through various sources:

1. Guide to Traditional Games by PP-PAUD and West Java Dikmas,
2. Handbook of Sports and Traditional Games by Wineka Media,
3. Guidelines for traditional games Gembatan by UMM.

Apart from the guideline sources, Indonesian traditional games can also be obtained from the following blogs:

1. https://kebudayaan.kemdikbud.go.id/
2. https://www.cnnindonesia.com/hiburan/20201203111743-60-577456/7-permainan-tradisional-indonesia
3. https://www.tokopedia.com/blog/permainan-tradisional-asli-indonesia
4. https://jatengprov.go.id/beritadaerah/purbalingga-wakili-jateng-pada-kompetisi-permainan-tradisional/
5. https://www.academia.edu/33464299/BUKU_PANDUAN_DIGITAL_PERMAINAN_TRADISIONAL_TRADITIONAL_GAME_BOOKLET_BERBASIS_MOBILE_Hasanudin

Ontology Model Formation Stage, In the ontology model formation stage, software requirements specifications are determined. In developing the ontology of traditional Indonesian games using the Protégé 4.3, OWL and SPARQL programs.

Refinement Stage, At the stage of compiling knowledge in the form of PeTra Indonesia's ontology based on information through guidebooks, journals or bloqs. Information explaining about Indonesian traditional games. Statement of Logic to form a PeTra Indonesia ontology that is developed based on the knowledge model. Here's a logical statement:

1. PeTra Indonesia's games consist of slim, snake_dragon, stilts, hompimpa, gatrik, jump_rope, galasin. Logical statement as follows:
   Game ⊆ gangsing ⊔ ular_naga ⊔ egrang ⊔ hompimpa ⊔ gatrik ⊔ lompat_tali ⊔ galasin.
2. Gangsing is PeTra Indonesia which has the types of players, has the rules of the game, has the winning conditions, has the equipment used to play. Logic Statement:
3. Gangsing ≡ Indonesian Traditional Game
   ⊓ (has a PlayerType.PlayerType)
   ⊓ (∀ Have Rules. Rules of Game)
   ⊓ (∀ Have Conditions.TermsWinner)
   ⊓ (∀ Have Wood Equipment)
4. Ular_Naga is PeTra Indonesia which has types of players, has game rules, has winning conditions. Logical statement as follows:
   Ular_naga ≡ Indonesian traditional games
   ⊓ (has a PlayerType.PlayerType)
   ⊓ (∀ Have Game Rules Rules)
   ⊓ (∀ Have Conditions -Terms of Winner.
5. Egrang is PeTra Indonesia which has the types of players, has the rules of the game, has the winning conditions and has the equipment used to play. Logic Statement as follows:
6. Egrang ≡ Traditional game
   ⊓ (has a PlayerType.PlayerType)
   ⊓ (∀ Have Rules. Rules of Game)
   ⊓ (∀ HaveConditions.TermsWinner)
   ⊓ (∀ Have Equipment.Bamboo)
7. Hompimpa is PeTra Indonesia which has the types of players, has the rules of the game, has the winning conditions and has the equipment used to play. Logic Statement as follows:
8. Hompimpa ≡ Traditional game
   ⊓ (has a PlayerType.PlayerType)
   ⊓ (∀ Have Rules. Rules of Game)
   ⊓ (∀ HaveConditions.TermsWinner)
   ⊓ (∀ Have Equipment.Bamboo)

   Gatrik is PeTra Indonesia which has types of players, has game rules, has winning conditions and has the equipment used to play. Logical statement as follows:
   Gatrik ≡ Traditional game
   ⊓ (has a PlayerType.PlayerType)
   ⊓ (∀ Have Rules. Rules of Game)
   ⊓ (∀ HaveTerms.TermsWinner)
   ⊓ (∀ Have Equipment.Bamboo)
   ⊓ (∀ Have Equipment. Stone)

   Lompat_tali are PeTra Indonesia which has the types of players, has the rules of the game, has the winning conditions and has the equipment used to play. Logic Statement as follows:
   Lompat_tali ≡ Traditional game

⊓ (has a PlayerType.PlayerType)
⊓ (∀ Have Rules. Rules of Game)
⊓ (∀ HaveTerms.TermsWinner)
⊓ (∀ HaveEquipment.Rope)

9. PeTra Indonesia equipment consists of wood, bamboo, rubber, stone, marble, balls, seeds, cloth, paper and rattan. logical statement as follows:
10. Game_equipment ⊆ wood ⊔ bamboo ⊔ rubber ⊔ stone ⊔ marble ⊔ ball ⊔ seed ⊔ cloth ⊔ paper ⊔ rattan.

The testing phase of the ontology model based on traditional game knowledge using the ontology model is tested and analyzed using three methods: consistency, ontology validation and completeness.

Consistency, on consistency testing to measure ontology consistency by using the HermiT reasoner through the Protégé program on class, object properties, and data properties.

Ontology Validation, in validation testing to prove data in accordance with formal data in ontologies based on description Logic.

Completeness, in this test to test the completeness of the PeTra Indonesia ontology data which contains several lists of question Table 1 based on the extraction results

Table 1. List of Test Questions

No	Question	Expected results
1	What are the types of traditional Indonesian games?	The system can display Indonesian traditional game categories
2	What games do boys play?	The system can display Game type
3	What games don't use tools?	The system can display the type of game
4	What games use tools made of bamboo?	The system can display game type
5	What games use tools made of wood and seeds?	The system can display game type

3.2 Implementation of the Traditional Game Ontology Model

Formation of classes in PeTra Indonesia's ontology knowledge system is made using the Protégé program based on information sources from various guidebooks or blogs. In the refinement stage, the formation of classes, instances and relations is used to form the Indonesian PeTra ontology by implementing a top-down and bottomup process. The implementation of the combination of the two processes begins with selecting the main topic and identifying the generalization and specification process for the needs of establishing the Indonesian PeTra Ontology. The Petra Indonesia ontology model has 4 classes, namely:

1. Game_type is a class that contains various game type instances

2. Game equipment is a class that contains various instances of equipment types in traditional games.
3. Player_type is a class that contains an instance of the gender that plays the traditional game
4. Cara_play is a class that contains instances of mechanisms for playing traditional games 5. Conditions_winner is a class that contains an instance of the rules to determine the winner.

Design of class hierarchies and T-box graphs on the PeTra Indonesia ontology model in Fig 4 and 5 using the Protégé program.

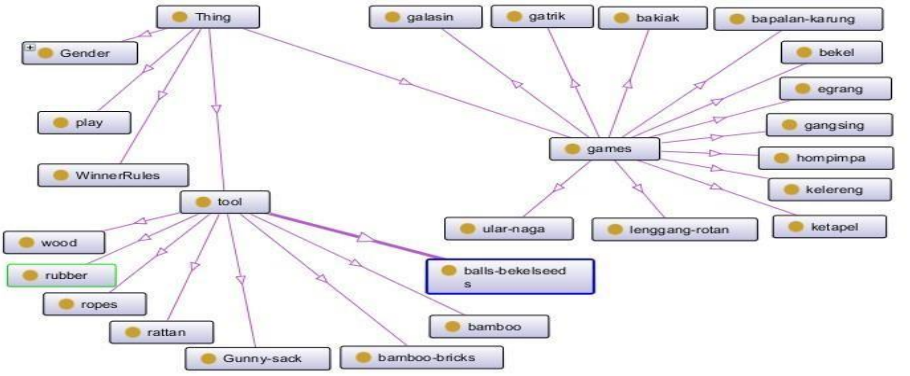

Fig. 4. Traditional Craft Ontology T-Box Graph.

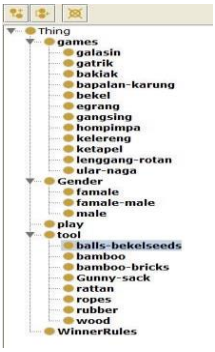

Fig. 5. Traditional Game Ontology Class Hierarchy

Defining Class Properties is declared after a class is created. In the Indonesian PeTra ontology, the Properties class is divided into two types of properties Table 2, namely object properties and data properties. In addition, there is also an inverse property that functions to define opposite properties. Table 3 describes the list of PeTra Indonesia's ontology model properties.

Table 2. List of Indonesian Traditional Games Ontology Properties

No	Property Name	Type	Domain	Range
1	hasGameType	Object Property	Equipment Type	Game Type
2	isGameTypeof	Object Property	Game Type	Equipment Type
3	hasRules of Play	Object Property	Game Type	Play Rules
4	isPlaying Rulesof	Object Property	Rules of Play	Game Type
5	hasTerms of Winner	Object Property	Game Type	Winner Terms
6	isTerms of Winnerof	Object Property	Terms of Winner	Game Type
7	HaveTypePlayer	Data Property	PenisPlayer	Text

Table 3. List of Facets from PeTra Indonesia Ontology Slots

No	Property Name	Range	Facets
1	hasGameType	Game Type	Cardinality/Value Type
2	isGameTypeof	Equipment Type	Multiple-Instances
3	hasRules of Play	Play Rules	Multiple-Instances
4	isPlaying Rulesof	Game Type	Multiple-Instances
5	hasTerms of Winner	Winner Terms	Multiple-Instances
6	isTerms of Winnerof	Game Type	Multiple-Instances
7	HaveTypePlayer	Text	Multiple-Instances

Instance creation is done in each class on the Indonesian PeTra ontology. In this example, there are 6 instances of the traditional game type class: Gangsing, Snake Dragon, Stilts, Hompimpa, Gatrik, Jump Rope and Galasin

Testing the PeTra Indonesia Ontology Model using quick search and SPARQL testing. Testing with Quick Search is enough to enter data according to the statement, then the PeTra ontology model will display information that matches the criteria. Whereas in Fig 6, the SPARQL test is by writing the SPARQL query statement on the query statement menu.

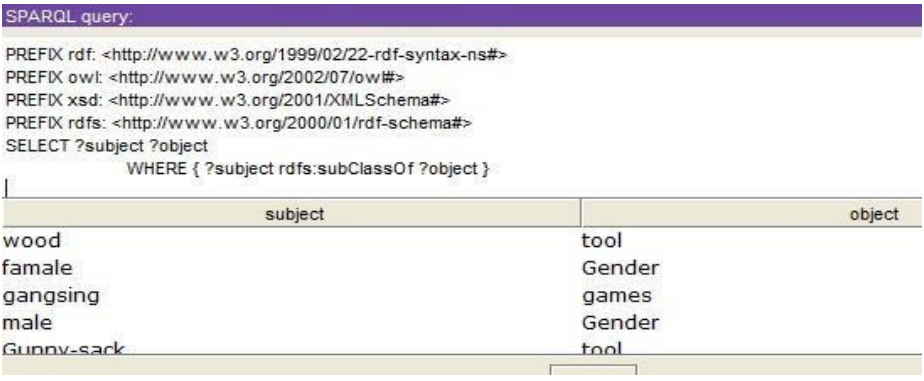

Fig. 6. SPARQL Statement

After the testing of the PeTra Indonesia ontology model was successfully carried out, the ontology model was validated by an arts and culture expert, namely Dr. Tarpan Suparman, S.Pd., M.Pd and Dr. Anggi Giri Prawiyogi, S.Pd., M.Pd., M.Sn from UBP Karawang.

4 Conclusion

The design of the PeTra Indonesia Ontology Model was successfully implemented in a protege application and testing was carried out using the Prototype Test and validation was carried out by experts. The test results show that the PeTra Indonesia ontology model can display information according to the criteria, so that it is able to provide detailed knowledge about a traditional game to the general public.

In the future, this research can be developed to be more interesting by providing game information visually or through YouTube videos. The Indonesian Traditional Games (PeTra) ontology model can be accessed by the general public through formal or non-formal education and this PeTra ontology model can be added with regional cultural values so that games can be preserved.

References

1. Dasar, S.S.; Pendidikan, M.T.; Lampung, U. 1 , 2 , 3 1. **2022**, *2*, 2587–2596.
2. Cordeiro, N.H.; Pedrino, E.C. Collision Risk Prediction for Visually Impaired People Using High Level Information Fusion. *Eng. Appl. Artif. Intell.* **2019**, *81*, 180–192, doi:10.1016/j.engappai.2019.02.016.
3. Sri Wiliah Ningtias Analisis Permainan Tradisional Daerah Kabupaten Sarolangun. *J. Eval. Educ.* **2021**, *2*, 125–133, doi:10.37251/jee.v3i2.241.
4. Peter Ozioma, U.; Bethran Chibuike, A.; Alphonsus Onyekachi, A.; V.C, A. Development of a Visual Semantic Web Ontology Based Learning Management System. *Int. J. Eng. Appl. Sci. Technol.* **2022**, *6*, 226– 238, doi:10.33564/ijeast.2022.v06i10.030.
5. Badron, Y.; Agus, F.; Hatta, H. Studi Tentang Pemodelan Ontologi Web Semantik Dan Prospek Penerapan Pada Bibliografi Artikel Jurnal Ilmiah. *Ontol. Semant. Web* **2017**, *2*, 164–169.
6. Muryanti, N.L.; Virginia, G.; Susanto, B.; Proboyekti, U. Pembangunan Model Pengetahuan Kerajinan Tradisional Indonesia Dengan Pendekatan On-To-Knowledge. *J. Terap. Teknol. Inf.* **2021**, *4*, 65–75, doi:10.21460/jutei.2020.42.196.
7. Agustini, E.P.; Andri Perancangan Ontologi Sebagai Meta Data Aplikasi Berbasis Web Semantik (Studi Kasus: Perpustakaan Universitas Bina Darma Palembang). *Semin. Nas. Inov. dan Tren IT* **2014**, 2–5.
8. Narayanasamy, S.K.; Srinivasan, K.; Hu, Y.C.; Masilamani, S.K.; Huang, K.Y. A Contemporary Review on Utilizing Semantic Web Technologies in Healthcare, Virtual Communities, and Ontology-Based Information Processing Systems. *Electron.* **2022**, *11*, doi:10.3390/electronics11030453.
9. Fensel, D.; van Harmelen, F.; Klein, M.; Akkermans, H.; Broekstra, J.; Fluit, C.; van der Meer, J.; Schnurr, H.-P.; Studer, R.; Hughes, J.; et al. On-To-Knowledge: Ontology-Based Tools for Knowledge Management. *Proc. {eBusiness} {eWork} 2000 ({EMMSEC} 2000) Conf.* **2000**.

10. Hildebrandt, C.; Kocher, A.; Kustner, C.; Lopez-Enriquez, C.M.; Muller, A.W.; Caesar, B.; Gundlach, C.S.; Fay, A. Ontology Building for Cyber-Physical Systems: Application in the Manufacturing Domain. *IEEE Trans. Autom. Sci. Eng.* **2020**, *17*, 1266–1282, doi:10.1109/TASE.2020.2991777.
11. Bakhri, A.S.; Kunci, K.; Informasi, T.; Word, M.; Masyarakat, P. Abdimas : Sistem Dan Teknologi Informasi
12. PELATIHAN APLIKASI MICROSOFT WORD PADA SISWA KELAS XII SMK TEXAR KARAWANG.
13. **2022**, *01*, 7–11.
14. Heidari, M.; Zad, S.; Berlin, B.; Rafatirad, S. Ontology Creation Model Based on Attention Mechanism for a Specific Business Domain. *2021 IEEE Int. IOT, Electron. Mechatronics Conf. IEMTRONICS 2021 - Proc.* **2021**, doi:10.1109/IEMTRONICS52119.2021.9422664.
15. Nugroho, A. Membangun Ontologi Jurnal Menggunakan Protege. *J. Transform.* **2012**, *10*, 20, doi:10.26623/transformatika.v10i1.66.
16. Schriml, L.M.; Munro, J.B.; Schor, M.; Olley, D.; McCracken, C.; Felix, V.; Baron, J.A.; Jackson, R.; Bello, S.M.; Bearer, C.; et al. The Human Disease Ontology 2022 Update. *Nucleic Acids Res.* **2022**, *50*, D1255– D1261, doi:10.1093/nar/gkab1063.