Systematic Review of Rubric Ontology in Higher Education

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***Abstract*—Assessing students is a common practice in educational settings. Students will be evaluated using several methods or tools to determine how well they have acquired knowledge or progressed. There are two distinct types of assessment is summative and formative. Rubrics are used to evaluate student performance. However, the development of the rubric is challenging because subject-matter expertise is required. Ontology has been utilized in certain research to communicate knowledge relevant to rubrics, but these studies do not map to the important learning outcomes. Rubrics are developed in Malaysia to support outcome-based education (OBE) based on the Malaysia Qualification Framework (MQF). It is essential to discover if the technology supports rubrics that leverage learning outcomes to produce the best possible rubric. A systematic review of the literature (SLR) was used to carry out this analysis. In the years 2018 through 2022, 42 papers were reviewed. In conclusion, the key finding of this work is that rubric-based outcome learning is the most recent research area to get attention and that only a small number of studies have used ontologies to develop rubrics based on learning outcomes.**

***Keywords*—Assessment; higher education; learning outcomes; Malaysia Qualification Framework (MQF); ontology; rubric**

I. Introduction

The practice of enhancing students' educational experiences by accomplishing learning outcomes through curriculum design is known as outcome-based education (OBE). The OBE process's results are crucial in enabling educational institutions to assess student's performance in an accurate and objective manner and to reassure pertinent stakeholders about the quality and competency of graduates. The OBE process is a crucial tool for promoting the quality of educational institutions, programs, and student employability [1]. OBE is employed in education because it organizes everything in a system of learning around what is essential for all students to be able to do at the end of their studies. [2]. To enhance student performance and learning experiences, OBE must link the curriculum, teaching and learning approaches, and assessment with learning outcomes.

One of the first proponents of OBE, Spady, characterized this approach as the design, production, and documentation of instruction with pre-specified goals and outcomes [3]. The term "outcomes" refers to the learning objectives for any proposed curriculum. These objectives must be clearly defined in order to choose a realistic set of topics and activities that will make up the students' experience [4]. The learning outcomes of the students are rated according to the Malaysia Qualification Framework (MQF) domain [5].

The curriculum should be developed when a Higher Education Institution (HEI) demonstrates the Program Learning outcome (PLO) that it wants its graduates to achieve. LOs are what the educated can perform because of education. It links with the Course Learning Outcome (CLO). Most courses are expected to foster problem-focused learning skills against the backdrop of academic convergence, improve problem-solving ability, instill criticality, and support creative faculty in the creation of new knowledge. The handling of sophisticated equipment in laboratories and workshops as well as experience with computer-simulated experiments, are expected outcomes of all scientific and technology courses.

The instructional design outlines the process by which students can complete a series of tasks utilizing the resources available in their environment and still meet the learning objectives. Experts claim that objectives oversee connecting general skills to specific knowledge so that learners may prove they can solve specific types of challenges. As a result, various taxonomies pertaining to students' abilities that serve to symbolize the acquisition of information have been constructed. Among them, Bloom's taxonomy is the most widely used [6]. It comprises three important domains: cognitive, affective, and psychomotor. The cognitive domain includes the intellectual area and learning related to knowledge, comprehension, and critical thinking [7]. The affective domain comprises the abilities to communicate and understand feelings, i.e., learning related to senses, emotions, and personal growth in attitudes [8]. The psychomotor domain covers people's abilities to make voluntary movements, skills, and actions [9].

One of the methods to achieve the objectives is through assessment. They need to scale the student's performance. One of the methods is based on assessment, which is done via a platform learning management system (LMS) that store and delivers learning content for training and educating the students. Academic evaluation of students is part of the learning process to monitor their learning progress. The evaluation of the learning process is a thorough and continuous procedure for determining a student's academic performance level in accordance with educational regulations. The assessment will indicate whether the student will succeed or fail, and it will serve as guidance for a teacher in future performance reviews [10].

A. Assessment

The evaluation criteria, definition criteria, and marking approach are the three key criteria of a rubric, a tool used to evaluate student work [11]. The assessment process requires monitoring of student progress throughout the instructor's planned instruction sequence in the LMS [12]. The objective of the evaluation is to infer, from the students' behavior, what learning objectives were achieved and the level of student knowledge. In this process, the use of a Taxonomy of Educational Objectives is highly recommended [13], [14]. Taxonomy of Educational Objectives can contribute to the evaluation of the student's academic performance.

B. Rubric

A rubric is a method that educators use to evaluate their students. It is critical to follow the learning objective. Every subject has objectives that need to be archived to qualify the subject and help the educator archive the output from learning. A rubric is used to notify students of expectations, provide informative and timely feedback, help with to grading consistency and fair assessment, and foster student learning and self-assessment [15]. There are two (2) types of rubrics which are analytic and holistic. The analytic rubric breaks down the objective into specific component parts. Every section is scored independently using a rating scale. It is a two-dimensional rubric with levels of achievement as columns and assessment criteria as rows. A holistic rubric consists of a single scale, with all criteria to be included in the evaluation being considered together. It may use a percentage or text-only scoring method.

The performance of the students was evaluated more methodically and objectively, and academics were better informed using standardized rubrics [1]. The educator needs to create teaching and learning activities and assignments that are directly related to the learning outcomes. The knowledge, skills, attitudes, and manners that are the subject of these learning outcomes won't be attained through lectures, tutorial classes, or written tests. The expectations for the performance of students and programs will be better understood with the standardization of a set of rubrics and the appropriate setting of learning outcomes since students will be more inclined to take ownership of their studies [1], [16]–[18]. Rubric is important to teacher/instructor/teaching assistant – Graduate teaching assistants also indicated that they could effectively use the rubrics to assess student work and that the rubrics clarified the instructor's expectations for how they should assess students [19].

In the meantime, the MQF's rubric domain is the evaluation and assessment of students' work using the Integrated Cumulative Grade Point Average (iCGPA) system, which assesses knowledge, skill, and attitude acquired from general subject courses as demonstrated in the Malaysia Qualification Framework's Learning Outcomes Domain (LOD-MQF) [5]. The criteria that educators want to evaluate must point to learning outcomes based on LOD-MQF. Every institution needs to follow Malaysia's Qualification Framework in education to evaluate students. Most of the rubric is created manually with the criteria that want to evaluate [20].

C. Ontology

Educators can create rubrics easily when using computational approaches. Educators can use ontology to map rubric criteria to related learning outcomes. Ontology is a technology used to represent knowledge domains in an understandable form that can be manipulated by machines. Ontology was created to share a common understanding of the structure of information among people, to enable the reuse of domain knowledge, to make domain assumptions explicit, to separate domain knowledge from operational knowledge, and to analyze the domain knowledge [21]. Developing ontology from scratch is hard and wastes time, however, the study in [22] state that using an existing ontology can save money and effort. The effort of this study, which adapts the pre-established ontology developed by [6], is motivated by the idea of reusing pre-made ontologies.

As employed in this study, a systematic review is an examination of a defined issue that employs methodical and clear techniques to identify, select, and assess pertinent research papers as well as analyze their data [23]. Systematic reviews also try to analyze secondary data by gathering, synthesizing, and rating the available data on a subject in a logical, intelligible, and analytical manner [24]. Given the current discourse issue surrounding this topic, it is imperative to do a thorough study of it. Gaps can be identified and future studies on how educators approach assessment and respond to student learning outcomes can be directed in the right direction using the methodology employed in this analysis.

Based on Systematic Literature Review and meta-analytical analysis, it may show patterns, identify gaps, and offer comparison results [25], [26]. A systematic review aids in understanding pertinent issues that may throw light on various assessments used by educators and enables researchers to identify trends in prior research. It is intended that the learning outcomes of assessments, such as student knowledge, abilities, competencies, and attitudes, will be clearly identified.

II. Methods

A systematic review needs to do as detail to get accurate result on how the research works. The recommended Preferred Reporting Items for Systematic review and Meta-analysis (PRISMA) guideline technique was used to conduct this systematic literature review. The research in [26], state that identification, screening, and inclusion are the three stages of preparation for papers prepared to utilize the PRISMA approach [27]. Research questions were first developed, and then papers on assessment and the creation of student learning outcomes, competencies, and performances were found. The researchers also talked about data extraction, analysis, and quality evaluation. Many researchers do some research to upgrade or modify the method in teaching and learning. Although, they need to be evaluated to identify the missing knowledge or the part where they are weak. Educator used a rubric to evaluate the student based on formative assessment.

A. Research Question

Currently, many methods are used to evaluate students using various computational approaches. The research questions for this research are:

- Are there any suitable computerization solutions that could be applied to help educators evaluate the students based on learning outcomes?
- Why ontology for rubric-based assessment is necessary to be used?

B. Preliminary Research

Preliminary research is used to validate the proposed idea, identify relevant articles, and avoid duplication of the article, and to ensure the article enough to conduct the analysis. This research is about education, and more specifically, is in higher education domain. Therefore, the article that related with the themes will be collected. The issues that appear will be analyzed and considered as important to people.

Search engines such as Google Scholar, Scopus, and Science Direct were used to get the information and documents that related to the research. The key words that used are 'learning', 'teaching', 'problem learning', and 'evaluate student'. The search was too wide, general document was found such as 'SMART learning; and 'Recommender system'. Then the search needs a specific keyword to get a more accurate result on what the research question is about. The specific keywords are 'rubric', 'learning objectives', 'outcome-based education', 'student feedback' and 'taxonomy'. According to the article, there is a gap in the research that has not yet been conducted in the higher education domain.

C. Inclusion and Exclusion Criteria

To get the desired information and avoid bias from a selection of papers and publications, inclusion and exclusion criteria must be established. Table I lists the article's inclusion and exclusion criteria, the studies in evaluation using the rubric on computational approach. The article was published between 2018 and 2022 and was written in English and was eligible for inclusion in the review. Meanwhile, publications were disqualified if they were studies that are not for evaluation using the rubric, written in a language other than English, did not specifically address the topic of evaluation using rubrics, and were duplicated studies.

TABLE I. INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria	Exclusion criteria
Studies that present OBE, LO, CLO and PLO.	Studies that not for evaluation using rubric
Studies in evaluation using rubric	Article that not available in digital library
Studies of computation approach in rubric	Non-English written article
Studies about conceptual model or theory in Outcome based	Technical reports and documents in the form of summaries
Study published between 2018 and 2022	Studies that related with learning object
English written papers	Duplicate studies

Two levels of inclusion and exclusion criteria were used: first, when reading the title and abstract, and then, after reading the complete article. There are titles, contents, and abstracts for every piece of writing and publication. Some of the book titles don't accurately describe the content. Reading the abstract might therefore save time before reading the entire article by providing an overview of the publication's substance. In addition, it saves us from having to read the full piece to learn what the publication is about and identify its goal or objective. The PRISMA flow diagram template that is used in studies can be found in Fig. 1.

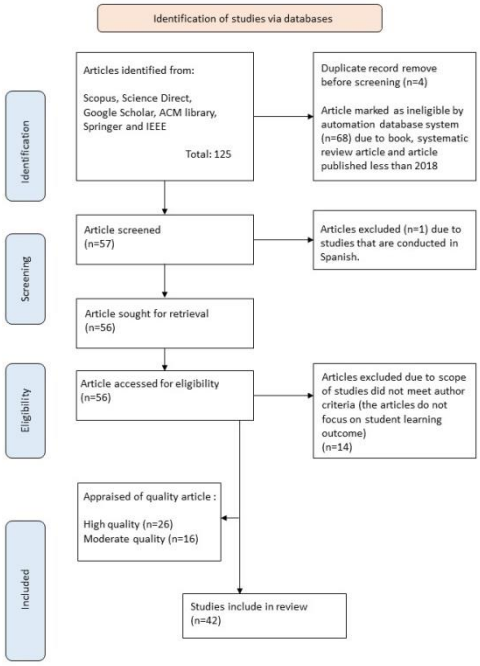

Fig. 1. PRISMA flow diagram.

D. Search Strategy

The formulation of the research question forms the foundation of the fundamental search strategy. With the assistance of a subject matter expert in the review topic area or an information specialist, search methods are created to include free-text phrases (in the title and abstract) and any applicable subject indexing expected to return acceptable studies. Additionally, because the result is not stated explicitly in the papers, using terms for the outcome may make it more difficult to find qualifying studies in the database because their inclusion. While conducting a trial search and looking for a different pertinent term within each concept from the papers that were collected, the search term is improved.

E. Search Database, Import and Export Data

According to the A MeaSurement Tool to Assess systematic Reviews (AMSTAR) criteria, the systematic review must search at least two databases [28], but as you increase the number of databases you search, the yield increases and the results become more precise and thorough. The review questions dominate how the databases are arranged. The studies used three databases. While some databases do not permit the usage of Boolean or quotation, others have unique searching methods. To obtain useful results, the original search keywords for each database must change. Lastly, all records are collected into Mendeley library to delete duplicates. All references that have same title and author and published in the same year and also the same title and author and published in the same journal would be deleted.

F. Title and Abstract Screening

Duplications will be eliminated in this step using Mendeley whenever the reviewers discover them. The team should be inclusive rather than exclusive when there is uncertainty regarding an article decision, at least until the main leader reaches a conclusion after discussion and consensus. There should be an explanation for every excluded record.

G. Full Text Downloading and Screening

Links to full text articles can be accessed for free using many search engines. If nothing is discovered, the researcher can search on research portals like ResearchGate, Science Direct, which provide the possibility of direct full-text requests from authors.

H. Manual Search

By explicitly hand-searching for reports that may have been missed in the initial search, one must exhaust all options for reducing bias [29]. The process for manual search; First, reviewing reference lists of articles that were included; second, performing citation tracking, in which reviewers track all the articles that cite each of the articles that were included; this may require using electronic databases; and third, following all "related to" or "similar" articles.

Following the same records produced by electronic databases, every potentially relevant article must be subjected to further examination against the inclusion criteria. To maximize retrieval and reduce bias, the author did an independent evaluation by giving each team member a "tag" and a unique approach before compiling all the data for discussion and comparison of the differences. In a similar vein, the number of included articles must be specified before being added to the total number of included records.

I. Data Extraction

By gathering data relating to the current issues in education, data extraction was carried out. All the published articles underwent a strengths and weaknesses analysis in this step. Articles are grouped based on the process used to identify rubric-based ontology after the data is extracted. The author's name and, more significantly, the publication year of the piece are listed after that. The article's advantages and disadvantages are combined to assess whether it can help the researcher identify a practical way to know the rubric in the computational approach.

J. Manuscript Writing, Revision, and Submission to a Journal

Writing that follows a four-part scientific structure which are introduction, methods, results, and discussion, with a conclusion in most cases. A necessary stage that has a template is creating a characteristic table for the study and patient characteristics. When the team has finished writing the manuscript and creating the characteristics table and PRISMA flow diagram, they should send it a leader or thorough revision, respond to his comments, and then choose a suitable journal for the manuscript with a high impact factor and relevant field. Before submitting the work, reading the author's rules of the journals is important.

III. Result and Discussion

Education is important and required for all people, so they have a wide range of knowledge. Education should be upgraded and use technology to provide many benefits. The majority of researchers have a focus on the university context, mainly in undergraduate research. Some issues in education concern the appropriate learning material [30], such as assessment; students also have issues with their senses, such as visual and auditory [31], and providing feedback [32]. Teachers also have some issues related to their teaching and need to improve learning and teaching methods with Information and Communication Technology (ICTs) [33], [34], and the Internet of Things (IoT) [35]. Students also have a problem choosing the path that they will take. The researcher should take these issues and try to solve the problem by creating a framework for smart learning to personalize learning material, generic smart education design, adaptive learning [36], [37], predict student performance [38], identify learning style [39], and make course recommendations [40] to help students with their studies and choices. Various studies indicate that the learning process may vary depending on the learner [31].

To produce the desired result, the systematic literature review went through each step. The first step was to conduct a thorough search. To search publications and gather data for the research, three Internet databases were employed which is Scopus, Science Direct, ACM library, Springer and IEEE and Google Scholar. There are 78 articles from the identification of the article that are related. Articles, papers, journals, web pages, manuscripts, and books that might be utilized as references for the research were produced from these sources [41]. The main keyword search was 'rubric' followed by the keyword 'evaluation student performance'. The other keyword that was used is already explained in Section B (Preliminary Research). The scope was decreased based on the amount of data retrieved during the search.

Every piece of information, including the research topic, sample type, methodology, evaluation method, participant type, and relevant details, was documented. This will assist the researchers in their data analysis and in determining whether the article is relevant. To gain a different perspective on the publications and to spot the research gaps between the articles, the data was saved as a table. How does it relate, then? It ought to respond to a research question. The author has read that there are four (4) scopes in the field of higher education that have been extensively used and studied. There are numerous perspectives, including (1) instructor perceptions of rubric use, (2) academic achievement in conjunction with rubrics, (3) rubrics for instructional and program assessments, and (4) validity and reliability of rubrics that was support by [42].

In step two (2), all the retrieved articles and publications' inclusion and exclusion criteria were determined. All the articles are then identified and reviewed critically in order to comprehend them. To get precise outcomes from the reading, comprehension is crucial. It is difficult to assess the student's performance on learning objectives using this reading evaluation. As a result, to suggest a remedy to the issue, the research should be in that field.

The data must then be extracted from each and every one of the gathered articles. The article is then extracted and classified using conventional methods, web-based expert systems, ontologies, etc. Based on whether they are PLO or CLO, these four techniques are utilized to determine how learning outcomes are implemented. Articles that discuss the validity and dependability of rubrics, as well as how instructors perceive the usage of them are not included in this article.

In the learning outcome domain research, there are up to 20 articles, as shown in Table II. This study has received considerable consideration from earlier researchers. All the details, including the research topic, sample type, methodology, assessment method, participant type, and relevant information, were documented. This will make it easier for the researchers to assess the data and determine whether the article is relevant. To gain a different perspective on the publications and to spot any gaps in the research among the articles, the data was recorded as a table. How does it relate as a result? A research question should be addressed.

The first analysis is by method that researcher used aim to evaluate, improve, give feedback and verities of solution and method that solve specific problem that related to outcome-based approach. Research used traditional or manual method to conduct exam [43], comparison between different rubric [44], evaluate coursework [20] and performance-based assessment [45], design curriculum [46], [47], improve process skill [19] and creating path [48]. Learning outcome also can be archive by using web based [49]–[53] and expert system such as text mining [54], ontology [6], [55], [56], natural language programming [57] and data mining [58], approach also analytic [59] that need the researcher to develop application. Based on analysis, it shows that only a few researches have been conducted to relate the learning outcome to a rubric evaluation approach using the LOD. The first method that will be employed is a computational technique that makes it simple for educators to assess students based on their learning. Educators can communicate their rubric evaluations using this method of communication virtually. The learning outcome of the student's assessment can also be clearly known, and thus it can be targeted. As a result, the learning objective can be met automatically.

In addition, using the data from the study, the researchers discovered additional ontologies with additional approaches or methodologies for using the expert system to categories individuals according to traits. The topic of the field is the computational method utilizing the scope of research, other than field education; there are two other fields (construction [50] and disaster [52]) that are evaluated based on learning outcomes. It is important to check the quality that greatly benefits others. It gauges how well the initiative succeeds in achieving the desired outcome(s) and how much more justifiable work is needed to attain and/or improve benefits. It offers data that could be utilized to guide decisions in the future. To determine the learning outcomes were focused on is shown in Table III. In the scope of the research, two other fields (building [51] and disaster [52]) are studied based on learning outcomes as well as to field education. It is crucial to look for qualities that are highly advantageous to others. It evaluates the initiative's effectiveness in reaching the desired outcome(s) and the amount of additional reasonable work required to achieve and/or improve benefits. It provides information that could be used as future decision-making input.

TABLE II. ANALYSIS OF THE LITERATURE REVIEW IN THE OUTCOME BASED APPROACH

Author and year	Method	Aim
Parmar et al., 2018 [43]	Traditional/ Manually	To conduct the exam through model making and assessing the graduate students of mechanical engineering
Yune et al., 2018 [44]		To compare holistic rubric and analytic rubric
Yaacob & Mahmud, 2019 [20]		To evaluate subject coursework
Dascalu et al., 2019 [46]		To design curriculum
Ram et al., 2020 [47]		To design curriculum using OBE and LO
Gresse Von Wangenheim et al., 2021 [45]		To evaluate performance-based assessment based on learning outcomes
Koutra et al., 2022 [48]		To creating path and assessment to patient
Aji et al., 2018 [49]	Web-based	To develop application in form of mobile apps
Demaidi et al., 2018 [50]		To give personalized feedback
Probst et al., 2019 [51]		To measuring construction safety climate
Johnson et al., 2019 [52]		To design observation rubric
Schoch-spana et al., 2019 [53]		To predicts post-disaster community functioning and resilience
Yago et al., 2018 [6]	Expert System	To support student learning
Hussain et al., 2018 [58]		To improve the student performance and to prevent drop out
Azmi et al., 2019 [57]		To automatically evaluate student essay
Nouira et al., 2019 [56]		To support student learning
Czajka et al., 2021 [59]		To give feedback by rubrics
Thirumoorthy & Muneeswaran, 2021 [54]		To identify the best students based on their Course Outcome attainment
IMS caliper, 2022 [55]		To support student learning

As demonstrated in Table IV, the researcher was also able to locate ontology-based rubrics that link to learning outcomes. A systematic literature review, as opposed to the conventional method, increases the accuracy of the analysis' output and enables more knowledge about the study's topic to be gleaned from the data.

TABLE III. COMPUTATIONAL APPROACH EVALUATED USING RUBRIC

Filed	Author and year	Tools/ Project
Construction	Probst et al., 2019 [51]	Rubric-based Safety Climate Assessment Tool (S-CAT)
Disaster	Schoch-spana et al., 2019 [53]	Composite of Post-Event Well-being (COPEWELL)
Education	Yago et al., 2018 [6]	Ontology Network-based Student Model for Multiple Learning Environments (ON-SMILLE)
	Aji et al., 2018 [49]	e-rubric
	Hussain et al., 2018 [58]	WEKA
	Azmi et al., 2019 [57]	Automatic evaluation of essay (AAEE)
	Nouira et al., 2019 [56]	Experience API (xAPI)
	Czajka et al., 2021 [59]	Enhancing Learning by Improving Process Skills in STEM (ELIPSS) analytic rubrics
	Thirumoorthy & Muneeswaran, 2021 [54]	Student Recruitment System
	IMS caliper [55]	IMS Caliper
Special education	Johnson et al., 2019 [52]	Explicit Instruction observation rubric

TABLE IV. RUBRIC-BASED ONTOLOGY

Author and year	Aim
Yago et al., 2018 [6]	To do assessments based on rubrics, various sorts of objectives, and learning units should be given to students to determine their knowledge levels.
Nouira et al., 2019 [56]	To obtain information from student interactions and disseminate it into different contexts using ontologies and users
IMS caliper [55]	To support student learning

The process of receiving or imparting systematic instruction, especially at a school or university, is referred to as education. Many issues that arise in the education domain that covered by researchers to solve the problem and give appropriate solutions. Education should be upgraded and used technology to provide benefits. MQF is a point of reference to explain and clarify qualifications and academic achievement in higher education with learning outcomes as the target, the MQF includes the eleven Learning Outcome Domains (LODs). This necessitates the curriculum to be designed through the mapping of the course and PLO onto the LODs. A little research has been conducted to relate the learning outcome to a rubric evaluation approach using the LOD-MQF, which can be used as a tool to evaluate students. It is supported by [6] that only used learning objectives in education as course learning outcomes for criteria that were evaluated using rubrics. However, there is no mapping between PLO and CLO. The research in [60] describes another study that focused on the assessment process, evaluation system, and assessment result of the mini project for module Digital System and Microprocessor (ECE511). The project delivered specifications based on existing CLO and aligned with PLO. However, the project does not include a rubric to evaluate student work.

Most researchers just map the course and PLO onto the CLO manually. It is also supported by [20] used the MQF to evaluate the subject coursework. However, the researcher creates a rubric by manually, which can lead to errors in the criteria that must be evaluated. The skill of the educator is lacking, though they follow the MQF to create rubrics. It is because there are some limitations to the impacts of the evaluator's evaluation skills, which encompass several criteria in evaluating proficiency [44]. The educator needs to have knowledge and experience to create a rubric.

According to socioformative methodology by [61], rubric design needs to be reviewed by an expert. The rubric also cannot be shared by other educators in the institution because the knowledge-based which is static. A computational approach using technologies that are ontologies can help the educator define rubric-based learning outcomes, support decision-making using MQF, and make the knowledge easily shareable. It is supported by [62] that state only 12% of researcher applications of ontologies in Higher Education focus on academic evaluation. It is proof that the evaluation of students is vital.

Other ontological approaches to curriculum exist, such as a curriculum ontology for EXTEND centres (international centres that can share data in a network of centers), knowledge transfer between centres in different countries and regions, exchange activities between those centres, double graduation certificates, and so on [46]. However, this curriculum was not implemented in Malaysia and was only exploited in Russia and Tajikistan. Another development is a website that used IMS Caliper model that apply ontological approach for framework. It also creates 16 rubrics based on learning outcomes [55]. The model also focuses on learning analytics [63]. The IMS Caliper framework is described in a way that is not entirely apparent, but it comprises of an ontology model that is applied to the rubric notion without having a learning outcome. Additionally, this rubric is not applicable in Malaysia because Malaysia has its own OBE framework.

According to the [56], xAPI specifications enable learning environments to capture data from student interactions and to share it with other environments using ontologies and users, but this model of xAPI does not have evaluation of students by assessment that is used rubric based learning outcome. The research by [64] shows that the researcher used an ontology approach in the engineering education field using the MQF. It is proposed that an ontology present a common vocabulary that facilitates electrical engineering curriculum development. The researcher, however, did not concentrate on evaluating students using a rubric-based map with learning outcomes. Fig. 2 show a part of ontological xAPI data model.

Research by [6], ON-SMMILE aims to promote student learning by developing a theoretical framework that makes use of the AR (Assessment Rubric) ontology model of rubric ontology. This ontology was modified from the rubric ontology [65]. The model of the rubric ontology is depicted in Fig. 3. The approach still doesn't apply to learning outcome based. An overview of the ON-SMMILE model is presented in Fig. 4.

This literature review demonstrates a few studies on an ontology design for PLO linked with CLO in higher education domain, particularly in support of the outcome-based learning and design rubric. With ontology, researchers or experts that conduct studies in the field of higher education can exchange and reuse the knowledge included in the model. It can also expressly state any domain assumptions. It is simple to alter the domain knowledge if it changes.

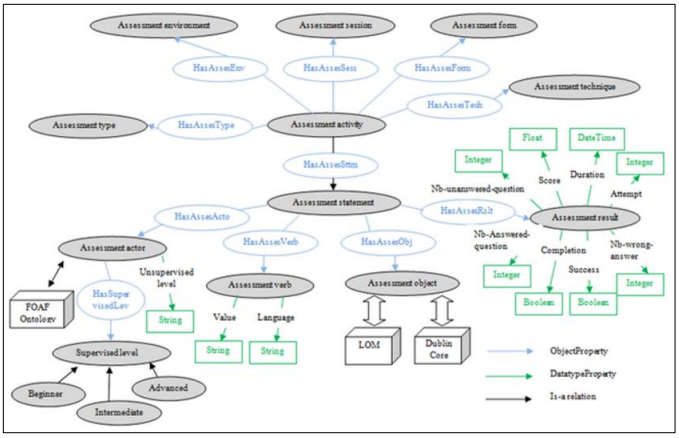

Fig. 2. A part of ontological xAPI data model [56].

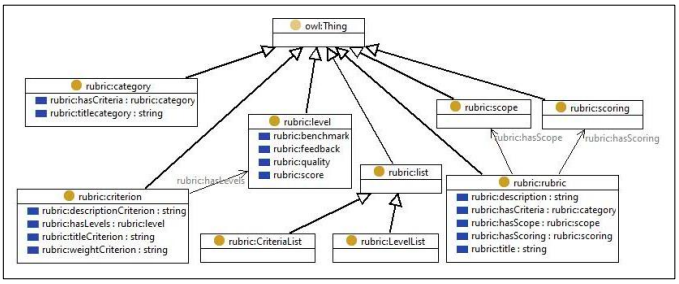

Fig. 3. Rubric based ontology [65].

In comparison to the standard method of conducting a literature review, a systematic literature review improves the accuracy of the analysis's output and makes it possible to glean more information about the subject of study from the data. It aids in the development of a structured literature review. The final step is to write a technical report or article about the complete systematic literature review process.

A structured literature review is beneficial. The final step is to write a technical report or article about the complete step in the systematic literature review process. Based on researchers' findings in the existing literature, none of the researchers used a rubric-based ontology to map CLO and align them with PLO. This rubric helps the educator create a rubric based on learning outcomes guided by the MQF.

IV. Conclusion

A systematic approach to the literature review is necessary to produce accurate results from relevant studies. To stay current with the research and to include new discoveries by other researchers, a literature review may need to be updated frequently. The steps in a systematic review or meta-analysis include developing a research question and validating it, creating criteria, searching databases, importing all results into a library, and exporting them to an Excel sheet. They also include writing a protocol and registering it; screening titles, abstracts, and full texts manually; extracting data and evaluating its quality; conducting statistical analysis manually; double-checking the data; writing a manuscript and revising it.

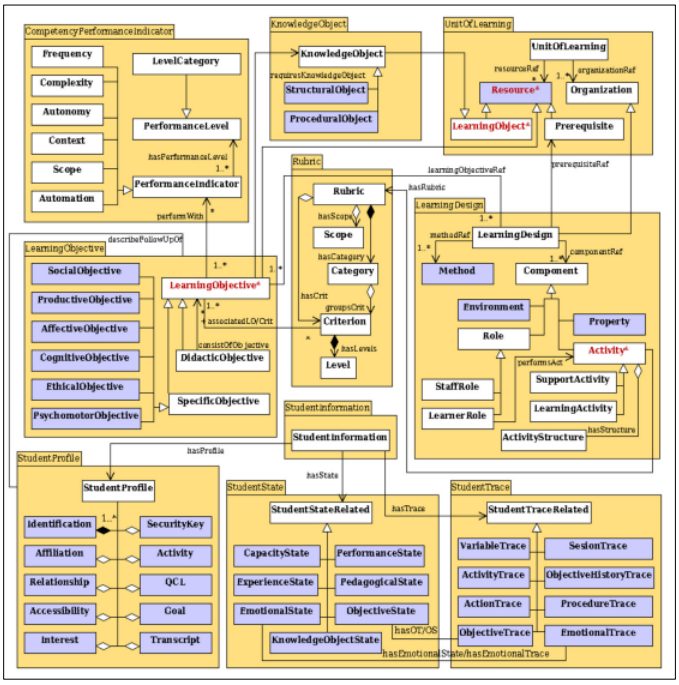

Fig. 4. The overview of the model of ON-SMMILE [6].

In this comprehensive research analysis, the characteristics of the most recent studies about the development of rubrics for student evaluation have been outlined and synthesized. The following is a summary of the key results from the literature review and the studied that were examined:

RQ1: Computational methods are now more frequently used in higher education to make complex problems simpler. However, there is still a need for a thorough analysis that provides an overview of how and to what extent computational approaches are integrated and implemented to address different concerns in higher education. To create a rubric based on learning outcomes, none of the scholars have employed the ontology technique or model. This aids in developing an appropriate framework for creating rubrics that are based on PLO and CLO.

RQ2: Ontology for rubric-based assessment is necessary to be used in PLO links with CLO because it is easy for educators to design rubric-based outcome-based learning that is guided by the MQF. Aside from that, the rubric ontology can be shared by other Malaysian educational institutions.

With these findings, researchers believe that scholars will better understand how the stages of computational techniques are employed when constructing a rubric, particularly for evaluating students, due to this thorough literature study. Researchers propose a study that focuses on the design of rubric-based outcome learning as future work to find solutions to fill gaps in this systematic literature review, such as the

interoperability issue and the understudied area of software needs. Focusing on the technology and approach techniques utilized in the development of a rubric utilizing outcome-based learning is another possibility.

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