Journal of Engineering, Electrical and Informatics
Vol.3, No.3 oktober 2023
e-ISSN: 2809-8706; p-ISSN : 2810-0557, page 01-19
DOI: https://ejurnal.stie-trianandra.ac.id/10.55606/jeei.v3i3.2216

Digital Asset Analysis, Design, Develop And Deliver For LMS According To Scorm Standard, Case Study: Vocational High School Of Software Engineering

Migunani Migunani
Universitas Sains dan Teknologi Komputer, Majapahit 605, Semarang, 50291, Indonesia
Email; migunani@stekom.ac.id

Abstract. In this study, we evaluated the limitations of using learning resources that can be used in a Learning Management System (LMS) platform, which cannot be packaged and can be used again in processing, combining, and rearranging learning based on learning objects that already exist in different LMS platforms. Studying content with formats other than SCORM is not easy adapted to the needs because the content must be reorganized every time using a different platform. Therefore, it is necessary to analyze and design learning according to the SCORM format to meet the ISO 19796-1 standard platform. This standard has the ability to share, reuse, and interoperate learning objects. The challenge in the world of education today is how to build a knowledge-based society. The building of e-learning plays an important role. Currently, the e-learning portal is a very diverse learning management system (LMS) platform used by schools or tertiary institutions. In addition, the types of learning resources and content are also diverse. It does not meet the e-material design requirements based on mechanisms that can be shared, reused, and operated on different platforms to meet the granularity element. The results provide insight and highlight the mismatch between digital learning and digital asset standards, especially in Indonesia. This helps us analyze, design, develop, and submit digital assets for electronic learning materials in vocational high school software expertise programs in accordance with SCORM Standards.
Keywords: e-Learning, SCORM, Aset Digital, LMS, Sekolah Menengah Kejuruan

Introduction

The challenge in education is how to build a knowledge-based society. Therefore, e-learning platforms play an important role in this regard. E-learning is a learning method that utilizes or applies information and communication technologies. e-Learning itself is a term that has a broad spectrum and experts define it as varying; even the term e-Learning with online learning often overlaps (Uwes, 2008). The current phenomenon is the diversity of the e-learning portal used in each institution. In addition, the types of learning resources and content are diverse. This condition certainly affects some of the following: Sengler and Winan (2008). Limited use of learning resources (digital assets) that can be shared (resource sharing) in management systems that are different from the LMS platform used. This limitation is caused by learning management system software that uses a variety of formats on digital assets. (Uwes, 2008).

Learning content cannot be packaged in one unit, but can be used again in a learning management system with another platform. Therefore, the learning content must be updated every time it is added to the system with other platforms. (3) Learning content with formats

Received Agustus 12, 2023; Revised September 30, 2023; Accepted Oktober 25, 2023

* **Migunani Migunani**, migunani@stekom.ac.id

other than SCORM is not easily adapted to the needs of individuals or organizations because they must rearrange the content of learning resources each time using a different LMS. (4) Not supporting the reuse of learning resources (reusability); less flexibility in processing, combining, and rearranging learning based on existing learning objects. Because there are many digital assets developed for Vocational High Schools and formats that still vary depending on their needs and preferences, this study will take case studies of learning materials at the Software Engineering Vocational High School so that learning materials with the standard e-format will be produced.

The results of an observation conducted in 2019 that is based on two perspectives, namely viewpoints based on e-material design and viewpoints based on the shareable mechanism, can be reusable and can operate on different platforms and granularity. The first point of view is used to assess the quality of existing e-materials in terms of their content. This viewpoint includes four aspects: e-material structure, learning material, training material, and assessment material. The second point of view is used to assess the physical e-material's ability to support shareable, reusable, interoperable, and granularity mechanisms. This assessment aims to ensure that the existing e-material can be considered high in accordance with ISO 19796-1 standards regarding shareability, reusability, and interoperability. The survey was conducted on several websites which provide learning content, two of which are https://belajar.kemdikbud.go.id and http://bse.kemdikbud.go.id

The "kelas maya" on https://belajar.kemdikbud.go.id site is one site that provides e-material products for Vocational High School Students and Teachers. The material provided is not only the result completed in various file formats, such as text format, video format, and presentation format, but is also available that explains how to make e-material, examples of curriculum, and various other supporting articles. In addition to providing e-material downloading facilities, this site provides news about activities at the Directorate of Vocational High School Development. While on the website http://bse.kemdikbud.go.id provide e- material products available on the jardiknas portal. At this site, portable electronic school books are provided (PDF), which contain lessons for elementary, junior high school, and upper secondary and vocational education (Mulyanto, 2008). Approximately one thousand two hundred books that have been uploaded by the end of July 2019. The survey results obtained directly related to the administration of https://belajar.kemdikbud.go.id as well as some material that will be uploaded to http://bse.kemdikbud.go.id. Observations were conducted to review the site's condition directly, if accessed via the Internet. The results of the e-material criteria survey for ditpsmk.net and bse.kemdiknas.go.id are shown in Table 1.

Table 1. Material criteria survey 2019

Material Criteria	belajar.kemdikbud.go.id	bse.kemdikbud.go.id
File format	doc, presentation, image	Pdf
Application Editor	Microsoft office	Microsoft word
Granularity	not appropriate yet	not appropriate yet
Sharable	not appropriate yet	not appropriate yet
Reusable	not appropriate yet	not appropriate yet
Interoperable	not appropriate yet	not appropriate yet
Refer at ISO 19796-1	not appropriate yet	not appropriate yet
SCORM Compliant	not appropriate yet	not appropriate yet

One of the products of the Electronic School Book (BSE) is an electronic software engineering book for Vocational High Schools. According to the survey results, this book does not meet the standards of learning material in e-learning in this context in the standard sharable-content object reference model (SCORM) format. SCORM is the standardization of e-Learning content distribution issued by Advanced Distributed Learning (ADL). SCORM can be distributed in e-learning packages used to accommodate various specifications and standards of web-based e-learning content with reference to interoperability, accessibility, and reusability (Rice, 2006). With this standard, it is possible to exchange learning objects between portal learning management systems so that the learning content can be used continuously (reusability) by updating content without making it from scratch again (Schellhase, Sengler, & Winan, 2008).

Based on the phenomena and conditions that occur it is necessary: (1) Methods that can produce a standard format for e-Learning content so that it can be used in various LMS platforms in designing learning resources that can be shared, (2) gathering learning resources completely in one unit that can be installed thoroughly in one package of material or can be divided granularly on learning material using content aggregation which contains a map of material structure used to combine learning materials that can be divided (sharable content object) into a complete learning module (Dodds, 2001). (3) learning content that can adjust the needs of individuals or organizations so as to facilitate the delivery aspect, (4) flexibility in processing, combining and rearranging learning objects based on existing learning objects. So, the purposes of this study are (1) to reduce or eliminate the limitations of the use of resource sharing that cannot be shared (resource sharing) on learning management systems that are different platforms. (2) integrating the entire learning content into one complete learning package and can be broken down in SCO form in granularity so that it can be reused in the learning system with different platforms. (3) facilitators in compiling learning content

that adapts to the needs of individuals or organizations for different needs using the same source, so that they no longer rearrange learning resources. (4) applying flexible ways to process, combine and recreate learning objects based on existing learning objects.

One of the products of the Electronic School Book (BSE) is an electronic software engineering book for Vocational High Schools. This book according to the survey results does not meet the standards of learning material in e-learning in this context is the standard sharable content object reference model (SCORM) format. SCORM is the standardization of e-Learning content distribution issued by ADL (Advanced Distributed Learning). SCORM can be distributed in e-Learning packages that are used to accommodate various specifications and standards of web-based e-Learning content with reference to interoperability, accessibility, and reusability (Rice, 2006). With this standard it is possible to exchange learning objects between portal learning management systems, so that the learning content can be used continuously (reusability) by updating content without making it from scratch again (Schellhase, Sengler, & Winan, 2008).

Based on the phenomena and conditions that occur it is necessary: (1) Methods that can produce a standard format for e-Learning content so that it can be used in various LMS platforms in designing learning resources that can be shared, (2) gathering learning resources completely in one unit that can be installed thoroughly in one package of material or can be divided granularly on learning material using content aggregation which contains a map of material structure used to combine learning materials that can be divided (sharable content object) into a complete learning module (Dodds, 2001). (3) learning content that can adjust the needs of individuals or organizations so as to facilitate the delivery aspect, (4) flexibility in processing, combining and rearranging learning objects based on existing learning objects.

So, the purposes of this study are (1) to reduce or eliminate the limitations of the use of resource sharing that cannot be shared (resource sharing) on learning management systems that are different platforms. (2) integrating the entire learning content into one complete learning package and can be broken down in SCO form in granularity so that it can be reused in the learning system with different platforms. (3) facilitators in compiling learning content that adapts to the needs of individuals or organizations for different needs using the same source, so that they no longer rearrange learning resources. (4) applying flexible ways to process, combine and recreate learning objects based on existing learning objects.

Previous research explains that SCORM focuses on the interface of learning content in a Learning Management System (LMS) environment and has no effect on the specific features and capabilities provided in certain LMS and its components. Preliminary studies of

the SCORM standard were conducted to obtain the LMS and learning content models. One component that is needed by an LMS is a Learning Content Management System (LCMS) to distribute digital material that provides an interface with individual users, the Test Builder System (TBS) to build tasks online, and other features (Srimathi & Srivatsa, 2008). The Share Content Object (SCO) promised by SCORM must support a pedagogical model that provides functions such as adaptive learning, collaborative learning and data retrieval and sharing across computer networks (Srimathi & Srivatsa, 2008). Likewise, the study of the training dilemma for employees faced by oil companies in the Arabian Gulf in an effort to develop English learning materials. This dilemma arises because of the demands for administrative efficiency and pedagogic needs that, at one time, there will be differences in the implementation of learning materials. SCORM seems to be able to answer these differences according to orientation towards learning design and supports the occurrence of efficiency in administrative activities. This affects the decision to choose the Learning Management System (LMS) to be used, the type of material (content) of the LMS, and the manner in which the material can be integrated more widely. A more informal and collaborative learning environment requires careful consideration and must involve management with the learning designer (Witthaus, 2009).

Online and blended learning modes continue to grow in popularity in higher education with the aim of streamlining and enhancing student learning, supporting collaboration and creativity, and equipping students with the skills they need to work and live in an increasingly digitized world. This practice-based case study highlights factors that positively and negatively affect user engagement with digital learning objects and explores students' perceptions of the role of online learning in their academic programs (McGuinness & Fulton, 2019).

Reaserch Methode

This study uses the ADDDEM approach (Dikti, 2012). This model contained six stages for the preparation of a comprehensive and sustainable e-material. Six stages are analyzed: design, development, delivery, evaluation, and maintenance. In this paper, we describe four stages: analysis, design, development, and delivery.

1. .Analyze Phase. This stage includes (a) analyzing subject competencies or one curriculum by considering the principle of reuse and repurpose so that it can be

described as removable objects (learning objects) that are sharable and reusable for vocational studies in engineering expertise software. (b) Analyzing the competency structure of learning objects in one subject or curriculum so that learning objects are connected in a pre-requisite, procedural, grouping, or combination structure. (c) Analyze alternative competency structures in one subject depending on the subject's oral entry.

2. .Design Phase. At this stage, the definition of learning objects at each level, prerequisites, and competencies of each learning object, the relation of each learning object, designing learning object metadata, designing learning object learning strategies, designing learning media learning objects, harmonizing competencies, training, and assessment.

3. Development Phase. At this stage, digital assets (e-material) are developed by applying expectations of reuse and repurpose learning objects at each level, as well as reuse and repurpose objects of information and digital assets. At this stage, new and existing content are identified. Furthermore, e-material using technology that is neutral to the delivery mode should be developed. At the end of the stage, the packaging e-material follows the e-learning standards and specifications.
4. Deliver Phase. This stage includes applying WWW technology to deliver e-material in various formats using LMS as a container for learning content.

Research Stage Phases

1.Analyze Phase

Analyze subject competencies or one curriculum by considering the principle of reuse and repurpose.

Software Engineering is a program of expertise in Vocational High Schools (SMK). Based on the viewpoint of the Computer Science field there are five sub-fields included in the field of Software Engineering, namely the sub-fields of Software Engineering, Operating Systems, Algorithms and Data Structures, Programming Languages and Databases. This is certainly adjusted to the vocational secondary education curriculum for the Software Engineering Expertise Program.

The subject matter of Software Engineering generally discusses the basics of Software Engineering, problems and problem solving, and software development methods. Discussion of the sub-field of the Operating System contains computer systems, operating systems and works in computer networks. The scope of the algorithm material includes basic algorithms and advanced algorithms. The sub-programming language takes a large portion, including GUI programming with VB & VB.Net, Java programming, C ++ programming, object-oriented programming and web-based programming. The last sub-field is the Database with coverage of database systems, conceptual modeling, relational databases, Microsoft Access and SQL. Competency Standards for Vocational School Software Engineering expertise programs based on Competency and Basic Competency (SKKD) Standards for Vocational Schools. Map of competency in Software Engineering expertise program.

Table 2. Vocational competency of software engineering expertise program

Competency Code	Software Engineering Expertise Program
ELKA-MR.UM.001.A	Mastering Basic Electronic Engineering
ELKA.MR.UM.004.A	Mastering the Basics of Digital Electronics and Computers
TIK.PR02.001.01	Using basic level programming algorithms
TIK.PR02.002.01	Using advanced programming algorithms
HDW.OPR.103.(1).A	Operates a text-based computer network operating system
HDW.OPR.104.(1).A	A Operates a GUI-based computer network operating system
TIK.PR02.020.01	Operate database applications
TIK.PR08.004.01	Creating applications based on Microsoft access
TIK.PR08.024.01	Create documents with HTML according to specifications
TIK.PR08.027.01	Applying the basics level of making web static.
TIK.PR08.003.01	Make an application program using VB & VB.NET
TIK.PR02.016.01	Creating an Application software package
TIK.PR03.001.01	Operate basic level SQL programming languages
TIK.PR03.002.01	Operate advanced SQL programming languages
TIK.PR04.002.01	Creating basic level dynamic webpages
TIK.PR04.003.01	Creating advanced dynamic webpages.
TIK.PR02.009.01	Operate object-oriented programming languages
TIK.PR08.012.01	Create application programs using Java
TIK.PR08.001.01	Make application programs using C ++
TIK.PR06.003.01	Describes the peripheral system
TIK.PR08.005.01	Creating database programs using PL / SQL
TIK.PR08.006.01	Creating database programs using SQL Server
TIK.PR08.008.01	Create JSP-based web application programs

The competencies in table 3. are grouped into two categories, first group the basis of the expertise program given to class X for all expertise programs namely RPL, Multimedia and TKJ, while Second group is a given expertise package in class XI (eleven) specifically for RPL expertise programs. The subjects in each level category are shown in table 3. of the program's basic subject and table 4. of the Software Engineering expertise package subjects.

Table 3. Basic course subject in expertise program

No	Basic Expertise Program	Class	Semester	Expertise Program
1	Computer Assembly	X	2	RPL, Multimedia, TKJ
2	Digital Simulation	X	2	RPL, Multimedia, TKJ
3	Operating System	X	2	RPL, Multimedia, TKJ
4	Basic Network	X	2	RPL, Multimedia, TKJ
5	Web Programming	X	2	RPL, Multimedia, TKJ

Table 4. Software engineering expertise course subjects

No	Course Subjects	Class	Semester
1	Modeling of Software	XI	1,2
2	Desktop Programming	XI	1,2
3	Object Oriented Programming	XI, XII	1,2;1,2
4	Database	XI, XII	1,2;1,2
5	Dynamic Web Programming	XI, XII	1,2;1,2
6	Graph Programming	XII	1,2;1,2
7	Mobile Devices Programming	XII	1,2;1,2
8	Database Administration	XII	1,2;1,2
9	Project Work	XII	1,2;1,2

Material management oriented to learning objects provides facilities for users to be able to determine the location of learning objects according to the plan of delivering material, changing components that are not suitable, and combining objects into organized, varied structures and exchanging between heterogeneous learning objects. Through the strategy of learning objects, material management can implement a sharing mechanism and reuse in a learning management system (LMS), or between different LMS. Table 5 represents the reusability and sharability of learning objects in different subjects in a vocational curriculum in computer engineering and informatics study programs.

Tabel 5. The subject matter map can be share and reuse

Basic Expertise Program	RPL	TKJ	MULTIMEDIA
Computer assembly	√	√	√
Digital Simulation	√	√	√
Operating system	√	√	√
Basic network	√	√	√
Web Programming	√	√	√
RPL Expertise Package			
Software Modeling	√	X	X
Desktop Programming	√	X	X
Object Oriented Programming	√	X	X
Database	√	X	X
Dynamic Web Programming	√	X	X
Graphic Programming	√	X	X
Mobile Device Programming	√	X	X
Database Administration	√	X	X
Project Work	√	√	√

It can be seen in table 5. Some subjects are basic courses of expertise programs consisting of computer assembly, digital simulations, operating systems, basic networks and web programming to the point and the sub-topics are given to the three information and communication technology programs namely programs RPL, TKJ and Multimedia expertise studies. Thus these subjects are learning objects that can be reused and sharable. Whereas the subjects in the Software Engineering (RPL) expertise group only devoted to Software Engineering expertise programs included Computer Engineering (TKJ) and Multimedia expertise groups.

1. Analyze the structure of the competencies of learning objects in one subject or in one curriculum, so that learning objects are connected in a pre-requisite, procedural, grouping or combination structure.

   Development of electronic learning in the form of SCORM digital assets is inseparable from instructional development with the understanding that electronic learning is one form of instructional media or media delivery of learning material to students. Therefore, an instructional analysis is needed to describe general learning objects into specific objects (more in depth, as prerequisites or as supporters) that are arranged logically and systematically. Some of the benefits of instructional analysis include identifying all competencies that must be mastered by learners, determining the order in which learning is carried out and determining the starting point of the

learning process. Instructional analysis to develop competency structures as shown in Figure 1.

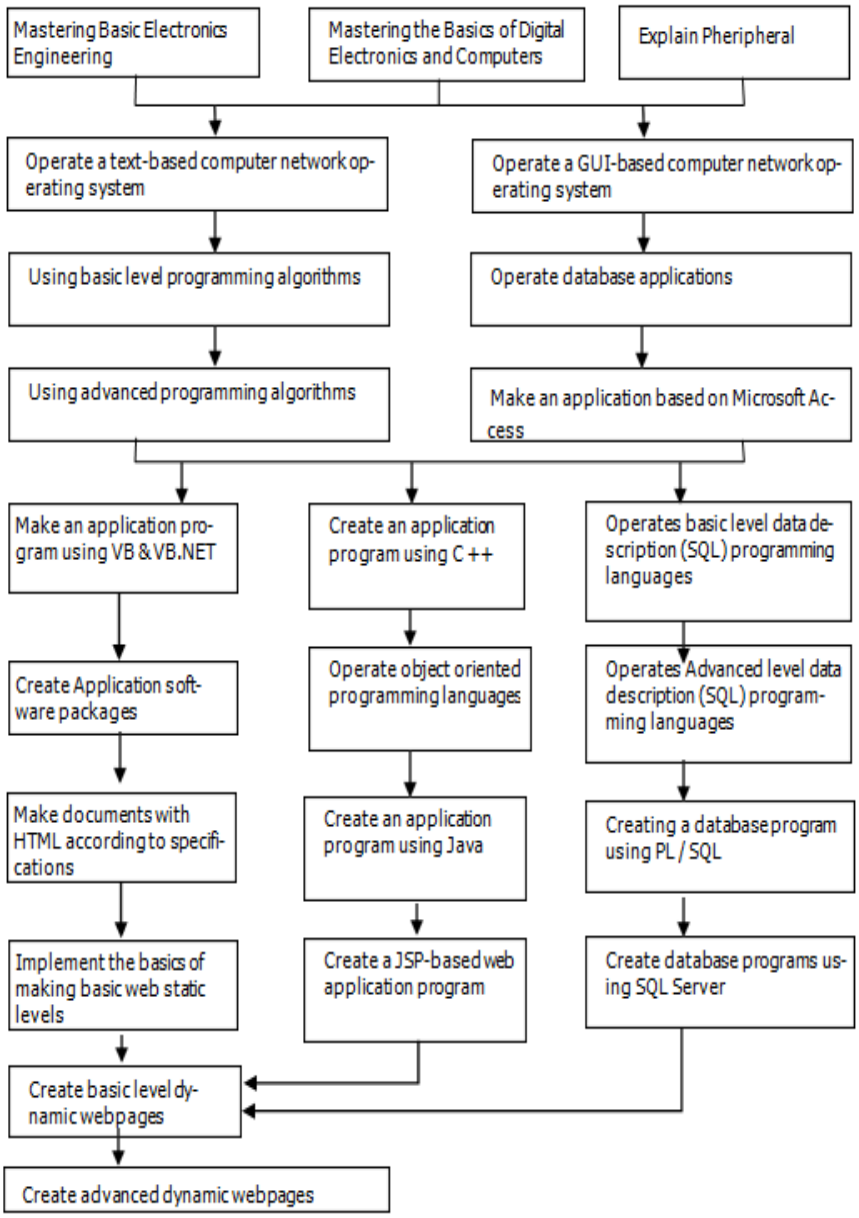

Figure 1. Competency Structure of Software Engineering

2. Analyzing alternative competency structures in one subject depends on the subject's behavioral entry.

   Alternative competency structures such as in table table 6. refers to subjects delivered at each grade level (entry behavior) at Vocational High School based on a reference book on software engineering expertise at the Directorate of Vocational High School Development [5].

Table 6. Alternative competency structures adjusted for instructional levels

Competency Code	Software Engineering Expertise Program	Chapter
ELKA-MR.UM.001.A	Mastering Basic Electronic Engineering	3
ELKA.MR.UM.004.A	Mastering the Basics of Digital Electronics and Computers	3
TIK.PR02.001.01	Using basic level programming algorithms	5
TIK.PR02.002.01	Using advanced programming algorithms	6
HDW.OPR.103.(1).A	Operates a text-based computer network operating system	4
HDW.OPR.104.(1).A	A Operates a GUI-based computer network operating system	4
TIK.PR02.020.01	Operate database applications	10,11
TIK.PR08.004.01	Creating applications based on Microsoft access	11
TIK.PR08.024.01	Create documents with HTML according to specifications	13
TIK.PR08.027.01	Applying the basics of making basic web static level.	13
TIK.PR08.003.01	Make an application program using VB & VB.NET	7
TIK.PR02.016.01	Creating an Application software package	7
TIK.PR03.001.01	Operate basic level SQL programming languages	12
TIK.PR03.002.01	Operate advanced SQL programming languages	12
TIK.PR04.002.01	Creating basic level dynamic webpages	13
TIK.PR04.003.01	Creating advanced dynamic webpages.	13
TIK.PR02.009.01	Operate object-oriented programming languages	8
TIK.PR08.012.01	Create application programs using Java	8
TIK.PR08.001.01	Make application programs using C ++	9
TIK.PR06.003.01	Describes the peripheral system	3
TIK.PR08.005.01	Creating database programs using PL / SQL	10,12
TIK.PR08.006.01	Creating database programs using SQL Server	12
TIK.PR08.008.01	Create JSP-based web application programs	14

1. Design Phase

1) Defining learning objects at each level, basic competencies and learning media.

The learning object is a collection of digital assets that are arranged in a meaningful and intended way for educational purposes. Digital assets in a learning object can be documents, pictures, simulations, films, music and so on. Arranging learning objects in a meaningful way can show that assets are interconnected and arranged in a logical arrangement so that without clear and measurable instructional goals, a set of digital assets becomes less meaningful. Meaningful arrangements that support instructional methods will make it easier to combine and reuse material components in applications and multilevel contexts (Mackanzie, 2004). In the asset model, the learning object can be likened to an object formed by smaller parts that are more meaningful if combined

together, can be combined according to certain needs that can form groups and can later be combined or separated again (Dikti, 2013). Taxonomy of learning objects as shown in Table 7.

Table 7. Taxonomy of Learning Objects

No	Learning Units in Vocational High Schools	Objectives or Competencies
1	Curriculum	Core Competence Standard
2	Subject	Graduate Competence Standard
3	Chapter	Basic Competencies
4	Sub Chapter	Learning Objectives
5	Learning Object	Learning Materials
6	Object Of Information	Introduction, Summary, Facts, Concepts, Procedures, Processes
7	Digital Assets	Documents, Images, Simulations, Animations, Movies, Music

Learning material must be decomposed so that a subject or subject is decomposed into several subjects. Each subject matter is decomposed into several sub-topics and so on so that digital assets can be defined in one subject. The decomposition process also needs to pay attention to the principles of shareability and reusability, where each learning object formed at each level should be shared and reused in relation to other subjects in one skill program or in the curriculum. The composition of the e-material building blocks is arranged in the following order:

Learning Objects of Course is a collection of subject.

Learning Objects from Subjects is a collection of learning subjects

Fundamental Learning Objects are collections of information objects

Information objects are collections of digital assets in the form of text files, graphics, audio, video

Assets are basic building blocks of learning material. Assets are electronic representations of a media, such as text, images, videos and other relevant media. The subject building block design in the Software Engineering expertise program according to the instructional level will be divided into three levels, namely subjects for class X, subjects in class XI and subjects for class XII. Refer to the Software Engineering handbook (BSE book) published by the Directorate of Vocational Middle School Development (Mulyanto, 2008). Learning objects for each subject matter of the RPL

expertise program are prepared in the Instructional plan into 14 (fourteen) tables of subjects. Information objects that exist on learning objects and digital assets for each subject matter are included. The following is one of the topics in table 8 with an introduction to software engineering.

Table 8. Subjects of Introduction to Software Engineering

Subject	Software Engineering Level 1 (Vocational X Class)		
Chapter (Basic Competence)	Sub Chapter (OP Fundamental)	Object of Information	Digita Assets
1.**Main Material :** Introduction to Software Engi- neering **Basic competencies:** Understand the defi- nition of software engineering, goals, scope, relationships with computer sci- ence disciplines and other sciences, their development, profes- sion and certification and problem solving with software engi- neering.	Definition of Software Engi- neering	Definition of software, programs, procedures and software engineering.	Text
	Objectives of Software Engi- neering	Software engineering goals.	Text, Image
	Scope	The scope of software engineering.	Text, Image
	Software Engi- neering and Computer Sci- ence Discipline	Position of the field of software engineering in computer science disci- plines and its relation to other fields of science.	Text, Image
	Software Engi- neering and Other Disciplines	Development of software engineering.	Text, Image
	Development of Software Engineering Professionals and Certificatior	Profession and certification in the field of software engineering.	Text
		Principles of problem solving in software engineering.	Text, Image
	Software Engi- neering and Problem Solving	Problems and Symptoms. Types of Problems.	Text
	Summary	Solution to problem. Summary of introduction to soft- ware engineering.	Text
	Exercise	Multiple choice questions and essays.	

2) Define the prerequisites and competencies of each learning object.

Based on the competency achievement at each level and the type of competency linearity in the RPL Vocational High School which is divided into 3 (three) levels; Class X, Class XI, and Class XII, the principles and competencies in each learning object are shown in table 9.

Table 9. Prerequisites of Each Competence.

	Competency	Prerequisite Competency
	Mastering the Basics of Digita Electronics and Computers	Mastering Basic Electroni Engineering
	Operate a GUI-based computer network operating system	Operate a text-based compute network operating system
	Operate a text-based computer network operating system	Mastering Basic Electronic Engineering
	Explaining Peripheral Systems	Mastering the Basics of Digita Electronics and Computers
	Using advanced programmin algorithms	Using basic level programmin algorithms
	Creating applications based on Microsoft access	Operate database applications
	Applying the basics of making a basic level static web	Creating documents with HTMI according to specifications
	Creating software package Applications	Make application programs using VI & VB.NET
	Operate advanced (SQL) data description programming languages	Operate basic level data descriptio (SQL) programming languages
	Creating Advanced Dynamic Wel Pages.	Create basic level dynamic webpages
	Creating an application progran using C ++	Operates an object-oriente programming language
	Creating an application progran using Java	Make an application program using C ++
	Creating a database program using SQL Server	Creating a database program using PI / SQL
	Creating JSP based web application programs	Create application programs usin Java

3. Defines the relation of each learning object.

At this stage it will define the relationship between learning objects at the level of basic competencies and the relations between information objects and digital assets.

In Figure 2. shows the relationship between learning objects with information objects that describe the relationship between learning objects that can be used again (reuse) and can be reused for certain needs (repurpose). Learning objects that can be done by the mechanism of reuse and repurpose with other learning objects. Learning objects and information objects that fulfill the mechanism of reuse and repurpose are given purple to distinguish. The learning object then compiled six objects of information that contain introduction, concepts, examples, summaries, and exercises. This arrangement refers to the conceptual model especially the conceptual learning cycle. An object of information can be further reduced to a number of discussions, for example for a concept it can be derived into a discussion of variables, constants and data types. Based on the information object that has been defined, then it is further reduced to digital assets. The following is the relation between learning objects that can be done by the mechanism of reuse and repurpose.

4. Learning object theory about variables, data types and constants can be reused and repositioned for algorithmic subjects and basic programming, application programming with VB.NET, object-oriented programming with JAVA and application programming with C++. This learning object has information objects in the form of concepts, examples, summaries and exercises.

The object of learning about operators can be reused and repose for application programming subjects with VB.NET and object-oriented programming with JAVA. This learning object has information objects in the form of concepts, examples, summaries and exercises.

Learning objects about program control structures can be reused and repose for algorithmic subjects and basic programming, application programming with VB.NET and object-oriented programming with JAVA. This learning object has information objects in the form of concepts, examples, summaries and exercises.

Learning objects about procedures and functions can be reused and reposed for algorithmic subjects and basic programming, application programming with VB.NET and Application Programming with C ++. This learning object has information objects in the form of concepts, examples, summaries and exercises.

The object of learning about Class can be reused and repose for object-oriented Programming subjects with JAVA and Application Programming with C ++. This learning object has information objects in the form of concepts, examples, summaries and exercises.

The object of learning about tables can be reused and repose for subjects based on Microsoft Access and SQL-based database applications. This learning object has information objects in the form of concepts, examples, summaries and exercises about defining tables and operations in the table.

The object of learning about queries can be reused and repose for subject matter database applications based on SQL access and SQL-based databases. This learning object has information objects in the form of concepts, examples, summaries and exercises about querying table relationships and data definition queries and data manipulation.

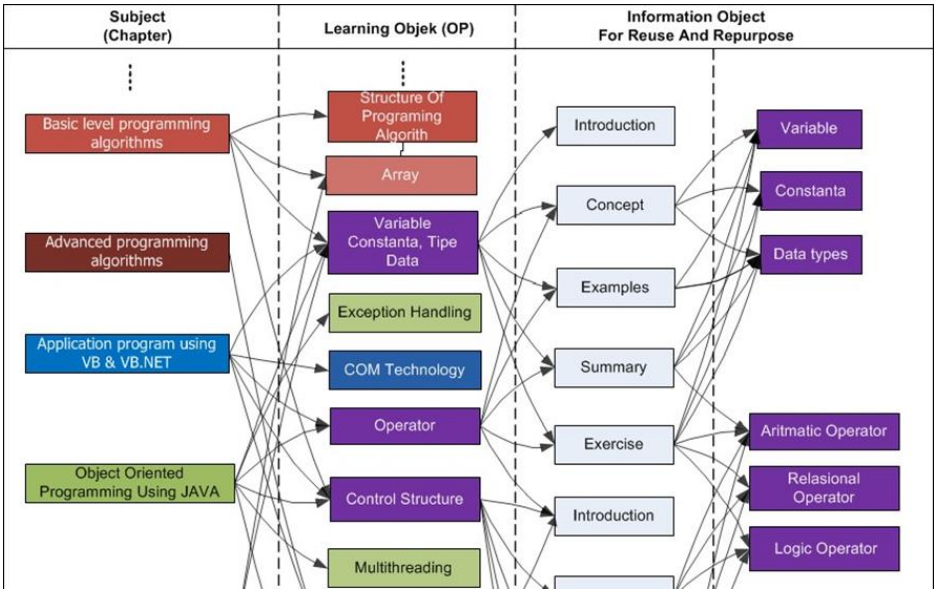

Figure 2. Relationship of learning objects with reuse and repurpose mechanism

1.Sta.ge of Develop

At this stage the development of digital assets (e-material) is carried out by applying reuse and repurpose learning objects at each level, as well as reuse and repurpose objects of information and digital assets. At this stage it will identify new content and existing content. Develop e-material using technology that is neutral to delivery mode (using exelearning development tools 2.0.4). E-material is packaged according to SCORM standards and e-Learning specifications. Learning objects that can be done by the mechanism of Reuse and Repurpose as in Table 10.

-

Table 10. Information objects that meet the relationship of reuse and repurpose

No	Learning Objects	Information Objects	Digital Assets
1	Theory of variables	Variables , constants and types of data	Text and Image
2	Operator	Operators Arithmetic, logic and relationa	Text and Images
3	Structure Control Program	Control program repetition and branching structure	Text and Images
4	Procedures and Functions	Procedures and Functions, Text an Images	Text dan Images
5	Classes	Class declarations (encapsulation), inheritance and polymorphisms	Text and Images
6	Tables	Defining tables and operations in tables	Text and Images
7	Queries	Make query table relationships, data resolution and manipulation of data	Text and Images

The learning objects in table 10 at the develop stage can be made separately (grained or granular) so that they can meet the needs of various resource use (resource sharing). Thus efforts to reuse (reuse) resources and use for different purposes (repurpose) on the LMS portal can be realized. Figure 3. The following illustrates the stage of developing SCORM digital assets for RPL learning material for Vocational High Schools. The packaging of digital assets with the SCORM standard will produce files that are ready to be up- loaded to the Learning Management System portal. In this case, LMS is used which is commonly used by e-learning portals, Moodle. Learning objects arranged granularly can be reused for the development of other digital assets that require existing digital assets, including can also be developed for individual needs or institutional needs.

2.Deliver Stage

At this stage it includes applying WWW technology to deliver e-material with various formats using LMS as a container for learning content. By setting up a domain and hosting specifically for Software Engineering e-material portals, digital assets can be uploaded to the user.

Figure 3. SCORM format uploaded to the LMS

By using the LMS Moodle RPL digital asset content package with the SCORM format that has been uploaded in Figure 4 the e-learning fund needs to be tested whether the content can be accessed through the Moodle as the execution environment. By adding the content to the RPL lesson then by selecting the Software Engineering content package link, a SCORM content package will be displayed through the web browser in Figure 5. Besides LMS Moodle digital assets can be run properly on other LMS that support SCORM format including Business LMS, eFront, Bro, LMS, ILIAS, OLAT LMS, Sakai CLE, Totara LMS and other LMS platforms.

Conclusion

Development of RPL digital assets for Vocational Schools with SCORM format can reduce or eliminate the limited use of resource sharing on learning management systems of different LMS platforms, eFront, Ganesha LMS, ILIAS, OLAT LMS, Sakai CLE, Totara LMS and other LMS platforms. With the SCORM standard the learning material packages the entire learning content into one complete learning package (not separate content in different formats) so that it can be reused (reusability) on the learning system with a different LMS platform. The compiler of learning content can be done by adjusting individuals or organizations for different needs using the same source, so that they no longer rearrange learning resources from the beginning. Applying a flexible way of processing, combining and recreating learning objects based on existing learning objects using development tools that can be exported into the 2014 version of SCORM ver- sion 1.2 or SCORM.

Referen

[1] Bohl, O., Schellhase, J., Sengler, R., Winan, U. 2002. The Sharable Content Object Reference Model (SCORM) - A Critical Review. Proceedings of the International Conference on Computers in Education. IEEE. https://doi.org/10.1109/CIE.2002.1186122

[2] Chaeruman, Uwes a., 2008. Encouraging the Application of e-learning in Schools. Teknodik Journal Vol. XII No. June 1, 2008

[3] Dikti, 2012, Guidelines for e-Material Development, Ministry of Education and Culture.

[4] Dodds, P. , 2001. The SCORM Content Aggregation Model. Advanced Distributed Learning. http://xml.coverpages.org/SCORM-12-CAM.pdf
[5] McGuinness, C. Fulton, C. 2019, Digital Literacy In Higher Education: A Case Study Of Student Engagement With E-Tutorials Using Blended Learning, Journal Of Information Technology Education : Innovations In Practice Vol 18. https://doi.org/10.28945/4190
[6] Mackenzie, G. 2004. SCORM 2004 Primer A (Mostly) Painless Introduction to SCORM Version 1.0.
[7] Mulyanto, A. R., 2008, Software Engineering for Vocational High Schools, Directorate of Vocational Middle School Development.
[8] Rice, W. 2015. Moodle e-Learning Course Development, complete guide to successful learning using Moodle. Birmingham-Mumbai: PACKT Publishing. https://moodle.tneu.edu.ua/pluginfile.php/24988/mod_resource/content/3/Moodle%20-%20E-learning%20course%20development.pdf
[9] Srimathi, H, Srivatsa, S.K, 2008., Design of Virtual Learning Environment Using Scorm Stand- ards, Journal of Theoretical and Applied Information Technology, 2008.
[10] Witthaus, G. 2009., The Implications of SCORM Conformance for e-Learning Workplace, Electronic Journal of e-Learning Volume 7 Issue 2 2009, ISSN-1479-4403