

An Assessment-Based Metamodel Towards a Best Practice Assessment Model in Higher Education

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Abstract

Objectives: There are numerous assessment practices being implemented by higher education practitioners. However, these best practices are not widely shared. In this study, a metamodel that shares the best practices is created to denote important concepts and knowledge related. **Methods/Statistical analysis:** The development is using 8-steps metamodeling approach adapted in [1]. This approach uses various models to analyse and construct the concepts, rules, constraint and relationships to model a predefined class of problem domain. There are twenty assessment models used for development and validation. The validation technique used is comparison against other model, in order to check the completeness of the metamodel. Then, the propose knowledge repository is created to represent the practicality of the metamodel. **Findings:** The resultant from metamodeling development is the *Assessment-based Metamodel* represented using UML class diagram. The concepts embedded together with the relationships cover 16 important related concepts. The creation of the metamodel can be used as a foundation of Assessment Knowledge Repository (AKR). It gathers all concepts, processes and allows various approaches to be easily shared and communicated. The AKR also consists of a collection of best practices in assessment viewed by various levels of stakeholders. **Application/Improvements:** This study proposes the *Assessment-based Metamodel* which has a capability to capture various knowledge and best practices in implementing assessment in higher education. The metamodel enables people to communicate in a well-defined language, simultaneously easy for knowledge sharing and helps in decision making. While the AKR demonstrates the usefulness of the metamodel.

Keywords: Best Practice, Higher Education, Metamodeling Approach, Metamodel, Student Assessment, Quality Assurance

1. Introduction

Assessment and evaluation in academic have different meaning, but some educationists do not distinguish them¹. According to², evaluation has a broader meaning; a systematic examination of all aspects of course, the selection and ordering of content, the choice of teaching and assessment methods, and the destination of its graduates. Furthermore, In^{3,4} also define assessment as indicating the external evaluation (reviewing, measuring, judging) process of the quality of higher education institutions and programmes, whilst the general meaning of assessment is the judgment or decision that is made, or the act of judging or deciding the amount, quality, or importance of

something⁵. In this study, the term of assessment is defined as the methods or processes to measure the level of knowledge among students in the tertiary education system for quality assurance purpose.

The purpose of assessment in higher education is for the direction and enhancement of student learning and for confirmation of learning outcomes and the maintenance of standards (accreditation). Moreover, student assessment has the capability to measure the level of student achievement and it can help students to improve their performance⁶. It can also be a motivation factor for students to gain better knowledge. Researched by Northem Ireland⁷ highlighted the importance of teaching, learning

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and assessment in producing a very high quality education system and students.

However the implementation on conducting the student assessment has not been shared widely. The important concepts and components in the assessment has not been determined. There is a lack of information system that gather all related assessment concepts. Thus, this study used best practices as a mean to gather the implementation of student assessment in higher education. The best practices should be shared among HLIs to avoid knowledge deprivation. Best practices or good practices is a system, activity or method that has been verified through a quality audit process as adding commendable value for the provider / agency and its stakeholders, and that may be beneficially transferable to other organisational settings⁸.

In Australia, Tertiary Education Quality Standard Agency (TEQSA) has worked up a *good practice database* to share the best practices in academic by various HLIs in Australia. Besides searching for information function, users can also contribute the best practices adapted by their institution in the database system. However, it has to be monitored by TEQSA to ensure its validity and reliability.

Two examples on the good practices shared by two universities (Queensland and Auckland) in Australia were retrieved. The resources are derived from the web-based system name 'AUQA Good Practice Database' developed by former Australian Universities Quality Agency (now known as Education Quality and Standards Agency (TEQSA)) in 2011⁹. The Central Queensland University shared best practice on the responsibilities of stakeholders on how the assessment is done. A procedure is well-explained in a flowchart Figure 1 which shows the stakeholders' (course coordinators, lecturers and tutors) responsibilities starting from receiving assessment task until final assessment marks are published. The standard procedure is developed to ensure that the process of marking students' work is equitable and consistent across campuses.

Besides that, University of Auckland also shared their system, (Computer-Supported Learning) CECIL as a best practice, communication medium in teaching and learning through a flexible and reliable 24x7 web-based system. It was designed to manage teaching and learning resources and facilitate access virtually without requiring a physical presence on campus.

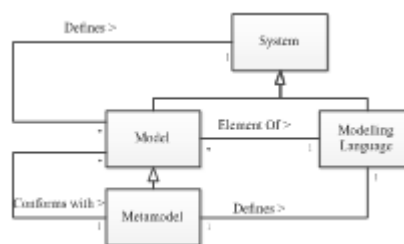


Figure 1. The metamodel definition: relationships between metamodel and model

These best practices are important information to nurture a quality assurance system in higher education. It should be shared among HLIs to avoid knowledge deprivation.

Therefore, we construct a new assessment metamodel consist of concepts, rules, relationships and constraint and propose a knowledge repository system to capture the best practices in the domain. To achieve the objective, the comprehensive analysis on various models, procedures, methods, techniques and workflow in assessment is enacted using metamodeling approach.

Metamodeling approach is a process to capture the frames, concepts, rules, constraints, models and theories applicable using various domain models as a source of data to produce a metamodel represents the domain. The approach is adopted from software engineering under Model-Driven Engineering (MDE) area, which uses models as a central artefact in the development of a system. It can be used not only for generating program code, but also for development of solutions of complex mathematical problems through definition of a new level of abstraction lying behind existing model abstractions¹⁰.

In¹¹ further discussed the important concepts entrenched in MDE comprehensively. He illustrated the relationship amongst system, model, metamodel and modeling language as in Figure 2. The model is a partial and simplified view of a system with contains concepts, elements, complexity, relationship and constraints which help to define the system under study without having to consider it directly. On the other hand, a metamodel is a model that defines the structure of a modelling language. Modelling language is a language that can build a structure to represent a system or concepts of abstract syntaxes, semantics and a set of rules which is used to create a metamodel.

In this study, we adopted metamodeling approach used in¹² as the researchers shown very in-depth process to construct a metamodel and to design a knowledge

repository. The best practices are used as an input data to the knowledge repository system.

The 8 Steps Metamodeling Approach		Expected outcome
Step 1	The preliminary observation of problem domain process	Identification of models, techniques, framework
Step 2	The identification of the best models collection process	Shortlisted models
Step 3	The extraction of general concepts process	General concepts
Step 4	Candidate concept shortlisted process	Shortlisted concepts
Step 5	Reconciliation of the shortlisted concepts process	The final concepts
Step 6	Validation of concept process	Validated concepts
Step 7	The formation of relationships among validated concepts	Initial metamodel
Step 8	The metamodel validation	The validated metamodel

Figure 2. Steps in metamodeling approach.

The organization of work pays close attention to articulate the development of metamodel for assessment in Academic Quality Assurance (AQA) using metamodeling approach (Section *Methodology*), the discussion on validated metamodel (Section *Results and Findings*) and discussion on the assessment metamodel towards best practices using repository system (Section *Discussions and Conclusions*).

2. Methodology

The metamodelling approach from Othman, Beydoun & Sugumaran¹² was adopted to develop the assessment metamodel in AQA. There are 8 steps involved in the development process ordered as depicted in Figure 3.

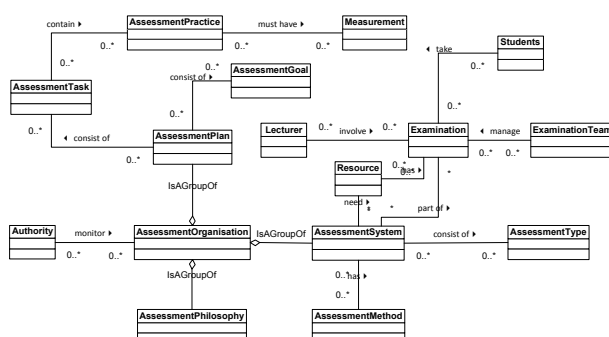


Figure 3. The initial Assessment-AQA – class of concept diagram.

Step 1 is an observation process of problem domain. The analysis on AQA domain is conducted to understand

the problem and also to identify all possible models, methods and frameworks. The document analysis technique is used to do the comprehensive literature analysis.

Step 2 involves choosing the best models which represent the problem domain to be an input for metamodel development. In this research, we focus only on assessment models and framework in the AQA. Listed 10 models for Set D1 (development) and 10 models for Set V1 (validation). The collection of models is chosen from the equitable sources such as reports and documentations guideline by authorities (Set D1) and the prominent models used in the quality management field (Set V1). Set D1 is comprised of quality assurance frameworks and models of higher education as shown in Table 1. While Set V1 discuss further in Step 6 (validation).

Step 3 involves extracting possible concepts from 10 chosen models for metamodel development. Table 1 shows general candidate assessment concepts derived from Set D1. There are 115 total concepts in the assessment.

In Step 4 and Step 5, the concept is shortlisted and the reconciliation process occurs. The concepts are short-listed when it shares the same definition or even name and the process is to harmonize and fit the definition in the metamodel. For example, concept of *Method* from Japan University and concept of *Assessment method* from ASEAN University Network, shared the same meaning and it has been reconciled as *AssessmentMethod*. Finally, there are 16 concepts shortlisted as an input to the development of metamodel. The concepts are *AssessmentPlan*; *AssessmentOrganisation*; *AssessmentPhilosophy*; *AssessmentGoal*; *AssessmentTask*; *AssessmentSystem*; *AssessmentMethod*; *AssessmentPractice*; *Measurement*; *Examination*; *AssessmentType*; *ExaminationTeam*; *Lecturer*; *Students*; *Authority*; *Resource*.

Step 6 validation of concepts involves using comparison models against a model. There are 10 models used to validate the concepts in an assessment practice. Set VI consists of Quality assurance guide for assessment - The Australian National Training Authority (ANTA), *Garis Panduan Kesetaraan Kualiti Penilaian Pelajar* UiTM (GPKKPP), UTM Self-Accreditation Portfolio, UKM Self-Accreditation Portfolio, Assessment model (AM) in a model of self-regulated learning and the feedback principles (SRL), Guideline of Good Practice, University of Tasmania, Guidelines to Good Practices: Assessment of Students (GGP), Deming Cycle (*Plan, design, check and action* – PDCA), and Total quality management in higher

Table 1. Candidate concepts of Assessment from 10 best models and frameworks collection.

Set D1	Source	Derived candidate concepts	Total
1	Quality Assurance evaluation for Malaysia Higher Education ¹⁴	Assessment; Monitoring System; Feedback System; Students Assessment System; Examination Results; Summative; Formative; Measurement; Method; Mode Programme; Students Activities; Documentation; External Expert; Best practice; Principle; Authority; Regulation; Fairness System	18
2	BDNAC Brunei Darussalam (2009) ¹⁵	<u>Plan</u> ; Type of Assessment; Assessment Team; Schedule & Itenary; <u>Do</u> ; Desktop Assessment; Site Assessment; <u>Check</u> ; Report Preparation; Presentation of Assessment; Finding; <u>Act</u> ; Assessment Report and Recommendations; Assessment Feedback	15
3	Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) ¹⁶	Examination Method; Assessors; Rubrics; Assessment Methods; Feedback; Examiner; Regulations; Fairness System; Appeal System	9
4	Quality Assurance for Higher Education in Japan ¹⁷	<u>Measurement of state and level</u> ; Benchmarking; Monitoring System; Programme Evaluation; <u>Performance Measurement</u> ; Outcome Level; Procedure; <u>Program Evaluation</u> ; Method; Lecturer; Student	11
5	ASEAN University Network-QA ¹⁸	Student Assessment; Criterion-referenced Method; Outcome-based Assessment; Assessment Method; Fairness System; Monitoring System; Document; Student; Teacher	9
6	Academic Audit Handbook for Universities – Academic Quality Agency for New Zealand Universities ¹⁹	Assessment; Monitoring And Moderating System; Assessment Standard and Procedure; Assessment Policies and Guidelines; Students; Staff; Programme Committees; Board of Studies; Academic Misconduct – plagiarism / Other forms of cheating; Academic Integrity; Feedback to Students; Student Performance; Student Result; Under-achieving Student; High-achieving Student; Academic Appeals and Grievances; Policies and Guideline (Appeal); Report	18
7	Accreditation Body for Higher Education in Indonesia	Student Evaluation; Evaluation Instrument; Evaluation Method; Monitoring System; Student Performance	5
8	Code of Practice on Assessment University of Liverpool ²⁰	Assessment; Assessment Strategies; Grading Criteria and Marking System; Requirements and Rules; Formal Examinations; Plagiarism, Collusion and Fabrication; Feedback on Assessment to Students; Boards of Examiners and External Examiners; Information for Students; Information for and Training of Assessors/Examiners; Monitoring and Review	11
9	National Assessment and Accreditation Council India ²¹	Evaluation of Teaching; Evaluation of Learning; Monitoring student progress; Evaluation technique; Evaluation Process; Evaluation Reforms; Learning outcome; Grading system; Calculating CGPA;	9
10	National Commission for Academic Accreditation & Assessment Saudi Arabia ²²	Assessment; Learning outcome; Cheating and plagiarism system; Grading system; Grading standard; Feedback; Level of performance; Student appeal procedure; student progress rules; student course evaluation	10

Table 2. Sample of validation concepts in Assessment against ANTA model

ANTA concept	Assessment concept	AQA for Assessment concept definition
Assessment Plan	<i>Assessment Plan</i>	An assessment plan is a document developed by examination team that includes the procedure and guideline how the assessment will occur, the assessment method, when the assessment is occur and the criteria for the assessment.

Assessment method	<i>Assessment Method</i>	The process how assessment is done, the way students being assessed. The method may be vary and depends on the course or programme undertaken and the level of students.
Assessment system procedures, Simulated assessment guidelines	<i>Assessment System</i>	A guideline comprises of policy, procedure, work process, rules and regulations in conducting any assessment. This is a reference to all stakeholders and monitored by the authorities.
Assessment tools	<i>Assessment Type</i>	A category of assessment implements in HLLs such as summative or formative assessment or other type of assessment suitable for mode of the programme.
Information for candidates	Not relevance	<i>Not included in the metamodel but it can be under AssessmentSystem concept.</i>
Record keeping	<i>Resource</i>	Resource is a database record consists of information, sources of references related to assessment.
Team assessment	<i>Examination Team</i>	People who are involved in set up the examination starting from preparation until the result is published.
Information for assessors	Not relevance	<i>Not included in the metamodel but it can be under AssessmentSystem concept.</i>

education (TQM). The validation process conducted thoroughly to compare all 10 models against the 16 shortlisted concepts. The sample on how the validation is done is as shown in Table 2. It compares the V1.1 validation model; *The Australian National Training Authority* (ANTA, 2011) concepts. Out of the 8 concepts from ANTA, only 6 is relevant and used in the *Assessment metamodel* concept.

Step 7 is identifying the relationship between concepts in *Assessment metamodel*. Table 3 is an example of relationship exists in the metamodel. In this metamodel there are association and aggregation relationship. Step 8 is the metamodel validation process. The models used to validate the metamodel is similar as validation for concept in Step 6 which is Set V1. Table 4 is the summarization of validated models against a model to validate the Assessment Metamodel. From the 10 models, there are 8 new concepts emerged which is not included in initial metamodel. The concepts are *AssessmentMonitoring*, *LearningOutcome*, *QFDomain*, *Feedback*, *ExternalExpert*, *AppealSystem*, *GradingSystem*, *AssessmentOutcome*.

3. Results and Findings

3.1 Resultant of Assessment Metamodel and Knowledge Repository

Unified Modeling Language (UML) is a standardized general-purpose modeling language to specify, visualize, modify, construct and document the artifacts in the

field of software engineering¹³. In this research, UML class diagram is used to represent the structural parts of the system and concepts of assessment in AQA. It is significant for easing of communication for various levels of users involved. In order to complete the class diagram, five steps are followed; i) Find classes exist in the class diagram; ii) Create associations or relationship between classes; iii) Substantiate associations; iv) Insert generalizations; and v) Verify the view. The resultant from metamodeling development is the *Assessment Metamodel* as in Figure 4 represented using UML class diagram. This is the initial *Assessment metamodel version 1.0* which covers only 16 concepts.

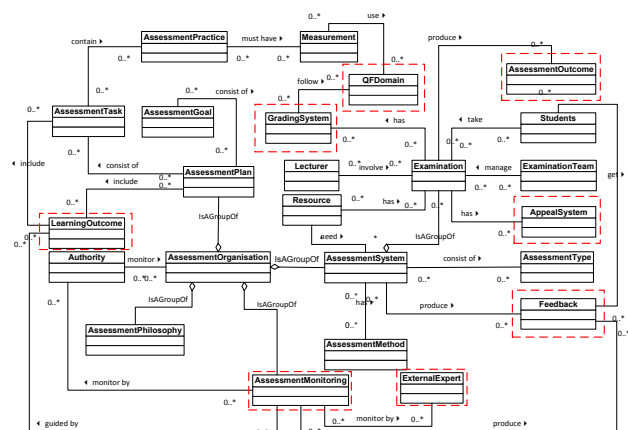
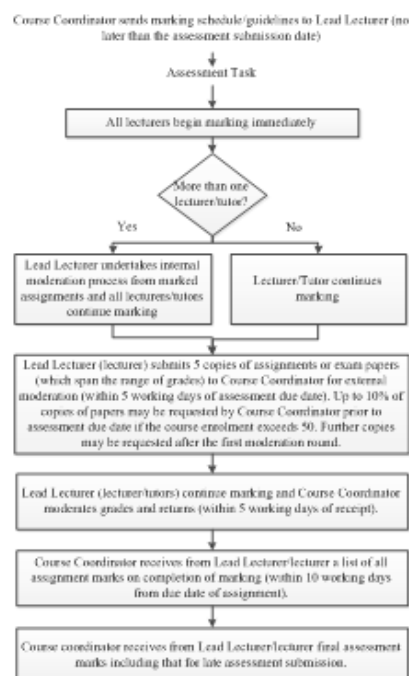


Figure 4. The validated version of Assessment-AQA class of concepts.

Table 3. The example of relationships among concepts in Assessment of AQA

Concept 1	Relationship	Concept 2
<i>Assessment Plan</i>	Association-consist of	<i>AssessmentGoal</i>
<i>Assessment System</i>	Aggregation-IsAGroupOf	<i>AssessmentOrganisation</i>
<i>Resource</i>	Association-need	<i>AssessmentSystem</i>
<i>Examination Team</i>	Association-manage	<i>Examination</i>
<i>Assessment Task</i>	Association-contain	<i>AssessmentPractice</i>
<i>Assessment Philosophy</i>	Aggregation-IsAGroupOf	<i>AssessmentOrganisation</i>

After the validation process in Step 8 is completed, the new concepts are added in the initial metamodel. Figure 5 shows the validated version of *Assessment Metamodel*. The dotted line rectangle represents the new concept, added to complete the metamodel. Generally, to have a very efficient assessment system, all concepts must be implemented and adopted in the new system. The concept can be instantiated to other new assessment system. For example, setting the final examination involves the examination team that organises the examination. A student who takes the exam must follow the rules and regulations, whilst lecturer is responsible to construct the final examination questions. In the end, students will be evaluated using assessment system and grading system and the result will be published to the students. If there is any dissatisfaction against the result, the students can make an appeal to the HLIs.

**Figure 5.** Moderation Process for Assessment at the Central Queensland University.

The creation of Assessment Metamodel can be used as a foundation of Assessment Knowledge Repository (AKR). It gathers all concepts, processes, relationships, attributes and allows various approaches to be easily shared and communicated.

3.2 The Assessment Knowledge Repository (AKR)

The purpose of Assessment Knowledge Repository (AKR) development is to demonstrate the usefulness of

Table 4. Comparing concepts in models of V1 against Assessment-AQA concepts.

Model in V1 set	Its Assessment Support concept in V1 (<i>concept in Assessment Metamodel</i>)		Assessment - AQA Lack of Support	Assessment modification
V1.1 ANTA ²³	<ul style="list-style-type: none">- Assessment plan (<i>Assessment plan</i>)- Assessment method (<i>Assessment method</i>)- Assessment system procedure, simulated assessment guideline (<i>Assessment System</i>)	<ul style="list-style-type: none">- Assessment tool (<i>Assessment type</i>)- Information for candidates, assessors (not relevance)- Record keeping (<i>Resource</i>)- Team assessment (<i>Examination Team</i>)	All supported	No

Model in V1 set	Its Assessment Support concept in V1 (<i>concept in Assessment Metamodel</i>)		Assessment - AQA Lack of Support	Assessment modification
V1.2 GPKKPP ²⁴	<ul style="list-style-type: none"> - assessment type (<i>Assessment type</i>) - assessment management (<i>Assessment system</i>) - assessment principle (<i>Assessment philosophy</i>) - assessment standard - test specification table (<i>Measurement</i>) - question bank item (<i>Assessment method</i>) 	<ul style="list-style-type: none"> - examination question paper management system (<i>Examination</i>) - marking system (<i>Measurement</i>) - action plan (<i>Assessment plan</i>) - question quality standard - monitoring quality standard of question - procedure of test/exam specification table (<i>Examination</i>) - rubrics for assessment (<i>Measurement</i>) 	- Monitoring quality standard concept	- Add: "Assessment monitoring"
V1.3 UTM ²⁵	<ul style="list-style-type: none"> - assessment principle (<i>Assessment philosophy</i>) - assessment method (<i>Assessment method</i>) - assessment practice (<i>Assessment practice</i>) - course learning outcome - programme learning outcome - Malaysian Qualification Framework (MQF) domain - monitor student assessment - Student assessment system (<i>Assessment system</i>) 	<ul style="list-style-type: none"> - validity, reliability, fairness (<i>Assessment philosophy</i>) - feedback - review assessment - assessment documentation (<i>Resource</i>) - examination regulations (<i>Examination</i>) - best practices (<i>Assessment Practice</i>) - external expertise - authority (<i>Authority</i>) - appeal policy - examination preparation process flow (<i>Examination</i>) 	- course learning outcome	- Add: "Learning outcome"
			- programme learning outcome	
			- MQF domain	- Add: "QF domain"
			- monitor student assessment	- Add: "Assessment monitoring"
			- feedback	- Add: "Feedback"
V1.4 UKM ²⁶	<ul style="list-style-type: none"> - learning outcome - MQF domain - mode of assessment (<i>Assessment type</i>) - assessment method (<i>Assessment method</i>) - student (<i>Student</i>) - examination (<i>Examination</i>) - assessment system (<i>Assessment system</i>) 	<ul style="list-style-type: none"> - measurement (<i>Measurement</i>) - rules and regulations (<i>Examination</i>) - assessment results - feedback - best practice (<i>Assessment practice</i>) - academic record (<i>Resource</i>) - assessment process (<i>Assessment organisation</i>) - authority (<i>Authority</i>) 	- learning outcome	- Add: "Learning outcome"
			- MQF domain	- Add: "QF domain"
			- assessment results	- Add: "Assessment outcome"
			- feedback	- Add: "Feedback"
V1.5 AM ²⁷	<ul style="list-style-type: none"> - assessment method (<i>Assessment method</i>) - learning outcome - examination (<i>Examination</i>) 	<ul style="list-style-type: none"> - modes of assessment (<i>Assessment type</i>) - fairness system (<i>Assessment philosophy</i>) - assessment monitoring 	- learning outcome	- Add: "Learning outcome"
			- assessment monitoring	- Add: "Assessment monitoring"
V1.6 SLR ²⁸	<ul style="list-style-type: none"> - task (goals/criteria/standard) (<i>Assessment task</i>) - domain knowledge (<i>Assessment practice</i>) - strategy knowledge (<i>Assessment practice</i>) - motivational belief (not relevant) - feedback information 	<ul style="list-style-type: none"> - self-assessment (not relevant) - tactics and strategies (<i>Assessment method</i>) - internal learning outcome - self-regulatory process (not relevant) - external feedback (teacher/peer/employer) - externally observable outcomes - student goals 	- external observable outcomes	- Add: "Learning Outcome"
			- internal learning outcome	
			- student goal	
			- external feedback	- Add: "Feedback"
			- feedback information	

Model in V1 set	Its Assessment Support concept in V1 (<i>concept in Assessment Metamodel</i>)		Assessment - AQA Lack of Support	Assessment modification
V1.7 UTAS ²⁹	<ul style="list-style-type: none"> - principle of assessment (<i>Assessment system</i>) - assessment policy and procedure (<i>Assessment system</i>) - criteria (<i>Measurement</i>) - assessment task (<i>Assessment task</i>) - students (<i>Student</i>) - teaching staff (<i>Lecturer</i>) - student service staff (<i>Examination team</i>) - reference librarians (not relevant) - criteria referenced assessment, CRA (<i>Assessment type</i>) - Competency-based Assessment, CBA (<i>Assessment Type</i>) 	<ul style="list-style-type: none"> - Norm-referenced Assessment, NRA (<i>Assessment Type</i>) - formative assessment, FA (<i>Assessment Type</i>) - summative assessment, SA (<i>Assessment Type</i>) - assessment criteria (<i>Measurement</i>) - achievement standard - level of achievement or grading scale - criteria sheets or rubrics (<i>Measurement</i>) - teaching method (<i>Assessment method</i>) - learning experiences - moderation of result 	- achievement standard - grading scale	- Add: "Grading system"
			- moderation result	-Add: "Assessment outcome"
V1.8 GGP ³⁰	<ul style="list-style-type: none"> - programme learning outcome - course learning outcome - student (<i>Student</i>) - methods of assessment (<i>Assessment methods</i>) - outcome based assessment (<i>Assessment system</i>) - continuous assessment (<i>Assessment system</i>) - examination procedure (<i>Examination</i>) - assessment review 	<ul style="list-style-type: none"> - assessment task (<i>Assessment task</i>) - assessment plan (<i>Assessment plan</i>) - performance standard (<i>Measurement</i>) - grading system - assessment criteria (<i>Measurement</i>) - assessment type (<i>Assessment type</i>) - feedback - reports on achievement (<i>Resource</i>) - plagiarism system (<i>Assessment philosophy</i>) - staff committee (<i>ExaminationTeam</i>) 	- programme learning outcome - course learning outcome	- Add: " Learning outcome"
			- grading system	- Add: "Grading system"
			- feedback	- Add: "Feedback"
			- assessment review	-Add: "Assessment monitoring"
V1.9 PDCA ³¹	<ul style="list-style-type: none"> - Plan the assessment (<i>Assessment plan, Assessment organisation</i>) - Do assessment (<i>Assessment system, Assessment goal, Assessment task</i>) - Do examination question (<i>Examination, Examination team</i>) 	<ul style="list-style-type: none"> - Check the achievement of learning outcome - Check the performance (<i>Measurement</i>) - Act – review assessment 	- Check the achievement of learning outcome	- Add: "Learning outcome" - Add: "Assessment outcome"
			- Review assessment	- Add: "Assessment monitoring"
V1.10 TQM ³²	<ul style="list-style-type: none"> - leadership (<i>Authority, Lecturer</i>) - educational management (<i>Assessment organisation, Assessment plan</i>) - human resource management (<i>Examination team</i>) 	<ul style="list-style-type: none"> - Information management (<i>Assessment system, Assessment task, Examination</i>) - customer focus and satisfaction (<i>Student, Measurement</i>) - partnership development and management (<i>External expert, Resource</i>) 	- partnership development and management	- Add: "External expert"

metamodel. It is used to show the instantiation for M0 level (user view), M1 level (model view) and M2 level (metamodel view). The stakeholders view is used to capture the best practices in assessment which also offers Figure 6 the decision making process. However, the AKR architecture and detail of its development are not discussed. shows the example of instantiation of concepts against model and metamodel in Assessment. The M0 is a user view, for example the practice of assessment in University of Glasgow, whilst M1 is the example of model being used to conform with the metamodel. Models in M1 are analysed and used as development and validation of metamodel, M2.

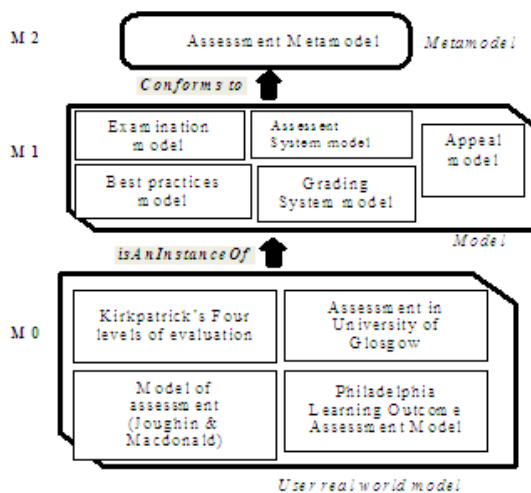


Figure 6. The relationship between M0, M1, and M2 metamodeling layers of how instantiation of model can be made from Assessment – AQA metamodel.

The AKR consists of a collection of best practices in assessment viewed by various levels of stakeholders. The stakeholders involved in assessment are examination team, lecturers, students, authority, external experts and HLIs. As shown in Table 5, there are sample of best practices in creating examination by two HLIs. Using AKR, the best practices are easy to be shared and it helps users to make decisions. It will also allow interoperability of assessment practice solutions and effectively transfer knowledge across broad boundaries

4. Discussions and Conclusions

This paper has served to provide a short review on the development of *Assessment Metamodel* towards best practices in HLIs. Metamodelling approach is one of the best alternatives to capture and codify knowledge in various domains. It is a systematic and reliable approach in developing the metamodel, also in validating it. There are 8-steps used to develop the *Assessment-based Metamodel*. This paper discusses the development phase comprehensively and demonstrates the usefulness of metamodel briefly.

The first outcome of this study is the *Assessment-based Metamodel* that consist of 16 concepts, relationships and rules in the domain. The concepts are *AssessmentPlan*; *AssessmentOrganisation*; *AssessmentPhilosophy*; *AssessmentGoal*; *AssessmentTask*; *AssessmentSystem*; *AssessmentMethod*; *AssessmentPractice*; *Measurement*; *Examination*; *AssessmentType*; *ExaminationTeam*; *Lecturer*; *Students*; *Authority*; *Resource*. To demonstrate

Table 5. Example of best practice in creating exam solutions and its relation to *Assessment-based Metamodel* concept

Source	Creating Examination Solution Sample	Assessment Concept
Eberly Center ³³ (HLIs)	Choose appropriate item types for your objectives Highlight how the exam aligns with course objectives. Write instructions that are clear, explicit, and unambiguous. Word questions clearly and simply.	Examination
	Enlist a colleague to read through your exam.	Lecturer
	Consider the point value of different question types.	Grading System
University of Oxford ³⁴ (HLIs)	Sitting your examination procedure Taking items into an examination Find candidates' number Examination conducts Alternative examination arrangements for religious observances	Examination
	Avoid plagiarism	Assessment Philosophy
	Complaints and appeal	Appeal System

University of Oxford ³⁴ (HLIs)	Result Papers and submissions are marked	Grading System
	Results considered by the Examination Board before the results are processed and released.	Examination Team
	Staff at the Examination Schools cannot give out results over the telephone and cannot advise when results will be available.	Assessment Outcome
	Appeals against the outcome of an examination should be referred via your college to the Proctors.	Appeal System

the usefulness of the metamodel, the knowledge repository is proposed. The repository used metamodel as a design system architecture to save the best practices in the student assessment.

The advantages of a using metamodel as a solution together with the repository, can be categorized into two; user view and developer view. From user view, it enables people to communicate in a well-defined language, is easy for knowledge sharing and helps in decision making. On the other view, it increases the developers' productivity because of the easiness in reusing the concept of a domain, facilitates new comers to apply domain concepts and focuses on improving the metamodel rather than developing a new one.

It is necessary to acknowledge several limitations of this study. First, development of *Assessment-based Metamodel* only covers students' assessment in higher education which uses 10 models for development and 10 models for validation. Further extended metamodel can be done using more relevant models. Second, the validation process only uses one technique which is using models comparison against other models to check the completeness of the metamodel. For future work, more validation techniques can be used to produce a reliable and complete metamodel.

This study can be prolonged for future work. We suggest furthering researches on the metamodel architecture, metamodel framework, development of the repository and extending the metamodel to AQA metamodel.

5. Acknowledgement

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