Journal for Re Attach Therapy and Developmental Diversities
eISSN: 2589-7799
2023 August; 6 (9s2): 1393-1405

The Architecture of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing

Satien Janpla[1], Pallop Piriyasurawong[2]
[1] Division of Information and Communication Technology for Education, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand
satien@ssru.ac.th
[2] Division of Information and Communication Technology for Education, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand
palloppi@gmail.com

Received: 19- June -2023
Revised: 02- July -2023
Accepted: 10-August-2023

Abstract

The objectives of this research were 1) to design the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing, 2) to assess the suitability of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing. The results of the research were divided into 2 phases as follows: Phase 1: Designing the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing; Designing could be divided into 3 layers: 1. User layer: consisting of users related to 3 groups of systems: 1) Teacher Admin/Program Designated Lecturers, 2) Teachers, 3) Students 2. Process layer: It was part of various modules of the Multilevel Item Bank System, which consisted of 8 main modules: 1) Question Management, 2) Cognitive Level Classification, 3) Trial Testing, 4) Item Analysis, 5) Item Standard Processing, 6) Testing, 7) Proficiency Level Processing, 8) Suggestion Processing, and 3. Output layer: consisted of three main modules;1) Testing Report, 2) Proficiency Level Report, and 3) Suggestion Report. Phase 2: Assessment of the suitability of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing by 7 experts in ICT for education, information technology, and computer science; It could be concluded that the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing had the overall suitability at the highest level.

Keywords: Intelligent multilevel item bank, evaluation of national undergraduate, classical test theory, revised bloom's taxonomy.

1. Introduction

Currently, teaching and learning management at the higher education level in Thailand has adopted the Thai Qualifications Framework for Higher Education as a guideline for developing or improving curriculum, teaching and learning management, and developing the quality of education management to be able to produce quality graduates, and for the benefit of accrediting qualification standards at the higher education level[1], [2]; In 2015, standard criteria for undergraduate programs have been established to produce quality graduates in line with the National Higher Education Qualifications Framework, the labor market, the advancement of science and technology, including the changing social context, academic standards and international professions to lead the country towards sustainable development and to meet international standards [3], [4], and in 2022, determined the learning outcomes of higher education graduates, must have at least four areas as follows: 1. Knowledge, 2. Skills, 3. Ethics, and 4. Character [5]; and must ensure the quality of graduates; universities must have a system for ensuring the quality of the actual learning outcomes of all Educational curricula, and monitoring and evaluation of such learning outcomes that can be monitored according to the principles of good governance, and used to improve the curriculum management process and learning process to achieve learning outcomes according to the aforementioned standards [6].

Quality assurance of graduates by examining learning outcomes requires the development or creation of assessment tools, therefore it is necessary to create an achievement test, which is considered very important and necessary for the Assessment of learners in the teaching and learning process, to measure and evaluate what

learners have learned, achieved objectives or learning outcomes according to qualification standards or not. [7]. One type of educational measurement tool that is widely used and effective is exams; which are the exams that are most commonly used are Multiple Choice Questions (MCQs) [8], because they measure achievement on the cognitive level of revised Bloom's taxonomy [9]–[12]; That is, from the Remembering hierarchy to the Creation level, so most teachers prefer to issue multiple choice tests to measure student achievement [13].

Creating an Examinations bank is therefore a way to solve this problem; the researcher is interested in conducting a research study, developing an intelligent multilevel item bank that will facilitate exam management to measure learning achievement. The Intelligent multilevel item bank system to be developed requires the following key modules: Question Management; It is able to create exams according to field of study, subjects, topics, and learning objectives; and most importantly, each exams is assigned Bloom's intellectual level, the exams is taken to try out, Automated test analysis to determine test quality based on classical test theory [14]–[17]; For the exams, the teacher can set the level of the exams, to suit the student or the level of the examinee who wants the exams at any level, such as Basic level, Intermediate level, and Advanced Level, etc.; There is also a system to advise candidates, by grading according to subjects, topics, the purpose of which is to advise students on their weaknesses, strengths in which purpose, or subject; and in addition, the use of test results as a guideline for developing, or improving the curriculum, and teaching and learning so that graduates have learning outcomes that meet the standards of the same qualifications, and have comparable standards at both national and international.

2. Objectives

1) To design the Architecture of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing.

2) To assess the suitability of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing.

3. Methodology

The Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing defined the process into two phases:

Phase 1: Designing the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing is designing the architecture of the system to know who the users of the system are to be built, what is the structure of the system, what subsystems and modules are divided into, how are the modules linked together.

Phase 2: Assess the suitability of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing by 7 experts with knowledge in ICT for education, information technology, and computer science.

4. Results

A. Architecture design

The Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing can be divided into 3 layers: 1. User layer 2. Process layer and 3. Output layer, which can show the developed architectures as shown in Figure 1.

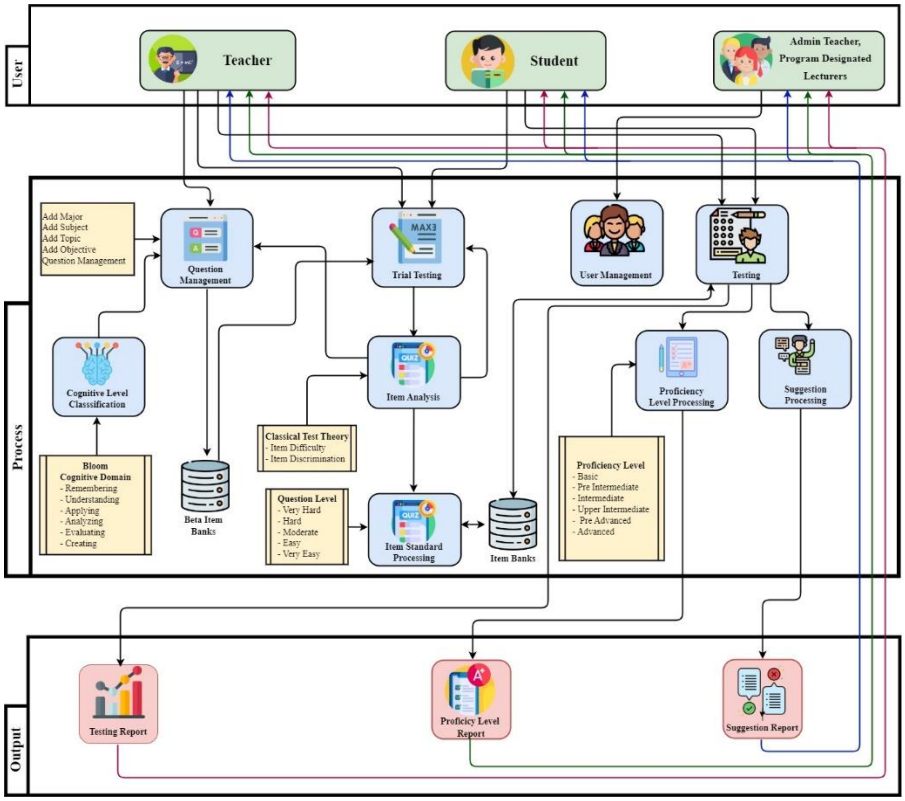

Figure 1. The Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing

Architectural details

User Layer

The Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing developed consists of 3 groups of involved persons: 1) Teacher Admins/Program Designated Lecturers, 2) Teacher, 3) Student; each group has different duties and uses of the system as follows: 1. Teacher Admin/Program Designated Lecturers Implement the following modules of the system: User management, Examination Report Review, Curriculum, and Teaching Update. 2. Teachers use the following system modules: Exams Management, Cognitive Level Classification, User Account Management, Trial Testing, Item Analysis, Item Standard Processing, Testing, Proficiency Level Processing, Suggestion Processing, and Examination Check List. 3. Students use the following modules of the system: Try out, Take the standardized test series, Check result report, Check recommendation report.

Process Layer

It is part of the modules of the Multilevel Item Bank System, which consists of 8 main modules.

1. Question Management

It is a module used to manage exams such as Add, Edit, Delete, and Show. Exams: Before creating exams, you need to create the following first; First, Add Major to create the exams, when the Add Major is finished; it has to create 3 more things: Add Subjects, Add Topics, and Add Objectives, respectively. Then Add Question; when the teacher adds an exam, the system will show a selection list for the following topics as created earlier.

Subject: Select a subject, which subject is this exam in?

Topic: Select a topic, which topic is this exam on?

Objective: Select an objective, what is the purpose of this exam?

Cognitive Level Classification: Select the level of intelligence (Cognitive level), which level of intelligence is this exam?

When all have been selected, it is part of the exam type; by typing the question, select the exam type, and type the option which will have a text box for typing exam questions. Radio button for selecting the Choice type (selecting the exams as multiple-choice question, True/False), and a Text Box for typing a list of Choice 1 – Choice 4, and answer options must be selected. In addition, questions and four options of the exams can be added with an image file; already created exams can be shown, edited, and deleted. Exams in this section are stored in the Beta Item Banks database for testing purposes next.

2. Cognitive Level Classification

The level of difficulty of the exams is determined using the cognitive level of Revised Bloom's Taxonomy; in order from basic to complex, the Cognitive Domain is divided into 6 levels as follows: 1) Remembering, 2) Understanding, 3) Applying, 4) Analyzing, 5) Evaluating, 6) Creation [18].In the process of creating the exams, if the teacher knows the Cognitive level, he/she can set it in the exams. The exams that have not specified the problem level will be processed by using Machine Learning to classify the information into six cognitive levels. [19]–[22], the teacher must provide a set of Data Training which is a test with a specified Cognitive level, for Machine Learning to classify; As a result, the exam data will be updated in the Multilevel Item Bank System, the exam will be assigned a Cognitive level to be used in the next exams.

3. Trial Testing

Once the required number of exams have been created, the exams must be taken for testing to determine the quality of the exams to select standardized exams to be stored in the Item Bank; by taking the exams for testing there are the following steps: Select a field of study (major). There are two types of exam selection options: Random and Select. Selecting randomly, the system will display the Subject, Topic, the total number of questions on All question, Question no select, and input num question, In which the teacher must enter the required number of items for each Topic that does not exceed the total number of questions contained in that Select that the teacher must select the exams that you want to take the exam individually, when entering the number of exams or selecting exams, then press the Save button; after that, Test Setting which must set the following settings: Name Exam, Password, Timer , Page split, and Status; Once the configuration is complete, it can be used for students to take the test, after the student completes the test will be the process of displaying the Report Trial Testing, students must select a field of study (major), select the test to let the system display a report on the screen; Teachers can select the reports they want, such as Subject report, Topic Report, Objective report, Student report, etc. The system will display #num questions, #Number of students taking the test, and will display the rank, first name, last name, subject, and score of each student; after the test data of the students is obtained, the data will be used to determine the test quality as the next step.

4. Item Analysis

Analyze the question paper according to Classical Test Theory to determine the quality of each item; by finding the Difficulty value and Discrimination power; this can be done by analyzing all test takers' responses, but if there are a large number of test takers for convenience of analysis, it may be possible to analyze some of the test takers' responses; For analyzing the case of a small number of test takers, for example, about 30-100 people, 50% of the technique will be used, which will sort the scores from the test takers with high scores to low scores and divide them into high and low groups, 50% each, and then calculate.

Difficulty

$$P = \frac{R_H + R_L}{N_H + N_L}$$

R_H = number of people who answered correctly in the high group

R_L = number of people who answered correctly in the low group

N_H = total number of people in the high group

N_L = total number of people in the low group

Discrimination power

$$D = \frac{R_H + R_L}{N_H}$$

R_H = number of people who answered correctly in the high group

R_L = number of people who answered correctly in the low group

N_H = total number of people in the high group

After exam analysis is complete, it will go to the standardized exam processing step to bring the standardized exams to be stored in the Multilevel Item Bank.

5. Item Standard Processing

Processing to find standardized exams will select exams based on the level of Difficulty of the exams and Cognitive Domain level of Revised Bloom's Taxonomy; Interpretation Criteria for the Difficulty of the Exams. [23], [24] are shown in Table 1.

Table 1: Interpretation Criteria for the Difficulty (p) of the Exams.

Difficulty (p)	Meaning
0.80 – 1.00	Too easy
0.60 – 0.79	Easy
0.41 – 0.59	Medium
0.20 – 0.39	Difficult
0.00 – 0.19	Too difficult

Revised Bloom's Taxonomy

The Cognitive Domain is divided into 6 levels as follows: 1) Remembering, 2) Understanding, 3) Applying, 4) Analyzing, 5) Evaluating, and 6) Creation [9]–[12].

Selection of standardized exams based on difficulty will select exams with a difficulty level of 0.20-0.79 and arrange the exams into 3 levels as follows:

Easy: p =0.60- 0.80

Medium: p = 0.40-0.59

Difficult: p = 0.20-0.39

Exam selection based on Bloom's Cognitive level by grouping the Cognitive level into 3 levels [15]

1. Easy Level
   - Remembering
   - Understanding
2. Medium Level
   - Applying
   - Analyzing
3. Difficult Level
   - Evaluating

- Creating

Therefore, the criteria for processing standardized examinations are summarized in Table 2.

Table 2: The criteria for processing standardized examinations**.**

Exam Level	Difficulty (p)	Cognitive Level
Easy	0.60 – 0.79	- Remembering - Understanding
Medium	0.40 – 0.59	- Applying - Analyzing
Difficult	0.20 – 0.39	- Evaluating - Creating

After receiving standardized exams, the next step will be taking the standardized exams for further examinations.

6. Testing

The exam is a standardized questionnaire stored in the Multilevel Item Bank, the test has 3 levels: Basic, Intermediate, and Advanced. For each level of the test, a different number of questions are selected as in Table 3.

Table 3: Level of Testing and Number of Testing

Level of Testing	Number of Exams
Basic	Easy 50%, Medium 25%, difficult 25%
Intermediate	Easy 25%, Medium 50%, difficult 25%
Advanced	Easy 25%, Medium 25%, difficult 50%

For example, if the level of testing is Basic, requires 100 questions to be used in the test, will select from Easy 50 questions, Medium 25 questions, and Difficult 25 questions, etc. There are 4 steps in the exam process:

6.1 Test Setting

It is to add a test and Test Setting by specifying Test Name, Test Level (Basic, Intermediate, Advanced), Number of Questions, Test Password, Test Time, and Test Status (Open, Close).

6.2 Select Item

Exams Selection: Teachers can select exams by choosing from Subjects, Topics, or Objectives; the program will show the list of exams selected by the teacher and will calculate the number of exams in each item automatically, but if the teacher wants to change, he/she can set the number of exams for each item as needed.

6.3 Testing

Testing: A list of students must be registered in the system first before they are eligible to take the exams; students must use username and password to log in to the exam system, when logged in, click on the questionnaire you want to take, the questionnaire will be displayed, to complete the questionnaire, therefore, submitting the exam; During taking the exams must look at the exam time, if the time is over, the system will stop the exam immediately.

6.4 Scoring

The system will process the test score and report the test score of each test taker to notify the test taker individually.

7. Proficiency Level Processing

Judging the results of the exam is the conversion of score information into proficiency levels according to the score obtained. [25]– [30]; in which the instructor must determine the score and Proficiency Levels, for example, as shown in Table 4.

Table 4: Determine the score and Proficiency Levels

Score	Proficiency Levels
0 – 49	1. Basic
50 - 59	2. Pre-Intermediate
60 – 69	3. Intermediate
70 – 79	4. Upper-Intermediate
80 – 89	5. Pre-Advanced
90 -100	6. Advanced

8. Suggestion Processing

Suggestion Processing is the introduction of test scores divided by subjects, topics, and objectives; it will be compared with the defined criteria. Passing or failing on a subject, topic, or objective leads to guidance to students taking the exams to return to the subject, topic, or objective; the initial pass is set at 60%.

Output Layer

The output module section of the Multilevel Item Bank System consists of three main modules:

1. Testing Report: This is a test report module, divided into 1.1 Student Report, the system will display the test score report of each candidate. 1.2 Subject Report, the system will report subject-level exam scores by showing student scores that each subject has received test scores and how many total scores. 1.3 Topics Report, the system will display a student score report showing each topic, how much did the student score and what was the total score? 1.4 Objective Report, the system will display a student score report showing each objective, how many points did the student get and what was the total score?

2. Proficiency Level Report: It is a report on the proficiency level of the students who took the exam, the system will display the test score report of each student on how many points they got and what level of proficiency they are.

3. Suggestion Report: It is a report of suggestions from the exam results, the system will display suggestions on topics that did not pass the exam and suggest which topics should be studied to pass the exam.

B. Evaluation results of the appropriateness of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing.

Assessment of the appropriateness of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing by 7 experts in ICT for education, information technology, computer science, using the criteria to interpret the Mean and Standard Division; Divided into 5 levels according to Likert's Scale [31] with the following criteria:

Mean 4.50-5.00 means the most appropriate.

Mean 3.50-4.49 means very appropriate.

Mean 2.50-3.49 means moderately s appropriate.

Mean 1.50-2.49 means less appropriate.

Table 5: Evaluation results of the appropriateness of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing.

Details of the Architecture	($\bar{X}$)	(S.D.)	Level of appropriateness
1. User Layer	**4.90**	**0.30**	**The most appropriate**
1.1 Teacher	5.00	0.00	The most appropriate
1.2 Student	4.86	0.38	The most appropriate
1.3 Teacher Admin/Program Designated Lecturers	4.86	0.38	The most appropriate
2. Process Layer	**4.76**	**0.43**	**The most appropriate**
2.1Question Management	**4.97**	**0.17**	**The most appropriate**
2.1.1 Add Major	5.00	0.00	The most appropriate
2.1.2 Add Subject	5.00	0.00	The most appropriate
2.1.3 Add Topics	5.00	0.00	The most appropriate
2.1.4 Add Objectives	5.00	0.00	The most appropriate
2.1.5 Question Management	4.86	0.38	The most appropriate
2.2 Cognitive Level Classification	**4.43**	**0.53**	**Very appropriate**
2.3 Trial Testing	**4.57**	**0.51**	**The most appropriate**
2.3.1 Select Item	4.57	0.53	The most appropriate
2.3.2 Test Setting	4.57	0.53	The most appropriate
2.4 Item Analysis	**4.71**	**0.49**	**The most appropriate**
2.5 Item Standard Processing	**4.57**	**0.53**	**The most appropriate**
2.6 Testing	**4.79**	**0.42**	**The most appropriate**
2.6.1 Test Setting	4.71	0.49	The most appropriate
2.6.2 Select Item	4.86	0.38	The most appropriate
2.6.3 Testing	4.71	0.49	The most appropriate
2.6.4 Scoring	4.86	0.38	The most appropriate
2.7 Proficiency Level Processing	**4.71**	**0.49**	**The most appropriate**
2.8 Suggestion Processing	**4.57**	**0.53**	**The most appropriate**
3. Output Layer	**4.91**	**0.28**	**The most appropriate**
3.1 Testing Report	**4.95**	**0.22**	**The most appropriate**
3.1.1 Subject Report	5.00	0.00	The most appropriate
3.1.2 Topic Report	5.00	0.00	The most appropriate

Details of the Architecture	($\bar{X}$)	(S.D.)	Level of appropriateness
3.1.3 Objective Report	4.86	0.38	The most appropriate
3.2 Proficiency Level Report	**4.86**	**0.38**	**The most appropriate**
3.3 Suggestion Report	**4.86**	**0.38**	**The most appropriate**
Total average	**4.81**	**0.39**	**The most appropriate**

Mean 1.00-1.49 means the least appropriate.

From Table. 5 Results of the appropriateness assessment by experts in the field of ICT for education, information technology, and computer science, it can be concluded that the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing is overall appreciated at the most level ($\bar{X}$=4.81, S.D. = 0.39); Considering each layer, it was found that every layer had the most level of appropriateness, with the Output Layer having the highest Mean, with the Mean ($\bar{X}$) =4.91, S.D.= 0.28, followed by the User Layer, the Mean ($\bar{X}$)= 4.90, S.D.= 0.30, followed by Process Layer, the Mean (($\bar{X}$)= 4.76 ,S.D. =0.43, respectively.

Architectural Appropriateness Assessment: User Layer

Graph of architecture appropriateness assessment results: User Layer is at the highest level, $\bar{X}$=4.90, S.D. =0.30, arranged in descending order of appropriateness as shown in Figure 2.

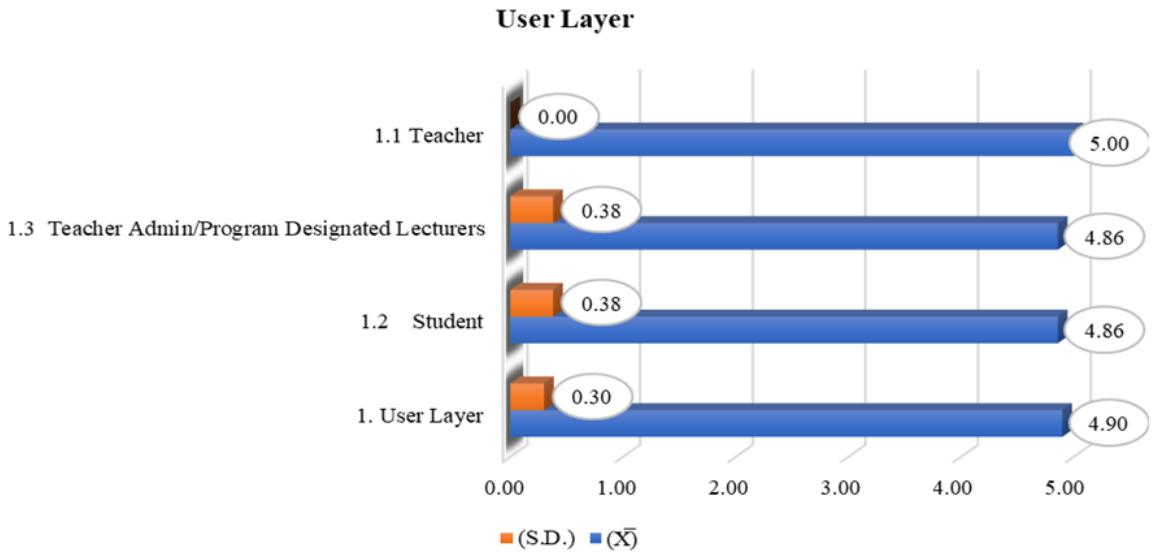

Fig. 2. User Layer Appropriateness Assessment Results Graph

Architectural Appropriateness Assessment: Process Layer

Graph of architecture appropriateness assessment results: Process Layer is at the highest level, $\bar{X}$=4.76, S.D. =0.43, in descending order of suitability as shown in Fig. 3.

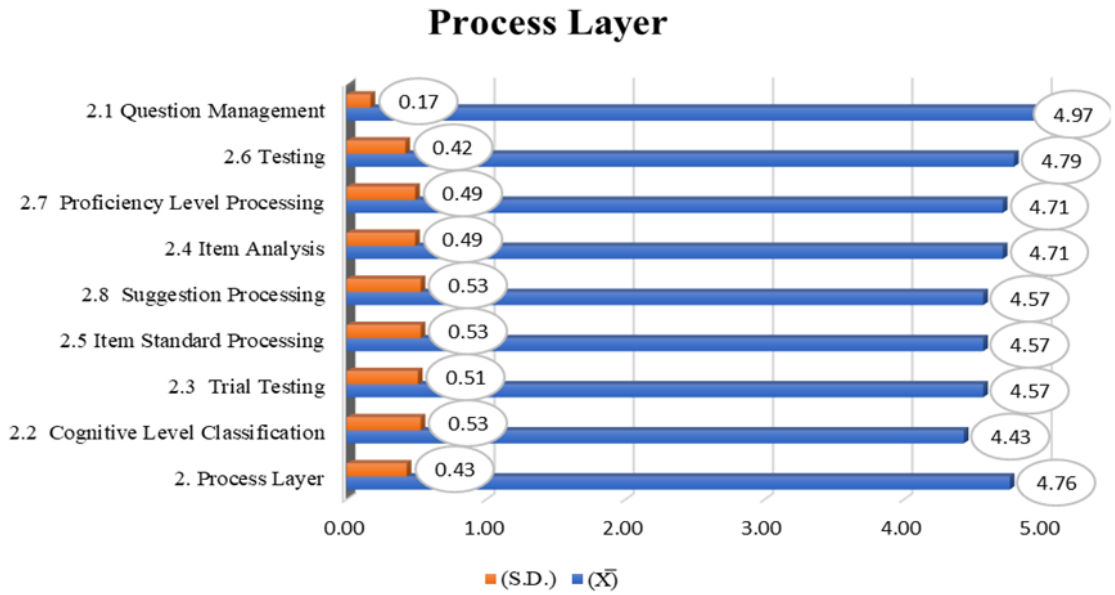

Fig. 3. Process Layer Appropriateness Assessment Results Graph

Architectural Appropriateness Assessment: Output Layer

Graph of Appropriateness Assessment Results: Output Layer is at the highest level, $\bar{X}$=4.91, S.D. =0.28, and in descending order of Appropriateness as shown in Fig. 4.

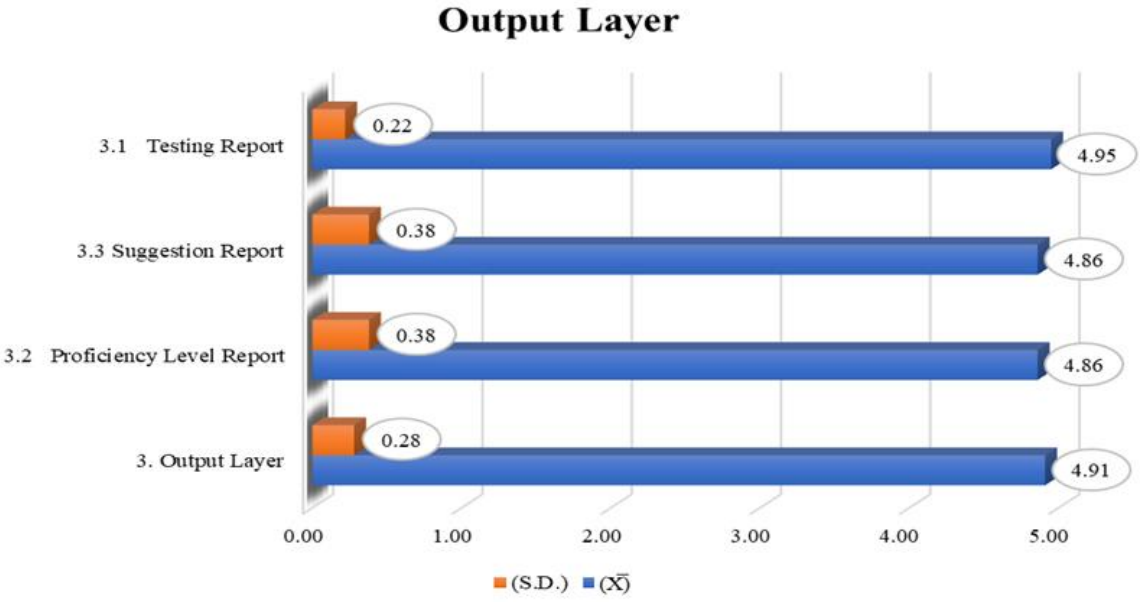

Fig. 4. Appropriateness Assessment Results Graph: Output Layer

5. Discussion

This research aims to design and develop to design the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing. Experts were asked to evaluate the Appropriateness of the architecture design and to evaluate the development efficiency of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing, with the following details.

1) Designing the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing.

The first objective of this research was to design the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing. The results of the design of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing. It is divided into 3 layers: 1. User layer, 2. Process layer, and 3. Output layer; The details of each layer are as follows: User layer: it is the part related to system users, consisting of 3 system users as follows: 1. Curriculum responsible person, 2. Instructor, and 3. Students, which correspond to [32], which designed the Online Examination System for State Vocational Schools and also corresponds to [33] Design and Implementation of Online Examination System for University Students in Iraq, and the Process layer: sub-processes that form a complete system that works on demand (Refinement), which consists of 8 main modules as follows: 1. Question Management, 2. Cognitive Level Classification, 3. Trial Testing Management, 4. Item Analysis, 5. Item Standard Processing, 6. Testing Management, 7. Proficiency Level Processing, and 8. Suggestion Processing; in line with the research of [34] that presented a framework for the Intelligent Examination System, which presented a system that consists of 4 parts: 1. User Management, 2. Course Management, 3. Question Management, 4. Examination and Evaluation Management; Details of various modules of the system and consistent with the research of [33].The system has the following modules: 1. User management, 2. Question Management, 3. Examination Management, 4. Reporting Result; Details for Process Layer; Output layer consists of 3 modules: 1 Testing Report, 2. Proficiency Level Report, 3. Suggestion Report. This module is used to give advice on student results, score errors in each topic, scoring less than the specified threshold for students to improve, which is in line with the research of [35], introduced Intelligent Examination System, which can guide students automatically and consistent with the research of [35] which has developed an Automated Feedback System as an add-on. (Extending) to the Adaptive Testing system, allowing the system to give advice to students such as Overall proficiency level, test results of each topic, recommended topics to be revised. Linking each layer, and linking each module of the system can be schematically illustrated as Figure 1.

2) Assessment of the Appropriateness of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing.

According to the results of the appropriateness assessment of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing by 7 experts in ICT for education, Information Technology, Computer Science, by assessing the appropriateness according to the architecture design that is divided into 3 layers: 1) User layer: has the highest appropriateness score, Mean ($\bar{X}$)=4.90, S.D. = 0.30, 2) Process layer: has the highest appropriateness score, Mean ($\bar{X}$)=4.76, S.D. = 0.43 ,3) Output layer: has the highest level of appropriateness score, Mean ($\bar{X}$)=4.91, S.D. = 0.28; At the highest level, Mean ($\bar{X}$)=4.81, S.D. = 0.39.

6. Conclusion

This research is divided into 2 phases, namely, Phase 1: designing the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing. Phase 2: Assessing the appropriateness of the Architectures of an Intelligent Multilevel Item Bank System for Higher Education Graduate Standardized Testing by 7 experts with knowledge in ICT for education, Information Technology, and Computer Science, totaling 7 people. The evaluation results are overall appropriate at most levels.

References

[1] Tamronglak, “Impacts of the Thailand qualification framework–Public administration on public administration education in Thailand,” *Journal of Public Affairs Education*, vol. 26, no. 3, pp. 276–290, 2020, doi: 10.1080/15236803.2020.1771991.

[2] N. Chaiyama and N. Kaewpila, “The development of life and career skills in 21st century test for undergraduate students,” *European Journal of Educational Research*, vol. 11, no. 1, pp. 51–68, 2022, doi: 10.12973/eu-jer.11.1.51.

[3] S. Boonlue, “Development and Efficiency Evaluation of the Learning Evaluation System According to the Standard Curriculum of the Bachelor ’ s Degree Programs,” *Journal of Graduate School, Pitchayatat*, vol. 14, no. 3, pp. 183–191, 2019.

[4] Chantani and S. Chuenchotkitti, “Analysis of the Performance of Curriculum Standard Criteria 2015,” *Journal of Management Science Review*, vol. 21, no. 2, pp. 219–228, 2019.

[5] Ministry of Higher Education Science Research and Innovation, *Thai Qualifications for Higher Education*. Thailand: https://www.mhesi.go.th/index.php/en/all-legal/76-ministerial-regulation/7213-2565-5.html, 2022, pp. 28–31]Online[. Available: https://www.mhesi.go.th/index.php/en/all-legal/76-ministerial-regulation/7213-2565-5.html.]Accessed: Jan. 26, 2023[

[6] Ministry of Higher Education Science Research and Innovation, *Higher Education Curriculum Standards*. Thailand: Higher Education Curriculum Standards, 2022, pp. 12–19]Online[. Available: https://www.mhesi.go.th/index.php/en/aboutus/all-legal/76-ministerial-regulation/7210-2565-2.html.]Accessed: Jan. 26, 2023[

[7] Pimpimool, "The Development of The Learning Achievement Test on Algorithms and Programming Subject," *Journal of Education Burapha University*, vol. 31, no. 2, pp. 12–26, 2020.

[8] P. McKenna, "Multiple choice questions: Answering correctly and knowing the answer," MCCSIS 2018 - Multi Conference on Computer Science and Information Systems; Proceedings of the International Conferences on e-Learning 2018, vol. 2018-July, pp. 105–114, 2018.

[9] W. I. Himmah, A. Nayazik, and F. Setyawan, "Revised Bloom's taxonomy to analyze the final mathematics examination problems in Junior High School," *J Phys Conf Ser*, vol. 1188, no. 1, 2019, doi: 10.1088/1742-6596/1188/1/012028.

[10] S. Baghaei, M. S. Bagheri, and M. Yamini, "Analysis of IELTS and TOEFL reading and listening tests in terms of Revised Bloom's Taxonomy," *Cogent Education*, vol. 7, no. 1, 2020, doi: 10.1080/2331186X.2020.1720939.

[11] E. Virranmäki, K. Valta-Hulkkonen, and A. Pellikka, Geography tests in the Finnish Matriculation Examination in paper and digital forms – An analysis of questions based on revised Bloom's taxonomy, vol. 66. 2020.

[12] M. D. Laddha, V. T. Lokare, A. W. Kiwelekar, and L. D. Netak, "Classifications of the summative assessment for revised bloom's taxonomy by using deep learning," *International Journal of Engineering Trends and Technology*, vol. 69, no. 3, pp. 211–218, 2021, doi: 10.14445/22315381/IJETT-V69I3P232.

[13] Imbulpitiya, J. Whalley, and M. Senapathi, "Examining the Exams: Bloom and Database Modelling and Design," *ACM International Conference Proceeding Series*, pp. 21–29, 2021, doi: 10.1145/3441636.3442301.

[14] T. Panjaitan and H. Retnawati, "The characteristics of final mathematics test items based on classical test theory," *J Phys Conf Ser*, vol. 1397, no. 1, 2019, doi: 10.1088/1742-6596/1397/1/012095.

[15] M. Fauzie, A. U. T. Pada, and S. Supriatno, "Analysis of the difficulty index of item bank according to cognitive aspects during the Covid-19 pandemic," *Jurnal Penelitian dan Evaluasi Pendidikan*, vol. 25, no. 2, pp. 162–169, 2021, doi: 10.21831/pep.v25i2.42603.

[16] F. K. M. Ismail and A. M. B. Zubairi, "Item Analysis of a Reading Test inaSri Lankan Context using Classical Test Theory," *International Journal of Learning, Teaching and Educational Research*, vol. 21, no. 3, pp. 36–50, 2022, doi: 10.26803/ijlter.21.3.3.

[17] Gyamfi, "Application of Classical Test Theory)CTT(in the Validation of Teacher Made Mathematics Multiple Choice Test)MMCT(Items," *Asian Journal of Advanced Research and Reports*, no. October, pp. 1–12, 2022, doi: 10.9734/ajarr/2022/v16i11434.

[18] and Krathwohl, ") A REVISION OF BLOOM ' S TAXONOMY (Sumber," *Theory Pract*, vol. 41, no. 4, pp. 212–219, 2002.

[19] Z. Wang, K. Manning, D. B. Mallick, and R. G. Baraniuk, "Towards Blooms Taxonomy Classification Without Labels," in Lecture Notes in Computer Science)including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics(, 2021, vol. 12748 LNAI, pp. 433–445, doi: 10.1007/978-3-030-78292-4_35.

[20] D. A. Abduljabbar and N. Omar, "Exam questions classification based on Bloom's taxonomy cognitive level using classifiers combination," *Article in Journal of Theoretical and Applied Information Technology*, vol. 31, no. 3, 2015]Online[. Available: https://www.researchgate.net/publication/282918840

[21] M. Mohammedid and N. Omar, "Question classification based on Bloom's taxonomy cognitive domain using modified TF-IDF and word2vec," *PLoS One*, vol. 15, no. 3, 2020, doi: 10.1371/journal.pone.0230442.

[22] M. D. Laddha, V. T. Lokare, A. W. Kiwelekar, and L. D. Netak, "Classifications of the summative assessment for revised bloom's taxonomy by using deep learning," *International Journal of Engineering Trends and Technology*, vol. 69, no. 3, pp. 211–218, Mar. 2021, doi: 10.14445/22315381/IJETT-V69I3P232.
[23] S. Jiraro and S. Angsuchot, "Validating Sukhothai Thammathirat Open University ' s Computer -Based English Proficiency Test) STOU-EPT (Under the Common European Framework of Reference for Languages) CEFR (," *Journal of Social Sciences in Measurement Evaluation Statistics and Research*, vol. 2, no. 1, pp. 27–35, 2021.
[24] P. Leewanich and V. Lekskulchai, "The relationship between mean and difficulty index of multiple choice questions test," *journal of Medicine and Health Science*, vol. 26, no. 3, pp. 159–165, 2019.
[25] Waluyo, "Thai First-Year University Students ' English Proficiency on CEFR Levels : A Case Study of Walailak University , Thailand," *The New English Teacher*, vol. 13, no. 2, pp. 51–71, 2019.
[26] K. Sridhanyarat, S. Pathong, T. Suranakkharin, and A. Ammaralikit, "The Development of STEP, the CEFR-Based English Proficiency Test," *English Language Teaching*, vol. 14, no. 7, p. 95, 2021, doi: 10.5539/elt.v14n7p95.
[27] J. Foley, "Issues on the initial impact of CEFR in Thailand and the region," *Indonesian Journal of Applied Linguistics*, vol. 9, no. 2, pp. 359–370, 2019, doi: 10.17509/ijal.v9i2.20233.
[28] R. A. Abouelgheat Kandeel, "Learners' mathematics proficiency levels on PISA 2018: A comparative study," *International Journal of Instruction*, vol. 14, no. 3, pp. 393–416, 2021, doi: 10.29333/iji.2021.14323a.
[29] M. Yaghoubi and P. Farrokh, "Investigating Iranian English Learners' Private Speech Across Proficiency Levels and Gender Based on Vygotsky's Sociocultural Theory," *J Psycholinguist Res*, vol. 51, no. 2, pp. 273–292, 2022, doi: 10.1007/s10936-022-09838-y.
[30] M. Mohammadi and M. H. Yousefi, "Iranian EFL teachers and learners' perceptions of grammar instruction and corrective feedback," *Asian-Pacific Journal of Second and Foreign Language Education*, vol. 4, no. 1, 2019, doi: 10.1186/s40862-019-0068-4.
[31] Paiwithayasiritham, P. Makmee, and K. Mingsiritham, "The Development of a training program for basic education school teachers on developing the higher level learning assessment methods," *Veridian E-Journal, Silpakorn University*, vol. 6, no. 1, pp. 904–913, 2013.
[32] Martono, A. Yulianjani, and D. I. Desrianti, "Online Exam System to Improve Student Learning Quality in State Vocational School 5 Tangerang City," *CCIT Journal*, vol. 13, no. 1, pp. 65–74, 2020, doi: 10.33050/ccit.v13i1.895.
[33] T. Q. Al-aqbi, R. R. K. Al-Taie, and S. K. Ibrahim, "Design and Implementation of Online Examination System based on MSVS and SQL for University Students in Iraq," *Webology*, vol. 18, no. 1, pp. 416–430, 2021, doi: 10.14704/WEB/V18I1/WEB18098.
[34] A. Alghamdi, "Novel Framework for Proposed Intelligent Examination System," *Indian J Sci Technol*, vol. 12, no. 25, pp. 1–4, 2019, doi: 10.17485/ijst/2019/v12i25/145195.
[35] Kosba, O. Badawy, and P. Sabri, "Intelligent Examination System to Support Teacher ' s Reflection Measurement of Students ' Guided Feedback."