Question-answer pair templates based on bloom’s revised taxonomy

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Abstract. Information Technology and Communication has altered the paradigm of Teaching and Learning Process into a process that is not limited by the problem of distance, time and method. This could be possible by means of the use of electronic learning system used as a media in teaching and learning activity. However, the utilization of Information and Communication Technology works, confirmed only as disseminator of teaching materials, so that we need to increase the performance of learning level. One of the ways is by doing the learning exercise to easily understand the teaching materials. This study is conducted with an aim to identify and classify the Expected Type Answer and question answer pairs templates based upon Bloom’s Revised Taxonomy at the level of knowledge acquisition and knowledge deepening, and this study is part of automatic question-answer system development. The research method used a descriptive approach to collect 1.354 training data from 10 documents of teaching materials from electronic books published by the Ministry of Education and Culture, Indonesia Republic. This research resulted in the parameter of Expected Type Answer for Question Answer System based on Blooms Revised Taxonomy and 109 question answer pair templates based on Blooms Revised Taxonomy. The result of this research becomes one of solutions to build the electronic learning sustainability.

1. Introduction
The use of Information and Communication Technology (ICT) in the Teaching and Learning Process has many positive impacts, but in terms of the achievement in learning objectives, it has not been able to compete the conventional teaching and learning process [1] where the use of e-Learning, as confirmed, only reached the lowest level of Blooms Revised Taxonomy ("to know" level) This indicates that the ICT just functions to disseminate the teaching materials, so it needs the development of e-learning system that can increase the learning level performance. Many things that can be done to improve the achievement of learning level, such as giving the learning exercise to facilitate the students in understanding the teaching material. With the consideration of effectiveness and efficiency in making the exercise questions, an automated Question and Answer System (QAS) was built based on information or text in the teaching material.

The research on the Question and Answer System for Indonesian Language has been done by [2] [3] both for factoid and non-factoid question type. The factoid question is a question with the answer in the form of a short phrase, while non-factoid question is a question with a quite long answer containing an explanatory description. The answers to factoid question can be in the form of short phrase such as location, people, date, organization, number and other type of brief answer [2]. Whilst,
the quite long answer for the non-factoid question is commonly oriented to definition, reason, method, changes level, and details [4]. A research specifically conducted for non-factoid question for the Indonesian language was performed by [3] with the orientation to the definition, reason and method. Meanwhile, the factoid question was conducted by [5] focused on the QAS development for health domain by using PPPICCOODTQ element and resulted in the template of medical question and answer pairs. The development of templates for question and answer pairs was done by [6] for non-factoid question with the category of definition, reasons, and methods.

The research conducted is aimed to build QAS for Indonesian language for the types of factoid and non-factoid question using the thinking taxonomy approach. The focus of research at this stage is the identification of expected answer type (EAT) parameter for the level remembering, understanding, applying, and analyzing from [7] and development of question answer pair templates based on Blooms Revised Taxonomy. The first section of this paper briefly explains the background of the study, the second part containing the research methods and the third section containing the results and discussions that will explain the development process of question answer pair templates based on Blooms Revised Taxonomy. The last section contains conclusions and suggestions as the input for further research.

2. Research method

The research was conducted in a number of phases: data preparation, data collection, data analysing, and data processing. The data preparation was about a study on relevant literatures as the reference in finding solution, selecting teaching materials as a material to do draft survey and determination of target of potential and relevant respondents to collect the question-answer pair templates from a number of teaching materials that have been selected. The question-answer pair templates were then analysed by doing classification of Expected Type Answer (EAT) based on Bloom’s Revised Taxonomy in order to make classification of question, answer and direction word for each level of taxonomy. In the last phase, Data Processing, it was conducted through the process of transforming the question and answer of each level taxonomy into the question-answer pair templates based on bloom’s revised taxonomy. The description of research methodology is shown in Figure 1.

![Figure 1. Research methodology.](image)

3. Result and discussion

This part is to discuss how the process of building the question-answer pair templates was. The process started from the selection of teaching materials and respondents, data analysis, and building the pattern of the template based on Bloom’s Revised Taxonomy.

3.1. Data preparation and data collection

Template building was started by selecting the teaching materials that would be used as the document for the material to make the question-answer pair templates.

The documents selected were limited to the teaching material in Indonesia Language and non-exacta material (5 learning courses such as Science, Geography, Religion, Social, and History) with a consideration to result in the various patterns. The teaching materials used were Electronic Book School (EBS) for grade 11 and 12 from the Ministry of Education and Culture of Indonesian Republic. Of 5 learning courses selected, 10 sub materials about Atmosphere, Tsunami, Virus Characteristics, The Role of Virus, Pollution, Social Issues, Paderi Battle, Cut Nyak Dhien, The Faith Pillars, and Islam Dissemination were selected. The respondents selected as the contributors in building the question-answer pair templates consisted of 135 potential respondents with the profession as teacher, Instructor, lecturer, and university student. Each respondent was given a number of teaching materials...
to make question-answer pair templates to result in 1,354 pairs of question and answer. The number of the detail question and answer collected is shown in Table 1.

**Table 1.** Question-answer sentences pair collection.

| No | Learning Course | Documents                  | Number of Sentences |
|----|-----------------|----------------------------|---------------------|
| 1  | Science         | Virus Characteristic       | 153                 |
|    |                 | The Role of Virus         | 101                 |
| 2  | Geographic      | Atmosphere                | 281                 |
|    |                 | Tsunami                   | 115                 |
| 3  | Religion        | The Faith Pillars         | 112                 |
|    |                 | Islam Dissemination       | 159                 |
| 4  | Social          | Social Issues             | 67                  |
|    |                 | Pollution                 | 68                  |
| 5  | History         | Paderi Battle             | 186                 |
|    |                 | Cut Nyak dhien            | 112                 |

3.2. **Identification and classification of Expected Answer Type (EAT)**

The documents of Question-Answer Pair Templates that have successfully been collected were then classified based upon the Expected Type Answer (EAT) based on Bloom’s Revised Taxonomy for the cognitive domain. Taxonomy Bloom’s is a method of classification of the human thought process into the cognitive domain (related to the cognition or reasoning), affective domain (related to the affection or feeling), and psychomotor movement) [8]. The selection of the cognitive domain was based upon that in that domain the expertise of human thinking is classified and ordered in order to identify the phases of competence that must be mastered. This was conducted to show the competence of human in managing his or her thoughts to be able to apply the theory in an action. Another consideration is that the classification of thinking process in the teaching and learning process in Indonesia so far still adopts that approach.

The selection was conducted in the revised version [7] with the reason that the version is a refinement from the previous version along with the development of the era. In the revised version, there was a change of the keyword from its originality as noun to be verb, integration of the competence in thinking analytically and synthetically only to be an analysis, and placing a new category that is creating that is not provided previously. The difference between Blooms taxonomy and its revised version is shown in Figure 2.

The classification of thinking process in the version of Bloom’s Revised Taxonomy was then classified as reaction [9] based upon the domain of Thinking Skills into 3 levels (Figure 3). As the scope of research, the classification of thinking process was focused on the phase of Knowledge Acquisition and Knowledge Deepening that consist of first four levels from Blooms Taxonomy and Bloom’s Revised Taxonomy. This was conducted with a consideration to make the identification of change in thinking process easier.
Figure 2. Differences between bloom taxonomy [8] and blooms revised taxonomy [7].

Figure 3. Thinking skill classification [9].

Bloom Taxonomy based EAT classification was resulted from the process of analysis to 1.354 pairs of question-answer sentences from the survey result. In this analysis process, the process of data cleaning was conducted firstly in which finally there were only 271 sentence pairs and the answer that was suitable with the expectation that is based upon:

- The selection of the sentence pair was based on the question word only located in the first sentence
- The question-answer sentences irrelevant with the content of the document were not included.
- The question-answer sentences that were the same would be selected only one.

EAT was used and resulted from the analysis process towards the characteristic of each level in the Bloom’s Revised Taxonomy (Table 2) and the development of EAT identified from [10]. The classification of EAT successfully identified in this research is shown in Table 3.
Table 2. Characteristics of bloom revised taxonomy classification for cognitive domain [7] [8].

| Characteristics of Blooms Revised Taxonomy Classification | C-1 : Remembering | C-2 : Understanding | C-3 : Applying | C-4 : Analysing |
|------------------------------------------------------------|------------------|---------------------|----------------|----------------|
| Ability to mention again the information/knowledge embedded in mind | Defining, listing, explaining, remembering, identifying, re-finding, stating, repeating, ordering, naming, locating, mentioning | Explaining, translating, elaborating, defining, restating, inferring, interpreting, summarizing, discussing, selecting, detecting, reporting, assuming, classifying, exemplifying, analogizing, changing, predicting | Selecting, applying, implementing, changing, using, demonstrating, modifying, interpreting, showing, proving, describing, operating, running, programming, practicing, starting | Reviewing, differentiating, comparing, contrasting, separating, correlating, showing the relation among variables, breaking into some parts, eliminating, assuming, considering, opposing, re-managing, characterizing, changing the structure, testing, integrating, organizing, framing. |

The use of EAT that is adapted with the thinking taxonomy functions to facilitate the process of identification of the capability in absorbing the materials and the knowledge from the e-learning process. The use of EAT that is a level in Bloom’s Revised Taxonomy is for building the remarking system of learning based upon the thinking taxonomy from Bloom’s. The classification of the pair of question and answer sentence resulted in the type of factoid and non-factoid sentence spread in each EAT in accordance with the characteristics of each EAT.
Table 3. EAT Classification based on Blooms Revised Taxonomy

| Level of Thinking | EAT | Question Word | Clue Word | Sentence Type |
|-------------------|-----|---------------|-----------|---------------|
| Person            | Siapa, siapakah (Who) | nama (name), yang mewakili (representative), yang memimpin/pemimpin (leader), yang menentukan (decision maker), penyebab (disseminator), pemimpin (leader), yang mewakili (representative), pendukung (supporter) |  |  |
| Organization      | Apa (What) | daerah (place), nama (name) |  |  |
|                    | Apa/Apakah (What/ Does) | istilah (term), nama (name), julukan (epithet), yang diajarkan (one taught) |  |  |
| Entity            | Sebutkan ( Mention) | bagian (part)/ pembagian (distribution), jenis (type), aspek (aspect) |  |  |
|                   | Sebutkan ( Mentioned) | apa (what) |  |  |
| REMEMBERING        | Date/Tim e | Kapan kapankah (when) | terjadi (occurred), perang (war), peristiwa (event), tanggal (date), bulan (month), abad (century), jam (hour), menit (minute), detik (second) | Factoid |
|                   | | jarak (distance), lama (length), ukuran (size), batas (limit), kekuatan (power), suhu (temperature), tinggi (height), kecepatan (speed), tanggal (date), bulan (month), tahun (year), abad (century), jam (hour), menit (minute), detik (second) |  |  |
| Size              | Berapa, berapakah (How Much) | letak (location), tempat (place), pusat (centre), terjadi (occurred) |  |  |
| Location          | Dimana, dimanakah (where) | fungsi (function), yang dimaksud (one meant), ciri/ciri-ciri (characteristic), pengertian (understanding), makna (meaning), syarat (condition), definisi (definition) |  |  |
| Apa, apakah (What/does) | komponen (components), contoh (example), ciri/ciri-ciri (features), bentuk (form), fungsi (function) |  |  |
| UNDERSTANDING     | Definition | Berikan (Give) | contoh (example) | Factoid |
|                   | | ciri/ciri-ciri (characteristic), awal mula (originality), syarat (condition), konsekuensi (consequence) |  |  |
|                   | Bagaimana (How) | pengertian (understanding) |  |  |
|                   | Jelaskan (explain) | langkah (step) |  |  |
|                   | Apa (What) | cara (way), proses (process), peran (feature), metode (method), pengaruh (influence), upaya (effort) |  |  |
| APPLYING          | Bagaimana (How) | tahapan/tahap (phase) |  |  |
|                   | Jelas/Jelaskan (Explain) | bukti (evidence), manfaat (benefit), penyebab (cause), alasan (reason), faktor (factor), unsur (elements of cause) |  |  |
|                   | Apa (What) | penyejutan (elements of cause) |  |  |
|                   | /Sebutkan (Mention) | jika (if), bila (when) |  |  |
| ANALYSING         | Bagaimana (How) |  |  |  |
|                   | Mengapa/Kenapa (Why) |  |  |  |
3.3. Building the question-answer pair templates based on Bloom’s revised taxonomy

The pattern of the question-answer pair template using EAT based on Bloom’s was used to facilitate the process of finding the answer and generating the question. The building this pattern used the syntaxes approach for the type of factoid and non-factoid sentences. The research conducted resulted in 109 patterns of question-answer pair template that can be used to identify the thinking level. The building the pattern was conducted by firstly breaking the teaching document into a number of its forming sentence. Each sentence identified was then given the question-answer sentence pair relevant with the documents collected previously. From the classification formed, it was then continued with the pre-processing text process such as Tokenization, POS Tag, and elimination of stop word. POS Tagger used was IPOS Tagger for Indonesia Language. The example of question-answer pair templates based on Bloom’s revised Taxonomy can be seen in the Table 4.

**Table 4. Example of Question-Answer pair Templates Based on Blooms Revised Taxonomy**

| Course Document | Question-Answer Pair Templates Based on Blooms Revised Taxonomy |
|-----------------|-----------------------------------------------------------------|
| **Blooms Level** | **Question Word** | **Clue Word** | **Question Sentence** | **Answer Sentence** |
| **REMEMBERING** | apa | istilah | Apa istilah perkembangbiakan virus? | replikasi |
| | <WH> + istilah | <VB> + <NN> | <VB> |
Table 4. Cont.

| UNDERSTANDING | Sebutkan ciri-ciri virus? | Template Pattern |
|---------------|--------------------------|------------------|
|               | Tidak memiliki bentuk sel, berukuran antara 20-300 milimikron, hanya memiliki satu macam asam nukleat saja, bentuknya berupa kristal | \(<WH>+<NN>+<WH>+<NN>+<WH><NN><explanantion><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason><reason>
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