

Education Question Answering Systems: A Survey

Teotino Gomes Soares, Azhari Azhari, Nur Rokhman, Edi Winarko

Abstract— Question answer (QA) is a field of research involving various disciplines, but it has to do with the development of information technology in various fields, especially in education. This is because of the increasing needs of users in completing their tasks, the more teaching and learning tasks that are now in the digital age, the more increasing interest in affective computing to produce increased data so that it can be available at any time according to users' needs. Where natural language processing (NLP) is a solution that can manipulate and replicate complex and complex requests and can collaborate with various other disciplines including QA to provide information automatically by assisting to get help in language for humans. The QA survey provides a general discussion about the categorization of answering literary systems that focus on education, the fields of science, social sciences, linguistics, biomedical sciences, and other disciplines related to education and discussion of research results, in terms of asking, receiving, remembering, F1 scores.

Index Terms—Question-Answering, Natural-Language-Processing, Information-Retrieval, Education

I. INTRODUCTION

Advances in information technology and interaction between humans and computers in the field of education have greatly increased, this is due to the user's need to complete teaching and learning tasks that currently exist in the digital world, thus affecting the increasing interest in effective computing to produce data large enough to be available every time days according to user requirements. This requires the large number of integration heterogeneous information, so that natural language processing (NLP) as a solution because it has the ability to manipulate and represent complex queries, so that it can lead to generating QA which consists of equations and answers that map between existing information [1] Where the QA is an area of research that combines a variety of different fields, but there are links, namely information retrieval (IR), information extraction (IE), and NLP [2]. This invites attention as the next step in getting information automatically by generating answers to questions in natural language from humans, which allows users to ask questions and can receive concise answers so that it can help in the teaching and learning process in a higher environment and secondary education.

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On the other hand, there are many research surveys related to the QAS conducted by [2] using evaluation metrics to compare the results of previous research and the models and methods used in developing QAS, to be able to help future researchers to choose models and methods good at developing new systems. [3] Conducted a survey that was a follow-up to the survey development from [2], but the survey also used evaluation metrics and was equipped with statistical analysis results about the ability of the answering system based on the types of questions, algorithms, NLP methods in the system, and domain-specific to the QAS. In the same year [4] conducted a survey focusing on answering systems in biology using by evaluation metrics and comparing several systems related to biology such as biomedical and biomedical. However, this survey is not specific to the system answering questions in the field of Biology, so that it becomes an object of new research for the future. Furthermore, [5] analyzing the previous survey which is the latest survey in the field of QAS also uses evaluation metrics and analyzes the system implementation approach, algorithms used in the system, and describes the methods, characteristics, and limitations of each previous research in the field of QAS.

Of the four surveys mentioned above [2] to [5] used the same evaluation metric survey model and the survey [4] was supplemented by statistical analysis, but all three surveys had the same purpose to help provide researchers with knowledge next to find out the methods, characteristics, and limitations of previous researchers so that in the future they can develop better systems to supplement the deficiencies raised in the survey. The four surveys described above have limitations because they do not involve all previous research, but only include the work of leading authors-publishers in the QA field and have a very broad coverage area so that they are less focused on providing further research direction.

So this survey will provide an overview of the QAS that focus on the education field, including linguistics, information technology, social science, biomedical sciences, and other disciplines related to education and previous research related to this approach. To provide further understanding for researchers about developing QAS in the field of education, so that it is used as a forwarding proposal later.

This article survey consists of several sections, including Part 1 explains several problem ideas that are interrelated with the previous survey as a matter of discussion in this article survey. Section 2 explains how the process of completing this article survey. Section 3 quotes and categorizes QA in education. Section 4 explains the results of the article review and future work that will be carried out as a continuation of this article survey.

II. RESEARCH METHOD

Paper on the QAS in the education field can be scattered in various journals and various scientific disciplines in both formal and non-formal education, so that a procedure and criteria as a guide are needed to obtain it. The flowchart diagram of the research survey can be seen in figure 1.

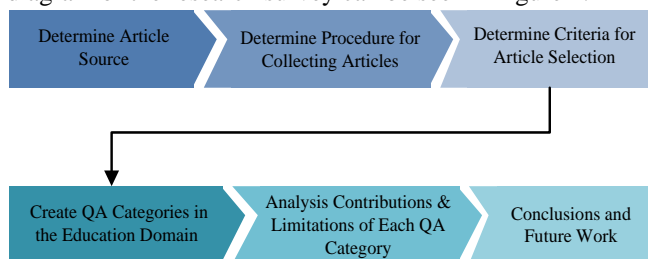


Fig. 1 The research survey process, as a step to complete this paper, begins with determining the source of the article, determining the procedures and criteria for article retrieval, carrying out categorization, continuing with the analysis of contributions and limitations, to produce a conclusion that becomes a reference for further research, in detail, it will be discussed in the following session.

A. Articles Source

The papers on the QAS are scattered in journals, the special proceedings in education are obtained from leading databases, such as science direct (Elsevier), IEEE/IEE library, digital association for computing machinery (ACM) library, springer link online library, mendeley library, and taylor & taylor & francis, digital association for computational linguistics (ACL) library.

B. Procedure for Collection Articles

Using the electronic library database stated above to select papers in the last ten (10) years, starting from 2011-2020 by filling research keywords involving electronic library search textbox such as the question answering system, educational question answering system. The search results are displayed in the electronic library by displaying paper titles, abstracts, book chapters, proceedings, and journals.

C. Articles Selection

There are three (3) criteria used to select and receive papers in the education QA field for further review. Paper will be excluded if it does not meet the selection criteria as follows:

- Papers must discuss trends in research topics in the field of educational answering. To meet these criteria, research must be updated which discusses between 2011-2020. The last ten (10) years period can be considered by the main research period in the field of education QA.
- Articles will be excluded if found from invalid sources, including book chapters, conference proceedings, workshop descriptions, master's and doctoral dissertations, and non-english articles.
- Making sure to only include peer-reviewed journal papers, because this is often used by academics to obtain and find research findings. Thus, this paper contains the highest level of research.

III. EDUCATION QUESTION ANSWERING SYSTEM CATEGORY

A. Question Answering System in Technology Information & Communication Science Teaching Learning

Research conducted by [6] built an intelligent system to answer questions based on ontology, using ontology

knowledge, can help students find the answers they need easily and find out what is needed, can help increase interest students in the online QA, this can happen because the database that is built can answer questions automatically without picking up the new online students can answer the questions asked. However, the limitations of this system improve the curriculum for software learning like Microsoft office and other IT materials. And [7] built an ipedagogy to answer questions based on information clustering on the web using information grouping; information search; named entity recognition (NER); relation extraction (RE); means the reciprocal ranking in the exam means the reciprocal rating is obtained 0.73 when compared to some other e-learning applications. Need research assistance to be better to improve the validity of information extraction and maximize the analysis of information clusters from the list of web search results. This is quite different from the research conducted by [6] by utilizing the knowledge of ontology to answer trainees' questions. Also, [8] developing an e-learning support system that supports the VSM-based question answering system using Chinese segmentation, feature weighting, feature selection, vector space model (VSM), to help provide the right answer and help it for the right students 82.24%, remember 81.21% and F1 75.73%. However, a good model is needed to improve system performance and can be applied to other domains. And [9] develop an intelligent system for QA around the ICT field using a knowledge base and text mining with implementation results proving that QAS does not only support the answers found in the research base, searching for the best and most relevant answers to user requests. However, this research focus on the field of ICT for middle school students, besides it also needs to improve the support QAS and support related to the ability to download to help the learning process for students who support, the knowledge base of the system can support by adding more files. Furthermore [10] establishes an intelligent system for answering questions in the domain of mobile-based education using knowledge-based, explicit semantic analysis, TF-IDF, cosine similarity and cuckoo search optimization can provide significant results with acquisitions reaching 79, 2%, but study has limitations in examining further questions from single words and long sentence questions and addressing the field of information technology.

And also research by [11] Improved the dynamic memory network (DNM+) and sequence to sequence (Seq2Seq) algorithm with a software engineering corpus to build a QAS for software engineering subjects in Portuguese languages, with results of evaluation accuracy reaching 77%. However, research focuses on software engineering subjects in Portuguese and perform of the algorithm need to be improved to answer complex questions and also create a corpus to facilitate QAS for other subjects, besides [12] using the context aware question & answer system (CAQAS) framework to build QAS for software engineering subjects, with the results of implementation can reduce barriers for students and increase participation in multi-class teaching and learning, but the focus of research on software engineering subjects and answers to further questions are not answered because they don't have facilities to track it down,

and [13] has built an intelligent QA network system model, with its main module designing taking into account the characteristics and needs of the massive open online course (MOOC) to build a question answering system for network course subjects computers, but this research focuses on computer network subjects and needs to add features for voice communication to be more effective in order to achieve more accurate answers to be extracted, and in addition [14] to use the gate recurrent unit convolutional neural network (GRU-CNN). Bidirectional gate recurrent unit (BiGRU)-attention to building a QAS for biology in junior high schools, with the experimental results showing the validity of the model in the biological dataset reaches 73% for GRU-CNN and 74% for BiGRU-Attention when compared to other traditional retrieval models, but other mechanisms are needed to improve system performance better, including research conducted by [15] on the geography domain for Turkish high school students using naive bayes multinomial (NBM), decision tree (DT), logistic regression (LG), and support vector machines (SVM), boosting method can contribute to the automatic determination of the quality of learning questions in computer science, and provide evidence of the feasibility of automatic facilitation of online questioning in large-scale computer science classes, but increases the accuracy of automatic classifications with broader classification methods.

From all the research that has been described above, it is necessary to know every research owned, but all of them are moving in the same domain, namely in education and development in information and communication technology. To find out more clearly about the inter-research and case studies that have been presented above can be seen in Table I

TABLE I
COMPARISON OF QAS IN INFORMATION TECHNOLOGY & COMMUNICATION SCIENCE TEACHING LEARNING

Ref.	Description	Methods/Technics	Result and Improvement	Limitation
[6]	The meaning of research on education question answering system in the field of information technology and communication with various methods and techniques to help the system to assist the teaching and learning process in various	Knowledge ontology, information clustering, information retrieval (IR)	Can answer the question automatically without running it must be new online the students can answer the questions asked	Software learning like microsoft office and other IT material
[7]		Named entity recognition, relation extraction, mean reciprocal rank (MRR).	The MRR test results obtained 0.73	Requires a better algorithm to increase the validity of information extraction and maximize the analysis of information clusters
[8]		Chinese Segmentat ion, Feature weighting, Feature selection, Vector space model	Can return answers to students' questions quickly by obtaining precision 82.34%, recall 81.21% and F1 75.73%	A good algorithmic model is needed to improve system performance and can be applied to other domains

[9]	students	Knowledge base text mining	Claiming that AQAS not only returns the answers it finds in the knowledge base but displays the best and most relevant answers to user questions and system performance as expected	Focus on the field of ICT for middle school students, it is necessary to improve system performance, speech recognition, increase the ability to support the expression to help the learning process for students with disabilities;
[10]		Knowledge-based, explicit semantic analysis, TF-IDF, cosine similarity also cuckoo search optimization	The evaluation results reached 79.2% accuracy	Limitations in examining questions are deeper than single words and long sentence questions and focus on the field of IT
[11]		Improved dynamic memory network (DNM+) and sequence to sequence (Seq2Seq) algorithms	The evaluation results reach an accuracy of 77%,	Focus on software engineering subjects in Portuguese, algorithm performance needs to be improved to answer complex questions and create a corpus to facilitate QAS in other subjects
[12]		Context-aware question & answer system (CAQAS) framework	Implementation results can reduce barriers for students and increase participation in multi-class teaching and learning processes	Focus on software engineering subjects and answers to follow-up questions from other questions were not answered because they did not have the facility to track them
[13]		Massive open online course (MOOC)	Has built a smart QA network system model, with its main module designing taking into account the characteristics and needs of MOOC	Focus on computer network subjects and the need to add features for voice communication to be more effective to achieve more accurate answers to be extracted
[14]		Gated recurrent unit convolutional neural network, bidirectional gate recurrent unit-	The experimental results show the validity of the model in the biological dataset for junior high schools achieving 73% results	Focus on Biology for junior high school and still need other mechanisms to improve system performance better

		attention	for GRU-CNN and 74% for BiGRU-Attention when compared to other traditional sampling models	
[15]		Naive bayes multinomial, decision treeE (DT), logistic regression (LG), and support vector machines (SVM), boosting method	The results of the study can contribute to the automatic determination of the quality of learning questions in computer science and provide evidence of the feasibility of automatic facilitation of online questioning in large-scale computer science classes	This study is in one large-scale computer science class that is applied by introductory programming and improving course the accuracy of automatic classification with broader classification methods, such as ensemble approach, neural networks, n-gram features, stop words

B. Question Answering System in Social Sciences Teaching Learning

In education and teaching in the social field [16] researched the analysis of the type of questions for the application of answering questions in the domain of education by using question processing techniques, information retrieval, answer generation, and knowledge base of teaching materials History and Geography, showing that the classification of systems uses triggers and the connecting keywords reach an accuracy of 0.771 and 0.861. However, it has limitations that are not connecting dependency parsing and linguistic resources, as well as student questions that contain errors in this study are removed so that in the future how to deal with these types of errors in the QAS will be investigated so that the wrong characters in student questions can be handled by the n-gram language model , besides that the development of this system is only for students in grades 5 and 6 with teaching materials for History and Geography, and also [17] using the rule-based method, hidden markov model (HMM) based Sequence classification method (HMM-Glasses), forward and backward modes, TF-IDF to build a QAS for geography courses for Turkish secondary school students with experimental results showing that the model built has obtained quite a lot of accuracy, but the focus of research is on the geographic domain for secondary school students in Turkish, and need a standard set of data manually and be for further research. The following is a description of the method, results, and improvement, and limitations of the study can be seen in Table II

TABLE II
 COMPARISON OF QAS IN SOCIAL SCIENCE TEACHING LEARNING

Ref.	Description	Methods/Technics	Result and Improvement	Limitation
[16]	Research articles	Multiple choice questions	The experimen	The distribution of types of

	on the Question Answering System in the Social field with a variety of methods and techniques aimed at helping the system to assist the teaching and learning process in a variety of materials in social science	(MCQs), knowledge-based	tal results show that the system trained with the MCQ corpus and tested on the student corpus has an accuracy of 59%	questions in MCQ corpus and corpus students affect performance so it needs to explore parsing dependency relationships and linguistic resources to improve system performance
[17]		A rule-based method, hidden markov model (HMM) based sequence classification method (HMM-Glasses), forward and backward modes, TF-IDF	The results of the experiment show that the model built has obtained quite an accurate accuracy	Focus on the geographic domain for secondary school students in Turkish, and requires a standard and manually annotated set of data for further research

C. Question Answering System in Languages Science Teaching Learning

Research conducted [18] on the Malaya language QAS using morphological, norder, TnT tagger approaches can provide up to 70% accuracy, research has limitations that only focus on closing the QA domain with factoid in Malayalam, besides that [19] researching the Hindi QAS with a machine learning approach using the smith waterman and naïve bayes models and knowledge base can increase accuracy to 90%, have limitations only in Hindi and use classification techniques and other datasets. And [20] examined to construct a QAS in Marathi using ontology and knowledge-based, can produce an overall precision evaluation reaching 93.95%, recall 94.55% and accuracy 89.28%, the limitations of this study using manual ontology in the Marathi language.

Also, research conducted by [21] developed a QAS in Arabic using NLP, semantic web, ontology, resource description framework (RDF) and SPARQL can provide promising results with an accuracy of 81%, but it has limitations in one domain and a few semantic rules, so it is recommended to develop a complete system that includes more than one domain and add more semantic rules to improve the accuracy of better results. In the same year [22] conducted a study on web-based question answering systems with a machine learning approach using a SVM classifier and MRR model, to obtain an accuracy of 88.4% higher than researchers [21]. However, the research focuses on factoid question types, so it is hoped that in the future it can be developed with other types of questions as well as training on the features used to improve system accuracy. As well as [23] researching the same field which is building the question classification system in Arabic Islamic Hadith by combining SVM and pattern matching models can improve system performance vary significantly by achieving Precision 88.39%, Recall 87.66%, and f-measure 87.93 %. However, this study focuses on the class questions "who", "where" and "what", so that in the future it can be expected to be developed with other question classes and add a lot of training data to improve system performance. Furthermore,

[24] researching the Chinese QAS in the medical domain using a knowledge base, fast text, sentence embedding, word2vec model can help users to ask and get answers in Chinese in the medical domain, but this research focuses on the medical domain in Chinese. And [25] uses word segmentation, part-of-speech (POS) tagging, stop words, logistic regression models, rule-based extractors to build a system for answering general knowledge questions in Vietnamese, with the results of implementation being able to answer a variety of general knowledge questions with 76.90% accuracy on the training dataset, but the focus of the research is on open domain questions that need to do some comparisons with other approaches that can find answers directly from the text to show the benefits of querying oncologists, in order to improve system performance better, besides that [26] using end-to end-memory network (MemN2N), multi-choice QA (MCQA), query-based attention CNN (QACNN) build answering systems in self-labeling learning techniques and transfer learning in TOEFL learning, with experimental results showing the effect of learning transfer on various types questions, and effectiveness of transfer learning is unlimited on certain types of questions so that self-labeling techniques, transfer learning is still useful, even when the correct answer to the target, but in the future it is necessary to generalize transfer learning outcomes to other QA models and datasets, because the original data format of the TOEFL audio comprehension test is not text, it is Eligible try initializing the QACNN embedding layer with semantic or acoustic word embedding learned directly from audio instead of those learned from text. From all the research that has been described above, it should be noted that each research has differences, but all of them move in the same domain, namely the domain of education and teaching in linguistics. To find out more clearly the comparisons between research and case studies that have been presented above can be seen in Table III

TABLE III
COMPARISON OF QAS IN LANGUAGES SCIENCE TEACHING LEARNING

Ref.	Description	Methods/Technics	Result and Improvement	Limitation
[18]	The meaning of research on QAS,	Morphologies, norder, ThT tagger	The evaluation results reach 70% accuracy	Limitations only focus on factoid and Malayalam language domains
[19]	Question and answering classification in various languages using various methods and techniques aims to	Smith-waterman, naïve bayes, knowledge-based	Evaluation results reach 90% accuracy	Limitations are only in the Hindu domain and can use classification techniques and other datasets
[20]	answer user questions in the natural language quickly both	Natural language processing, semantic web, ontology, resource	Evaluation results reached an overall precision of 93.95%, 94.55% recall, and accuracy of 89.28%	Limitation is using manual ontology and only for the Marathi language domain
[21]			Got 81% accuracy	Has limited domains and few semantic rules;

	offline and online	description framework, SPARQ		
[22]		Support vector machine, mean reciprocal rank;	Achieve 88.4% accuracy	Limitations that focus on factoid question types
[23]		Support Vector Machine and Pattern Matching	Achieved Precision 88.39%, Recall 87.66% and F-measure 87.93%	Focusing on the class questions "Who", "Where" and "What"
[24]		knowledge base, Fast Text, sentence embedding, model Word2Vec	Help users to ask questions and get answers in Chinese on the medical domain	Focusing on Chinese in the medical domain
[25]		Word Segmentation Part-of-speech Tagging, Stop Words, logistic regression model, rule-based extractor	The question answering system can answer a variety of general knowledge questions with 76.90% accuracy in the training dataset	Focus on open-domain questions in Vietnamese, so we need to do some comparisons with other approaches that can find answers directly from the text to show the benefits of querying oncologists, to improve system performance better
[26]		End-to-End Memory Network, Multi-choice QA, Query-Based Attention CNN	The experimental results show the effect of a transfer of learning on various types of questions, and shows that effectiveness Transfer learning is not limited to certain types questions so the technique of self-labeling, transfer learning still useful, even when the correct answer to the target	In the future it is necessary to generalize transfer learning outcomes to other QA models and datasets because the original data format of the TOEFL audio comprehension test is not text, it worth trying to initialize the QACNN embedding layer with semantic or acoustic word embedding learned directly from audio instead learned from the text

D. Question Answering System in Biomedical Science Teaching Learning

In research [27] about answering questions in the medical field by using semantic relations that can answer questions quickly and accurately, where the results of evaluating truth answers reach 68% but have limitations that only use semantic relations and in the biomedical domain. And research [28] examines the classification of questions in the medical domain for answering systems using the question classifier approach, Rule based and Syntactic patterns can obtain accuracy results for each question classification namely to 'What: 5.33%', 'Where: 55%' , 'When: 50%',

'Why: 66%', 'How: 44.54%', but have limitations in identifying good categories and classification patterns of questions, and [29] using the SentiWordNet Lexical model, Unified Medical, Language System (UMLS) Met thesaurus and Term Frequency Metric, Biomedical (BM25) to build a question answering system in the biomedical domain with the results of implementation showing good and competitive results in the task of answering and extracting compared to the participating systems, but an evaluation of the system in question classification is needed, document search, part search and answer extraction components, in addition [30] make use of the rapid methods based on pubmed, rapid methods on Epistemic Database to provide question answering systems based on patient recommendations, with the results of implementing both methods rapid in accordance with grading of recommendations assessment, development and evaluation (GRADE) able to answer 100 questions out of 200 recommendations obtained, 6.5% (95% CI 3% to 9.9%) is classified as potentially misleading and 93.5% (95% CI 90% to 96.9%) makes sense, but other methods are needed to improve system performance, and can guarantee optimal recommendations from the system. Furthermore [31] developed a medical question answering system using conditional random field (CRF), SVM, interpolated smoothing, with the evaluation results showing that a new form of answering medical questions obtained very promising results in (a) identifying accurate answers and (b) increase the ranking of medical articles by 40% from pubmed, however, it is necessary to combine various sources of knowledge (knowledge about medical cases, knowledge from scientific articles, knowledge from large EMR collections) to improve system performance.

Research conducted by [32] uses lexical sentiwordnet, unified medical language system (UMLS), MMR, extract medical entities and semantic relations, semantic graph, SVM to build a QAS from MEDLINE articles in the biomedical domain, overall system performance evaluation results on real questions and answers taken from MEDLINE articles show promising results and suggest that demand relaxation strategies can further improve overall performance, but need more specific processes with complex questions (why, when) and include other factors to combine existing methods to improve system performance, and [33] conduct research in the same domain, using reciprocal-rank article score (RRAS), factorized markov network, clinical picture and therapy graph (CPTG) interpolated smoothing which as a follow-up study from [31] with a different approach, can increase biomedical article ranking by 49% compared to the previous sophisticated results, but in the future it is necessary to automate to recognize semantic attributes so that it can easily be included in the knowledge graph and consider the paragraph not the entire article in creating a knowledge base, other than that [34] uses text convolution neural networks (TEXTCNN), sparse auto-encoders (SAE), with evaluation results has a significant effect with the accuracy of 0.915 and can avoid excessive installation, but it is necessary to further investigate the application of deeper semantic analysis for feature extraction, automate the creation of semantic features, and also [35] using deep neural network (DNN), expected answer type (EAT) or

lexical answer type (LAT), word2vec, word embedding, with the results of the analysis showing that wrong answers might be drawn when adding word embedding criteria and calculations for biomedical terms to be improved for QAS based on neural networks.

From all the research that has been described above, please note that each research has differences, but all of them are moving in the same domain, namely in education and teaching in medical. To find out more clearly the comparisons between research and case studies that have been presented above can be seen in Table IV

TABLE IV
 COMPARISON OF QAS IN BIOMEDICAL SCIENCE TEACHING LEARNING

Ref.	Description	Methods/Techniques	Result and Improvement	Limitation
[27]	The meaning of research on the QAS the field of Biomedical with a variety of methods and techniques to help users in the processes of obtaining targeted information through a system by asking questions	Semantic relations	Claiming a question and answer system for biomedical can quickly provide the right answers to user questions	Limitations because it only uses semantic relations as well as in the biomedical domain
[28]		Question classification, rule-based approach, a question processing module, Syntactic patterns	Said that the experimental results with the proposed method show that the accuracy in the classification of questions can be increased, namely for 'what: 5.33%, 'where: 55%, 'when: 50%, 'why: 66%, 'how: 44.54%	Limitations in identifying good categories and question classification patterns
[29]		sentiwordnet lexical, unified medical language system (UMLS) met thesaurus and term frequency metric, biomedical (BM25) model	Implementation gets good and competitive results in the tasks of answering and extracting compared to the participating systems	However, an evaluation of the system is needed in the classification of questions, document search, part search, and answer extraction components
[30]		Rapid methods was Based On pubmed, rapid methods on epistemikonis database	The results of the implementation of the two methods rapid matches the grading of recommendations The assessment, development, and evaluation (GRADE) was able to answer 100 questions from 200 recommendations obtained, 6.5% (95% CI 3% to 9.9%) were classified potentially misleading and	Other methods are needed to improve system performance and can guarantee optimal recommendations from the system

			93.5% (95% CI 90% up to 96.9%) makes sense	
[31]	Conditional Random Field (CRF), Support Vector Machine (SVM), Interpolated Smoothing		Evaluation results show that this new form of answering medical questions has very promising results in (a) accurately identifying answers and (b) increasing the ranking of medical articles by 40% from PubMed	But it is necessary to combine various sources of knowledge (knowledge of medical cases, knowledge from scientific articles, knowledge from large EMR collections) to improve system performance
[32]	SentiWordNet Lexical, Unified Medical Language System (UMLS), Mean Reciprocal Rank (MMR), Extract Medical Entities and Semantic Relations, Semantic Graph, Support Vector Machine		The overall system performance evaluation results on real questions and answers taken from MEDLINE articles show promising results and suggest that demand relaxation strategies can further improve overall performance	But it needs to be more specific processes with complex questions (why, when) and include other factors to combine existing methods to improve system performance
[33]	Reciprocal-Rank Article Score (RRAS), Factorized Markov Network, clinical Picture and therapy graph (CPTG) interpolated smoothing		The evaluation results show the representation of medical knowledge and inference methods that work optimally can improve biomedical article ranking by 49% compared to the sophisticated results	However, in the future, it is necessary to automate to recognize semantic attributes so that they can be easily entered into the knowledge graph and to consider the paragraphs instead of the entire article in creating a knowledge base
[34]	Text convolution neural network (TextCNN), sparse auto-encoders (SAE)		The evaluation results achieved a significant effect with an accuracy of 0.915 and can avoid over-installation	But it is necessary to further investigate the application of deeper semantic analysis to feature extraction, automating the creation of semantic features
[35]	Deep neural network (DNN), expected answer type (EAT) or lexical		The analysis shows that wrong answers might be drawn when adding embedding criteria and	But it is necessary to learn how to model information or research into a system

		answer type (LAT), word2vec, word embedding	word calculations to biomedical terms to be improved for neural network-based QAS	
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E. Question Answering Systems in Others Science Teaching Learning

QAS on other domains, conducted by [36] develop crowdsourcing application using preprocessing filtering, real-time filtering, post-processing filtering, guess process filtering to create a QAS that acts as a question recipient account and is given to resource persons so as to produce answers that are in accordance with the questions sent, but still, need to measure the performance of the system built, and [37] using NLP techniques, namely stop-words removal, stemming, part of speech (POS) marking, dictionary of index terms that can be tested based on various evaluation parameters by entering 100 questions related to the education system (education law), results of experiment precision 86% and recall 68%, but other parameters and classification techniques are needed to improve system performance, in addition [38] used stop words, word suffixes, term frequency, k-means grouping, term similarity, term relationship, word cloud to build an online learning management system (LMS) with analysis of delay factors in answering student questions. system results can play a big role in finding the right answer but administrators must involve faculty to answer students' questions smoothly, as well as educators and instructors must have essential skills to answer students, but need to adopt automated techniques for data extraction from teacher and student interactive learning management systems, so that the extracted data can be used to find a better stage for collaboration in answering student questions, and [39] building and providing practical schemes about intelligent system design Chinese language answering questions with online learning platforms, as well as discussion of key algorithms such as Chinese word segmentation, computational similarity and text clustering using word segmentation, reverse maximum matching method, vector space model and text clustering, term frequency - inverse document frequency (TF-IDF) with implementation results shows that IQAS that is built can increase the interactivity of online courses, help teachers adjust the focus on teaching, provide learning and procedural situations for students to use statistical data and even evaluate student performance on online courses based on statistical data, but still needs to be explored and exploited in an intelligent system of answering questions in Chinese in the future and [40] using dynamic concept networks (DCN), wordnet, tokenization to explore the fields of answering questions related to the educational context, and analyzing the existing framework by proposing a framework based on DCN, which was built specifically for subjects, by chapter with the results of the model and a set of 50 questions taken from chapter 8 the class built can answer correctly 80% of the questions based on definition and 65% from other types of questions, but in the future it can also involve the best methods for combining complex subjects such as mathematics and automating development and adding reasoning-based features to complex questions.

Further research conducted by [41] proposes a new method for two main problems in question analysis, namely the extraction focus and the classification of closed domain questions aimed at secondary school students to support their education, based on the hidden markov model (HMM) in Turkish, using HMM, integrating a rule-based, POS-tagging with the evaluation results show that the classification of questions based on rules obtained an f-score of 86.9% which is better than the classification of questions based on TF.IDF f-score 56.9%, but need to provide a series of manually annotated questions for both forward reproducibility, and [42] use a reverse SQL question generation algorithm (RSQLG) to develop automated questions generated from the reverse SQL question generation algorithm (RSQLG)) which automatically generates exercises (including answers and questions) from the data source base in student learning, with the results of the evaluation can increase the effectiveness of student learning by using results-based learning with post-test scores to pre-test compared, can find students who use the system increase the score by 26% in giving suggestions that match the questions for each student, however in the future it is necessary to improve the RSQL generation algorithm with more variety of exercises and complexity as well as analyzing field and table text descriptions without manual input into database metadata, and [43] providing a QAS which helps students to find the best answers to questions and assist tutors to answer questions raised by their students in the e-Learning environment, using a syntactic and multi-agent semantic approach to answer questions using syntactic and semantic multi-agents with the proposed architecture that can benefit from various technologies and methods for introducing an efficient system, but in the future it is necessary to improve this architecture and system implementation in the e-learning environment, besides [44] proposing an automatic answering system for customer service with a high quality knowledge base based on the unsupervised learning algorithm, this system extracting pairs of questions and answers from documents and storing them in a knowledge base using seq2seq, crawlers and regular expressions, matching methods, stop-words removal, with the results of implementing this system can have an accurate understanding of questions, then return the appropriate answers from the knowledge base, in addition it can improve efficiency and accuracy by saving dialogue history and adding repair functions, but in the future it needs to be explored with other methods to improve system performance.

Including research conducted by [45] can provide a system to generate answers to product-aware questions from product reviews and attributes using a product-aware answer generator (PAAG) using semantic extracts, key-value memory networks obtain test results demonstrating the effectiveness of PAAG has found a significant improvement over sophisticated baselines in terms of metric-based evaluations and human evaluations, but it is necessary to extend the model that has been built into multiple hop of memory networks so that it can be used as an encoder attribute, besides that [46] using SVM, wordnet, POS-tagging, stop words, tokenization, semantic similarity, RDF as the presentation of the first study on the semantic

classification of questions to be EAT in the Travel domain, with the results of trials for the identification stage of questions seem promising although they do not arrive at significant results from results previous research because it is due to ambiguity in the question base, but needs to be developed in domains with more specific features such as gazette lists of hotels and attractions with other travel assistance related to ontology and improving extraction algorithms while increasing the rule base to achieve promising results and research that conducted by [47] providing a regex-based approach to answering factoid questions in the tourism domain QAS using regex, evaluation matrix obtained evaluation results showing an overall accuracy of 80% of TREC 8 and 9 questions related to the tourism domain, but need to match nouns with synonym ontologies like wordnet and matching all synonyms with dbpedia classes and properties.

From all the research that has been described above, it should be noted that each research has a difference, but all of them move in the same domain, namely in education and teaching in other games. To find out more clearly the comparisons between research and case studies that have been presented above can be seen in Table V

TABLE V
 COMPARISON OF QAS IN OTHERS SCIENCE TEACHING LEARNING

Ref.	Description	Methods /Technics	Result and Improvement	Limitation
[36]	Create a QAS in the education domain that can receive question from the account and made a speaker with using crowdsourcing platforms for public record data	Preprocessing filtering, real-time filtering, post-processing filtering, guess process filtering	The QAS can produce answers that are suitable for receive questions and submit them to the questioner	But still, need to measure the performance of the system built
[37]	Present implementation methods and experimental results with QAS analysis for closed domains that only handle documents related to the education system (education act) to take more appropriate answers using NLP techniques	Stop-words removal, stemming, POS-tagging, index term dictionary	The system was tested based on various evaluation parameters with an input of 100 questions showing 86% precision results and 68% recall	Required parameters and other classification techniques to improve system performance
[38]	Investigate the delay factor in answering student questions. Student guidance will be very effective if student questions are	Stop words, word suffixes, term frequency, k-means grouping, term similarity	The information and communication technology built plays a major role in finding the right and right answers	Need to adopt automated techniques for data extraction from the interactive LMS of teachers and students, thus the extracted data can be

	responded to well in time. Student questions are answered by instructors using online learning management systems (LMS)	y, term relations hip, word cloud	but the administrator must involve the faculty to answer students' questions smoothly, and the educators and instructors must have important skills to answer students	used to find better stages for collaborating to answer student questions.		domain questions aimed at secondary school students to support their education, based on the HMM in Turkish		the classification of questions based on TF-IDF F-score of 56.9%	
[39]	Establish and provide practical schemes about design of intelligent chinese language QAS the online learning platform, as well as discussions about key algorithms such as Chinese Word Segmentation, Similarity Computing and Text Clustering	Word segmentation, reverse maximum matching method, vector space model and text clustering. TF-IDF	The implementation results show that IQAS that is built can increase the interactivity of online courses, help teachers adjust the focus on teaching, provide learning and procedural situations for students to use statistical data, and even evaluate student performance on online courses based on statistical data	It still needs to be explored and exploited in the future Chinese intelligent QAS		[42] Develop automated questions that are generated from the reverse SQL question generation algorithm (RSQLG) algorithm which automatically generates exercises (including answers and questions) from the source database in student learning	Reverse sql question generation algorithm (RSQLG)	The results of the evaluation can improve the effectiveness of student learning by using results-based learning with post-test scores to pre-test compared, can find students who use the system increase the score by 26% in giving suggestions that match the questions for each student	In the future, it is necessary to improve the RSQL generation algorithm with more variety of exercises and complexity as well as analyzing field and text table descriptions without manual input to database metadata
[40]	Explore the field of QA in connection with the educational context, as well as analyzing the existing framework by proposing a framework based on the dynamic concept network (DCN), which was built specifically for subjects, chapters	Dynamic concept network (DCN), wordnet, tokenization	Model examiners do a set of 50 questions taken from chapter 8 of the class. The constructed answers correctly 80% of the questions based on definitions and 65% of other types of questions	But going forward can also involve the best methods for combining complex subjects such as mathematics and automating development and adding reasoning-based features to complex questions		[43] Provides a QAS that helps students to find the best answers to their questions and helps tutors to answer questions raised by their students in the e-learning environment, using a syntactic and multi-agent semantic approach to answering questions	Syntactic and semantic multi-agent	Proposed architecture can benefit from a variety of technologies and methods for introducing efficient systems	But in the future, it is necessary to improve this architecture and system implementation in the e-learning environment
[41]	Propose a new method for two main problems in the analysis of the question, namely the extraction focus and classification of closed	Hidden markov model (HMM), integrating a rule-based, POS-tagging,	The evaluation results show that the classification of questions based on rules obtained an F-score of 86.9% which is better than	But it is necessary to provide a series of manually annotated questions for both reproducibility going forward		[44] Proposing an automatic answering system for customer service with a high-quality knowledge base based on an unsupervised learning algorithm, this system extracts question and answer pairs from documents and stores them in	Seq2seq, crawler and regular expressions, matching method, stop-words removal	The results of the implementation of this system can have an accurate understanding of the questions, and then return the appropriate answers from the knowledge base; in addition to that it can improve	But in the future, it needs to be explored with other methods to improve system performance

	the knowledge base		efficiency and accuracy by saving dialogue history and adding repair functions	
[45]	Provides a system for generating answers to product-aware questions from product reviews and attributes by using a product-aware answer generator (PAAG)	extract semantic, key-value memory network	The trial results show the effectiveness of PAAG has found a significant improvement over the sophisticated baseline in terms of metric-based evaluation and human evaluation	Need to expand the model that has been built into multiple hops of memory networks so that it can be used as an encoder attribute
[46]	Presents the first study on the semantic classification of questions into EAT in the travel domain	SVM, wordnet, POS-tagging, stop words, tokenization, semantic similarity, RDF	Test results for the question identification stage look promising even though they don't get to the results significant from the results of previous studies because it is caused by the ambiguity that is based on the question	But it needs to be developed in a domain that has more specific features such as a list of hotel gazettes and attractions with other travel assistance related to ontology and enhancing extraction algorithms additionally increase the rule base to achieve promising results
[47]	Provides a regex-based approach to answering factoid questions in the tourism domain QAS	Regex, evaluation metrics	The evaluation results show an overall accuracy of 80% of TREC 8 and 9 questions related to the tourism domain	Need to match nouns with synonym ontologies like Wordnet and match all synonyms with DBpedia classes and properties

F. Discussion

During the 2011-2020 period, QA research in the field of education was very minimal compared to general time, this was due to challenging research trends and new research fields. Therefore most of the QA research in education is always related to system architecture, discussion space, evaluation metrics, and basic components of the QA system namely collection of questions, document retrieval, and answer extraction, which discusses techniques from NLP, IR, IE, but also begin to feel machine learning, deep learning and reinforcement learning in question classification, answer classification, answer validation, with various existing methods.

IV. CONCLUSIONS AND FUTURE WORK

This paper survey is not much different from other research surveys, which provide understanding to the scientific community by summarizing and organizing the latest research results in a new integrated way and increasing understanding for working in the field of QA focused on education and teaching. This QA survey emphasizes the categorization of education literature in technology information & communication science teaching-learning, social sciences teaching-learning, languages science teaching-learning, biomedical science teaching-learning, and in others science teaching learning related with education, as well as analyzing the results of evaluations, in terms of accuracy, precision, recall, Score F1 and others. However, this survey does not include all or even most of the previous research, but only includes the work of top authors in the implementation of QA in the field of education that matches the procedures and criteria in this survey. In the future, this survey will become a reference for ongoing research in the field of QA that focuses on education question classification, with a variety of good models and or methods, so that it can obtain satisfactory results.

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