

Abdullah: An Intelligent Arabic Conversational Tutoring System for Modern Islamic Education

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Abstract— This paper focuses on the development of a novel Arabic Conversational Intelligent Tutoring System (CITS) called Abdullah the tutor, Abdullah CITS is an online system that teaches students aged 10 to 12 years old the essential topics in Islam utilizing supportive evidence from the Quran and Hadith, allowing conversation, discussion and interpretation with verses in classical Arabic language by engaging in dialogue using Modern Arabic language. The proposed framework for developing Abdullah CITS is based on a Pattern Matching approach to handle the user's conversations, and to solve the complexity and ambiguity of processing the Arabic language. This paper describes the architecture of Abdullah and introduces the novel scripting language that has also been developed. The results of a pilot study are reported where the evaluation has indicated promising results.

Index Terms— Conversational agents, intelligent tutoring system, knowledge base, pattern matching.

I. INTRODUCTION

THE Arabic language is an official language of more than twenty countries, and a major spoken language by over 300 million people worldwide [1]. Two forms of Arabic language that are typically used in daily conversations between people are: Modern Standard Arabic (MSA), which is the official language throughout the Arab world, as it is used in everyday language, in the media, education, and literature. MSA is mainly derived from the Classical Arabic language (CAL). CAL known as Classical Arabic or Quranic Arabic is the standard form of the language used in the holy Quran, the religious text for Muslims. The ability to develop an intelligent tutoring system able to converse in MSA and CAL poses a significant challenge. The Arabic language is considered as being a complex language which is often ambiguous in nature. There is also a lack of computational natural language resources especially for CAL.

AutoTutor [2] and Oscar [3] are recent examples of CITS, which are designed to help students learn about a domain using a CA. However both of these CITS's are designed only to converse in English and use language specific supported language. AutoTutor does not incorporate or consider the various different learning styles during a tutoring session, which effectively means each student is provided with the same learning experience regardless the ability. Oscar CITS incorporates the Index of Learning Styles (ILS) to facilitate personalized learning but has been

designed only for the English language. In this paper, a novel architecture for an Arabic CITS, known as Abdullah is presented. Abdullah is a CITS which delivers of the main principles that every Muslim must know which is to know your God, his messenger and the religious of Islam with supporting evidence from the Quran and Hadith [4].

Intelligent tutoring systems (ITS) are adaptive educational systems that employ intelligent technologies to provide individualised instruction. The main goal of ITS is to provide the benefits of one to one instruction automatically, and cost effectively [5]. ITS enables participants to practice their skills and to build a model of the preferences and knowledge of the student by carrying out the tasks within highly interactive learning environments [6]. A conversational agent (CA) is a software program intended to converse with a human in ordinary natural language [7].

Two forms of Conversational Agents have been developed: namely, Linguistic Conversational Agents and Embodied Conversational Agents [8]. Embodied CAs possess attributes such as an animated humanoid body and facial expressions, including movement of mouth and eye gaze [9], while Linguistic CA's handle conversation in written or spoken forms [10]. CAs has been used effectively in many applications, such as database interfaces [11], student's debt management guidance [12], computerised learning [13] and conversational intelligent tutoring systems. This paper describes Abdullah the Tutor, a web based CITS with a CA interface which leads the tutoring session, asking questions, moving from topic to topic in a session and offering intelligent feedback to students. Abdullah CITS also incorporates a variety of learning support to students such as the use of illustrations, and sound effects in order to stimulate the learning environment. A novel generic architecture has been designed which will facilitate the development of future Arabic CITS for application in other domains. In addition, a new Arabic scripting language has been created to be able to analyse and interpret both MSA and CAL. This paper is organised as follows: Section II will describe the design of the Tutoring Knowledge Base, Section III describes current CA developments and the challenges faced by the Arabic language, Section IV introduces the Abdullah CITS, Section V describes the Pilot Study, Section VI will discuss the results and VII will conclude and highlight areas for further work.

II. DESIGNING AND BUILDING THE KNOWLEDGE BASE

The knowledge base of Abdullah CITS consists of four main components that are the Islamic Database (IDB), the Arabic Grammar Database (AGDB), CA Scripts (CAS), and the Tutorial Database (TDB). These Databases work together in a novel way, and it's considered being the brain

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of Abdullah the Tutor CITS. These components were organized into two main partitions, the first one which considers the primary parts of the knowledge base consists of the (IDB, AGDB, and CAS). The CA uses scripts to guide the user through predefined topic paths for a particular domain. The script contains a number of contexts which are organized according to the domain's topics. Each context contains rules that have a pattern to represent the user input and an appropriate response from the specific domain [14]. Figure 1 shows a small example of one rule that has been produced using the new Arabic CA Scripting language.

Context #1 Context Name : Facts About Quran
RuleNumber: 1
RuleName: how many
Pattern: How many times the word * repeated in Quran
Response : the word # is not in Quran
RunSQL: select count(word) form QuranTable;

Figure 1. Scripting Language

Figure 1, illustrates one of the features of the new Arabic CA Scripting Language. The CA has the ability to retrieve dynamic information by calling (RunSQL) when the user type an utterance like “How many times the word Muhammad repeated in Quran” this will match with the pattern in rule #1. The CA will then extract the word (Muhammed) from the user utterance and then use the word in (RunSQL) to get the response from the Quran table in IDB. And if the RunSQL statement returns a null value this mean word is not in the Quran and the CA will display the default response which is (the word ‘User Word’ is not in the Quran). The IDB is the most important part in Abdullah CITS brain, as it is the source of the tutoring material during the session. The Islamic Database has been derived from two main sources that are being the Quran and Hadith (the statements of prophet Muhammed) [15]. The Quran is originally written in classical Arabic language, and is organized into 114 chapters (surah) of various lengths with specific number of verses (ayat) in each chapter. While the Hadith is organized according to Sahih Al-Bukhari [16]. Al-Bukhari groups Hadiths to a number of chapters each one covers the almost aspects of Muslim life (so there is for example a chapter about prayers, charity, and so on) [17] [18]. The Arabic Grammar Database is an essential part for Abdullah CITS as it contain the classification of the Arabic sentences (Questions and Statements sentences), and information related to the specific language grammar such as whether the given sentence is a question or an exclamatory sentence. The tutorial knowledge base is the second partition of Abdullah CITS knowledge base and it's responsible for managing subject information between learners.

III. CONVERSATIONAL AGENT AND THE CHALLENGES FACED BY ARABIC LANGUAGE

Conversational agents (CA) allow people to interact with computer systems using natural language dialogue. Existing CA's can be categorized according to the development process into three main approaches: These approaches are Natural Language Processing (NLP) [19]; short text semantic sentence similarity measures (STSS) [20]; and

Pattern Matching (PM) [21]. CA based on NLP refers to the process of constructing machine understandable meaning representations from natural language input. Arabic CAs potentially has a number of limitations. First, user utterances are expected to be grammatically correct, which is often not the case. Second, natural language used by humans is extremely rich in form and structure, and very ambiguous. A word might have more than one meaning (lexical ambiguity) or a sentence might have more than one structure (syntactic ambiguity), and for these reasons, the NLP approach is not appropriate to build a CA based on the Arabic language [22]. The second approach for developing CA is the use of a STSS to measure the similarity between short texts of sentence length (10 -25 words long) [23]. The STSS measure focuses directly on computing the similarity between short texts of sentence length through the use of knowledge base such as the English WordNet [24]. Using a STSS measure within a CA is more effective as it reduces the scripting effort to a minimum by replacing the scripted patterns by a few natural language sentences in each rule [25]. However the lack of resources, such as an appropriate Arabic Wordnet (AWN) for classical Arabic language (AWN is only available for Modern Arabic language [26]), as well as the ambiguity of Arabic language (such as Morphological and Syntactic ambiguity), led the researchers to the traditional approach for building a CA using Pattern Matching techniques.

Pattern Matching (PM) is the process of matching a string or a sequence of strings within an utterance in a pattern-based rather than attempting to understand the user input. PM utilizes wildcards to match a portion of the user's utterance to patterns within each rule. As PM techniques focus on matching key words within an utterance, they do not require the utterance to be grammatically correct or the input to be a complete. Therefore the PM approach is considered to be an ideal solution for an Arabic based CA as it solves the complexities of understanding the Arabic language, by matching the utterance with a set of scripted patterns [27].

IV. ABDULLAH CITS

Abdullah CITS is a novel conversational intelligent tutoring system which can ask questions and offering problem-solving support rather than simply presenting the answers. Abdullah was designed to model a human tutor by directing a tutoring conversation. Abdullah employs an Arabic Goal Oriented CA (AGO-CA) and a novel scripting language to intelligently lead an online tutorial, and to teach the Quran allowing conversation and discussion in both classical and modern Arabic language. The AGO-CA aims to steer the conversation towards the goal fulfillment by carefully written the CA's responses, and by managing the unexpected utterances in a way that appears intelligent. Abdullah works as a personal tutor that is available at any time and place, and which provides instant answers to questions, feedback, and support through natural language conversation with the user. Abdullah depends on the tutorial knowledge base and the CA scripts to deliver the tutorial conversation to the learners. To improve the learning process and to deliver the best materials to learners during the tutoring session Abdullah has a number of distinct Arabic CITS features such as:

- Using images and sound effects to capture student’s attention during the session.
- Recording the learner’s behavior and knowledge in order to direct the session according to the learners level (discussed in more detail in section VII).

Figure 2 shows a screenshot of Abdullah the Tutor CITS graphical user interface (GUI) which leads the student through a set of questions aimed to teach learners about the topic. During the tutoring session, the student has been asked a previous question about the main topic (Knowing your God), and Abdullah has responded to confirm that the learner’s previous answer was correct. Abdullah also provided the full answer to the question along with the appropriate verse from the Quran and has stated the next step in the tutorial by asking the linking question to the next part of the tutorial session.



1. Abdullah the Tutor Answer
2. An answer to a previous question (Sign of god are a lot, moon and sun are an examples of god’s signs)
3. And of His signs are the night and day and the sun and moon. Do not prostrate to the sun or to the moon, but prostrate to Allah, who created them, if it should be Him that you worship.
4. God create human, can you give another example

Figure 2. A screen shot from Abdullah CITS Tutoring session

The proposed framework for Abdullah CITS consists of three main components as shown in figure 3.

The ITS (to personalise teaching according to individual student’s characteristics such as the knowledge of the subject, and the behaviour), the knowledge base (to provide the sources/material of the learning topics), and the CA (to lead the tutorial through a natural language dialog).

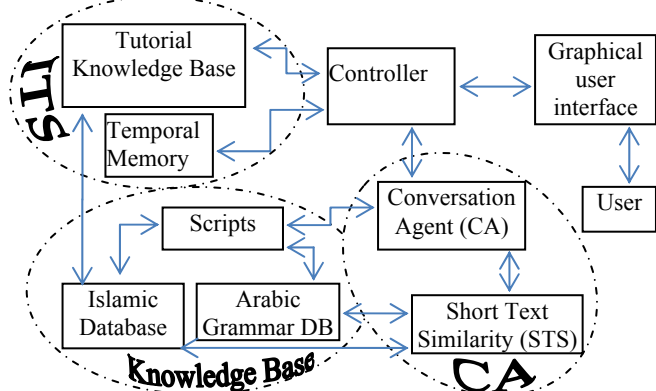


Figure 3. Abdullah CITS Architecture

The controller communicates with all components to manage the conversation between the user and the Arabic CA, as well as to provide the suitable material content to suit different students’ knowledge by interacting with the Tutorial knowledge base and temporal memory (TM). The TM is used to record a number of variables such as answers, questions, and user statements during the conversation which are stored in a Log File (described in section V).

The controller will build a model of the students’ knowledge and uses that model for teaching students and to provide intelligent assistance. The controller also provides an utterance checking process. Before proceeding to match against the patterns within the rules, the controller will check whether the utterance is empty, repeated, or unsuitable for the tutoring purpose. The Arabic CA will receive natural Arabic language text (modern and classical Arabic) and information about the tutoring topic from the graphical user interface (GUI), tutoring knowledge base via the controller. The Arabic CA accesses the scripts database to find the best match to generate the response back to user.

Storytelling is one of the most powerful and simplest methods for learning. The use of stories in education has been found to be most useful in language learning, such as religious subjects, and for encouraging students to share personal experiences [28][29]. Interactive digital storytelling is a valid educational tool to teach multimedia, literacy and narrative skills and has been shown to excite people about learning [30]. Stories must also be learner designed, in that they need to be tailored for the specific audience they are delivered too [31]. In most religious texts, such as the Quran, storytelling is the natural way in which information about fundamental beliefs is taught.

Abdullah CITS was designed according to a number of theories (Gagne theories for learning [32]). Applying Gagne’s theories is an excellent way to ensure an effective and systematic learning program as it gives structure to the lesson plans and a wider view to the teaching [33]. Gagne presented five learning outcomes which are Verbal Information (Describing the basic description of knowledge and facts “Allah is the Creator of all things, and He is, over all things, Disposer of affairs” Quran), Intellectual Skills, Cognitive Strategies, Motor Skills, and Attitudes (mental states that influence the choices of personal actions “i.e. An utterance describing that the user don’t like Angles “ , then Abdullah CITS will gave an appropriate response along with a verse from the Quran). These learning outcomes are extremely useful for analyzing learning in a school context [34]. Gagne learning theories are now briefly described along with a description of how they are applied in Abdullah.

1. Gaining learner’s attention, Capturing student’s attention is the first and most important issue for learning. Two techniques have been used to deal with this event, in the design of Abdullah. A graphical user interface (GUI) that begins with an animated title screen accompanied by sound effects, to increase children’s visual orientation. In addition each lesson will start with thought-provoking question or interesting fact about the selected topic to be learned.

2. Informing learners of the objective. To help the learners complete the lesson and to get the maximum benefit of the topic, the learning objective must be listed early in each lesson. An initial image is displayed at the beginning of the lesson describing that on completion of the lesson, the leaner will have a brief understanding of the topic, along with supportive evidence from the Quran and the Hadith.

3. Stimulating recall of prior learning. The recall will be stimulated by asking questions about how well the learners understand previous concepts or the body of contents in general. However all the tutorial questions are organized in the Tutorial Knowledge Base as questions with answers in a

default style (A normal basic question which designed to suit different level of student's knowledge), or as questions with answers in basic detailed style (A type of questions for the student's with low level of knowledge). Student's knowledge will be measured during the tutorial by a number of variables, such as the percentage of the correct answers, whether or not the students ask a question related to the main topic, and have the students provided any information using CAL (i.e. a verse from Quran or Hadith). During a tutorial, Abdullah CITS will direct the learner either into the default or detailed Question Answer style.

4. Presenting the content. The way that the course content is presented to students will reflect the teaching style of the instructor. Abdullah's intelligent approach includes presenting contents in the sequence and style most suited to the individual's knowledge. However the contents of Abdullah CITS was organized according to the book of monotheism of the primary school year (3, 4 and 5) [35], that's been printed and organized by the Ministry of Education and Deputy Ministry for school in Saudi Arabia.

5. Providing feedback. As learners practice new topics it is very important to provide a specific and immediate feedback on the learner's performance. Abdullah will display an appropriate encouragement after each correct answer, partially correct, and Low near miss Answers. As an example a match of 80% between utterance and pattern script is classified as correct answer and Abdullah will respond with a message like "excellent God bless you". A match of 50% is classified as partially correct answer and Abdullah will respond with a message like "Excellent". A match of 30% classified as low near miss answer and the response message is limited to "Good" finally a match below 30% is considered as a wrong answer.

However if the student makes a mistake, the tutorial immediately responds with an audible cue, and then gives the student another chance to correct their answers. If the student enters a second incorrect answer, the system will provide the correct answer and continue the tutorial.

V. PILOT STUDY

A. Domain

The domain used to script the CA is concerned with teaching the students at the age (10-12 years old) the three principals that every Muslim must learn which is to know Your God (Allah), his messenger (prophet Muhammed), and the religion of Islam, with the supportive evidences (Quran and Hadith). Scripts consisting of a context structured according to the main topics in Islamic religious such as the pillars of Islam (Faith or belief in the Oneness of God, Establishment of the daily prayers, etc.). Abdullah CITS is therefore designed to deliver the Islamic topics to learners in classical Arabic language while the learners converse in MSA.

B. Experiments

Twelve participants were asked to revise their knowledge of Islamic topics by completing the online Abdullah CITS tutorial. The scenario is described as follows: Each participant will engage in a tutorial conversation within one of the three Islamic fundamental by answering a set of

tutorial questions that cover different contents in the selected topic. The participant will move from one context to another in a goal oriented structure. Two sets of experiments were undertaken to measure the participants learning over the session. The first experiment where based on Log File to record the dialogue, timings, knowledge and other behavioral factors were analyzed to assess each learner's performance during the tutoring session. Each log file comprises of two components:

- The classification component records the classification of the user utterance (as show in Table I section A). Utterance classifications were devised in order to make Abdullah CITS reply with responses which were appropriate to the user's utterance's type.
- The Log component is used during the development stage of the CA for debugging and improving CA scripts, allowing adjustments to rules and patterns to be made. (as described in Table I section B).

Table I. Log file classification

A.classification components	Description
1- Question utterance	User utterance that includes an interrogative word
2- Statement utterance	User utterance that give an information, or describe something
3- Response utterance	Abdullah the tutor can tell whether the utterance is a response to a question related to the tutorial
4- Answers classification	<ul style="list-style-type: none"> • highly corrected • partially corrected • near miss answers
5- Quran utterance	verse in Quran
5- Agreement & disagreement utterance	<ul style="list-style-type: none"> • Agreement utterance • Disagreement utterance (have a disagreement word)
6- Utterance not valid	<ul style="list-style-type: none"> • Not belonging to a topic • Not written in Arabic language • Empty utterance ,or have a special character • Have one or more impolite word
B. Log components	Description
7- Selected topic	the session is started by a random topic selected to user; User will then move from one subtopic to another until the end of session
8- Fired Rule	The rules that fires during the conversation, will help to maintain if the user following the right progression path for the tutorial.
9- Response Classification	two levels of responses that's the high level and low level response
10- Current Context	Will help to maintain if the user following the right path for the tutor.
11- Rejects Utterance	The number of times that the user cannot produce a result with enough confidence (ex. When user says: It could be, or I think, etc.).

12- Timing	<ul style="list-style-type: none"> •timing in each interaction during the conversation •Timeouts
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The second experiment will base on the user feedback after participants had completed the tutorial. The participants were asked to complete a short user evaluation questionnaire, to evaluate the learner experiences in using Abdullah CITS, and to assess existing Islamic knowledge. The feedback questionnaire consists of eight questions to be rated using a five-point scale, four questions requiring a Yes/No answer, and three open questions. The tutoring success was evaluated in terms of participant experiences reported in the feedback questionnaires.

VI. RESULTS AND DISCUSSION

The results of the two experiments conducted as part of the pilot study can be found in Figure 4. They show the transcript of the tutoring dialogue of one participant. The experiments show that Abdullah CITS can successfully directing a tutoring conversation by asking the participants to think about the correct datatype rather than simply telling them the answer.

1-Abdullah: Welcome to Abdullah the tutor, please write your name
2-User: my name is Mariam
3-Abdullah: **Dear sister Mariam** welcome to the program, do you like to converse about the prophet Muhammed? Do you know where he is born?
4-Mariam: Makah
5-Abdullah: **excellent**, Muhammed (pace be upon him) born in The Year of the Elephant in Makah. What is the secret beyond this name the elephant?
6-Mariam: Abraha wish to demolish Kaaba
7-Abdullah: **excellent**, Abraha, the ruler of Yemen, marched upon the Kaaba with a large army, which included elephants, intending to demolish it. So does the army demolish the Kaaba?
8-Mariam: No they can't
9-Abdullah: **Good**, the elephant is said to have stopped at the boundary around Mecca, and refused to enter (**Quran:** Have you not considered, [O Muhammad], how your Lord dealt with the companions of the elephant? (1) Did He not make their plan into misguidance?), do you know The First Verse of the Qur'an?
10-Mariam: The Verse of the Al-Fatiha
11-Abdullah: **I think the right answer is**, the Verse of Al-Alaq (**Quran:** Recite in the name of your Lord who created - (1) Created man from a clinging substance. (2)). do you know how the beginning proselytizing or preaching of Islam was?
12-Mariam: Secret
13-Abdullah: **excellent**, Muslims worship first years of Islam in a secret way. Do you know where is the prophet going?
14-Mariam: Kaf, Ha, Ya, 'Ayn, Sad.
15-Abdullah: **Quran** ([This is] a mention of the mercy of your Lord to His servant Zechariah), can you please answer my question (Do you know where is the prophet going?)
16-Mariam: who's Hinduism?

17-Abdullah: Hinduism is the predominant religion of the Indian. Can you please answer my question (Do you know where the prophet is going?)

18-Mariam: to al Madina

19-Abdullah: **excellent**, In 622, Muhammad and around 70 Meccan believers left Mecca for sanctuary in al Madina. Do you know what the first battle in Islam was?

20-Mariam: the battle of Badr

21-Abdullah: **excellent God bless you**, The Battle of Badr was a key battle in the early days of Islam. Do you know what was the second battle in Islam?

22-Mariam: the Battle of Hunayn

23-Abdullah: The Battle of Hunayn was fought between Muhammad and his followers against the Bedouin tribe of Hawazin. can you please answer my question (Do you know what was the second battle in Islam ?)

24-Mariam: I don't know

25-Abdullah: The Battle of Uhud, in 625, Abu Sufyan ibn Harb, King of Mecca. Once again led a Meccan force against Medina. What was the next battle after Uhud?

26-Mariam: Battle of the Confederates

27-Abdullah: **excellent God bless you**, Battle of the Trench or (Battle of the Confederates) the battle that was Surrounding Medina in 627 , and the results Decisive Muslim victory , During these battles God helps Muslims by angels whose they fight with against non-Muslims. What was the last battle during the prophet period?

28-Mariam: I don't like angels

29-Abdullah: **Dear Mariam be careful.** God says in **Quran** (Whoever is an enemy to Allah and His angels and His messengers and Gabriel and Michael - then indeed, Allah is an enemy to the disbelievers). Can you please answer my question (what was the last battle during the prophet period?)

30-Mariam: Conquest of Mecca

31-Abdullah: **excellent God bless you**, Mecca was conquered by Muslims on 11 December 629 AD

Figure 4. Dialogue

Table II. Utterances classification

Participant Interaction #	Utterance classification
2	Name is : Mariam M/F : F
4	Partially correct answer
6	Partially correct answer
8	Near miss answer
10	Wrong answer
12	Partially correct answer
14	Quran
16	Question Not related to Topic
18	Partially correct answer
20	Correct Answer
22	Statement Related to Topic
24	Don't know Answer
26	Correct Answer
28	Negative Statement
30	Correct Answer

The participant interaction number and the Log file utterance classification are displayed in table II. Figure 4

shows Abdullah CITS was leading the tutorial so the first sentence was delivered by the CITS asking the participant to enter his/her name. The user was entered Mariam and, the system has recognized the name as a female name and continued to converse with the user (Mariam) in a female conversation style (interaction 3 shows that Abdullah CITS using the word Sister for the user Mariam). The system also picked a random topic to start the tutorial (knowing your prophet Muhammed), and began by asking a provoking question (do you know where the prophet was born). Mariam answered the question by writing the word (Makah). Abdullah dealt with this utterance as a correct answer and gave an encouragement message to the participant (Excellent) then continued onto the next question. As the tutorial progress, Abdullah continues to recognize the user's utterance and give different levels of encouragement (interaction 9 & 21). In addition, Abdullah also uses supportive material in the session like (chapter 105 verse 1-3, and chapter 96 verse 1-3) from the Quran (interactions 9 and 11). Interaction 14 asks the participant to write a verse from Quran instead of writing the answer to the previous question (interaction 13). Abdullah has then responded with the next relevant verse from Quran and repeated the same question again (interaction 15). This illustrates the goal –orientation which is built into the system as a learner must answer a question in the tutorial before progressing. Interaction 16 demonstrates the participant asking a question. The system then provides an answer to the question and also repeats the previous tutoring question (interaction 17) to keep the participant on the tutoring path. Interaction 22 shows that the participant gets the wrong answer for the previous question, but the participant's answer shows a related fact to the topic (Table II show that's interaction 22 it's not an answer, but a related statement to the topic), Abdullah sends a declaration response to user and repeats the previous question to give the user another chance to get the right answer. Abdullah can get the utterances that reflect a misunderstanding facts by the user, interaction 28 state that the user (Don't like Angles) the system here send a warning message combined by an appropriate verse from Quran back to user (interaction 29).

The initial pilot study showed that Abdullah was well received, understandable and helpful. 85% of the user would use a CITS like Abdullah to support classroom tutoring, 20% stating they use Abdullah instead of face to face teacher. Only 30% of learners agreed that they would use the Abdullah CITS instead of reading a book.

VII. CONCLUSIONS AND FURTHER WORK

This paper has presented the novel architecture and Arabic Scripting methodology for developing Abdullah the Tutor CITS. The developed tutor aims to teach students the basic fundamentals of Islam allowing a conversational tutorial to take place in both modern and classical Arabic language. Pattern matching technique implemented in the Arabic CA because it's been consider being an ideal solution for a Conversation agent based on Arabic language. PM solves the complexities of understanding the Arabic language, by simply matching the utterance with a set of scripted patterns.

Further work will entail an evaluation with students in primary school using more in depth tutorial scenarios and an educational based assessment which can be delivered in a classroom environment.

REFERENCES

- [1] Arabic language." Encyclopedia Britannica. (2009). Encyclopaedia Britannica Online. Retrieved on 29 July 2009.
- [2] Graesser, A., Chipman, P., Haynes, B.C., Olney, A.: AutoTutor: An Intelligent Tutoring System With Mixed-Initiative Dialogue. *IEEE Trans. Education* 48(4), 612–618 (2005).
- [3] A. Latham, K. Crockett, D. McLean and B. Edmonds (2010). Oscar: An Intelligent Conversational Agent Tutor to Estimate Learning Styles, 2010 IEEE International Conference, Barcelona.
- [4] "Hadith," Encyclopedia of Islam and the Muslim world. Available at <http://www.encyclopedia.com/article-1G2-3403500174/hadith.html>
- [5] Anderson, J. R.; Corbett, A. T.; Koedinger, K.R.; and Pelletier, R. 1995. Cognitive Tutors: Lessons Learned. *The Journal of the Learning Sciences* 4(2): 167–207.
- [6] A. Latham, K. Crockett, D. McLean and B. Edmonds, "Using Learning Styles to Enhance Computerised Learning Systems", in *Proc. of the 2009 Annual Research Student Conference*, Manchester Metropolitan University, UK.
- [7] Wallace, R. S. (2008). ALICE: Artificial Intelligence Foundation Inc. Available at: <http://www.alicebot.org>.
- [8] D. W. Massaro, M. M. Cohen. Beskow, S. Daniel, and R. A. Cole, *Development and Evaluation Conversational Agent*, Santa Cruz: University of California 1998.
- [9] J. Cassell, *Embodied Conversational Agents*, Cambridge MA, 2000.
- [10] Mairesse, F., Walker, M., Mehl, M. and Moore, M. (2007) 'Using Linguistic Cues for the Automatic Recognition of Personality in Conversation and Text' *Journal of Artificial Intelligence Research*, Vol. 30, pp 457-501
- [11] Owda, M., Bandar, Z. and Crockett, K. (2011) 'Information Extraction for SQL Query Generation in the Conversation-Based Interfaces to Relational Databases (CBIRD) Lecture Notes in Artificial Intelligence, Vol. 6682. Berlin: Springer-Verlag, pp. 44-53
- [12] Karen O'Shea, Zuhair Bandar, and Keeley Crockett. Application of a Semantic-Based Conversational Agent to student debt management.
- [13] D'Mello, S., Lehman, B., Sullins, R., L. & Graesser, A. (2010). A Time for Emoting: When Affect-Sensitivity Is and Isn't Effective at Promoting Deep Learning. *ITS 2010, LNCS 6094*, 245-254.
- [14] Michie, D. and Sammut, C. (2001) *Infochat Scripter's Manual*. Manchester, UK: ConvAgent Ltd.
- [15] Sahih Bukhari, hadith number 208 'Holding Fast to the Quran and Sunnah'.
- [16] Fath ul-Bari fi Sharh Sahih al-Bukhari by al-Hafith Ibn Hajar.
- [17] U. al Qari fi Sharh Sahih al Bukhari' written by B. al-Din al-Ayni and published in Beirut by Dar Ihya' al-turath al-'Arab.
- [18] Irshad al-Sari li Sharh Sahih al-Bukhari by Al-Qastallani (died: 923H); one of well-known of explanations of Sahih al-Bukhari'.
- [19] Marilyn, A. W., Diane, J. L., Candace, A. K. and Alicia, A. (1997). *Interactive Spoken Dialog Systems on Bringing Speech and NLP Together in Real Applications*, Madrid, Spain: Association for Computational Linguistics.
- [20] O'Shea, K., Bandar, Z. and Crockett, K. (2010) 'A Conversational Agent Framework using Semantic Analysis' *International Journal of Intelligent Computing Research*, Vol. 1 no. 1/2, pp. 23-32
- [21] Hang C., Min-Yen, K. and Tat-Seng, C. (2007). Soft pattern matching models for definitional question answering. *ACM Trans. Inf. Syst.*, 25(2), pp. 8.
- [22] ABDEL MONEM, A., SHAALAN, K., RAFAA, A., AND BARAKA, H. 2009. Generating Arabic Text in Multilingual Speech-to-Speech Machine Translation Framework, *Machine Translation*.
- [23] Landauer, T.K., Foltz, P.W. & Laham, D. (1998). Introduction to Latent Semantic Analysis. *Discourse Processes* 25, 259–284.
- [24] Y. Li, Z. A. Bandar, and D. Mclean, "An Approach for Measuring Semantic Similarity between Words using Multiple Information Sources", *IEEE Transactions on Knowledge and Data Engineering*, Vol. 15, (4), 2003, pp. 871-881.
- [25] K.O'Shea, Z. Bandar, and K. Crockett. A Novel Approach for Constructing Conversational Agents using Sentence Similarity Measures.
- [26] Black, W., Elkateb, S., Rodriguez, H, Alkhalifa, M., Vossen, P., Pease, A., & Fellbaum, C., (2006). *Introducing the Arabic WordNet*

- Project. In Proceedings of the Third International WordNet Conference, Fellbaum and Vossen (eds).
- [27] Hijjawi, M., Bandar, Z., Crockett, K. and Mclean, D. (2011a). ArabChat: an Arabic Conversational Agent .pp 34-36.
- [28] Bruner, J. (1990). Acts of meaning. Cambridge, MA: Harvard University Press.
- [29] Gils, F. (2005). Potential applications of digital storytelling in education. In 3rd Twente Student Conference on IT, University of Twente, Faculty of Electrical Engineering, Mathematics and Computer Science, Enschede, February 17–18.
- [30] Yazdani, B; Emadi, M. (2006). Storytelling. How to enjoy stories to help children solve life problems. Roshan, A. Tehran: Javane Roshd.
- [31] Moon, Y. 1998. Intimate Self-Disclosure Exchanges: using Computers to Build Reciprocal Relationships with consumers .Cambridge, MA: Harvard Business School Working Paper 99-059
- [32] Gagne R, Briggs L, Wager W, eds. Principles of instructional design. 3rd edition. New York: Holt, Rinehart and Winston; 1998.
- [33] Conditions of Learning (Robert Gagné). Available at <http://www.instructionaldesign.org/theories/conditions-learning.html>.
- [34] Ellington H, ed. Selecting appropriate teaching/learning methods. Aberdeen, Scotland: The Robert Gordon University; 1996.
- [35] The Ministry of Education Saudi Arabia. Available at http://www.ed.edu.sa/elementary_books.