An Evaluation of Use of Ontologies in Web Assessment Systems

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The field of electronic learning (e-learning) has improved tremendously in the past decade with the invention of all kinds of e-learning systems. The undertaken research was done to improve web assessment systems which are limited to summative assessment and does not have a feedback section to the student hence does not promote learning. A web assessment system which uses ontologies was proposed to promote formative assessment with a feedback loop to the students so that the structured type of questions can be implemented in web assessment. An experimental research design was employed looking at the difference in marking between the human teacher and a web assessment system. Data was gathered from a Shona Test which was written by 60 primary school students from two schools in Bindura Zimbabwe. A T test analyses using SPSS seem to suggest that there is no difference in marking between the human examiner and the web assessment system which uses ontologies. Furthermore it also emerged that the web assessment system is far much more accurate as compared to the human examiner.

Keywords: E-learning, web assessment, summative assessment, ontology, formative assessment, Shona.

INTRODUCTION

The field of e-learning has advanced tremendously but it seems few have embraced it. Though there have been some aspects of e-learning which have been extensively used such as e-books, The author feels this technology (e-learning) if implemented correctly in the right environment and with adequate resources can infiltrate or be used in many areas such as education, companies or even in public institutions used by people of all works of life. Not to say such systems do not exist, the author proposes an assessment system that is flexible and with enough functionality to be implemented in different environments as those described above. Since the advancement of such a system is to replace the examiner in the area of assessment, the system basically has to employ aspects of artificial intelligence for it to be useful. Incorporating ontologies in such systems would give them the advantage of a wider and intelligent knowledge base.

Background of study

Distance education has helped to overcome various obstacles faced in imparting education to students who cannot make it to education centers for one reason or the other. It conquers the problems of logistics, transportation, infrastructure, time etc. that are commonly faced by educational organizations and students. With the spread of internet growing across the globe it is becoming more and more accessible to all the corners of the world which also means that students now have access to better education on the Internet. Lessons, lectures, notes, assignments, exams etc can be made available online using Internet so that students can access them from anywhere. The student need not be at the premises of the university, school to be able to get education. Given the emergence of online learning as a new form of education, a number of studies have been
devoted to it. However assessment, which is an important, well established and popular slice of the e-learning universe, has not attracted the attention it deserves [1]. According to Jorge Gaytan [2] Future research studies should be designed to explore more innovative, efficient, and effective instructional and assessment techniques for the online environment. Current learning approaches to assessment commonly demand the multiple choice type of questions which encourage guessing and does not effectively assess students [2]. Hence there is need to automate assessment of exams and to employ artificial intelligence so that we preserve human aptitudes since the human examiner scenario is considered the best. On the other hand development of ontology based systems has been a topic of interest for computing scientists since the early 1990s.

The authors introduced this phenomenon of ontologies to online examination systems as a way of imitating human examiners and to bring confidence in the use of such systems whilst reducing examination personnel with an overall goal of promoting distance learning.

Research Objectives

1. To design and implement ontology based web assessment system for primary school students that mark short textual answers.
2. To assess if ontology web assessment system can mark as human examiners do.

Research Propositions / Hypothesis

In this research the author hypothesize that the available web assessment systems lag behind in marking short textual answers and complexity of different possible answers to a question remains a challenge hence incorporating ontology will reduce that complexity. The hypothesis for this study is:

\[ H_0: \text{If ontologies are incorporated in web assessment, web assessment systems can assess as human examiners do.} \]

or

\[ H_1: \text{Whether ontologies are incorporated in web assessment or not web assessment systems will never match human examiners.} \]

Research Questions

1. Can ontology based web assessment systems mark as human examiners?
2. Is ontology based web assessment system more accurate than human examiners?

Significance of Study

How will the assessment system change the assessment process as a whole, and what effects will it have is depending on where the system is implemented? The following are deduced:

1. The marking process is redundant, the same template (marking scheme) is used for marking each and every paper, though a sense of intelligence is required, a system possessing a knowledge base can execute the very same process as the examiner and much faster with a greater degree of accuracy.
2. With the current way of assessment, examiners take longer time in assessing and marking candidates performances from the beginning of the assessment to the end, everything is done serially (especially during marking were each answer sheet is marked one at a time one after the other). Now with the implementation of a system, there is parallel processing of the assessment.
3. Introducing e learning of this criterion in schools enforces computer literacy and also would positively increase student's interests in computer related activities to a large extent in the long run.
4. The system can also be used in interviews where the interviewee might be required to take a short assessment, which makes it easy also to know which individuals have basic computer skills as these are essential at almost every level of profession these days.
5. The above stated environments in which this system can be implemented show just how flexible the system is and how in each situation the system is expected to change and enhance the assessment process in that it replaces a lecturer in the marking process to a larger extent as it incorporates aspects of artificial intelligence.
6. A system with this level of artificial intelligence would increase the student's confidence in using such assessment systems.

Literature Review

E-Learning

E-learning is an alternative method of teaching and learning where students do not necessarily have to be at the site or school where teaching and learning is taking place. E-learning has got quite a number of advantages over the traditional method of learning and many learning institutions are adopting online learning [1]. However assessment, which is an important, well established and popular slice of the e-learning universe, has not attracted the attention it deserves (1). Although educators at all levels have embraced using online technology as a teaching tool, the issue of assessment of student learning in an online course has not been thoroughly addressed [3].

Web Assessment

Online assessment may be defined as a method of using computers to deliver and analyse tests or exams and such systems have been around since the seventies [4].
Assessment may be defined as that part of the learning process used to better understand the current knowledge that a student possesses. It is the process of identifying, collecting and interpreting information on students' achievement and progress. This implies that assessment may affect decisions about grades, placement, instructional needs, and curricula [1]. Although there are a lot of researches on e-learning, the development and refinement of web assessment tools is lagging behind yet it is a crucial aspect of the learning process. According to Jorge Gaytan [2], Future research studies should be designed to explore more innovative, efficient, and effective instructional and assessment techniques for the online environment [2]. According to Honarmand [5], there are five major uses for assessment and they are defined as:

- Converse the success status for students
- Offer self-evaluation information to the learner
- Student assignment for educational paths or programmes
- Stimulate the learner
- Assess the efficiency of instructional programmes [5]

Assessment is mainly divided into two types that are formative assessment and summative assessment.

**Formative Assessment**

Formative assessments entail sampling student learning and providing feedback to guide the learning process [6]. Formative assessments can be anonymous surveys or they can be individual or group learning activities. In all instances, feedback rather than grading is the ultimate goal [6]. According to Heinrich [7] an essential component of formative assessment is feedback [7]. Feedback assists the students in identifying gaps in their knowledge and guides them towards measurements to close these gaps. Formative assessments allow the instructor the opportunity to modify the teaching plan and learning experience in order to meet the learning outcomes [6].

**Summative Assessment**

Summative assessments are done towards the end of a learning period and are not designed to give students immediate or continuous feedback but rather an overview of what have been learnt up to that point. Summative assessment is given to summarize the student’s learning over a period of time, such as midterm and final exams. Summative assessment is used to give a summary of the student’s learning over a period of time, most examination boards use this method of assessment so that students can be graded according to their performance in the summative assessment [1]. Graff [4] adds that summative assessment which can be administered during the presentation of a course as a means of checking on student learning. Summative assessments are formal assessments conducted at the end of lessons, projects, and/or course to evaluate the learning achievement. Summative assessments are graded and are reflected in the final course grade [6]. Examples of summative assessments include papers, quizzes, tests, and synthesis [6].

**Formative Assessment vs Summative Assessment**

In both assessment methods, the teacher assumes two different roles. In the case of formative assessment, the teacher plays the role of a coach and facilitator so as to boost students’ learning; but in summative assessment, he performs the role of a judge about students’ attainment at a given period [1]. Within any assessment system question types may vary. For example, questions may include short essay type questions, true or false type questions, or multiple-choice questions. There are many potential advantages of online assessment to learners. For example, tests are available on demand and at any time. Furthermore, computerised assessment systems give immediate feedback to the user; therefore users learn by taking the test [4]. Formative assessment promotes learning on the part of the student and summative assessment only gives feedback in the form of an average mark scored. Many studies undertaken over the last years have demonstrated that formative assessment can be effectively supported by utilising web-based computer environments [7].

We can react to the demand of shifting attention towards formative assessment by building repositories that contain essay-type assignments and formative feedback annotations. This is in contrast to components widely available in current learning management systems that focus on multiple choice-style tests representing summative assessment [6]. Characteristic of formative assessment is that it requires open-ended response from the students and that multiple-choice style tests therefore are not sufficient. As a consequence automated marking is not possible and the assessment and here specifically the feedback has to be provided by a human marker [7].

**Ontology**

Ontological studies are becoming a major area of research in the computer science field but the word has got philosophical origins. The study of formal ontological distinctions can be organized around a number of core theories (or, better, theoretical tools), which have always been at the basis of philosophical research. Guarino [8] in the philosophical sense, we may refer to ontology as a particular system of categories accounting for a certain vision of the world. As such, this system does not depend on a particular language: Aristotle’s ontology is always the same, independently of the language used to
describe it [8]. On the other hand, in its most prevalent use in Artificial Intelligence, ontology refers to an engineering artefact, constituted by a specific vocabulary used to describe a certain reality (see Figure 1), plus a set of explicit assumptions regarding the intended meaning of the vocabulary words [9].

**Entity Sets**

The entity set Concepts denotes the meaning of words, and it has two attributes: Concept ID and Concept Definition; intended for the textual definition of the meaning. The entity set ConceptProperties represents the set of properties, and it has one attribute: ConceptProperties used to represent each property. The entity set Relations represents the set of relations that can exist in ontology, and it has two attributes: Relation that captures the textual name of each relation (e.g., is-a, part-of, etc.), and RelationDefinition for the textual definition of relations.

The entity set AlgebraicProperties represents the properties of relations, and it has one attribute: AlgebraicProperty that denotes each algebraic property. The entity set intrinsic properties conveys the set of properties and has one attribute: IntrinsicProperty representing each intrinsic property.

**Relationship Sets**

The relationship set HasProperty is used to assign properties to concepts. The ternary relationship set HasRelation is used to represent those two concepts in ontology can be linked by a given relation. The relationship set HasAlgProperty is used to convey that relations could have attached a set of algebraic properties; the same applies for the relationship set HasIntProperty but for intrinsic properties.

**Ontology tools**

Ontology tools can be classified into three categories:

i. Ontology editors,
ii. Ontology-based annotation tools and
iii. Ontology-based reasoning tools.

Ontology editors facilitate the ontology developer’s task in constructing ontologies, in terms of defining the domain concepts, and the relationships among these concepts in the form of a class hierarchy.

**Ontology editors**

1. OntoEdit,
2. OilEd and

**OntoEdit**

OntoEdit is an Ontology Engineering Environment that supports the development and maintenance of ontologies using graphical means. It is built using a powerful internal ontology model, which can be serialized using XML, thus supporting internal file handling. The modeling paradigm in OntoEdit supports representation-language neutral modeling for concepts, relations and axioms. Multiple graphical views can be used to support the ontology modeling during the different phases of ontology
engineering cycle.

OilEd

OilEd is a free OIL editor which aims to provide a simple interface for developing OIL based ontologies. It is not intended to be a full ontology development environment, nor does it support the development of large-scale ontologies. OilEd includes the necessary functionality required by an Ontology development kit, in terms of creating class hierarchy, various class operations, describing classes and class properties, and others.

Protégé-2000

Protégé-2000 is an integrated software tool used to develop knowledge-based systems and various domain problem solving and decision-making applications. It has a uniform GUI (graphical user interface), which consists of several tabs. This tabbed structure facilitates the creation of a knowledge-acquisition tool for collecting knowledge, the entering of specific instances of data and creation of a knowledge base, and the execution of applications. Protégé ontology defines a set of concepts and their relationships. In Protégé, the knowledge-acquisition tool is domain-specific, thus allowing domain experts to easily input domain instances utilizing their knowledge of the area. The resulting knowledge base can be used with a problem-solving method.

Ontology in web assessment system

The model proposed is designed mainly to focus on assessments involving structured answers where the marking tends to be a complex process. Most of the currently running learning management systems mainly concentrate with the multiple choice type of assessment which does not support learning. The system is designed to detect errors which students should not be penalized for, that is the system should be able to distinguish between a wrong answer and a spelling error but right answer, to do this the system uses comparison algorithms to compare the answers given by the tutor and those generated by the system to the answers given by the student. The system has an option on the level of leniency which can be set by the tutor.

The system is also designed to generate its own answers using those given by the tutor, this is done by using the answers given by the tutor to query the ontology based electronic dictionary. The use of the ontology based electronic dictionary gives the system an edge over other systems of the same type. The ontology based electronic dictionary can be edited and reused which implies knowledge reuse.

This approach has several educational advantages. First, the dictionary serves as a useful cognitive tool to extend memory and ease information processing, by allowing a learner to express meanings and relations directly. Second, the grouping of words is also cognitively meaningful, as grouping makes clear the common features and differences between groups. With the incorporation of the dictionary the problem of synonyms is easily addressed.

METHODOLOGY

In view of the limited research in this area of study, particularly in a developing country like Zimbabwe, a quantitative research design was considered the most suitable approach since the participants in this case are primary school level pupils who cannot interpret qualitative instruments for example questionnaires. The study employed an experimental study looking at the difference in marking between the human teacher and a web assessment system.

Research Design

An experimental design was conducted at Hermann Gmeiner Primary school and Chipindura Primary school in a town called Bindura in Zimbabwe to examine the differences in marking between the primary school teacher and the web assessment system. At each school a group of ten students from grade four with three classes i.e. 4A, 4B and 4C were used for the research. Random sampling was used to select the ten students by using a hat were the students would pick papers numbered one to ten and if a student picks a number from one to ten would qualify for the experiment.

The primary school students were given a Shona (local language) test which they wrote manually on their scripts and their respective teachers manually marked the scripts and recorded the results. The same test was applied to the web assessment system and the same answers which were manually marked were entered to the system to automatically mark. The results from the system and the results manually marked by the teacher were analyzed and compared using the paired t test.

Research Participants

The pupils are put in grades from grade zero up to grade seven, of which each grade consists of three classes A, B, and C. Each class has its own class teacher and so have their own time-table to use the computer laboratories. Grade four pupils participated in the research as shown in the table 1.

Table 1 indicates the Schools, Classes and the number of pupils who participated in the research. The students follow their normal time-table to use the computer laboratories which had 30 minutes computer laboratory session per day for five days. The teacher was the one who was the implementer and facilitator of the
Table 1. Participants.

<table>
<thead>
<tr>
<th>School</th>
<th>Grade</th>
<th>Number of students who participated</th>
<th>Number of students in class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hermann Gmainer primary school (School A)</td>
<td>4A</td>
<td>10</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>4B</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>4C</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Chipindura Primary School (School B)</td>
<td>4A</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>4B</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>4C</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>60</td>
<td>101</td>
</tr>
</tbody>
</table>

ontology web based assessment system project.

**Proposed Ontology based Web Assessment System Design**

**Programming Language**

The online learning platform was designed and programmed with the view to make online assessment intelligent and preserve the human aptitudes when assessing students. The system implements ontology as a basis for its assessment. Web protégé was used to build the ontology and it was integrated with Mysql and PHP to support the development of Web assessment system.

**Proposed system design process**

**Use case diagrams**

Use-case modeling is a technique used to describe the functional requirements of a system. It makes it easier to show the functional requirements in an abstract way that can easily be understood even by the stakeholders of the system, therefore acting more like a communicating tool between the stakeholders and the developers.

**Requirements specification**

System users:

- Students
- Tutor/lecturer will also be referred to as the examiner
- System administrator

The requirements will be classified according to each user:

**Functional requirements**

Statements of services the system should provide how the system should react to particular inputs and how the system should behave in particular situations.

**Student module**

- Change password—students should be able to change their passwords.
- Take exam—after logging in the student should be able to take the exam
- Login—Each student would need a unique login user name and password.
- Results—after the exam the student should be able to see their result.
- Logout—the student be able to logout his/her profile.

**Instructor or Examiner module**

The instructor’s main process is to set the exam and provide answers that the system will use to generate any other possible answers (see Tables 2-4); these will be used to mark the exam.

The following system functions are needed for the instructor to achieve the above:

- Login—the instructor should also have a unique login username and password.
- Add and update exam questions—the instructor should be able to add exam questions.
- Add and update answers—the instructor should be able to add and update exam answers.
- View exam results—the instructor should also be able to view the results of all the students.
- View answers generated by the system-instructor should be able to view answers generated by the system.

**System administrator module**

The system administrator keeps the system running and therefore should have more access than any other user. The administrator should be able to reset passwords and add new users to the system. To achieve this, the following system functions should be available:

- Administrator should be able to from the back end.
- Add new users—should be able to add new users and activate registered examiners.
Table 2. Set questions and answers use case for the proposed system.

<table>
<thead>
<tr>
<th>Use case name</th>
<th>Set questions and answers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor(s)</td>
<td>Examiner</td>
</tr>
<tr>
<td>Description</td>
<td>Set exam questions and answers and insert into database.</td>
</tr>
<tr>
<td>Typical flow of events</td>
<td>Actor action: use case is initiated when the examiner logs in to set exam questions and answers</td>
</tr>
<tr>
<td>Precondition</td>
<td>User has the examiner security level to login and set exams.</td>
</tr>
<tr>
<td>Post conditions</td>
<td>Question answer sets have unique Qn_id.</td>
</tr>
</tbody>
</table>

Table 3. Generate and verify answers use case for the proposed system.

<table>
<thead>
<tr>
<th>Use case name</th>
<th>Generate and verify answers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor(s)</td>
<td>Examiner</td>
</tr>
<tr>
<td>Description</td>
<td>System generates answers and examiner verifies generated answers</td>
</tr>
<tr>
<td>Typical flow of events</td>
<td>Actor actions: Use case initiated when examiner enters answer.</td>
</tr>
<tr>
<td>Alternative</td>
<td>Answers not generated because the specified word does not exist in the dictionary.</td>
</tr>
<tr>
<td>Preconditions</td>
<td>User is has examiner access level.</td>
</tr>
<tr>
<td>Post conditions</td>
<td>User has verified the generated answers and inserted them into the database.</td>
</tr>
</tbody>
</table>

Table 4. Exam use case for the proposed system.

<table>
<thead>
<tr>
<th>Use case name</th>
<th>Take exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor</td>
<td>Student</td>
</tr>
<tr>
<td>Description</td>
<td>User answers the set questions</td>
</tr>
<tr>
<td>Typical flow of events</td>
<td>Actor action: user takes exam answering questions.</td>
</tr>
<tr>
<td>Alternative</td>
<td>Student takes exam or aborts.</td>
</tr>
<tr>
<td>Preconditions</td>
<td>Student should be registered</td>
</tr>
<tr>
<td>Post conditions</td>
<td>User clicks finish to get result or time is up and result is computed.</td>
</tr>
</tbody>
</table>

☐ Update user profiles
☐ Delete user profiles
☐ Reset passwords-administrator should be able to reset password for users who would have forgotten their
Activity diagrams are useful in showing the sequence of activities from the time the user login to the time they logout. The activity diagram (figure 2) shows the events that take place from the time the student logs on takes the exam to the point where they get their result. This diagram concentrates mainly on the activities that take place when the student logs on and no other user.

The activity diagram (figure 2) shows the sequence of activities the student can do when they login into the system. The student can login to register for an exam or they can login to take an exam.

The activity diagram (figure 3) shows the sequence of events that take place when the examiner logs in, the different activities he/she can do.

Ontology design process for the proposed system

The structure of the ontology based electronic dictionary is that similar to Word Net for example, the following is the WorldNet description of one of the senses of gudo in Shona language:

Sense 1
=>gudo,
Figure 3. Proposed Activity diagram for examiner.

Each with its own set of attributes the result being the same format as that in word net:

Class: answer
  ➞ Subclass: synonyms
    ➞ Subclass: antonyms
      ➞ Subclass: derived
        ➞ Subclass: related

Entity –relationship model of the proposed web based assessment system

The E-R model (Figure 5) is used to show the relationship that exists between the different entities in the system.

The E-R diagram (Figure 5) shows the relationships between the different entities and their associated attributes

RESULTS

The marking done by the human examiner and that done by the web based system was analysed using the one sample paired t-test and yielded the following descriptive

Sense 2
  ➞ Mangwanani?
  ➞ Mararasei?
  ➞ Mamakasei?
  ➞ Mavatavakaka here?
  ➞ Kumhorosa,
  ➞ Kumhorosa, mangwanani?
    ➞ entity, something

This type of representation of data specifies the different relations between concepts. For example ‘mangwanani?’ is_a ‘kumhorosa’, ‘mararasei?’ is_a ‘kumhorosa’. If the answer for a question is ‘mangwanani?’ as set by the examiner, if this answer is used to query the ontology based dictionary all the above relations associated with ‘kumhorosa’ are generated as possible answers to the question.

The dictionary is represented as an xml schema for easy implementation in web based systems. In this format the data is divided into classes and subclasses
group statistics for the grade 4 students who participated in the research. Table 5 shows SPSS output for one sample paired t-test carried on to assess the null hypothesis at 5% level of significance.

Table 6 shows the mean values of the teacher marks for the two schools thus School A is Hermann Gmeiner Primary school and School B is Chipindura Primary school.

Table 7 shows the mean values of the web assessment system marks for the two schools.

Figure 6 is a chart that shows the distribution of the marks awarded by the human examiner to the grade four tests.

Figure 7 is a chart that shows the distribution of the marks awarded by the web assessment system to the grade four test.

Table 5 indicates that the mean teacher mark is 11.80 and the mean computer mark is 11.63 which show that there is a small difference between the means and implies that the computer mark from the web based system is not far away from that of the human examiner. This means that the mark obtained by the student in the exam is not dependent on the evaluation method used, that is, the student obtains the same mark by using manual examiner or system examiner. This is also suggested in the two figures above which shows that the mark distribution of the human examiner and that of the web assessment system are almost the same. Table 5 also shows that web assessment system is more accurate than the human examiner because the standard error mean of a computer is far much less than that of the human examiner which is 0.618 compared to 0.637.

Table 8 shows correlation between teacher mark and system mark and it can be deduced from the table that there is highly positive correlations between the teacher mark and the web based computer mark since $r=0.968$. 
**Figure 5.** E-R model of proposed web based assessment system.

**Table 5.** T-test results for grade 4 pupils.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Srd. Error Mwan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Mark</td>
<td>11.80</td>
<td>60</td>
<td>4.933</td>
<td>.637</td>
</tr>
<tr>
<td>Computer Mark</td>
<td>11.63</td>
<td>60</td>
<td>4.787</td>
<td>.618</td>
</tr>
</tbody>
</table>

**Table 6.** Mean values for the teachers per school (Teacher Mark).

<table>
<thead>
<tr>
<th>Schools</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>10.77</td>
<td>30</td>
<td>4.337</td>
</tr>
<tr>
<td>School B</td>
<td>12.83</td>
<td>30</td>
<td>5.337</td>
</tr>
<tr>
<td>Total</td>
<td>11.80</td>
<td>60</td>
<td>4.933</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Although the human criterion of assessment is considered the best way of assessment, Results from this research indicates that using ontologies in web assessment system leads to optimistic improvements in
Table 7. Mean values for the system per school (Computer Mark).

<table>
<thead>
<tr>
<th>Schools</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>School A</td>
<td>10.67</td>
<td>30</td>
<td>4.188</td>
</tr>
<tr>
<td>School B</td>
<td>12.60</td>
<td>30</td>
<td>5.210</td>
</tr>
<tr>
<td>Total</td>
<td>11.63</td>
<td>60</td>
<td>4.787</td>
</tr>
</tbody>
</table>

Figure 6. Human mark distribution.

Figure 7. Web assessment system mark distribution.

Table 8. Paired sample correlations.

<table>
<thead>
<tr>
<th>Pair</th>
<th>N</th>
<th>Correlation</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1: Teacher Mark</td>
<td>60</td>
<td>.968</td>
<td>.00</td>
</tr>
<tr>
<td>and Computer Mark</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
the student's assessment because it is more accurate as compared to the human way of assessment as indicated in the t-test results. The findings suggest that the Shona test which was administered at the two primary schools was marked almost the same by both the human teachers and the ontology based web assessment system. This goes on to show that the aspects of artificial intelligence incorporated by the use of ontology preserve the human aptitudes like leniency in a web assessment system so much that it can mark just like the human examiner does. This supports and adds to the findings of Colace et al [10] and Kovatcheva and Nikolov [11] who showed similar results for introducing ontologies in web assessment. This study has taken a step further in justifying that objective assessment which concentrate more on multiple choice type of questions does not assess like the human examiner do instead introduction of ontologies improves the assessment method [1]. The results shown above shows us that if ontologies are incorporated the online assessment can become lenient and judgmental just like the human examiners. The approach outlined in this study should be replicated with other students in other subject areas, as well as at other levels in order to be able to recommend the use of ontology based assessment systems for all students in all subject areas.

Conclusion

In this paper, a system that supports the assessment of students’ exams has been presented. This system makes use of semantic web technologies to achieve its goal. In order to face important problems concerning evaluation of open questions, a solution has been described that allows for simplifying and improving evaluation processes. In particular, the solution proposes the use of ontologies for performing several activities for a defined domain. The main challenge for such systems is the complexity that is accompanied by free use of words without restrictions; in the system under review the system restricts the answers to short word answers. Further study should be done in wider implementation of ontology based dictionaries whereby both answers from the examiner and answers from the student are both used to query the ontology. There is also need to try and implement ontology based systems in tertiary education where we have courses which are a bit demanding.

REFERENCE