Automatic Usability Evaluation on Educational Websites using Data Mining Methods

DECLARATION

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name: 
Signature: 
Date: 2013/8/25
Automatic Usability Evaluation on Educational Websites using Data Mining Methods

Prepared By: Ibrahim M. Abu-Zaid
Supervised By: Dr. Alaa El-Halees

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science In Information Technology

2013
نتيجة الحكم على أطروحة ماجستير

بناءً على موافقة عمادة الدراسات العليا بالجامعة الإسلامية بغزة على تشكيل لجنة الحكم على أطروحة الباحث/ إبراهيم محمود إبراهيم أبو رزق لدرجته الماجستير في كلية تكنولوجيا المعلومات برنامج تكنولوجيا المعلومات وموضوعها:

تقييم سهولة استخدام المواقع التعليمية آليًا باستخدام تقنيات تنقيب البيانات

Automatic Usability Evolution on Educational Websites using Data Mining Methods

وبعد المناقشة التي تمت اليوم الاثنين 05 شوال 1434هـ الموافق 12/08/2013م الساعة الحادية عشرة صباحًا، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

د. علاء مصطفى الهليس
د. توفيق سليمان برهوم
أ.د. سامي سليم أبو ناصر

وبعد المداولات، أوصت اللجنة بمنح الباحث درجة الماجستير في كلية تكنولوجيا المعلومات برنامج تكنولوجيا المعلومات.

واللجنة إذ تمنح هذه الدرجة فإنها توصية بتبقى الله ولزوم طاعته وأن يسخر علمه في خدمة دينه ووطنه.

والله وإلى الله...

مساعد نائب الرئيس للدراسات العليا

أ.د. فؤاد علي المحاجر
"وقَل رَبِّ زَدْنِي عِلْماً"
سورة طه: 114

"فَأَمَّا الزَّبَدُ فِيذَهَبُ جَفَاةً وَأَمَّا مَا يَنْفَعُ النَّاسَ فِيمَكْتُ فِي الأَرْضِ"
سورة الرعد: 17
Dedication

To my beloved father
To my beloved mother
To my beloved wife
To my beloved sons
To sisters and brothers
To my best friends
Acknowledgements

All praise is to Allah........

Many thanks and sincere gratefulness goes to my supervisor Dr. Alaa El-Halees, without his help, guidance, and continuous follow-up; this research would never have been.

I would like to extend my thanks to the academic staff of the Faculty of Information Technology who helped me during my master’s study and taught me different courses.

I would like to thank the officials in Alazhar University - Gaza and faculty of intermediate college -Gaza for full collaboration.

Last but not least, I am greatly indebted to my family for their support during my course studies and during my thesis work.
Abstract

The Web is playing a major role in various application domains such as business, education, engineering and entertainment. As a result, there are increasing interests in designing and developing an effective and usable websites to deliver high degree of quality. A university website is a gateway to its information, services and about their courses and programs, delivering online learning facilities and assignments. University websites are used by students, faculty, researchers, librarians and members of the public, from information novices to power users. As such, it should ideally be a reflection of the needs of the users it serves; more universities are creating their own web pages to create awareness and promoting university services to the user community. Only a small percentage of these websites reach far above the ground level in satisfying their users’ needs. Despite the fact that many academic websites do not satisfy their users’ needs, the institutions’ reliance on using these websites for a wide variety of tasks is increasing.

Therefore, we need to evaluate the usability of websites, in a usability evaluation, problem are predicted that users will have with the Website. A usability test with representative users tells whether the predictions are valid or not.

In this research, we propose an approach to automatic usability evaluations of universities website by using data mining method. We conducted two experiments to evaluate universities website, the first experiment by using a questionnaire directed towards students of these website such as (Use of color, Display space, Scroll left and right) and the second by use automatic tools that used to measure task scenario of the website attributes which cannot be perceived by students such as (Task time, Number of clicks and Number of pages). We carried out our approach on two universities Alazhar University –Gaza and faculty of intermediate college –Gaza. Our approach is implemented using machine learning tool and exploits Association rules through data mining method to evaluate usability on universities website. The results show that the proposed approach generated strong rules of automatic evaluation for the two universities; finally we give some useful recommendations for universities.

Keywords: Data Mining, Evaluation, Association Rules, Usability
عنوان البحث
تقييم سهولة استخدام المواقع التعليمية آلياً باستخدام تقنيات تنقية البيانات

ملخص البحث
تلعب مواقع الإنترنت دوراً كبيراً في مختلف المجالات مثل التجارة، التعليم، الهندسة والتربية، ونتيجة لذلك هناك تزايد في تصميم وتطوير مواقع الإنترنت لتقديم فعالية وسهولة الاستخدام لجميع المستخدمين.

المواقع التعليمية الإلكترونية تعتبر بوابة المعلومات والخدمات الإلكترونية التي يستخدمها الطلاب والأكاديميين والباحثين ومستخدمين المكتبات والزائرين من المبتدئين والمتمرسين في استخدام المواقع التعليمية، ونتيجة لذلك يجب أن تكون نتائج المشاريع المستخدمين وخدماتهم جزءاً من إغلب الجامعات وتوفي صفحاتها الإلكترونية لخلق الوعي وتزويد الجامعة من خلال المستخدمين لها.

هناك نسبة عالية من مواقع الجامعات الإلكترونية تصل إلى مستوى جيد في إعطاء حماية للمستخدمين، وعلى الرغم من أن العديد من المواقع الإلكترونية لا ترضي حاجات المستخدمين، ونجد استخدام المؤسسات التعليمية على المواقع الإلكترونية يتزايد لأنجاز المهام المختلفة.

لذلك نحتاج إلى تقييم سهولة الاستخدام للمواقع الإلكترونية، وإشراف سهولة الاستخدام. يتيح لنا التوقعات إذا كانت صحيحة أم خاطئة.

في هذا البحث، اقترحنا استراتيجية منهجية للتنقيح سهولة الاستخدام لمواعظ الجامعات الإلكترونية باستخدام تقنيات تنقية البيانات. وقد أجرينا تجربة لتقييم مواقع الجامعات الإلكترونية التجارية الأولى، باستخدام استبيان موجه نحو الطلاب المستخدمين للمواقع الإلكترونية مثل: استخدام اللون، سهولة العرض (الانتقال لليمين واليسار)، والتحديات التكنولوجية. واستخدام أدوات لقياس سهولة الاستخدام، لتقييم سيناريو مهمته معرفة وقياس خصائص المواقع الإلكترونية.

وقت البدء: 1.3
وقت المراقبة: 2
عدد المشاركين: 2
عدد الصفحات: 5

لقد نفذنا منهجيتنا على جامعتين (جامعة الأزهر - نصر، كلية الدراسات المتوسطة - نصر)، وطبقنا منهجيتنا باستخدام أداة التقييم، واستخراج القواعد عن طريق تقنية تنقية البيانات لتقديم سهولة الاستخدام لمواعظ الجامعات الإلكترونية.

وتظهر النتائج بأن المنهجية المستخدمة انتجت لنا قواعد قوية للتنقيح الآلي لسهولة الاستخدام على الجامعتين. وفي النهاية نقدم بعض التوصيات المفيدة للجامعات.

كلمات مفتاحية: تنقية البيانات، التقييم الآلي، سهولة الاستخدام.
# Table of Contents

<table>
<thead>
<tr>
<th>Dedication</th>
<th>.ii</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgment</td>
<td>iii</td>
</tr>
<tr>
<td>Abstract</td>
<td>.iv</td>
</tr>
<tr>
<td>List of Figures</td>
<td>viii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>ix</td>
</tr>
<tr>
<td>List of Abbreviations</td>
<td>Xi</td>
</tr>
<tr>
<td><strong>Chapter 1: Introduction</strong></td>
<td></td>
</tr>
<tr>
<td>1.1 Usability Evaluation</td>
<td>2</td>
</tr>
<tr>
<td>1.2 Data Mining</td>
<td>4</td>
</tr>
<tr>
<td>1.3 The problem statement</td>
<td>5</td>
</tr>
<tr>
<td>1.4 Objectives</td>
<td>5</td>
</tr>
<tr>
<td>1.5 Importance of research</td>
<td>6</td>
</tr>
<tr>
<td>1.6 Scope and Limitations</td>
<td>6</td>
</tr>
<tr>
<td>1.7 Research Methodology</td>
<td>6</td>
</tr>
<tr>
<td>1.8 Thesis Structure</td>
<td>9</td>
</tr>
<tr>
<td><strong>Chapter 2: Theoretical Foundation</strong></td>
<td>10</td>
</tr>
<tr>
<td>2.1 Usability testing</td>
<td>11</td>
</tr>
<tr>
<td>2.2 Data Mining</td>
<td>16</td>
</tr>
<tr>
<td><strong>Chapter 3: Related Works</strong></td>
<td>28</td>
</tr>
<tr>
<td>3.1 Usability testing in website</td>
<td>29</td>
</tr>
<tr>
<td>3.2 Usability testing in university websites</td>
<td>32</td>
</tr>
<tr>
<td>3.3 Usability testing by using data mining technique</td>
<td>34</td>
</tr>
<tr>
<td>3.4 Conclusion</td>
<td>35</td>
</tr>
<tr>
<td><strong>Chapter 4: Research Methodology</strong></td>
<td>36</td>
</tr>
<tr>
<td>4.1 Investigating the best metrics of usability test for educational websites</td>
<td>37</td>
</tr>
<tr>
<td>4.2 Data Acquisition</td>
<td>41</td>
</tr>
<tr>
<td>4.3 Collect data sets from testers, and from the tools</td>
<td>48</td>
</tr>
<tr>
<td>4.4 Determine data mining method</td>
<td>50</td>
</tr>
<tr>
<td>4.5 Evaluation</td>
<td>53</td>
</tr>
<tr>
<td><strong>Chapter 5: Experiments Description</strong></td>
<td>54</td>
</tr>
<tr>
<td>5.1 Experiments Setup</td>
<td>55</td>
</tr>
<tr>
<td>5.2 Experimental cases</td>
<td>56</td>
</tr>
<tr>
<td>5.2.1 Alazhar University – Gaza</td>
<td>56</td>
</tr>
<tr>
<td>5.2.2 Faculty of intermediate college</td>
<td>63</td>
</tr>
<tr>
<td><strong>Chapter 6: Results and Discussions</strong></td>
<td>68</td>
</tr>
<tr>
<td>6.1 Questionnaire experiment in Alazhar University Gaza</td>
<td>69</td>
</tr>
<tr>
<td>6.2 Task scenario experiment in Alazhar University Gaza</td>
<td>78</td>
</tr>
<tr>
<td>6.3 Questionnaire experiment in Faculty of intermediate college</td>
<td>82</td>
</tr>
<tr>
<td>6.4 Task scenario experiment in Faculty of intermediate college</td>
<td>88</td>
</tr>
<tr>
<td>Chapter 7: Recommendations and Future works</td>
<td>92</td>
</tr>
<tr>
<td>7.1 Summary</td>
<td>93</td>
</tr>
<tr>
<td>7.2 Conclusions</td>
<td>93</td>
</tr>
<tr>
<td>7.3 Recommendations</td>
<td>95</td>
</tr>
<tr>
<td>7.4 Future works</td>
<td>98</td>
</tr>
<tr>
<td>References</td>
<td>99</td>
</tr>
<tr>
<td>Appendix</td>
<td></td>
</tr>
</tbody>
</table>
## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1.1</td>
<td>The steps of implement the usability testing approach</td>
<td>7</td>
</tr>
<tr>
<td>Figure 2.1</td>
<td>The Knowledge Discovery Process</td>
<td>17</td>
</tr>
<tr>
<td>Figure 2.2</td>
<td>Data mining as a step in the process of knowledge discovery</td>
<td>19</td>
</tr>
<tr>
<td>Figure 2.3</td>
<td>Apriori Algorithm</td>
<td>24</td>
</tr>
<tr>
<td>Figure 2.4</td>
<td>Partition Algorithm</td>
<td>25</td>
</tr>
<tr>
<td>Figure 2.5</td>
<td>SETM Algorithm</td>
<td>25</td>
</tr>
<tr>
<td>Figure 2.6</td>
<td>Procedure FP growth</td>
<td>27</td>
</tr>
<tr>
<td>Figure 3.1</td>
<td>The steps of evaluate web site</td>
<td>31</td>
</tr>
<tr>
<td>Figure 4.1</td>
<td>The steps of implement the usability testing approach</td>
<td>37</td>
</tr>
<tr>
<td>Figure 5.1</td>
<td>The value of min support in the questionnaire experiment</td>
<td>58</td>
</tr>
<tr>
<td>Figure 5.2</td>
<td>The value of min confidence in the questionnaire experiment</td>
<td>58</td>
</tr>
<tr>
<td>Figure 5.3</td>
<td>The main process of FP-growth method in RapidMiner tools</td>
<td>58</td>
</tr>
<tr>
<td>Figure 5.4</td>
<td>The main process of FP-growth method in RapidMiner tool</td>
<td>62</td>
</tr>
<tr>
<td>Figure 5.5</td>
<td>The main process of FP-growth method in RapidMiner tool</td>
<td>65</td>
</tr>
</tbody>
</table>
## List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 3.1</td>
<td>Comparison between on line tools and task scenario tools</td>
<td>35</td>
</tr>
<tr>
<td>Table 4.1</td>
<td>The proposed metrics</td>
<td>38</td>
</tr>
<tr>
<td>Table 4.2</td>
<td>The information's about academic reviewed</td>
<td>40</td>
</tr>
<tr>
<td>Table 4.3</td>
<td>The attributes of questionnaire data set</td>
<td>41</td>
</tr>
<tr>
<td>Table 4.4</td>
<td>The questions in the web application questionnaire</td>
<td>42</td>
</tr>
<tr>
<td>Table 4.5</td>
<td>The scenario tasks in the evaluations of Alazhar University</td>
<td>46</td>
</tr>
<tr>
<td>Table 4.6</td>
<td>The scenario tasks in the evaluations of faculty of intermediate college</td>
<td>46</td>
</tr>
<tr>
<td>Table 4.7</td>
<td>The best effective attributes in task scenario</td>
<td>48</td>
</tr>
<tr>
<td>Table 4.8</td>
<td>The attributes from university programs</td>
<td>50</td>
</tr>
<tr>
<td>Table 5.1</td>
<td>The environment of the experiments</td>
<td>55</td>
</tr>
<tr>
<td>Table 5.2</td>
<td>Student's cumulative rate</td>
<td>56</td>
</tr>
<tr>
<td>Table 5.3</td>
<td>Student level</td>
<td>56</td>
</tr>
<tr>
<td>Table 5.4</td>
<td>College name</td>
<td>57</td>
</tr>
<tr>
<td>Table 5.5</td>
<td>Student's cumulative rate</td>
<td>59</td>
</tr>
<tr>
<td>Table 5.6</td>
<td>Student's levels</td>
<td>60</td>
</tr>
<tr>
<td>Table 5.7</td>
<td>Student's cumulative rate</td>
<td>60</td>
</tr>
<tr>
<td>Table 5.8</td>
<td>The number of mouse clicks</td>
<td>60</td>
</tr>
<tr>
<td>Table 5.9</td>
<td>The number of page open</td>
<td>60</td>
</tr>
<tr>
<td>Table 5.10</td>
<td>The time of task scenario</td>
<td>61</td>
</tr>
<tr>
<td>Table 5.11</td>
<td>The total time of five scenarios tasks</td>
<td>61</td>
</tr>
<tr>
<td>Table 5.12</td>
<td>Confirmation task</td>
<td>61</td>
</tr>
<tr>
<td>Table 5.13</td>
<td>Student's cumulative rate</td>
<td>63</td>
</tr>
<tr>
<td>Table 5.14</td>
<td>Student Levels</td>
<td>64</td>
</tr>
<tr>
<td>Table 5.15</td>
<td>College name</td>
<td>64</td>
</tr>
<tr>
<td>Table 5.16</td>
<td>Student's cumulative rate</td>
<td>66</td>
</tr>
<tr>
<td>Table 5.17</td>
<td>Student levels</td>
<td>66</td>
</tr>
<tr>
<td>Table 5.18</td>
<td>College name</td>
<td>66</td>
</tr>
<tr>
<td>Table 5.19</td>
<td>Number of mouse clicks</td>
<td>66</td>
</tr>
<tr>
<td>Table 5.20</td>
<td>Number of page open</td>
<td>67</td>
</tr>
<tr>
<td>Table 5.21</td>
<td>The time of task scenario</td>
<td>67</td>
</tr>
<tr>
<td>Table 5.22</td>
<td>The total time of five scenarios tasks</td>
<td>67</td>
</tr>
<tr>
<td>Table 5.23</td>
<td>Confirmation task</td>
<td>67</td>
</tr>
<tr>
<td>Table 6.1</td>
<td>The Strength of Alazhar University website (questionnaire experiment)</td>
<td>69</td>
</tr>
<tr>
<td>Table 6.2</td>
<td>The Weakness of Alazhar University website (questionnaire experiment)</td>
<td>73</td>
</tr>
<tr>
<td>Table 6.3</td>
<td>The Strength of Alazhar University website (Task scenario)</td>
<td>78</td>
</tr>
<tr>
<td>Table 6.4</td>
<td>The Weakness of Alazhar University website (Task scenario)</td>
<td>80</td>
</tr>
<tr>
<td>Table 6.5</td>
<td>The Strength of faculty of intermediate college website (questionnaire experiment)</td>
<td>82</td>
</tr>
<tr>
<td>Table 6.6</td>
<td>The Weakness of faculty of intermediate college website (questionnaire experiment)</td>
<td>85</td>
</tr>
<tr>
<td>Table 6.7</td>
<td>The Strength of faculty of intermediate college website (Task scenario)</td>
<td>88</td>
</tr>
<tr>
<td>Table 6.8</td>
<td>The Weakness of faculty of intermediate college website (Task scenario)</td>
<td>89</td>
</tr>
</tbody>
</table>
List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>KDD</td>
<td>Knowledge Discovery in Databases</td>
</tr>
<tr>
<td>DM</td>
<td>Data Mining</td>
</tr>
<tr>
<td>ML</td>
<td>Machine Learning</td>
</tr>
<tr>
<td>RWD</td>
<td>Responsive Web Design</td>
</tr>
<tr>
<td>AR</td>
<td>Association Rules Method</td>
</tr>
<tr>
<td>TM</td>
<td>Text Mining</td>
</tr>
<tr>
<td>FR</td>
<td>Frequent Pattern</td>
</tr>
<tr>
<td>HE</td>
<td>Heuristic Evaluation</td>
</tr>
<tr>
<td>MUG</td>
<td>Microsoft Usability Guideline</td>
</tr>
<tr>
<td>WDP</td>
<td>Web Design Perspectives-based</td>
</tr>
</tbody>
</table>
CHAPTER 1

Introduction
The Web is playing a main role in diverse application domains such as business, education, industry and entertainment. As a result, there are increasing concerns about the ways in which websites are developed and the degree of quality delivered. Developing a website should be passed through several design guidelines to ensure that the website can achieve the purposes and goals intended to be accomplished. Unfortunately, website design is often driven by technology, organizational structure or business objectives, rather than by user's needs [15].

With the rapid of information technology and developing a huge number of web sites, we have to evaluate these systems depend on the need of customers; the most important issue to evaluate the system from the customer perspective of usability [12].

1.1 Usability Evaluation:

The term usability was coined some 32 years ago in order to replace the term “user friendly” which by the early 1980s had acquired a host of undesirably vague and subjective connotations. However, in the intervening years, the word usability itself has become almost as devalued as the term it was intended to supplant. There are still many different approaches to making a product usable, and no accepted definition of the term usability [20].

Definition 1: Usability as defined by ISO 9241-11, is “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” [35].

Definition 2: Usability evaluation is a technique used in user centered interaction design to evaluate a product by testing it on users. This can be seen as an irreplaceable usability practice, since it gives direct input on how real users use the system. This is in contrast with usability inspection methods where experts use different methods to evaluate a user interface without involving users [9].

Definition 3: Usability evaluation is a technique for ensuring that the intended users of a system can carry out the intended tasks efficiently, effectively and satisfactorily [47].

1.1.1 important of Usability Evaluation:

The study of user behavior on the Web shows that they do not perceive the slow sites and sites with complex designs. People do not want to wait. Also, they do not want to learn how to use the home page. There are no such things as web-site training or instructions for the website. Usability evaluation is part of a larger effort to improve the profitability of products. There are many aspects to doing so, which in the end also benefits users greatly: design decisions are informed by data gathered from representative users to expose design issues so they can be remedied, thus minimizing or eliminating frustration for users [19].
a-Eliminating Design Problems and Frustration:

One side of the profitability coin is the ease with which customers can use the product. When you minimize the frustration of using a product for your target audience by remedi ing flaws in the design ahead of product release, you also accomplish these goals:

- Set the stage for a positive relationship between your organization and your customers.
- Establish the expectation that the products your organization sells are high quality and easy to use.
- Demonstrate that the organization considers the goals and priorities of its customers to be important.
- Release a product that customers find useful, effective, efficient, and satisfying.

b- Improving Profitability:

Goals or benefits of testing for your organization are:

- Creating a historical record of usability benchmarks for future releases. By keeping track of test results, a company can ensure that future products either improve on or at least maintain current usability.
- Standards.
- Minimizing the cost of service and support calls. A more usable product will require fewer service calls and less support from the company.
- Increasing sales and the probability of repeat sales. Usable products create happy customers who talk to other potential buyers or users.
- Happy customers also tend to stick with future releases of the product, rather than purchase a competitor’s product.

c-The customer’s benefits at a glance:

- Increased efficiency of applications use.
- Reducing of application study time by end users.
- Reducing of you resources required for usability testing.

1.1.2 Goals of Usability Evaluation:

Goal of evaluation is to satisfy users and it mainly concentrates on the following parameters of a system:

- Effectiveness of the system
  The degrees to which objectives are achieved and the extent to which targeted problems are solved. In contrast to efficiency, effectiveness is determined without reference to costs and, whereas efficiency means “doing the thing right”, effectiveness means “doing the right thing”.

-
- **Efficiency**
  - Navigation required to reach desired screen/webpage should be very less.
  - Uniformity in the format of screen/pages in your application/website.
  - Provision to search within your software application or website

- **Accuracy**
  - The website has no outdated or incorrect data like contact information/address should be present.
  - The website has no broken links should be present.

- **User Friendliness**
  - Controls used should be self-explanatory and must not require training to operate.
  - Help should be provided for the users to understand the application website.
  - Alignment with above goals helps in effective usability testing.

1.2 **Data Mining:**
In this research we try to automatically evaluate educational web sites using Data Mining techniques.

**Data Mining (DM)** is a discipline which involves the nontrivial extraction of implicit, previously unknown, and potentially useful information from data [33]. DM can be formalized as a process in which data coming from (possibly) sources, in which features or attributes are identified. The extraction can be modeled as a process in which different steps [24][33] can be identified:

- **Data preprocessing:** This first step condenses a number of intermediate steps required to prepare data for the mining task, such as data cleaning, integration, selection and transformation.

- **Data Processing:** Once data has been preprocessed and condensed in a database, data mining techniques can be applied in order to extract relevant patterns from it.

- **Pattern evaluation and knowledge representation:** Different criteria (e.g. interest measures) are applied to evaluate the patterns obtained as an output of the data mining algorithms.

In this research, we propose an approach called Automatic Usability Evaluation on University Websites using Data Mining Methods that uses to achieve a best evaluation for the system by using data mining methods, in data mining we can get the best solutions about our problem for automatic usability testing for web sites. This gives us a more accurate and fast performance, and with a little efforts.

We will create a new approach to replace a traditional usability testing to automatic usability testing by using data mining techniques.

The website of universities in the world are the most important sites visited by the thousands of students and teachers every day because they contain many services that used by student, teacher and the visitor, therefore the universities website must be easy to
use [25]. These universities are the main gate of many academic users, so we must find a mechanism to evaluate the usability of using these websites. There are a lot of opinions and interpretations to evaluate the usability of universities Website, we have focused on the opinions of students to evaluate the website, using the Data Mining can extract knowledge and relationships that benefit us in the evaluation process. Data Mining is useful to find automatic mechanism to evaluate the university websites to reach the accurate, speed, and high performance of usability.

1.3 The problem statement:

We want all of our websites to be used easily, without defects, where everyone is aware and informed of the outcomes of usability testing. However, today we have too many release failures that result in too many rollback failures. If we ignore this problem; resources will need to increase to handle the cascading problems. And “Only a small percentage of these websites reach far above the ground level in satisfying their users’ needs” [47], so we need to test educational website to ensure effectiveness (support and confidence).

But human usability testing of educational web sites is subjective, hard, time consuming and not accurate, and the educational websites are very important because they contain many services are used by users, therefore the educational website must be easy to use

The sub problems we face are:

1 - What are the best metrics that we shall use to evaluate the university websites?
2 - What are the best tools that we shall use to evaluate some technical metrics of university sites?
3 - How can we collect the data set from users?
4 - What are the proper preprocessing steps are performed on the data sets before it is used for analysis?
5 - What are the best data mining methods to be used to evaluate the university websites?
6 - How to evaluate the performance of the proposed approach?

1.4 Objectives:

1.4.1 Main objective:
The main objective in this research is to find an automatic way to evaluate the usability of the educational web sites by creating an approach based on data mining methods.

1.4.2 Specific objectives:
1- Investigate the best metrics of usability test for educational websites.
2- Using the metrics for test the site by set of testers (students) and some tools.
3- Collect data set (the answers) from testers, and from the tools.
4- Investigating of data mining methods to extract useful knowledge from our data set to automatic usability test of the systems.
5- Evaluation: we will use two important measures to evaluate the metrics for our generated association rules which are support and confidence.

1.5 Importance of research:

If we want efficient Web site, we must test its usability. And we should mention that if no one has complained about the website doesn't mean that all your visitors are using your site effectively, efficiently and to their full satisfaction.

But manual usability testing (by human) requires lots of time, effort and not accurate. The researcher developing new approach about usability testing for educational universities and we will be applied to the Alazhar university-Gaza site and Faculty of intermediate college-Gaza as two cases for automatic usability testing by using data mining methods to enhanced the usability testing to overcome the human usability testing that have no accurate results and need more efforts.

1.6 Scope and Limitations:

The outcome of the research will be new approach for applying data mining methods to automatic usability testing for a university websites.

In the research we have some of limitations such as
- Select Alazhar University -Gaza for our Research and Faculty of intermediate college as a sample of Palestinian universities.
- We will use as possible as built tools for collecting data, preprocessing and data mining.
- We concentrate on objective data.
- We consider only students as users, since they are the majority of users.

1.7 Research Methodology:

To accomplish the objectives of the research, the following methodology will be followed (see Figure 1.1):
a) **Determine the best metrics of usability testing**

There are a large number of metrics for usability testing; these metrics may be user’s metrics and technical metrics, for more focus in this research need to find the best metrics for educational websites.

**The first metrics** (Users metrics) will be used to ask the students whose using the universities websites to test the usability, for example (Access to home page, Friendly interface, Text design, Number of elements in menus).

Usability evaluation methods that are conducted by human intervention (users and experts) can assess only the users attributes of the website (such as readability of the contents of the website).

**The second metrics** depend on the technical attributes that the users cannot evaluate such as (time of using website, Number of mouse clicks, Number of open pages, Number of error pages).

Before using the metrics in the research we will ask two academic expertise’s to ensure that we determined the best metrics to evaluate the usability of the educational sites.

b) **Testing the site by set of testers**

After determining the best metrics from a previews step, we have two approach of the testing:

**The first** is conducting a questioners’ for the students (testers): The students answer all the questions (as a simple and electronic question), for example:
- I can easily find what I want at this website?
- I can access this website any time.?
- Do you know your financial record by Website?
The second step is using some tools to test the technical metrics of website that can measure:

- Time of using website.
- Number of mouse clicks.
- Number of open pages.
- Number of error pages.

c) Collect data set (the answers) from testers

In the research, the data set that is needed to test the website are collecting from the testers answers of the question's from previews step and from the tools, these objectives answers are the main backbone of the research, because the usability testing depend on opinion of testers.
This dataset will be inserted and automatic prepossessing operations will be applied such as:
- Select effective attributes.
- Replace missing values.
- Integration between (Questioners, Tool).

This prepossessing operation is very important to ensure the accurate of data set to reach accurate and effective results when applying data mining algorithms.

d) Investigating of data mining methods for extracting useful knowledge from our data set to automatic usability test of the systems

Data mining methods are the backbone of our approach in the research, to extract the useful and meaningful knowledge about the usability testing from students whose test the usability of site.
In the research, we try to find and implement some of data mining methods, finally after applying this method on our data set we must extract useful and meaningful knowledge about the usability testing of the university site.

e) Evaluations

In this phase, we will analyze the obtained results and justify the feasibility of our approach.
**1.8 Thesis Structure**

This thesis consists of seven mainly chapters, which are structured around the objectives of the research. The main points discussed throughout the chapters are listed below:

**Chapter 1: Introduction:** It gives a short introduction about usability testing for university web sites, the thesis problem and objectives.

**Chapter 2: Theoretical Foundation:** Presents Literature Review of usability testing for websites. Also, this chapter presents details about data mining methods used on “Automatic Usability Evaluation on University Websites using Data Mining Methods” approach.

**Chapter 3: Related Works:** It presents other works related to the thesis.

**Chapter 4: Research Proposal and Methodology:** Includes the methodology steps and the architecture of the “Automatic Usability Evaluation on University Websites using Data Mining Methods” approach. An explanation about the data sets used in the experiments, preprocessing of these data set, and the experiment cases are included as well.

**Chapter 5: Experiments Description:** It gives in detail about the sets of experiments, for Alazhar university-Gaza and Faculty of intermediate college-Gaza

**Chapter 6: Results and Discussions:** analyzes the experimental results. In addition, it gives a discussion for each of set experiments.

**Chapter 7: Recommendations and future works:** It discusses the final conclusions and presents possible future works, finally we gives some useful recommendations about thesis.
CHAPTER 2

Theoretical Foundation
The main categories for this thesis are usability evaluation and data mining, therefore this Chapter is divided into two main sections; the first section usability testing that includes usability testing methods, ways of usability testing, usability testing data formats, manual and automatic evaluation testing, and usability quality factors. The second section is data mining methods and techniques that includes descriptions about data mining methods.

2.1 Usability Testing

Usability testing is a technique used to evaluate a product (in this case a website) by testing by users. Most people who set up a usability test carefully construct a scenario where in a person performs a list of tasks that someone who is using the website for the first time is likely to perform. Someone else observes and listens to the person who is performing the tasks while taking notes. Watching someone perform common tasks on a website is a great way to test whether the site is usable because you will immediately be able to see whether they are able to perform the tasks and any difficulties they have while doing so [19].

2.1.1 Categories of usability testing

There are three main categories of usability testing: [58]

- **Explorative**: Used early in product development to assess the effectiveness and usability of a preliminary design or prototype, as well as users’ thought processes and conceptual understanding.
- **Assessment**: Used midway in product development or as an overall usability test for technology evaluation. Evaluates real-time trials of the technology to determine the satisfaction, effectiveness, and overall usability.
- **Comparative**: Compares two or more instructional technology products or designs and distinguishes the strengths and weaknesses of each.

In our research we will use a mix between two categories of usability testing, we will use assessment category to evaluate the university website by conducting two experiments and we will use comparative category to distinguish the strengths and weaknesses of the website universities.

2.1.2 Types of usability testing methods

The following is a brief description of the main usability testing methods that are used to evaluate websites:

- **Hallway Testing**: Using random people to test the website rather than people who are trained and experienced in testing websites. This method is particularly effective for testing a new website for the first time during development [58].
- Remote Usability Testing: Testing the usability of a website using people who are located in several countries and time zones. Sometimes remote testing is performed using video conferencing, while other times the user works separately from the evaluator. Nowadays, there are various software available at a relatively low cost that allow remote usability testing to be carried out even by observers who are not usability experts. Typically, the click locations and streams of the users are automatically recorded and any critical incidents that occurred while they were using the site are also recorded, along with any feedback the user has submitted. Remote usability testing allows for the length of time it took each tester to complete various tasks to be recorded. It is a good method of testing because the tests are carried out in the normal environment of the user instead of a controlled lab [58].

- Expert Review: An expert in the field is asked to evaluate the usability of the website. Sometimes the expert is brought to a testing facility to test the site, while other times the tests are conducted remotely and automated results are sent back for review. Automated expert tests are typically not as detailed as other types of usability tests, but their advantage is that they can be completed quickly [58].

- Paper Prototype Testing: Quite simply, this usability testing method involves creating rough, even hand-sketched, drawings of an interface to use as prototypes, or models, of a design. Observing a user undertaking a task using such prototypes enables the testing of design ideas at an extremely low cost and before any coding has been done [58].

- Questionnaires and Interviews: Due to their one-on-one nature, interviews enable the observer to ask direct questions to the users (apart from double checking what they are really doing). Similarly, the observer can also ask questions by means of questionnaires. The advantage of questionnaires is that they allow more structured data collection. However, they are rigid in nature as opposed to interviews [58].

- Do-it-Yourself Walkthrough: Just as the name implies, in this technique, the observer sets up a usability test situation by creating realistic scenarios. He or she then walks through the work themselves just like a user would. A variation of this technique is the group walkthrough where the observer has multiple attendees performing the walkthrough [58].

- Automated Usability Evaluation: Probably the Holy Grail of usability testing. Various academic papers and prototypes have been developed in order to try and automate website usability testing, all with various degrees of success [58].

- Heuristic Evaluation (HE): A heuristic evaluation is a usability inspection method for computer software that helps to identify usability problems in the user interface (UI) design. It specifically involves evaluators examining the interface and judging its compliance with recognized usability principles (the "heuristics") The main goal of heuristic evaluations is to identify any problems associated with the design of user interfaces [22].
In our research we will use two different types of usability testing methods; we will use questionnaire method by conducting web application questionnaire and Do-it-Yourself walkthrough method by conducting tasks scenario experiment for university website.

2.1.3 Ways of usability testing

There are three core ways of running usability testing [56]:

**Lab-Based:** Lab usability testing measure a user’s ability to complete tasks. In a typical usability test, a user attempts to complete a task or set of tasks using a web site (or software or a product).

Each of these tasks has a specified goal with effectiveness, efficiency and satisfaction identified in a specified context of use.

The benefits of lab usability testing are really great at getting close to a customer and really observing them, and even interacting with them. But the reality is that 99% of us will complete our employment with a company never having seen a real customer (and all the while we are supposed to be solving for them). This is a amazingly eye opening experience for everyone involved (no matter how much you do it)

**Remote Moderated:** Remote usability testing is a method of website usability testing when the user is in a different location to the researcher. A test can be moderated by the researcher watching and interacting with the test participant using internet screen sharing tools and a telephone connection.

Moderated remote usability testing is used to gain insight into the barriers users face when completing typical tasks with a website. The key aspect of remote testing is that it offers a researcher and the participant the ability to test from their own location. This provides a realistic user environment compared to the less natural environments often used for traditional user testing.

Remote testing can also recruit participants live when they enter the website. When using the live recruiting method researchers can catch people at the beginning of their journey with the site, ask them to share their screen, and then watch how they complete their journey. This is a critical difference with traditional lab based usability which places participants in an unfamiliar environment and asks them to perform pre-defined tasks[59].

**Advantages of Remote Moderated:** [59]

- Time and cost savings over hiring a professional usability lab
- Easier to recruit participants as they do not have to travel to the research facility
- Participants can conduct the test in their natural environment which can offer key insights into true behavior.
- Offers the ability to test higher numbers of participants per day compared with lab based testing.
- Researchers can test the locations of people from various geographical regions from a single location.
Remote Unmoderated:

Unmoderated usability testing lets you do test sessions with hundreds of people simultaneously, in their natural environment, which, in turn, provides quantitative and even some qualitative data. The exact metrics and feedback you can collect vary, depending on the tool you use. Most unmoderated testing tools can gather the following quantitative data (task-completion rate, time on task, time on page, clickstream paths, satisfaction ratings or opinion rankings, Web analytics data such as browser, operating system, and screen resolution) [19][59].

Most of these tools can also capture qualitative feedback as users complete their task such as users’ suggestions and comments. This is where the true value of unmoderated usability testing can come into play. Some unmoderated testing tools can recruit users for tests by intercepting them on your live Web site. This lets you collect invaluable data on participants’ true intent and motivation for visiting your Web site [19][59].

In our research we will use Remote Unmoderated usability testing way, by using unmoderated testing tools to collect and gather quantitative data such as (task time, number of mouse clicks, number of pages open).

2.1.4 Usability testing data formats

Usability evaluations gather both subjective and objective quantitative data in the context of realistic scenarios-of-use, as well as descriptions of the problems representative participants have trying to complete the scenarios. There are two core data format of usability testing [38]:

Subjective Evaluation:
Subjective data are measures of participants' opinions or attitudes concerning their perception of usability. Subjective measures include the Cooper-Harper scale, Sheridan's dimensional scale, and the Subjective Workload Assessment Technique. For situations in which objective and subjective workload measures agree, the subjective measures are better because they do not disrupt primary task activity, and are easier, quicker and less expensive to obtain [38].

Objective Evaluation:
Objective data are measures of participants' performance (such as scenario completion time and successful scenario completion rate). Objective measures of mental workload include primary-task performance, secondary-task performance, and physiological measures such as pupil diameter and heart-rate variability [38].

In our research we will focus in objective evaluation which evaluates participants' performance (such as scenario completion time and successful scenario completion rate) to evaluate the usability of universities websites.
2.1.5 Manual and automatic usability testing

The system evaluation can be done manually or automatically. In manual evaluation of usability need more efforts, a lot of time and it is conducted by human, that means more mistakes and less in accuracy. Automation of usability evaluation has several potential advantages over manual evaluation, such as the following [38]:

- Reducing the cost of usability evaluation.
- Increasing consistency of the errors uncovered.
- Predicting time and error costs across an entire design.
- Reducing the need for evaluation expertise among individual evaluators.
- Increasing the coverage of evaluated features.
- Enabling comparisons between alternative designs.
- Incorporating evaluation within the Design phase of UI development, as opposed to being applied after implementation.

2.1.6 Quality Factors for Usability

Some quality factors are very important when performing usability testing. Usability is subjective and not all requirements for usability can be documented clearly. However focusing on some of the quality factors given below help in improving objectivity in usability testing are as follows [56]:

**Comprehensibility:** The product should have simple and logical structure of features and documentation. They should be grouped on the basis of user scenarios and usage.

**Consistency:** a product needs to be consistent with any applicable standards, platform look-and-feel, base infrastructure, and earlier versions of the same product. Also, if there are multiple products from the same company, it would be worthwhile to have some consistency in the look-and-feel of these multiple products.

**Navigation:** this helps in determining how easy it is to select the different operations of the product. An option that is buried very deep requires the user to travel to multiple screens or menu options to perform the operation.

**Responsiveness:** how fast the product responds to the user request is another important aspect of usability. This should not be confused with performance testing.
2.2 Data Mining

In this section we present some descriptions of data mining techniques and the steps of data mining life cycle process, we will present also data mining methods, finally we focus in association rule method, Since we will use it in our research.

2.2.1 Introduction

We live in a data driven world, the direct result of advents in information and communication technologies. Millions of resources for knowledge are made possible thanks to the Internet and Websites collaboration technologies. No longer do we live in isolation from vast amounts of data. The Information and Communication Technologies revolution provided us with convenience and ease of access to information, mobile communications and even possible contribution to this amount of information. Moreover, the need of information from these vast amounts of data is even more pressing for enterprises [24].

Mining information from raw data is an extremely vital and tedious process in today’s information driven world. Enterprises today rely on a set of automated tools for knowledge discovery to gain business insight and intelligence. Many branches of knowledge discovery tools were developed to help today’s competitive business markets thrive in the age of information. World’s electronic economy has also increased the pressure on enterprises to adapt to such new business environment [10].

Knowledge discovery and data mining have become areas of growing significance because of the recent increasing demand for KDD techniques, including those used in machine learning, databases, statistics, knowledge acquisition, data visualization, and high performance computing. Knowledge discovery and data mining can be extremely beneficial for the field of Artificial Intelligence in many areas, such as industry, commerce, government, education and so on [40].

An important Knowledge Discovery and Data Mining goal is to “turn data into knowledge.” For example, knowledge acquired through such methods on a medical database could be published in a medical journal. Knowledge acquired from analyzing a financial or marketing database could revise business practice and influence a management school’s curriculum [18].
2.2.2 Knowledge Discovery

Knowledge Discovery has been defined as the ‘non-trivial extraction of implicit, previously unknown and potentially useful information from data’. It is a process of which data mining forms just one part, albeit a central one [10][24].

![Knowledge Discovery Process](image)

Figure 2.1 the Knowledge Discovery Process [24]

Figure 2.1 shows a slightly idealized version of the complete knowledge discovery process. Data comes in, possibly from many sources. It is integrated and placed in some common data store. Part of it is then taken and pre-processed into a standard format. This ‘prepared data’ is then passed to a data mining algorithm which produces an output in the form of rules or some other kind of ‘patterns’. These are then interpreted to give—and this is the Holy Grail for knowledge discovery—new and potentially useful knowledge. Data mining is the core part of the Knowledge Discovery in Database (KDD) process [10].

The KDD Disciplines:

KDD research can be divided into different “disciplines”, i.e. data mining, text mining, graph mining, image mining, and web mining [10].

Data Mining:

The analysis step of the "Knowledge Discovery in Databases" process, or KDD), an interdisciplinary subfield of computer science is the computational process of discovering patterns in large data sets involving methods at the intersection of artificial intelligence, machine learning, statistics, and database systems [5], we will present more details of this discipline in other section.
**Text Mining:**

Text mining, also referred to as text data mining, roughly equivalent to text analytics, refers to the process of deriving high-quality information from text. High-quality information is typically derived through the devising of patterns and trends through means such as statistical pattern learning. Text mining usually involves the process of structuring the input text (usually parsing, along with the addition of some derived linguistic features and the removal of others, and subsequent insertion into a database), deriving patterns within the structured data, and finally evaluation and interpretation of the output [5].

**Graph Mining:**

This discipline specializes on mining data represented in the form of graphs. Graph mining may be categorized into transaction graph mining, which searches for patterns in sets of graphs, or single graph mining, which looks for patterns within a single large graph [21].

**Image Mining:**

Image mining deals with the extraction of knowledge, image data relationship, or other patterns not explicitly stored in the images [21]. It uses methods from computer vision, image processing, image retrieval, data mining, machine learning, database, and artificial intelligence. Rule mining has been applied to large image databases there are two main approaches. The first approach is to mine from large collections of images alone and the second approach is to mine from the combined collections of images and associated alphanumeric data [21].

**Web Mining:**

Web mining allows you to look for patterns in data through content mining, structure mining, and usage mining. Content mining is used to examine data collected by search engines and Web spiders. Structure mining is used to examine data related to the structure of a particular Web site and usage mining is used to examine data related to a particular user's browser as well as data gathered by forms the user may have submitted during Web transactions [5].

In our research we use data mining methods to evaluate the usability of universities websites.
2.2.3 Data Mining (DM)

It is considered as one of the applications of supervised machine learning, and it plays an important role in the process of retrieving the lost information [10]. Data mining refers to extracting or “mining” knowledge from large amounts of data [24].

Data mining (sometimes called data or knowledge discovery) is the process of analyzing data from different perspectives and summarizing it into useful information - information that can be used to increase revenue, cuts costs, or both. Data mining software is one of a number of analytical tools for analyzing data. It allows users to analyze data from many different dimensions or angles, categorize it, and summarize the relationships identified. Technically, data mining is the process of finding correlations or patterns among dozens of fields in large relational databases [10][53][24].

Data Mining is essentially a process of data drive extraction of not so obvious but useful information from large databases that is interactive and iterative. Knowledge discovery as a process consists of an iterative sequence of the following steps [24]:

Figure 2.2 Data mining as a step in the process of knowledge discovery [24]
1. **Data Cleaning**: is removing the noise and inconsistent data.
2. **Data Integration**: where multiple data sources may be combined. These sources may include multiple databases, data cubes, or flat files.
3. **Data Selection**: where data relevant to the analysis task are retrieved from the database. So, irrelevant, weakly relevant or redundant attributes may be detected and removed.
4. **Data Transformation**: where data are transformed or consolidated into forms appropriate for mining by performing summary or aggregation operations, for instance.
5. **Data Mining**: an essential process where intelligent methods are applied on data to extract data patterns for decision making.
6. **Pattern Evaluation**: to identify the truly interesting patterns based on some interestingness measures. A pattern consider interesting if it is: Valid, Novel, Actionable, Understandable
7. **Knowledge Presentation**: is the framework that converts a large amount of data into a particular data or procedure that human being can figure out based on an intention. In Knowledge representation visualization tools and knowledge representation techniques are used to present the mined knowledge to the user

Data mining functionalities are used to specify the kind of patterns to be found in data mining tasks. In general, data mining tasks can be classified into two categories: descriptive mining and predictive mining. Descriptive mining tasks characterize the general properties of the data in the database such as association rule and clustering. Predictive mining tasks perform inference on the current data in order to make predictions such as classification, prediction and outlier analysis [6].

**Classification**: is the organization of data in given classes also, known as supervised classification, the classification uses given class labels to order the objects in the data collection. Classification approaches normally use a training set where all objects are already associated with known class labels. The classification algorithm learns from the training set and builds a model. The model is used to classify new objects [40].

**Prediction**: has attracted considerable attention given the potential implications of successful forecasting in a business context. There are two major types of predictions: one can either try to predict some unavailable data values or pending trends, or predict a class label for some data. Prediction is tied to classification. Once a classification model is built based on a training set, the class label of an object can be foreseen based on the attribute values of the object and the attribute values of the classes. Prediction is, however, most often referred to the forecast of missing numerical values, or increase/decrease trends in time-related data. The major idea is to use a large number of past values to consider probable future values [6].

**Clustering**: is a division of data into groups of similar objects. It is similar to the classification. However, unlike classification, in clusters, class labels are unknown and it is up to the clustering algorithm to discover acceptable classes. Clustering is also called
unsupervised classification because the classification is not dictated by giving class labels. There are many clustering approaches all based on the principle of maximizing the similarity between objects in a same class (intra-class similarity) and minimizing the similarity between objects of different classes (inter-class similarity) [24].

**Association rules:** are if/then statements that help uncover relationships between seemingly unrelated data in a relational database or other information repository. It studies the frequency of items occurring together in transactional databases, and based on a threshold called support, identifies the frequent item sets. Another threshold, confidence, which is the conditional probability than an item appears in a transaction when another item appears, is used to pinpoint association rules. Association analysis is commonly used for market basket analysis [36]. Association rules are central technique of our thesis, we will discuss in next Section.

**Outlier analysis:** outliers are data elements that cannot be grouped in a given class or cluster. Also known as exceptions or surprises, they are often very important to identify. While outliers can be considered noise and discarded in some applications, they can reveal important knowledge in other domains, and thus can be very significant and their analysis valuable [36].

### 2.2.4 Association Rules Method

Association rule mining, one of the most important and well researched techniques of data mining [36]. Are used to identify relationships among a set of items in a database. These relationships are not based on inherent properties of the data themselves (as with functional dependencies), but rather based on co-occurrence of the data items.[17] Association rules are widely used in various areas such as telecommunication networks, market and risk management, and education [36][55].

Association rule mining is to find out association rules that satisfy the predefined minimum support and confidence from a given database. The problem is usually decomposed into two sub problems. One is to find those item sets whose occurrences exceed a predefined threshold in the database; those item sets are called frequent or large item sets. The second problem is to generate association rules from those large item sets with the constraints of minimal confidence [36][40].

The first sub-problem can be further divided into two sub-problems: candidate large item sets generation process and frequent item sets generation process. Those item sets whose support exceeds the support threshold as large or frequent item sets, those item sets that are expected or have the hope to be large or frequent are called candidate item sets.

In many cases, the algorithms generate an extremely large number of association rules, often in thousands or even millions. Further, the association rules are sometimes very large. It is nearly impossible for the end users to comprehend or validate such large number of complex association rules, thereby limiting the usefulness of the data mining results [40].
Several strategies have been proposed to reduce the number of association rules, such as generating only “interesting” rules, generating only “non-redundant” rules, or generating only those rules satisfying certain other criteria such as coverage, leverage, lift or strength [55].

2.2.5 Association Rules Metrics:

Two important measures for association rules support (s) and confidence (α), can be defined as follows:

Support:

Definition 1: As the percentage/fraction of records that contain $X \cup Y$ to the total number of records in the database. The count for each item is increased by one every time the item is encountered in different transaction $T$ in database $D$ during the scanning process. It means the support count does not take the quantity of the item into account [17].

Definition 2: Support of a rule is a measure of how frequently the items involved in it occur together. Using probability notation: support ($A \implies B$) = $P(A, B)$ [26].

Support(s) is calculated by the following formula [36]:

$$Support(XY) = \frac{Support \ count \ of \ XY}{Total \ number \ of \ transaction \ in \ D} \quad (1)$$

From the definition we can see, support of an item is a statistical significance of an association rule. Suppose the support of an item is 0.1%, it means only 0.1 percent of the transaction contains purchasing of this item. Before the mining process, users can specify the minimum support as a threshold, which means they are only interested in certain association rules that are generated from those item sets whose supports exceed that threshold [26][55].

Confidence:

Definition 1: Confidence of a rule is the conditional probability of $B$ given $A$. Using probability notation: confidence ($A \implies B$) = $P(B \ given \ A)$ [40].

Definition 2: the percentage/fraction of the number of transactions that contain $X \cup Y$ to the total number of records that contain $X$, where if the percentage exceeds the threshold of confidence an interesting association rule $X \Rightarrow Y$ can be generated [36].

Support(s) is calculated by the following formula [36]:

- 22 -
Confidence is a measure of strength of the association rules, suppose the confidence of the association rule $X \Rightarrow Y$ is 80%, it means that 80% of the transactions that contain $X$ also contain $Y$ together, similarly to ensure the interestingness of the rules specified minimum confidence is also pre-defined by users.

2.2.6 Association Rules Algorithms

Many algorithms for generating association rules were presented over time such as (Apriori algorithm, Partition algorithm, SETM algorithm, FP-growth algorithm), in this section we will discuss some of this algorithms, finally of section we will discuss the (FP-growth algorithm) in details because we use it in our research.

Apriori algorithm:

The Apriori algorithm is a great achievement in the history of mining association rules. It is by far the most well-known association rule algorithm [16]. Apriori is more efficient during the candidate generation process for two reasons; Apriori employs a different candidate’s generation method and a new pruning technique [16].

Apriori uses breadth-first search and a Hash tree structure to count candidate item sets efficiently. It generates candidate item sets of length $k$ from item sets of length $k - 1$. Then it prunes the candidates which have an infrequent sub pattern. According to the downward closure lemma, the candidate set contains all frequent $k$-length item sets. After that, it scans the transaction database to determine frequent item sets among the candidates [4].

The Apriori generates the candidate item sets by joining the large item sets of the previous pass and deleting those subsets which are small in the previous pass without considering the transactions in the database. By only considering large item sets of the previous pass, the number of candidate large item sets is significantly reduced [36].

There are two processes to find out all the large item sets from the database in Apriori algorithm. First the candidate item sets are generated, and then the database is scanned to check the actual support count of the corresponding item sets. In the process of finding frequent item sets, Apriori avoids the effort wastage of counting the candidate item sets that are known to be infrequent. The candidates are generated by joining among the frequent item sets level-wisely, also candidate are pruned according the Apriori property [10] in the figure 2.3 below the algorithm of Apriori Algorithm:
Partition algorithm

The idea behind Partition algorithm is as follows. Recall that the reason the database needs to be scanned multiple number of times is because the number of possible item sets to be tested for support is exponentially large if it must be done in a single scan of the database [49].

Partition algorithm accomplishes this in two scans of the database. In one scan it generates a set of all potentially large item sets by scanning the database once. This set is a superset of all large item sets, i.e., it may contain false positives [49].

The algorithm executes in two phases. In the first phase, the Partition algorithm logically divides the database into a number of non-overlapping partitions. The partitions are considered one at a time and all large item sets for that partition are generated. At the end of phase one, these large item sets are merged to generate a set of all potential large item sets. In phase two, the actual support for these item sets are generated and the large item sets are identified. The partition sizes are chosen such that each partition can be accommodated in the main memory so that the partitions are read only once in each phase, in the figure 2.4 below the algorithm of Partition Algorithm [49][10][36].
1) \( P = \text{partition\_database}(\mathcal{D}) \)
2) \( n = \text{Number of partitions} \)
3) \( \text{for } i = 1 \text{ to } n \text{ begin} \quad // \text{Phase I} \)
4) \( \text{read\_in\_partition}(p_i \in P) \)
5) \( L^i = \text{gen\_large\_itemsets}(p_i) \)
6) \( \text{end} \)
7) \( \text{for } (i = 2; L^i_j \neq \emptyset, j = 1, 2, \ldots, n; i++) \text{ do} \)
8) \( C_i^G = \bigcup_{j=1,2,\ldots,n} L^j_i \quad // \text{Merge Phase} \)
9) \( \text{for } i = 1 \text{ to } n \text{ begin} \quad // \text{Phase II} \)
10) \( \text{read\_in\_partition}(p_i \in P) \)
11) \( \text{for all candidates } c \in C^G \text{ gen\_count}(c, p_i) \)
12) \( \text{end} \)
13) \( L^G = \{ c \in C^G | c\_\text{count} \geq \text{minSup} \} \)

Figure 2.4 Partition Algorithm [49]

**SETM algorithm**

The algorithm consists of a single loop, in which two sort operations and one merge-scan join are performed. The first sort is needed to implement the merge-scan join that follows it. The second sort is used in order to generate the support counts efficiently. Generating the counts involves a simple sequential scan over \( R_k \). Deleting the tuples from \( R_k \) that do not meet the minimum support, involves simple table look-ups on relation \( c_k \). The \( c_k \) relations are of interest to us for rule generation, in the figure 2.5 below the algorithm of SETM Algorithm [28].

\[
\begin{align*}
  k &:= 1; \\
  \text{sort } R_1 \text{ on } \text{item}; \\
  C_1 &:= \text{generate counts from } R_1; \\
  \text{repeat} & \\
  \text{\quad \quad } k &:= k + 1; \\
  \text{\quad \quad } \text{sort } R_{k-1} \text{ on } \text{trans\_id, item}_1, \ldots, \text{item}_{k-1}; \\
  R'_k &:= \text{merge-scan } R_{k-1}, R_1; \\
  \text{\quad \quad } \text{sort } R'_k \text{ on } \text{item}_1, \ldots, \text{item}_k; \\
  C_k &:= \text{generate counts from } R'_k; \\
  R_k &:= \text{filter } R'_k \text{ to retain supported patterns}; \\
  \text{until } R_k = \{ \}
\end{align*}
\]

Figure 2.5 SETM Algorithm [28]
FP-Growth algorithm

FP-growth uses a combination of the vertical and horizontal database layout to store the database in main memory. Instead of storing the cover for every item the database, it stores the actual transactions from the database in a tire structure and every item has a linked list going through all transactions that contain that item. This new data structure is denoted by FP-tree (Frequent Pattern tree) [21].

FP-Growth frequent pattern mining is used in the development of association rule mining. FP-Growth algorithm overcomes the problem found in Apriori algorithm. The frequent item set generation process requires only two passes over the database there is no need for candidate generation process. By avoiding the candidate generation process and less passes over the database, FP-Growth found to be faster than the Apriori algorithm [16][54].

An FP-Growth is a prefix tree for transactions; every node in the tree represents one item and each path represents the set of transactions that involve with the particular item. All nodes referring to the same item are linked together in a list, so that all the transactions that containing the same item can be easily found and counted [16].

FP-Growth algorithm involves the generation of frequent patterns using the frequent patterns generation process which includes two sub processes:

- Constructing the FP-Growth.
- Generation of frequent patterns from the FP-Growth.

The process of constructing the FP-Tree is as follows [16]:

1. The database is scanned for the first time, during this scanning the support count of each items are collected. As a result the frequent 1-item sets are generated process is the same as in Apriori algorithm. Those frequent item sets are sorted in a descending order of their supports. Also the head table of ordered frequent 1-item sets is created.

2. Create the root node of the FP-Tree T with a label of Root. The database is scanned again to construct the FP-Tree with the head table, for each transaction the order of frequent items is resorted according to the head table.

3. The function Insertf[p j P]; Tg works as follows. If T has a child N such that N.item name= p.item-name then the count of N is increased by 1, else a new node N is created and N.item name= p.item-name with a support count of 1. Its parent link be linked to T and its node link is linked to the node with the same item-name via a sub-link. This function Insert fP;Tg is called recursively until P becomes empty.

The FP-tree is mined by calling FP growth (FP tree, null), which is implemented as follows in figure 2.6 [10]:

- 26 -
The efficiency of FP-Tree algorithm account for three reasons [16]:

(1) FP-Tree is a compressed representation of the original database because only those frequent items are used to construct the tree, other irrelevant information are pruned. Also by ordering the items according to their supports the overlapping parts appear only once with different support count.

(2) This algorithm only scans the database twice. The frequent patterns are generated by the FPgrowth procedure, constructing the conditional FPTree which contain patterns with specified suffix patterns, frequent patterns can be easily. Also the computation cost decreased dramatically.

(3) FP-Tree uses a divide and conquer method that considerably reduced the size of the subsequent conditional FP-Tree, longer frequent patterns are generated by adding a suffix to the shorter frequent patterns.

“"A study on the performance of the FP-growth method shows that it is efficient and scalable for mining both long and short frequent patterns, and is about an order of magnitude faster than the Apriori algorithm. It is also faster than a Tree-Projection algorithm, which recursively projects a database into a tree of projected databases" [24].

In our research we will use FP-Growth algorithm for generate association rules for the following reasons:

1- To study the relationships between the metrics in our experiments.
2- It is quickly for extracting knowledge.
3- The output rules are easy understood and definitions.
4- It is no need high specifications of computer machine to implement the experiments.
5- It is useful for high number of metrics and records.

2.3 Summary

In this chapter we presented the two main categories of theoretical foundation in our thesis, usability testing and data mining methods. In usability testing we presented the main aspects and methods that we used in our research ,in data mining we presented the algorithm that we used in our research.
CHAPTER 3

Related Works
In this chapter, different related works are studied and investigated. The related works are introduced and analyzed for usability testing. The chapter is divided into four sections, in section 3.1 we will give some related work about usability testing in general websites, in section 3.2 we will present some related works about usability of university websites, in section 3.3 we will present usability testing worked by using data mining technique, finally in section 3.4 we will give some conclusions about this chapter.

3.1 Usability testing in website

Sivaji, Abdullah and Giffin Downe in [51] the following research conducted on usability testing and focused on understanding the effectiveness of Heuristic Evaluation (HE) as a methodology for defect detection. The results show the effectiveness of the HE as a usability testing methodology in capturing defects and prioritizing development and design efforts.

The results also reinforce the need for integrating traditional heuristics with modified heuristics customized to the domain or field of the project being tested such as E-Government.

The researchers on this work concluded that the quality assurance team members such as the usability and quality engineer can use heuristic to assess the quality of a website. In this research they did not use any automatic technique to evaluate the websites.

Wang and Liu in [52] proposed an evaluation methodology based on revised Microsoft Usability Guideline MUG for web site usability. Using this evaluation methodology, it can do: (1) evaluate the usability of a B2C web site; (2) rank B2C web sites by usability; (3) point out superiorities and inferiorities of each web site in usability; (4) give some indications to improving the usability of B2C web site, finally they concluded that proposed evaluation methodology can take account every factor as the characteristics of all customers are hardly foreseeable. This work concentrated on B2C systems.

Granizo, Yánez, Ramíre and Machado in [23] presented a usability study conducted on the three E-government sites whose common service is providing to the citizens a complaints system through the web. The researchers proposed methodology used to discover recurrent problems in three e-government sites evaluated. The methodology starts with the selection of case studies and then the assessing of them, using the g-Quality evaluation method, and identification of recurrent problems, finally analysis and comparison of results.

The selected case studies are National Secretariat of Government Management of the Ecuadorian Government, Assistance to the Buenos Aires citizen, and Virtual Office to Complaints.

The researchers divided the Usability evaluations on the case studies in six stages:
- Stage 1: Each evaluator inspects individually the interface of each case study on the base of the set of heuristics. The evaluator should register clearly each usability problem detected together to the heuristics infringed.
- Stage 2: The individual conclusions of each evaluator are joined in a unique list to be commented on by all evaluators.
- Stage 3: The unique list is distributed to each evaluator for them to assign individual ratings to all of the problems.
- Stage 4: The criticality of each usability problem discovered is calculated by adding the ratings of severity and frequency of occurrence.
- Stage 5: The individual ratings of each problem are averaged with the goal of establishing rankings of the ratings obtained by the problems or rankings of the heuristics infringed.
- Stage 6: The results are analyzed to establish the final conclusions.

Finally, the researchers conclude it is vital to obtain a set of specifics design parameters for the successful development of e-government sites. A first step in this process is to discover the main problems that present these kinds of web sites, with the goal of resolving them through the application of patterns in this specific context.

**Huang and Li** in [30] selected C2C ecommerce business website for the research on usability evaluation system. The C2C e-commerce website usability evaluation system scale is obtained based on an empirical study. It is concluded that content, technology, architecture, emotion, promotion, shopping operation and customization service are the seven leading indicators for evaluating and improving China's C2C e-commerce website usability.

Through the factor analysis of questionnaire data, seven factors of C2C E-commerce website usability evaluation system are proposed. Which are: Content Usability, Technology Usability, Architecture Usability Emotion Usability, Shopping Operation Usability, motion Usability and Customization Service Usability:

Finally, the researchers conclude by using the "C2C e-commerce website usability evaluation system scale", the usability of the existing C2C ecommerce website is evaluated. Problems of improving website usability that need in-depth consideration are comprehensively explored.

**Hassan** in [50] suggested developing a comprehensive set of evaluation criteria for general websites in line with international standards for website design. The proposed evaluation criteria are used to analyze the top 10 websites in UAE in order to measure their compliance with the developed criteria. The proposed criteria can be used as a benchmark of website quality and compliance, and he describes thirteen evaluation criteria: accessibility and visibility, accuracy and credibility, authority, coverage, currency, interactivity, metadata, navigability, orientation & objectivity, privacy, searchability, security, and services.

Each criterion includes several evaluative and comparative key items called “indicators”. Finally he concluded the findings of his work are expected to contribute to the set of theory-based and specific criteria for general website users, designers, owners, and developers for the following reasons:

- With the rapid changes in information technologies, this study can be used by other researchers in website usability and satisfaction studies.
The study developed a ranking scheme to help users in selecting among general websites.

Poorly designed websites frustrate users and cause them to leave.

This study provided a set of criteria to facilitate finding what is needed in order to satisfy the users, but these criteria are for general websites not only for educational websites that we need to evaluate.

Liu in [38] described how to use the methods to evaluate a website. First, the common evaluating procedure is introduced. Secondly some usability evaluation techniques are introduced, which are usability testing, heuristic evaluation, cognitive walkthrough, focus group, thinking aloud and questionnaires.

The common evaluating procedure includes:
- Decide when we should evaluate our websites.
- Gather information.
- Choose the right technique.
- Evaluate the website.
- Analysis in depth, and apply results to actual designing.

Finally, the researcher concluded that usability evaluation has increasingly become a part cannot be ignored in web site design. Designers should learn these techniques and use them in practice so that they can evaluate their websites skillfully, generally speaking.

And he concluded the steps of how we can evaluate web site as a following figure 3.1:

Conte, Massollar, Mende and Travassos in [14] proposed a usability evaluation technique based on the combination of Web design perspectives adapted from existing literature, and heuristics. This new technique is assessed using a controlled experiment aimed at measuring the efficiency and effectiveness of their technique. They suggest use of four Web design perspectives:

- **Conceptual**: represents the conceptual elements that make up the application domain.
- **Presentation**: represents the characteristics related to application layout and arrangement of interface elements.
• **Navigation:** represents the navigational space, defining the information access elements and their associations.

• **Structural:** represents the structural and architectural characteristics of the application, that is, how the application is structured in terms of components and their associations.

The new technique call Web Design Perspectives-based Usability Evaluation (WDP) and its principles are as follows:

The researchers used a formal experiment to compare the efficiency and effectiveness between the WDP and HEV techniques. Finally, the results showed that the WDP technique was significantly more effective than the HEV technique, with similar efficiency.

In this section we presented some examples of researches about evaluation usability of websites, for example E-commerce, E-governments websites, we can conclude that the usability is important for many domains websites.

### 3.2 Usability testing in university web sites:

In this section we will present some of related works for Evaluation University websites, these works are applied in different countries and different universities.

**Mustafa and Al-Zoua’bi** in [43] proposed an evaluation study of usability about academic Websites of Jordan's Universities. They used two evaluation approaches: the evaluation based on questionnaire method and the evaluation based on online automated tools. The results obtained from both approaches showed that the usability of Jordan's university websites reasonably acceptable, based on the measures of evaluation used.

The researchers concluded that the results of their study should view with the fact that the design of some websites undergoes changes from time to time. But in their research they did not use any automatic technique or approach to evaluate the universities sites, and he used on line tool to evaluate the website as a general metrics without using task scenario for tracking the users behavior on the university website. Beside they only evaluated Jordanian website.

**Islam and Tsuji** in [31] used two evaluation approaches: the evaluation based on questionnaire method and the evaluation based on online automated tools to evaluation of usage of university websites in Bangladesh. The researchers concluded that the present study showed in general that usability features of the university websites in Bangladesh do not have good features. And they suggested the following:

- Universites websites design should go through several design guidelines to ensure that users are more satisfied with the services provided by these websites.
- Universities webmaster should pay more attention to the universitiesweb design and content to make them more attractive to the user community.
But in this research the authors did not use any automatic technique or approach to evaluate the universities sites, and he used on line tool to evaluate the website as a general metrics without using task scenario for tracking the users behavior on the university website. Their work only in Bangladeshi university Websites

**Daher and Elkabani** in [3] investigated the factors affecting the usability of university web portals in some Lebanese universities. The study is divided into two parts: A qualitative study done on six Lebanese Universities by distributing questionnaires to students with comparable fields of studies and with comparable level of computer literacy.

The second part is an extended study applied on Beirut Arab University (BAU) web portal, but the research using The Single Usability Metric (SUM) model, single metric in order to measure the efficiency, effectiveness and satisfaction of the web portal.

In this research the authors did not use any automatic technique or approach to evaluate the universities sites, and he used just the Single Usability Metric (SUM) model, their work only in Lebanese university Websites.

**Abdullah and Wei** in [2] focused on website usability issues and evaluating for four Malaysia’s online news: The Star, The New Straits Times, Berita Harian and Utusan Malaysia. Based on literature research, a 24 questions evaluation questionnaire has been formulated, which break into four parts in order to evaluate the usability of their online news websites. The results of analysis show the good and bad usability aspects of their website. Result also shows that New Straits Time news website obtained the highest satisfaction from the participants.

The researchers summarized some of the evaluation methods into following categories:

According to Jakob Nielsen, heuristic evaluation, heuristic estimation, cognitive walkthrough, feature inspection, and standards inspection normally have the interface inspected by a single evaluator at a time (though heuristic evaluation is based on combining inspection reports from a set of independent evaluators to form the list of usability problems and heuristic estimation involves computing the mean of the individual estimates).

In contrast, pluralistic walkthrough and consistency inspection are group inspection methods. Many usability inspection methods are so easy to apply that it is possible to have regular developers serve as evaluators, though better results are normally achieved when using usability specialists. Most of the work published concerns technical issues (e.g. different communication protocols, document formats and Web programming tools), or issues about the design of Web sites from a usability perspective.

**Hassan** in [25] purposed to evaluate the usability of educational websites. In particular, it focused on nine Jordanian university websites. Evaluation criteria for assessing the usability of educational websites were developed; these consisted of five categories: navigation, architecture / organization, ease of use and communication, design and
content. Then 237 students were asked to provide ratings for nine Jordanian university websites using the developed usability criteria and their categories. Students were also asked to report qualitatively what they liked and disliked regarding the design of the tested websites. The results provided detailed information for each tested website regarding their conformance with the developed usability criteria. The results showed that the majority of the students were satisfied with the usability of the Jordanian university websites. Finally, the researcher concluded the results of this research agreed with the results obtained in the study conducted by Mostafa and Al-Zou‘bi, but the study of Mustafa and Al-Zou‘bi did not report the specific strengths and weaknesses of each Jordanian university website; it reported the overall results of all the investigated websites with regard to five categories without explaining the usability level of each Jordanian university website.

3.3 Usability testing by using data mining technique:

In this section we will present related works about usability testing through data mining techniques.

**González** in [22] described a new approach in which two data mining techniques (association rules and decision trees) are used to extend the existing Qualitative Usability Testing process in order to provide a general usability diagnosis of a given context of use from a qualitative viewpoint. In order to validate the research, usability problems patterns belonging to academic webpages in Spanish-speaking countries are assessed by processing 3450 records which store qualitative information collected by means of a Heuristic Evaluation. The researchers conclude that the integration of a KDD-based methodology for assessing qualitative usability of a context of use data mining can be performed successfully as part of a real-world case (the assessment of usability problem patterns in the university portals). On the other hand, the Evaluation can be enriched with the detection of hidden relationships among qualitative data that are detected and documented with a formal basis.

**García,Sicilia,González,and Hilera** in [44] describe how some specific machine-learning algorithms can be used to obtain knowledge that will subsequently be used to implement some basic learning behaviors in a questionnaire design system. This work focus on usability evaluation through questionnaires, which are used to obtain information about users’ likes, dislikes, needs, and understanding of the system by asking them about some concrete interface’s aspects. He suggested Apriori algorithm for the extraction of association rules between questions. The application of the algorithm on answered questions requires a first step before the mining process (a pre-processing phase). In the first must change the relational database
format of our evaluation facts to one in which each application of a questionnaire is represented in a tuple with questions as attributes.

And he suggested the M5’ algorithm classifier to Automated evaluation only considers internal attributes, that is, attributes that can be obtained by parsing the HTML code, he use the following quantitative measures that can be computed automatically: Total number of links, page size in bytes, total number of images, total colors employed, reading complexity.

Finally, the researcher concluded his work described tested techniques only in a medium size repository, and, under this condition they obtained the awaited results. He guesses some possible constraints in the application of some algorithms on actual data repositories. Specifically, the clustering approach requires that all evaluators answered a high number of questions, evaluated all the criteria.

### 3.4 Conclusion

From previous studies we can conclude that:

- Most of the previous studies rely on humans directly without finding automatic technique to evaluate the usability.
- Most of the previous studies do not use data mining technology to reduce efforts in the process of usability testing.
- These researches were done in educational websites outside Palestine.
- Some of these researches used on line tool to evaluate the website as a general metrics without using task scenario for tracking the user’s behavior on the university website[1][2][11]. We can see the comparison of the metrics between on line tools and task scenario tools in the following table 3.1:

<table>
<thead>
<tr>
<th>Metrics of task scenario tools</th>
<th>Metrics of on line tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Task time</td>
<td>- Total number of html files</td>
</tr>
<tr>
<td>- Confirm (scenario task)</td>
<td>- Total html page size</td>
</tr>
<tr>
<td>- Total tasks time</td>
<td>- Total size of images</td>
</tr>
<tr>
<td>- Number of clicks</td>
<td>- Total number of images</td>
</tr>
<tr>
<td>- Number of pages</td>
<td>- Download time</td>
</tr>
<tr>
<td>- Task satisfaction</td>
<td>- Browsers compatibility</td>
</tr>
<tr>
<td>- Number of error pages</td>
<td></td>
</tr>
</tbody>
</table>

The metrics of on line tool measures general attributes of the website, but the metrics of the task scenario tools measures the behavior of the students on the website.
CHAPTER 4

Research Methodology
This chapter explains our proposed approach about usability evaluation on university websites using data mining methods. To implement and evaluate this research, various steps have to be performed (see Figure 4.1). The main required steps are: first we investigated the best metrics of usability test for educational websites, second we using the metrics for test the site by set of testers (students) using questionnaire approach, third using other metrics to test website using some tools, forth collecting data set (the answers) from testers, and from the tools, fifth also investigating of data mining methods for extracting useful knowledge from our data set to automatic usability test of the systems, the final step is evaluation.

![Figure 4.1: The steps of implement the usability testing approach](image)

This chapter is organized into five sections. Section 4.1, presents investigating the best metrics of usability test for educational websites. Section 4.2 describes data acquisition. It will give a description of the collecting data sets for designing experimental data. Section 4.3 conducts the research a set of preprocessing operations on the data sets. Section 4.4 presents and determines data mining methods. Section 4.5 discuses evaluation of the websites.

4.1: Investigating the best metrics of usability test for educational websites:

There are many metrics for websites usability testing. In this research, we focus on the metrics that need to evaluate universities websites, Using metrics proposed by [43] [31] [50] [22] and [3] we proposed six categories for identifying the metrics which are:

1. Evaluating content, organization and readability:
   This category normally used to evaluate the content of the website of the university information’s and topic, and it evaluates the extent of regulating the contents of the site, and evaluates the readability of the contents of the site.
2. Evaluating navigation and links:
This category evaluates navigation and links of websites; the purpose of navigation is the essence of the web experience, menus and in-page links are the means of navigation to go to a new page or, to move to another position on the current page.

3. Evaluating user interface design:
The goal of this category is to make the user's interaction as simple and efficient as possible, in terms of accomplishing user goals.

4. Evaluating performance and effectiveness:
The goal of this category is to evaluate the speed of opening web pages and the effectiveness of the website in response to orders quickly.

5. Evaluating education purpose:
This category is used to evaluate the educational requirements for students such as the registration of courses and services, as well as to communicate with teachers.

6. Services in the website:
This category evaluates some services in the university site.
This category normally used to evaluate university website that to ensure receiving accurate data from students. The research proposed 55 metrics as in table 4.1 [43][31][22][3][47]:

Table 4.1: The proposed metrics

<table>
<thead>
<tr>
<th>1. Evaluating content, organization and readability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 This website contains most of my interest material</td>
</tr>
<tr>
<td>1.2 The topics are up-to-date.</td>
</tr>
<tr>
<td>1.3 I can easily find what I want at this website</td>
</tr>
<tr>
<td>1.4 The content of this website is well organized.</td>
</tr>
<tr>
<td>1.5 Reading content of this website is easy.</td>
</tr>
<tr>
<td>1.6 I am comfortable and familiar with the used language.</td>
</tr>
<tr>
<td>1.7 I do not need to scroll left and right when reading at this website.</td>
</tr>
<tr>
<td>1.8 Is the vision and objectives and the laws and regulations of the University and programs exist</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Evaluating navigation and links</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 I can easily know where I am at this website.</td>
</tr>
<tr>
<td>2.2 This website provides useful links for me to get the desired information.</td>
</tr>
<tr>
<td>2.3 I can easily know how did get here</td>
</tr>
<tr>
<td>2.4 I can easily know where can I go from here</td>
</tr>
<tr>
<td>2.5 It is easy to move around at this website by using the links or back button of the browser.</td>
</tr>
<tr>
<td>2.6 The links at this website are well maintained and updated.</td>
</tr>
<tr>
<td>2.7 The website does not open too many new windows when I am moving around.</td>
</tr>
<tr>
<td>2.8 Placement of links or menu is standard throughout the website and I can easily recognize them.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Evaluating user interface design</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 This website’s interface design is attractive.</td>
</tr>
<tr>
<td>3.2 I am comfortable with the colors used at this website.</td>
</tr>
<tr>
<td>3.3 This website contains no feature that irritates me such as scrolling or blinking text and looping animations.</td>
</tr>
</tbody>
</table>
3.4 This website has a consistent feel and look.
3.5 This website does not contain advertisements.
3.6 The design of the website makes sense and it is easy to learn how to use it.

### 4. Evaluating performance and effectiveness

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>I need not wait too long to download a file or open a page.</td>
</tr>
<tr>
<td>4.2</td>
<td>I can easily distinguish between visited and not visited links.</td>
</tr>
<tr>
<td>4.3</td>
<td>I can access this website any time.</td>
</tr>
<tr>
<td>4.4</td>
<td>This website responds to my actions as expected.</td>
</tr>
<tr>
<td>4.5</td>
<td>It is efficient to use this website.</td>
</tr>
<tr>
<td>4.6</td>
<td>This website always provides clear and useful messages when I do not know how to proceed.</td>
</tr>
<tr>
<td>4.7</td>
<td>I am able to quickly complete my work using site</td>
</tr>
</tbody>
</table>

### 5. Evaluating education purpose

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>I can easily access the registration page</td>
</tr>
<tr>
<td>5.2</td>
<td>I can easily register for semester.</td>
</tr>
<tr>
<td>5.3</td>
<td>When I need to register, the website provides information about what the courses are offered</td>
</tr>
<tr>
<td>5.4</td>
<td>The website provides information about who is teaching the courses.</td>
</tr>
<tr>
<td>5.5</td>
<td>This website is regularly updated in terms of personnel and course information in order to keep their information up-to-date</td>
</tr>
<tr>
<td>5.6</td>
<td>I can easily contact with my instructors because this website provides information about instructors’ office location and hours, and e-mail addresses.</td>
</tr>
<tr>
<td>5.7</td>
<td>This website suffers from problems during registration process for students.</td>
</tr>
<tr>
<td>5.8</td>
<td>I know who I can contact for more information about anything in this website.</td>
</tr>
<tr>
<td>5.9</td>
<td>You can search for a book in the library through the website</td>
</tr>
<tr>
<td>5.10</td>
<td>Can you find out borrowed books through the website</td>
</tr>
<tr>
<td>5.11</td>
<td>Can you communicate with the teacher through the site</td>
</tr>
<tr>
<td>5.12</td>
<td>Can you download lectures and tutorials through the site</td>
</tr>
<tr>
<td>5.13</td>
<td>Do you know your financial record by Website</td>
</tr>
</tbody>
</table>

### 6. The services in the site

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>The Online Grades Service</td>
</tr>
<tr>
<td>6.2</td>
<td>Courses schedules service</td>
</tr>
<tr>
<td>6.3</td>
<td>Exam Schedules Service</td>
</tr>
<tr>
<td>6.4</td>
<td>Email for students in the site</td>
</tr>
<tr>
<td>6.5</td>
<td>The evaluate of teachers service</td>
</tr>
<tr>
<td>6.6</td>
<td>The evaluate of courses service</td>
</tr>
<tr>
<td>6.7</td>
<td>Online advising service</td>
</tr>
<tr>
<td>6.8</td>
<td>Announcements service</td>
</tr>
<tr>
<td>6.9</td>
<td>social networks (Facebook, Twitter)</td>
</tr>
<tr>
<td>6.10</td>
<td>Graduates gate</td>
</tr>
<tr>
<td>6.11</td>
<td>Personal Site for teachers</td>
</tr>
<tr>
<td>6.12</td>
<td>Scientific conferences</td>
</tr>
<tr>
<td>6.13</td>
<td>Complaints service</td>
</tr>
</tbody>
</table>
As stated in appendix 1, these metrics reviewed by two academic besides my supervisor. They have experiences to ensure accurate, effective metrics and covered most issues of usability to evaluate the university site.

In addition to these general metrics, we used other metrics to measure the performance of the website which are [62][63]:

1. **Task time:**
   This metric evaluates the time of the task.

2. **Confirm (scenario task):**
   This metric is used to ensure the task is complete or not.

3. **Total tasks time:**
   This metric evaluates the total time of the tasks.

4. **Task satisfaction:**
   This metric is evaluating the satisfaction of student about task.

5. **Number of clicks:**
   This metric evaluates the number of mouse clicks of the task.

6. **Number of pages:**
   This metric evaluates the number of site open pages of the scenario task.

7. **Number of error pages:**
   This metric measures the number of error open pages of the scenario task.

These metrics evaluate performance of the websites that are the testers (students) cannot evaluate them. These metrics are used by conduct a set of (scenario task) for some operations in the website, via these tasks we can measure the performance of the student interact of websites.

By conducting these scenarios, we can measure some of previews metrics such as the task time of the task, the number of mouse clicks from start task to end and the number of page open from start task to end.
4.2: Data Acquisition:

In the research, two datasets were collected from two different sources Alazhar University –Gaza and faculty of intermediate college-Gaza to evaluate the usability for universities sites. We used two different methods to collect the data which are:

a) Questionnaire:

Because the university students are the most of the university websites users, we conduct Web application questionnaire that uses to collect the answers from students, the student must answer all the questions to evaluate his university. The questionnaire is inserted in the portal of students, which about 55 different questions organized into 6 categories as stated above.

1 -limitation of answers:
The answers limit between 5 choices:
- Always (A).
- Sometimes (B).
- Rarely (C).
- Never (D).
- This service is not available (E).
The students must be answered all the questions to complete the questionnaire.

2- The students sample (testers):
The sample was chosen from students according to the following criteria:
1- The sample covered all colleges in the university.
2- The sample covered all departments of the colleges.
3-The sample covered two genders (Male, Female).
4- The sample covered all levels of student’s study which are (1, 2, 3, 4,5).
5-The sample covered the Student's cumulative rate between (53% to 98%).

3- The attribute of the questionnaire data set:

In this data set we collect a number of attribute which is effective to evaluate the site as the table 4.3:

<table>
<thead>
<tr>
<th>No.</th>
<th>Attribute name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>STDNO</td>
<td>The ID number of the student</td>
</tr>
<tr>
<td>2</td>
<td>COL_NAME</td>
<td>The college name of the student</td>
</tr>
<tr>
<td>3</td>
<td>STD_LEVEL</td>
<td>The student level study</td>
</tr>
<tr>
<td>4</td>
<td>STD_SEX</td>
<td>The student gender</td>
</tr>
<tr>
<td>5</td>
<td>STD_CGPA</td>
<td>The Student's cumulative rate</td>
</tr>
<tr>
<td>6</td>
<td>Q1 ----Q 55</td>
<td>The questions of the questionnaire.</td>
</tr>
</tbody>
</table>
4- The Web application questionnaire:

There are 55 questions in the web application questionnaire table 4.4:

Table 4.4: the questions in the web application questionnaire

<table>
<thead>
<tr>
<th>Phrase</th>
<th>م</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>يحتوي الموقع على معظم المعلومات التي تهمي This website contains most of my interest material</td>
<td>1</td>
<td>استفسال عن مدى سهولة الموقع وسهولة القراءة والتنظيم Questions for evaluating content, organization and readability</td>
</tr>
<tr>
<td>المواضيع محدثة ولا بد</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>استطيع الوصول إلى ما اريده من الموقع I can easily find what I want at this website</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>المحتويات الموقع منظمة بطريقة جيدة The content of this website is well organized</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>استطيع قراءة المحتويات الموقع بسهولة Reading content of this website is easy</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>اللغة المكتوب بها الموقع مألوفة I am comfortable and familiar with the used language</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>لا احتاج إلى التنقل إلى اليسار واليمين لقراءة محتوى الموقع I do not need to scroll left and right when reading at this website</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>هل رؤية والهداف وقوانين الجامعة والبرامج موجودة Is the vision and objectives and the laws and regulations of the University and programs exist</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>استطيع بسهولة تحديد مكان تواجدي في الموقع I can easily know where I am at this website</td>
<td>9</td>
<td>استفسال لتقييم التجول في الموقع والوصلات Questions for evaluating navigation and links</td>
</tr>
<tr>
<td>يوفر الموقع الوصلات المطلوبة للحصول على المعلومات المطلوبة This website provides useful links for me to get the desired information</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>استطيع بسهولة معرفة كيف وصلت لهذه الصفحة في الموقع I can easily know how did get here</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>استطيع بسهولة معرفة إلى أي سوف أذهب من مكان تواجدني I can easily know where can I go from here</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>يوجد سهولة في التنقل داخل الموقع من خلال الوصلات وزر الراجوع في المتصفح It is easy to move around at this website by using the links or back button of the browser</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>الوصلات في الموقع دائما تعمل وحديثة The links at this website are well maintained and updated</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Arabic</td>
<td>English</td>
<td>Page</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>الموقع لا يفتح صفحات جديدة كثيرا أثناء تصفح الموقع</td>
<td>The website does not open too many new windows when I am moving around</td>
<td>15</td>
</tr>
<tr>
<td>مكان الاتصال والقوائممنظمة وسهل الوصول إليها</td>
<td>Placement of links or menu is standard throughout the website and I can easily recognize them</td>
<td>16</td>
</tr>
<tr>
<td>واجهة الموقع لها تصميم جذاب</td>
<td>This website’s interface design is attractive</td>
<td>17</td>
</tr>
<tr>
<td>انا مرتاح للالوان المستخدمة للموقع</td>
<td>I am comfortable with the colors used at this website</td>
<td>18</td>
</tr>
<tr>
<td>لا يحتوي الموقع على خصائص ومض النصوص وحركات الصور</td>
<td>This website contains no feature that irritates me such as scrolling or blinking text and looping animations</td>
<td>19</td>
</tr>
<tr>
<td>الموقع متناسق ومريح</td>
<td>This website has a consistent feel and look</td>
<td>20</td>
</tr>
<tr>
<td>لا يحتوي الموقع على دعايات</td>
<td>This website does not contain advertisements</td>
<td>21</td>
</tr>
<tr>
<td>تصميم الموقع سلس وسهل في تعلم الاستخدام</td>
<td>The design of the website makes sense and it is easy to learn how to use it</td>
<td>22</td>
</tr>
<tr>
<td>لا احتاج إلى الانتظار طويلا عند تحميل ملف أو فتح صفحة</td>
<td>I need not wait too long to download a file or open a page</td>
<td>23</td>
</tr>
<tr>
<td>يستطيع بسهولة تحديد الواصلة التي زرتها والتي لم أزورها</td>
<td>I can easily distinguish between visited and not visited links.</td>
<td>24</td>
</tr>
<tr>
<td>يستطيع الوصول إلى الموقع في أي وقت</td>
<td>I can access this website any time</td>
<td>25</td>
</tr>
<tr>
<td>يستطيع الموقف للامر الذي اطلبه كما هو متوقع</td>
<td>This website responds to my actions as expected.</td>
<td>26</td>
</tr>
<tr>
<td>هناك فعاليه في استخدام الموقع</td>
<td>It is efficient to use this website</td>
<td>27</td>
</tr>
<tr>
<td>يستطيع الموقع الرسائل والتنبيهات اللازمة لإتمام أي عملية</td>
<td>This website always provides clear and useful messages when I do not know how to proceed.</td>
<td>28</td>
</tr>
<tr>
<td>استطيع استكمال العمل الذي اريده من الموقع بسرعة</td>
<td>I am able to quickly complete my work using site</td>
<td>29</td>
</tr>
<tr>
<td>استطيع بسهولة الدخول لوابة الطالب</td>
<td>I can easily access the registration page</td>
<td>30</td>
</tr>
</tbody>
</table>

Questions for evaluating user interface design

Questions for evaluating performance and Effectiveness

Questions for evaluating education
<table>
<thead>
<tr>
<th>No.</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>I can easily register for semester</td>
</tr>
<tr>
<td>32</td>
<td>When I need to register, the website provides information about what the courses are offered</td>
</tr>
<tr>
<td>33</td>
<td>The website provides information about who is teaching the courses</td>
</tr>
<tr>
<td>34</td>
<td>This website is regularly updated in terms of personnel and course information in order to keep their information up-to-date</td>
</tr>
<tr>
<td>35</td>
<td>I can easily contact with my instructors because this website provides information about instructors’ office location and hours, and e-mail addresses.</td>
</tr>
<tr>
<td>36</td>
<td>This website suffers from problems during registration process for students</td>
</tr>
<tr>
<td>37</td>
<td>I know who I can contact for more information about anything in this website</td>
</tr>
<tr>
<td>38</td>
<td>You can search for a book in the library through the website</td>
</tr>
<tr>
<td>39</td>
<td>Can you find out borrowed books through the website</td>
</tr>
<tr>
<td>40</td>
<td>Can you communicate with the teacher through the site</td>
</tr>
<tr>
<td>41</td>
<td>Can you download lectures and tutorials through the site</td>
</tr>
<tr>
<td>42</td>
<td>Do you know your financial record by Website</td>
</tr>
<tr>
<td>43</td>
<td>The Online Grades Service</td>
</tr>
<tr>
<td>44</td>
<td>Courses schedules service</td>
</tr>
<tr>
<td>45</td>
<td>Questions for the services in the site</td>
</tr>
<tr>
<td>Service Name</td>
<td>Page</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Exam Schedules Service</td>
<td>45</td>
</tr>
<tr>
<td>Email for students in the site</td>
<td>46</td>
</tr>
<tr>
<td>The evaluate of teachers service</td>
<td>47</td>
</tr>
<tr>
<td>The evaluate of courses service</td>
<td>48</td>
</tr>
<tr>
<td>Online advising service</td>
<td>49</td>
</tr>
<tr>
<td>Announcements service</td>
<td>50</td>
</tr>
<tr>
<td>Graduates gate</td>
<td>51</td>
</tr>
<tr>
<td>Personal Site for teachers</td>
<td>52</td>
</tr>
<tr>
<td>Scientific conferences</td>
<td>53</td>
</tr>
<tr>
<td>Complaints service</td>
<td>54</td>
</tr>
</tbody>
</table>

**b) The tools (Scenario Tasks):**

In this research we used tools to evaluate the usability of website of the university. We used these tools to measure and evaluate some metrics that cannot be measured by the user (students).

The advantage of these tools that its measurements are objective and they are useful to evaluation process for the universities sites, to ensure the accuracy and comprehensiveness of the process of assessing the ease of usability of universities sites.

We used these tools to collect data about (scenario tasks). Scenario task is a short task present to the student to tracking the process.

We conduct five different scenario tasks to evaluate set of metrics about usability of the universities Websites, the tables 4.5 and 4.6 gives the scenario tasks we used in our evaluations.
Table 4.5: the scenario tasks for evaluations of Alazhar University

<table>
<thead>
<tr>
<th>المصطلحات</th>
<th>الهدف المهمة</th>
<th>رقم المهمة</th>
</tr>
</thead>
<tbody>
<tr>
<td>من خلال موقع الجامعة الإلكتروني قم بطباعة السند البنكى للفصل الدراسي الأول 2012/2013</td>
<td>By using the University's website, print the banking document for the first semester of 2012/2013</td>
<td>Task1</td>
</tr>
<tr>
<td>من خلال موقع الجامعة الإلكتروني قم بعرض الهيئة التدريسية لكلية التربية - قسم إصول التربيع</td>
<td>By using University's website, present the staff of Education college - Department of Education</td>
<td>Task2</td>
</tr>
<tr>
<td>من خلال موقع الجامعة الإلكتروني قم بالبحث في مكتبة الجامعة عن كتاب عن القضية الفلسطينية</td>
<td>By using the University's website, search at the university library for a book about the Palestinian issue</td>
<td>Task3</td>
</tr>
<tr>
<td>من خلال موقع الجامعة الإلكتروني قم بتحميل الخطة الدراسية للتخصص الخاص بك</td>
<td>By using the University's website, download the study plan for your department</td>
<td>Task4</td>
</tr>
<tr>
<td>من خلال موقع الجامعة الإلكتروني للجامعة قم بفتح البوابة الإلكترونية لطلب نسخة من الملف الشخصي الخاص بك</td>
<td>By using the University's website, view your faculty staff C.V via personal staff C.V</td>
<td>Task5</td>
</tr>
</tbody>
</table>

Table 4.6: the scenario tasks for evaluations of faculty of intermediate college

<table>
<thead>
<tr>
<th>المصطلحات</th>
<th>الهدف المهمة</th>
<th>رقم المهمة</th>
</tr>
</thead>
<tbody>
<tr>
<td>من خلال موقع الكلية الإلكترونية قم بطباعة السند البنكى للفصل الدراسي الثاني 2012/2013</td>
<td>By using the college website, print the banking document for the second semester of 2012/2013</td>
<td>Task1</td>
</tr>
<tr>
<td>من خلال موقع الكلية الإلكترونية قم بعرض الهيئة التدريسية لبرنامج الحاسوب في الكلية</td>
<td>By using college website, present the staff of IT Department</td>
<td>Task2</td>
</tr>
<tr>
<td>من خلال موقع الكلية الإلكترونية قم بعرض النظام الأكاديمي</td>
<td>By using the college website, Display the academic system of the college</td>
<td>Task3</td>
</tr>
<tr>
<td>من خلال موقع الكلية الإلكترونية قم بتحميل الخطة الدراسية للتخصص الخاص بك</td>
<td>By using the college website, download the study plan for your department</td>
<td>Task4</td>
</tr>
<tr>
<td>من خلال موقع الكلية قم بالبحث عن الخبر &quot;كلية الدارسات المتوسطة تحتفل بتخرج فوج &quot;الهوية والاتمء&quot;</td>
<td>By using the college website, search in news for college about</td>
<td>Task5</td>
</tr>
</tbody>
</table>
In the research we collect the data by using two tools as the follows:

2.1 Testrockit tool:

TestRockit was made for usability benchmark studies, it delivers usability metrics for success, efficiency, and satisfaction in compliance with the ANSI/INCITS-354 Common Industry Format (CIF) for Usability Test Reports [62]. This tool provides some of metrics, we select the best significant metrics which has an impact on the appearance of results during the evaluation process of the task scenario experiment to evaluate the performance of the educational websites because these metrics is important to measure the behavior of students when visit the educational websites such as [62]:

- **Task time:**
  This metric measure the time of the (scenario task), from start the task to end.

- **Confirm (scenario task):**
  This metric to ensure the time in complete or the student not complete the task.

- **Total tasks time:**
  This metric measure the total time about the all five (scenario task) of the student.

- **Task satisfaction:**
  This metric measure the satisfaction the student about (scenario task) of the student.

2.2 Screen recorder pro:

This tool provides some of metrics, we select the best significant metrics which has an impact on the appearance of results during the evaluation process of the task scenario experiment to evaluate the performance of the educational websites because these metrics is important to measure the behavior of students when visit the educational websites such as [63]:

- **Number of clicks:**
  This metric measure the number of mouse clicks of the (scenario task), from start the task to end.

- **Number of pages:**
  This metric measure the number of site open pages of the (scenario task), from start the task to end.

- **Number of error pages:**
  This metric measure the number of error open pages of the (scenario task), from start the task to end.

In the light of the preceded tools, we choose the best metrics to evaluate the usability of the educational websites, these metrics are important because the questionnaire does not cover these metrics, and important to making sure the accurate of the usability testing [43][22].
4.3: Collect data set (the answers) from testers, and from the tools:

To get data that is ready to use in data mining, we conduct in the research a set of preprocessing operations on the data sets before conducting the final experiment. We conducted two set of operations on Data Preprocessing and Data Integration.

4.3.1 Collecting data:

In data preprocessing, we apply a set of important operations before implement the final experiment including:

4.3.1.1 Select attributes:

For more powerful results in the research we choose all available attributes for our research, that's we asks two academic experiences to ensure accurate, effective metrics and covered most issues of usability to evaluate the university website, as the following table 4.7:

Table 4.7: the best effective attributes in task scenario

<table>
<thead>
<tr>
<th>Name of data set</th>
<th>Attribute name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire</td>
<td>STDNO</td>
<td>The ID number of the student</td>
</tr>
<tr>
<td></td>
<td>COL_NAME</td>
<td>The college name of the student</td>
</tr>
<tr>
<td></td>
<td>STD_LEVEL</td>
<td>The student level study</td>
</tr>
<tr>
<td></td>
<td>STD_SEX</td>
<td>The student gender</td>
</tr>
<tr>
<td></td>
<td>STD_CGPA</td>
<td>The Student's cumulative rate</td>
</tr>
<tr>
<td></td>
<td>Q1 ---- Q 55</td>
<td>The questions of the questionnaire.</td>
</tr>
<tr>
<td>Tools(scenario tasks)</td>
<td>Task_time</td>
<td>the time of the (scenario task), from start the task to end</td>
</tr>
<tr>
<td></td>
<td>Confirm</td>
<td>to ensure the task in complete or the student not complete the task</td>
</tr>
<tr>
<td></td>
<td>Total_time_tasks/sec</td>
<td>the total time about the all five (scenario task) of the student</td>
</tr>
<tr>
<td></td>
<td>No. Clicks</td>
<td>the number of mouse clicks of the (scenario task), from start the task to end</td>
</tr>
<tr>
<td></td>
<td>No.page</td>
<td>the number of site open pages of the (scenario task), from start the task to end.</td>
</tr>
<tr>
<td></td>
<td>No. error pages</td>
<td>the number of error open pages of the (scenario task), from start the task to end.</td>
</tr>
</tbody>
</table>

4.3.1.2 Choose sample:

In this research we conduct the experiment on two different universities:

4.3.1.2.1 Alazhar University – Gaza:

Alazhar University – Gaza includes 13 different colleges and it has 12,000 registered students.

We ask statistical academic experts about the number of best sample to implement the experiment on Alazhar university students; they suggest we need sample between 300 to 500 students to ensure the results are covered the university, that’s depending on the following formula see eq.5 [37]:
\[ s = X^2NP(1 - P) + d^2(N - 1) + X^2P(1 - P). \] (5)

s = required sample size.
X2= the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).
N = the population size.
P = the population proportion (assumed to be .50 since this would provide the maximum Sample size).
d = the degree of accuracy expressed as a proportion (.05).

Based on population size 12000, in this university we collect 390 students as a sample for applying the experiment.

4.3.1.2.2 Faculty of intermediate college -Gaza:
Faculty of intermediate college includes five different departments and it has 2000 registered students.
Also we ask statistical academic experts about the number of best sample to implement the experiment on Faculty of intermediate college students; they suggest we need sample between 50 to 150 students to ensure the results are cover the university, that’s depending on the previews formula (5) [37].
Based on population size 2000, in this university we collect 100 students as a sample for applying the experiment.

4.3.2 Data preprocessing:
Data preprocessing is a data mining technique that involves transforming raw data into an understandable format. Real-world data is often incomplete, inconsistent, and/or lacking in certain behaviors or trends, and is likely to contain many errors. Data preprocessing is a proven method of resolving such issues. Data preprocessing prepares raw data for further processing [10][24].

Remove missing data:
This operation is important to ensure the accurate input data to the experiment, remove missing record operation is remove the records that have bad effect on the data to ensure extract accurate results from the experiment.

Remove identical answers:
In the questionnaire experiment, we have some identical answers for the same student, for example when the student choose the same answer for all questions in the web application questionnaire that mean he does not read all the question’s, in this state we remove this record from the data set.
4.3.3 Data integration:

In order to increase effective data about the cases study in the research (Alazhar University – Gaza, Faculty of intermediate college) we integrate some attributes from register programs in this cases universities. After conduct the experiments (Questionnaire, Tools) on the universities students we choose the best effective attributes from register programs in these cases universities in table 4.8:

<table>
<thead>
<tr>
<th>No.</th>
<th>Attribute name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COL_NAME</td>
<td>The college name of the student</td>
</tr>
<tr>
<td>2</td>
<td>STD_LEVEL</td>
<td>The student level study</td>
</tr>
<tr>
<td>3</td>
<td>STD_SEX</td>
<td>The student gender</td>
</tr>
<tr>
<td>4</td>
<td>STD_CGPA</td>
<td>The Student's cumulative rate</td>
</tr>
</tbody>
</table>

The same attribute in the different data sets may have different names. So for efficient later integration, simplified data description and understanding of data mining results, we unified these attributes to a unified attribute name in the datasets.

4.4: Determine data mining method:

Data mining methods are the backbone of our approach in the research, to extract the useful and meaningful knowledge about the usability testing from students whose test the usability of site.

In the research we choose Associations rules method because association rule learning is a popular and well researched method for discovering interesting relations between variables in large databases. That mean we can extract a useful relations about our two experimental in the research. For example we can extract relation between the level of students and using interface web site in the questionnaire experiment, also we can find strong relation between the number of mouse clicks and the number of open page in the task scenario experiment [31][13][55]

It is intended to identify strong rules discovered in databases using different measures of interestingness. For example, the rule \{onions, potatoes\} \Rightarrow \{burger\} found in the sales data of a supermarket would indicate that if a customer buys onions and potatoes together, he or she is likely to also buy hamburger meat. Such information can be used as the basis for decisions about marketing activities such as, e.g., promotional pricing or product placements. In addition to the above example from market basket analysis association rules are employed today in many application areas including Web usage mining, intrusion detection, Continuous production and bioinformatics. As opposed to sequence mining, association rule learning typically does not consider the order of items either within a transaction or across transactions [24].
1- Process:

Association rules are usually required to satisfy a user-specified minimum support and a user-specified minimum confidence at the same time. Association rule generation is usually split up into two separate steps: First, minimum support is applied to find all frequent item sets in a database. Second, these frequent item sets and the minimum confidence constraint are used to form rules, while the second step is straightforward, the first step needs more attention. Association analysis: Suppose, as a marketing manager of All Electronics, you would like to determine which items are frequently purchased together within the same transactions. An example of such a rule, mined from the All Electronics transactional database, is

\[\text{buys}(X; \text{“computer”}) \text{buys}(X; \text{“software”}) \{\text{support} = 1\%; \text{confidence} = 50\%\}\]

where \(X\) is a variable representing a customer. A confidence, or certainty, of 50\% means that if a customer buys a computer, there is a 50\% chance that she will buy software as well. A 1\% support means that 1\% of all of the transactions under analysis showed that computer and software were purchased together. This association rule involves a single attribute or predicate (i.e., buys) that repeats [24].

2- Algorithms:

Many algorithms for generating association rules were presented over time, Some well known algorithms are Apriori, Eclat and FP-Growth, but they only do half the job, since they are algorithms for mining frequent itemsets. Another step needs to be done after to generate rules from frequent itemsets found in a database.

2.1 Apriori algorithm:

Apriori is the best-known algorithm to mine association rules. It uses a breadth-first search strategy to count the support of itemsets and uses a candidate generation function which exploits the downward closure property of support [17]. Apriori is designed to operate on databases containing transactions (for example, collections of items bought by customers, or details of a website frequentation). Other algorithms are designed for finding association rules in data having no transactions (Minepi and Minepi), or having no timestamps (DNA sequencing). Each transaction is seen as a set of items (an itemset). Given a threshold \(C\), the Apriori algorithm identifies the item sets which are subsets of at least \(C\) transactions in the database.[55] Apriori uses breadth-first search and a Hash tree structure to count candidate item sets efficiently. It generates candidate item sets of length \(k\) from item sets of length \(k - 1\). Then it prunes the candidates which have an infrequent sub pattern. According to the downward closure lemma, the candidate set contains all frequent \(k\)-length item sets. After that, it scans the transaction database to determine frequent item sets among the candidates [24].
2.2 FP-growth algorithm:

FP stands for frequent pattern. In the first pass, the algorithm counts occurrence of items (attribute-value pairs) in the dataset, and stores them to 'header table'. In the second pass, it builds the FP-tree structure by inserting instances. Items in each instance have to be sorted by descending order of their frequency in the dataset, so that the tree can be processed quickly. Items in each instance that do not meet minimum coverage threshold are discarded. If many instances share most frequent items, FP-tree provides high compression close to tree root [49]. Recursive processing of this compressed version of main dataset grows large item sets directly, instead of generating candidate items and testing them against the entire database. Growth starts from the bottom of the header table (having longest branches), by finding all instances matching given condition. New tree is created, with counts projected from the original tree corresponding to the set of instances that are conditional on the attribute, with each node getting sum of its children counts. Recursive growth ends when no individual items conditional on the attribute meet minimum support threshold, and processing continues on the remaining header items of the original FP-tree [54].

For example in questionnaire we need to know the degree of relation between “I can easily know where I am at this website” and “This website has a consistent feel and look”, that is more important in evaluating the web site. Also in tasks we need to know the degree of relation between “Number of clicks” and “Number of pages”, that is more important in evaluate the web site. These extract relations are gives from data mining method “Associations rule”, and we can extract a set of useful relations between all attributes in our research to ensure the accurate evaluation of the university web site. The final results of our research are generating useful Association Rules, This operator generated a set of association rules for a given set of frequent item sets.

In RapidMiner, the process of frequent item set mining is divided into two parts: first, the generation of frequent item sets and second, the generation of association rules from these sets. For the generation of frequent item sets, you can use for example the operator FPGrowth. The result will be a set of frequent item sets which could be used as input for this operator [28].

Input :item sets: expects: Frequent Item Sets

Output :rules:

Parameters

- criterion: The criterion which is used for the selection of rules
- min confidence: The minimum confidence of the rules
- min criterion value: The minimum value of the rules for the selected criterion
- gain theta: The Parameter Theta in Gain calculation
- laplace k: The Parameter k in LaPlace function calculation

- 52 -
4.5: Evaluation

Two important measures to evaluate the metrics for association rules support (s) and confidence (α) can be defined as follows:

Support: Support of a rule is a measure of how frequently the items involved in it occur together. Using probability notation: support (A implies B) = P(A, B) [26].

Support(s) is calculated by the following formula [36]:

\[ \text{Support}(XY) = \frac{\text{Support count of } XY}{\text{Total number of transaction in } D} \]  

(3)

From the definition we can see, support of an item is a statistical significance of an association rule. Suppose the support of an item is 0.1%, it means only 0.1 percent of the transaction contains purchasing of this item. Before the mining process, users can specify the minimum support as a threshold, which means they are only interested in certain association rules that are generated from those item sets whose supports exceed that threshold [26][55].

Confidence: the percentage/fraction of the number of transactions that contain \( X \cup Y \) to the total number of records that contain \( X \), where if the percentage exceeds the threshold

\[ \text{Confidence}(X|Y) = \frac{\text{Support}(XY)}{\text{Support}(X)} \]  

(4)

Confidence is a measure of strength of the association rules, suppose the confidence of the association rule \( X \rightarrow Y \) is 80%, it means that 80% of the transactions that contain \( X \) also contain \( Y \) together, similarly to ensure the interestingness of the rules specified minimum con” Confidence is also pre-defined by users.
CHAPTER 5

Experiments Description
In this chapter, we present and analyze our experiments; in section 5.1 we present the experiments setup that includes experimental environment, experimental tools and experimental setting, in Section 5.2 we have two different case studies for conducting the experiments, Alazhar University – Gaza and Faculty of intermediate college-Gaza. In section 5.3 we present conclusions of this chapter.

5.1 Experiments Setup:
In this section, we will description the experimental environment of the experiments, and determine the experimental tools that are used in the experiments, final determine the setting of the experiments in the research.

5.1.1 Experimental Environment:
We applied experiments on a machine with properties that is Intel (R) Core (TM) 2 Duo CPU P7550 @ 2.26 GHz, 4.00 GB RAM, 500 GB hard disk drive and Windows 7, 32 bit operating system installed.

5.1.2 Experimental Tools:
In our experiments we use the following tools:

1- RapidMiner program:
RapidMiner provides data mining and machine learning procedures including: data loading and transformation (Extract, transform, load, etc.), data preprocessing and visualization, modeling, evaluation and deployment. RapidMiner is written in the Java programming language [60].

2- Testrockit tool:
TestRockit was made for usability benchmark studies, TestRockit delivers usability metrics for success, efficiency, and satisfaction in compliance with the ANSI/INCITS-354 Common Industry Format (CIF) for Usability Test Reports [62].

3- My screen recorder pro tool:
My Screen Recorder Pro is screen recording software that lets you record desktop screen activity for later playback, any application that runs on Windows PC can be recorded including applications with video and audio. It can create presentations from the screen recordings by adding your own audio narration. It can demonstrates how to use a web site or explain a product concept [64].

4- Microsoft Office Excel: used to organize and store datasets in tables, do some simple preprocessing and analyze the results.

5.1.3 Experimental setting:
In the research we have some of setting and configurations that are modified in the experiments to ensure a fix environment of the experiments in table 5.1:

<table>
<thead>
<tr>
<th>No.</th>
<th>Experiment Issue</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The internet browser</td>
<td>In this issue we determine the Google chromo browser of experiments</td>
</tr>
<tr>
<td>2</td>
<td>Internet speed</td>
<td>In our experiments we have 2 Mb/s internet speeds of all task scenarios for test students.</td>
</tr>
<tr>
<td>3</td>
<td>Computer Pc</td>
<td>In our experiments we select one computer to conduct the task scenario for test students.</td>
</tr>
</tbody>
</table>
5.2 Experimental cases:

In the research we have two different case studies for conduct our experimental, Alazhar University – Gaza and Faculty of intermediate college-Gaza.

5.2.1 Alazhar University – Gaza:

Alazhar University – Gaza includes 13 different colleges and it has 12,000 registered students.
In this case we have two different experimental processes the questionnaire experiment and the tools experiment, with different data sets.

5.2.1.1 Questionnaire experiment:

In the research we conduct (Web application questionnaire) that uses to collect the answers from students, the student must answer 55 different questions Organized according to 6 categories, that the student evaluate his university and based on predefined metrics. The questionnaire inserted in the portal of students, to ensure that the students ask the questions quickly and compulsory.
In the Questionnaire experiment we have some descriptions of the attributes and the counts of students for attributes that we are using them in the Questionnaire experiment as the following table 5.2, table 5.3, and table 5.4:

1- Student's cumulative rate (STD-CGPA):

There are three levels of The Student's cumulative rate in data set:

<table>
<thead>
<tr>
<th>Rang name</th>
<th>From</th>
<th>To</th>
<th>Count of rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail</td>
<td>50%</td>
<td>64%</td>
<td>87</td>
</tr>
<tr>
<td>Good</td>
<td>65%</td>
<td>79%</td>
<td>229</td>
</tr>
<tr>
<td>V Good</td>
<td>80%</td>
<td>89%</td>
<td>70</td>
</tr>
</tbody>
</table>

2- Student level (STD-LEVEL):

There are five levels of student’s case in bachelor degree:

<table>
<thead>
<tr>
<th>Level</th>
<th>Name</th>
<th>Count of rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>a</td>
<td>84</td>
</tr>
<tr>
<td>Level 2</td>
<td>b</td>
<td>88</td>
</tr>
<tr>
<td>Level 3</td>
<td>c</td>
<td>78</td>
</tr>
<tr>
<td>Level 4</td>
<td>d</td>
<td>107</td>
</tr>
<tr>
<td>Level 5</td>
<td>e</td>
<td>29</td>
</tr>
</tbody>
</table>
3- College name(Col-Name):

There are 13 different colleges in the university, but we summarize in to two categories:

<table>
<thead>
<tr>
<th>Category name</th>
<th>Colleges</th>
<th>Count of college rang</th>
<th>Count of college category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>IT</td>
<td>48</td>
<td>205</td>
</tr>
<tr>
<td></td>
<td>Dental</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medicine</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pharmacy</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Science</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Applied</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Agriculture</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Humanity science</td>
<td>Economic</td>
<td>40</td>
<td>181</td>
</tr>
<tr>
<td></td>
<td>Sharia</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td></td>
<td>law</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ART</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Graduate</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

**Apply data mining method:**

In the first experiment process “questionnaire experiment” we applied FP-Growth algorithm, this learner efficiently calculates all frequent item sets from the given data, after that we extract the useful rules by “Create Association Rules” that operator generated a set of association rules for a given set of frequent item sets [17].

**FP-Growth setting for experiment:**

**A- Min support and min confidence setting:**

In questionnaire experiment of Alazhar University-Gaza we select the best value of “min-support” of FP-Growth algorithm and “min-confidence” of Create Association Rules by a set of tests and analyzes conducted on the experiment [33][13].

The best value of “min-support” and “min-confidence” means there are strong relations between attributes in data set experiment, and large number of relations between them [24], you can see the setting in the following figures 5.1, 5.2:
1- FP-Growth:

![Figure 5.1: The value of min support in the questionnaire experiment](image1)

2- Create Association Rules:

![Figure 5.2: The value of min confidence in the questionnaire experiment](image2)

From previous figures we can see the best value of “min- support” of FP-Growth algorithm is 0.15, and the best value of “min-confidence” of Create Association Rules is 0.1, because there are strong relations between the experiment attributes in data set, and large number of relations between them.

**B- The process of FP-growth method:**

The following figure 5.3 is the main process of the FP-growth method that we applied on the questionnaire experiment, this method is implemented via RapidMiner tools:

![Figure 5.3: The main process of FP-growth method in RapidMiner tool](image3)
The previews figure 5.3 “the main process of the FP-growth method” includes the following steps:

1- **Read Excel:** this step is choosing the data set input to the FP-growth method, it is the collected data from answers of the web application questionnaire.

2- **Discretize by User Specification:** This operator discretizes a numerical attribute to either a nominal or an ordinal attribute. The numerical values are mapped to the classes according to the thresholds specified by the user. The user can define the classes by specifying the upper limits of each class,[60] in our experiment we discretized the attribute “STD_CGPA” in to three level which we explain in the descriptions attributes.

3- **Discretize by Frequency:** This operator discretizes all numeric attributes in the dataset into nominal attributes. This discretization is performed by equal frequency binning [60]. In our experiment the “Discretize by Frequency” automatic discretized the attributes (COL_NAME, STD_LEVEL, the questions).

4- **Nominal to Binominal:** This operator maps the values of all nominal values to binary attributes [60].

5- **FP-Growth:** This operator calculates all frequent items sets from a data set by building a FPTree data structure on the transaction data base. This is a very compressed copy of the data which in many cases fits into main memory even for large data bases. From this FPTree all frequent item set are derived. A major advantage of FPGrowth compared to Apriori is that it uses only 2 data scans and is therefore often applicable even on large data sets [16].

6- **Create Association Rules:** This operator generates association rules from frequent item sets. In RapidMiner, the process of frequent item set mining is divided into two parts: first, the generation of frequent item sets and second, the generation of association rules from these sets. For the generation of frequent item sets, you can use for example the operator FPGrowth. The result will be a set of frequent item sets which could be used as input for this operator [28].

### 5.2.1.2 Experiment using the tools for the Tasks scenarios:

In the research we conduct five different (Task scenario) that is used to collect the data set from students by using (Testrockit tool and My screen recorder pro tool), the student must conduct these scenarios on the Alazhar University web site, that he evaluate his university, the (Tasks scenarios) are predefined in the previews chapter.

In the (Tasks scenarios) experiment we have some descriptions of the attributes that we are using it in the (Tasks scenarios) experiment as the following table 5.5, table 5.6, table 5.7, table 5.8, table 5.9, table 5.10, table 5.11 and table 5.12:

1- **Student’s cumulative rate (AVG):**

<table>
<thead>
<tr>
<th>Range</th>
<th>From</th>
<th>To</th>
<th>Count of rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail</td>
<td>50%</td>
<td>64%</td>
<td>4</td>
</tr>
<tr>
<td>Good</td>
<td>65%</td>
<td>79%</td>
<td>12</td>
</tr>
<tr>
<td>V Good</td>
<td>80%</td>
<td>89%</td>
<td>4</td>
</tr>
</tbody>
</table>

There are three levels of The Student’s cumulative rate in data set:
2- Student's levels (Level):
There are four level of students case in bachelor degree:

<table>
<thead>
<tr>
<th>Level</th>
<th>Name</th>
<th>Count of rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>a</td>
<td>2</td>
</tr>
<tr>
<td>Level 2</td>
<td>b</td>
<td>4</td>
</tr>
<tr>
<td>Level 3</td>
<td>c</td>
<td>2</td>
</tr>
<tr>
<td>Level 4</td>
<td>d</td>
<td>12</td>
</tr>
<tr>
<td>Level 5</td>
<td>No students testers was show in the experiment</td>
<td></td>
</tr>
</tbody>
</table>

3- College name (College):
There are 7 different colleges in the university, but we summarize in to two categories:

<table>
<thead>
<tr>
<th>Category name</th>
<th>Colleges</th>
<th>Count of college range</th>
<th>Count of college category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>IT</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Science</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Agriculture</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Humanity science</td>
<td>Economic</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>law</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ART</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

4- The number of mouse clicks (No. Clicks_1):
The number of mouse clicks of the (scenario task), we summarized the ranged in to five ranges to suitable with the number of students:

<table>
<thead>
<tr>
<th>Range</th>
<th>From</th>
<th>To</th>
<th>Task1</th>
<th>Task2</th>
<th>Task3</th>
<th>Task4</th>
<th>Task5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rang1</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>15</td>
<td>13</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Rang2</td>
<td>6</td>
<td>10</td>
<td>15</td>
<td>5</td>
<td>7</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Rang3</td>
<td>11</td>
<td>15</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Rang4</td>
<td>16</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rang5</td>
<td>21</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

5- The number of page open (No.page):
The number of site opens pages of the (scenario task), we summarized the ranged in to five ranges to suitable with the number of students:

<table>
<thead>
<tr>
<th>Range</th>
<th>From</th>
<th>To</th>
<th>Task1</th>
<th>Task2</th>
<th>Task3</th>
<th>Task4</th>
<th>Task5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rang1</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>Rang2</td>
<td>6</td>
<td>10</td>
<td>20</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Rang3</td>
<td>11</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Rang4</td>
<td>16</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rang5</td>
<td>21</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
6- Task_time/sec:

The time of the (scenarios tasks) by seconds, we summarized the ranged in to five ranges (Task1_time, Task2_time, Task3_time, Task4_time, and Task5_time):

<table>
<thead>
<tr>
<th>Range</th>
<th>From</th>
<th>To</th>
<th>Task1</th>
<th>Task2</th>
<th>Task3</th>
<th>Task4</th>
<th>Task5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rang1</td>
<td>1</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Rang2</td>
<td>23</td>
<td>60</td>
<td>2</td>
<td>11</td>
<td>9</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Rang3</td>
<td>61</td>
<td>100</td>
<td>15</td>
<td>7</td>
<td>9</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Rang4</td>
<td>101</td>
<td>145</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Rang5</td>
<td>146</td>
<td>190</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 5.10: The time of task scenario

7- Total_time_tasks/sec:

The total time of five (scenarios tasks) for each student, we summarized the ranged in to four ranges:

<table>
<thead>
<tr>
<th>Range</th>
<th>From</th>
<th>To</th>
<th>Count of rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANGE 1</td>
<td>1</td>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td>RANGE 2</td>
<td>201</td>
<td>300</td>
<td>8</td>
</tr>
<tr>
<td>RANGE 3</td>
<td>301</td>
<td>400</td>
<td>10</td>
</tr>
<tr>
<td>RANGE 4</td>
<td>401</td>
<td>500</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 5.11: The total time of five scenarios tasks

8- Confirm:

To ensure the task in complete (Yes, No):

<table>
<thead>
<tr>
<th>Range</th>
<th>Task1</th>
<th>Task2</th>
<th>Task3</th>
<th>Task4</th>
<th>Task5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>20</td>
<td>15</td>
<td>12</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>No</td>
<td>0</td>
<td>5</td>
<td>8</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 5.12: confirmation task

Apply data mining method:

In the first experiment process “Tasks scenarios experiment” we applied FP-Growth algorithm, this learner efficiently calculates all frequent item sets from the given data, after that we extract the useful rules by “Create Association Rules” that operator generated a set of association rules for a given set of frequent item sets.

The process of FP-growth method:

The following figure 5.4 is the main process of the FP-growth method that we applied on the Tasks scenarios experiment, this method is implemented via RapidMiner tools:
1- **Read Excel: this** step is choosing the data set input to the FP-growth method, it is the collected data from Tasks scenarios experiment, that’s by using (Testrockit tool and My screen recorder pro tool).

2- **Select attributes**: This operator selects which attributes of an ExampleSet should be kept and which are removed. Therefore, different filter types may be selected in the parameter attribute filter type and only attributes fulfilling this condition type are selected. In this experiment we choosing all attributes Except the ID student.

3- **Discretize by User Specification (1)**: This operator discretizes a numerical attribute to either a nominal or an ordinal attribute. The numerical values are mapped to the classes according to the thresholds specified by the user. The user can define the classes by specifying the upper limits of each class.[60] in our experiment we discretized the attributes “No. Clicks, No.page” in to five level which we explain in the descriptions attributes (table 5.8, 5.9).

4- **Discretize by User Specification (2)**: In our experiment we discretized the attribute “Task_Time” in to five level which we explain in the descriptions attributes (table 5.10).

5- **Discretize User Specification (3)**: In our experiment we discretized the attribute “AVG” in to three level which we explain in the descriptions attributes (table 5.5).

6- **Discretize User Specification (4)**: In our experiment we discretized the attribute “Total_time_tasks/sec” in to four level which we explain in the descriptions attributes (table 5.11).

7- **Discretize by Frequency**: This operator discretizes all numeric attributes in the dataset into nominal attributes. This discretization is performed by equal
frequency binning [60]. in our experiment the “Discretize by Frequency” automatic discretized the attributes (level, college, confirm).

8- Nominal to Binominal: This operator maps the values of all nominal values to binary attributes [60].

9- FP-Growth: This operator calculates all frequent items sets from a data set by building a FPTree data structure on the transaction data base. This is a very compressed copy of the data which in many cases fits into main memory even for large data bases. From this FPTree all frequent item set are derived. A major advantage of FP-Growth compared to Apriori is that it uses only 2 data scans and is therefore often applicable even on large data sets [16].

10- Create Association Rules: This operator generates association rules from frequent item sets. In RapidMiner, the process of frequent item set mining is divided into two parts: first, the generation of frequent item sets and second, the generation of association rules from these sets. For the generation of frequent item sets, you can use for example the operator FP-Growth. The result will be a set of frequent item sets which could be used as input for this operator [28].

5.2.2 Faculty of intermediate college:

Faculty of intermediate college includes five different sections and it has 2000 registered students.
In this case we have two different experimental processes the questionnaire experiment and the tools experiment, with different data sets.

5.2.2.1 Questionnaire experiment:

In the research we conduct (Web application questionnaire) that uses to collect the answers from students, the student must answer 55 different questions Organization is according to the 6 categories, that he evaluate his university and based on predefined metrics.
The questionnaire inserted in the portal of students, to ensure the students ask the questions quickly and compulsory.
In the Questionnaire experiment we have some descriptions of the attributes and the counts of students for attributes that we are using it in the Questionnaire experiment as the following table 5.13, table 5.14 and table 5.15:

1- Student's cumulative rate (STD-CGPA):

There are three levels of The Student's cumulative rate in data set:

Table 5.13: Student's cumulative rate

<table>
<thead>
<tr>
<th>Rang name</th>
<th>From</th>
<th>To</th>
<th>Count of rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail</td>
<td>50%</td>
<td>59%</td>
<td>12</td>
</tr>
<tr>
<td>Good</td>
<td>60%</td>
<td>74%</td>
<td>66</td>
</tr>
<tr>
<td>V Good</td>
<td>75%</td>
<td>89%</td>
<td>21</td>
</tr>
</tbody>
</table>
2- Student Levels (STD-LEVEL):

There are two levels of student’s case in bachelor degree:

<table>
<thead>
<tr>
<th>Table 5.14: Student Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level</strong></td>
</tr>
<tr>
<td>Level 1</td>
</tr>
<tr>
<td>Level 2</td>
</tr>
</tbody>
</table>

3- College name (Col-Name):

There are 8 different departments in the college, but we summarize them into two categories:

<table>
<thead>
<tr>
<th>Table 5.15: College name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category name</strong></td>
</tr>
<tr>
<td>Science</td>
</tr>
<tr>
<td>Design</td>
</tr>
<tr>
<td>maintenance</td>
</tr>
<tr>
<td>Humanity science</td>
</tr>
<tr>
<td>Account</td>
</tr>
<tr>
<td>press</td>
</tr>
<tr>
<td>secretary</td>
</tr>
<tr>
<td>policy</td>
</tr>
</tbody>
</table>

**Apply data mining method:**

In the first experiment process “questionnaire experiment” we applied FP-Growth algorithm, this learner efficiently calculates all frequent item sets from the given data, after that we extract the useful rules by “Create Association Rules” that operator generated a set of association rules for a given set of frequent item sets [16].

**FP-Growth setting for experiment:**

**The process of FP-growth method:**

The following figure 5.5 is the main process of the FP-growth method that we applied on the questionnaire experiment, this method is implemented via RapidMiner tools:
The previews figure 5.5 “the main process of the FP-growth method” includes the following steps:

1- **Read Excel**: this step is choosing the data set input to the FP-growth method, it is the collected data from answers of the web application questionnaire.

2- **Discretize by User Specification**: This operator discretizes a numerical attribute to either a nominal or an ordinal attribute. The numerical values are mapped to the classes according to the thresholds specified by the user. The user can define the classes by specifying the upper limits of each class. In our experiment we discretized the attribute “STD_CGPA” into three level which we explain in the descriptions attributes (table 5.13).

3- **Discretize by Frequency**: This operator discretizes all numeric attributes in the dataset into nominal attributes. This discretization is performed by equal frequency binning. In our experiment the “Discretize by Frequency” automatic discretized the attributes (COL_NAME, STD_LEVEL, the questions).

4- **Nominal to Binominal**: This operator maps the values of all nominal values to binary attributes.

5- **FP-Growth**: This operator calculates all frequent items sets from a data set by building a FPTree data structure on the transaction data base. This is a very compressed copy of the data which in many cases fits into main memory even for large data bases. From this FPTree all frequent item set are derived. A major advantage of FP-Growth compared to Apriori is that it uses only 2 data scans and is therefore often applicable even on large data sets.

6- **Create Association Rules**: This operator generates association rules from frequent item sets. In RapidMiner, the process of frequent item set mining is divided into two parts: first, the generation of frequent item sets and second, the generation of association rules from these sets. For the generation of frequent item sets, you can use for example the operator FP-Growth. The result will be a set of frequent item sets which could be used as input for this operator.
5.2.2.2 Experimental for using the tools for the (Tasks scenarios):

In the research we conduct five different (Task scenario) that are used to collect the data set from students by using (Testrockit tool and My screen recorder pro tool), the student must conduct these scenarios on the Faculty of intermediate college web site, that he evaluate his university, the (Tasks scenarios) are predefined in the previews chapter.

In the (Tasks scenarios) experiment we have some descriptions of the attributes that we are using it in the (Tasks scenarios) experiment as the following table 5.16, table 5.17, table 5.18, table 5.19, table 5.20, table 5.21, table 5.22 and table 5.23:

1- Student's cumulative rate (AVG):

There are three levels of The Student's cumulative rate in data set :

Table 5.16: Student's cumulative rate

<table>
<thead>
<tr>
<th>Range</th>
<th>From</th>
<th>To</th>
<th>Count of rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail</td>
<td>50%</td>
<td>64%</td>
<td>2</td>
</tr>
<tr>
<td>Good</td>
<td>65%</td>
<td>75%</td>
<td>2</td>
</tr>
<tr>
<td>V Good</td>
<td>80%</td>
<td>89%</td>
<td>2</td>
</tr>
</tbody>
</table>

2- Student levels (Level):

There are two level of students case in bachelor degree :

Table 5.17: Student levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Name</th>
<th>Count of rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>a</td>
<td>4</td>
</tr>
<tr>
<td>Level 2</td>
<td>b</td>
<td>2</td>
</tr>
</tbody>
</table>

3- College name (College):

There are 7 different colleges in the university, but we summarize in to two categories:

Table 5.18: College name

<table>
<thead>
<tr>
<th>Category name</th>
<th>Colleges</th>
<th>Count of college rang</th>
<th>Count of college category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>IT</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Humanity science</td>
<td>manage</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>secretary</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

4- The number of mouse clicks (No. Clicks_1):

The number of mouse clicks of the (scenario task), we summarized the ranged in to two ranges:

Table 5.19: number of mouse clicks

<table>
<thead>
<tr>
<th>Range</th>
<th>From</th>
<th>To</th>
<th>Task1</th>
<th>Task2</th>
<th>Task3</th>
<th>Task4</th>
<th>Task5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rang1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Rang2</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>
5- The number of page open(No.page):
The number of site opens pages of the (scenario task), we summarized the ranged in to two ranges:

Table 5.20: number of page open

<table>
<thead>
<tr>
<th>Range</th>
<th>From</th>
<th>To</th>
<th>Task1</th>
<th>Task2</th>
<th>Task3</th>
<th>Task4</th>
<th>Task5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rang1</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Rang2</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

6- Task_time:
The time of the (scenarios tasks) by seconds, we summarized the ranged in to five ranges (Task1_time, Task2_time, Task3_time, Task4_time, and Task5_time):

Table 5.21: The time of task scenario

<table>
<thead>
<tr>
<th>Range</th>
<th>From</th>
<th>To</th>
<th>Task1</th>
<th>Task2</th>
<th>Task3</th>
<th>Task4</th>
<th>Task5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rang1</td>
<td>1</td>
<td>30</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Rang2</td>
<td>31</td>
<td>60</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Rang3</td>
<td>61</td>
<td>90</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

7- Total_time_tasks/sec:
The total time of five (scenarios tasks) for each student, we summarized the ranged in to two ranges:

Table 5.22: The total time of five scenarios tasks

<table>
<thead>
<tr>
<th>Range</th>
<th>From</th>
<th>To</th>
<th>Count of rang</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANGE 1</td>
<td>1</td>
<td>200</td>
<td>3</td>
</tr>
<tr>
<td>RANGE 2</td>
<td>201</td>
<td>300</td>
<td>3</td>
</tr>
</tbody>
</table>

8- Confirm:
To ensure the task in complete (Yes, No):

Table 5.23: confirmation task

<table>
<thead>
<tr>
<th>Range</th>
<th>Task1</th>
<th>Task2</th>
<th>Task3</th>
<th>Task4</th>
<th>Task5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>No</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

5.3 Conclusions:
In this chapter, we presented and discussed our experiments; we presented the experiments setup that includes experimental environment, experimental tools and experimental setting, and discuss two different case studies for conducting the experimental: Alazhar University – Gaza and Faculty of intermediate college-Gaza.
CHAPTER 6

Results and Discussions
In this chapter we present the results of research experiments presented in the previous chapter and finally we discuss these results. The results include four sections, in section 6.1 we present the results by using questionnaire experiment in Alazhar university Gaza, in section 6.2 we present the results by using task scenario experiment in Alazhar university Gaza, in section 6.3 present the results by using questionnaire experiment in faculty of intermediate college – Gaza, and in section 6.4 we present the results by using task scenario experiment in faculty of intermediate college – Gaza.

6.1 Questionnaire experiment in Alazhar University Gaza:

In this section we present the results about questionnaire experiment in Alazhar University Gaza that include the strength and weakness of the universities websites after applying our approach of “Automatic Usability Evaluation on University Websites using Data Mining Methods”.

6.1.1 Strength:

In this section, we present the strength of Alazhar University website; these strength are extracting after applied automatic usability evaluation on university websites using Data Mining Methods approach by using questionnaire experiment, some strong rules are in the following table 6.1:

<table>
<thead>
<tr>
<th>Rule</th>
<th>Description</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule 1</td>
<td>If answer of question 6 (I am comfortable and familiar with the used language) = Always And answer of question 9 (I can easily know where I am at this website) = Always And answer of question 42 (Do you know your financial record by Website) = Always And answer of question 43 (The Online Grades Service) = Always And answer of question 44 (Courses schedules service) = Always Then The Student's cumulative rate = Good</td>
<td>[STD_CGPA = Good] → [Q6 = A, Q42 = A, Q44 = A, Q43 = A, Q9 = A] (confidence: 0.254)</td>
</tr>
<tr>
<td>Rule 2</td>
<td>If answer of question 5 (Reading content of this website is easy) = Always</td>
<td>[COL_NAME = Elmi] → [Q42 = A, Q5 = A, Q6 = A, Q12 = A, Q43 = A] (confidence: 0.279)</td>
</tr>
</tbody>
</table>
And answer of question 6 (I am comfortable and familiar with the used language) = Always
And answer of question 12 (I can easily know where can I go from here) = Always
And answer of question 42 (Do you know your financial record by Website) = Always
And answer of question 43 (The Online Grades Service) = Always

Then

The student study in Science colleges

Rule 3

[COL_NAME = Adapi] -->
[Q6 = A, Q42 = A, Q43 = A, Q44 = A]
(confidence: 0.273)

Description

If
answer of question 6 (I am comfortable and familiar with the used language) = Always
And answer of question 42 (Do you know your financial record by Website) = Always
And answer of question 43 (The Online Grades Service) = Always
And answer of question 44 (Courses schedules service) = Always

Then

The student study in Humanity science colleges

Rule 4

[Q3] = A -->
[Q6 = A, Q42 = A, Q43 = A, Q44 = A]
(confidence: 0.205)

Description

If
answer of question 6 (I am comfortable and familiar with the used language) = Always
And answer of question 42 (Do you know your financial record by Website) = Always
And answer of question 43 (The Online Grades Service) = Always
And answer of question 44 (Courses schedules service) = Always

Then

Question 3 (I can easily find what I want at this website) = Always

Rule 5

[Q5] = A -->
[Q6 = A, Q12 = A, Q22 = A, Q42 = A, Q43 = A]
(confidence: 0.228)

Description

If
Question 6 (I am comfortable and familiar with the used language) = Always
And Question 12 (I can easily know where can I go from here) = Always
And Question 22 (The design of the website makes sense and it is easy to learn how to use it) = Always
And answer of question 42 (Do you know your financial record by Website) = Always
| Rule 6 | \[Q9\] = A --> \\
|       | \[Q6 = A, Q12 = A, Q13 = A\]  \\
|       | (confidence: 0.229)  \\

**Description**

**IF**  
Question 6 (I am comfortable and familiar with the used language) = Always  
And Question 12 (I can easily know where can I go from here) = Always  
And Question 13 (It is easy to move around at this website by using the links or back button of the browser) = Always  
**Then**  
Question 9 (I can easily know where I am at this website) = Always

| Rule 7 | \[Q16\] = A --> \\
|       | \[STD\_CGPA = Good\, Q11 = A, Q12 = A, Q43 = A\]  \\
|       | (confidence: 0.229)  \\

**Description**

**IF**  
The Student's cumulative rate = Good  
And Question 11 (I can easily know how did get here) = Always  
And Question 12 (I can easily know where can I go from here) = Always  
And answer of question 43 (The Online Grades Service) = Always  
**Then**  
Answer of question 16 (Placement of links or menu is standard throughout the website and I can easily recognize them) = Always

| Rule 8 | \[Q22\] = A --> \\
|       | \[Q5 = A, Q6 = A, Q11 = A, Q12 = A, Q13 = A, Q18 = A\]  \\
|       | (confidence: 0.289)  \\

**Description**

**IF**  
Question 5 (Reading content of this website is easy) = Always  
And question 6 (I am comfortable and familiar with the used language) = Always  
And Question 11 (I can easily know how did get here) = Always  
And Question 12 (I can easily know where can I go from here) = Always  
And Question 13 (It is easy to move around at this website by using the links or back button of the browser) = Always  
And Question 18 (I am comfortable with the colors used at this website) = Always  
**THEN**
<table>
<thead>
<tr>
<th>Rule 9</th>
<th>Answer of question 22 (<strong>The design of the website makes sense and it is easy to learn how to use it</strong>) = Always</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[Q43]=A --&gt; [Q42 = A, Q44 = A, Q45=A, Q50=A, Q51=A] (confidence: 0.289)</td>
</tr>
<tr>
<td>Description</td>
<td><strong>IF</strong> Answer of question 42 (<strong>Do you know your financial record by Website</strong>) = Always</td>
</tr>
<tr>
<td></td>
<td>And answer of question 44 (<strong>Courses schedules service</strong>) = Always</td>
</tr>
<tr>
<td></td>
<td>And answer of question 45 (<strong>Exam Schedules Service</strong>) = Always</td>
</tr>
<tr>
<td></td>
<td>And answer of question 50 (<strong>Announcements service</strong>) = Always</td>
</tr>
<tr>
<td></td>
<td>And answer of question 51 (<strong>social networks (Facebook, Twitter)</strong> = Always</td>
</tr>
<tr>
<td></td>
<td><strong>Then</strong> answer of question 43 (<strong>The Online Grades Service</strong>) = Always</td>
</tr>
<tr>
<td>Rule 10</td>
<td>[STD-Level]=D --&gt; [Q6 = A, Q7 = A, Q42 = A, Q43 = A, Q44=A] (confidence: 0.274)</td>
</tr>
<tr>
<td>Description</td>
<td><strong>IF</strong> answer of question 6 (<strong>I am comfortable and familiar with the used language</strong>) = Always</td>
</tr>
<tr>
<td></td>
<td>And answer of question 7 (<strong>I do not need to scroll left and right when reading at this website</strong>) = Always</td>
</tr>
<tr>
<td></td>
<td>And answer of question 42 (<strong>Do you know your financial record by Website</strong>) = Always</td>
</tr>
<tr>
<td></td>
<td>And answer of question 43 (<strong>The Online Grades Service</strong>) = Always</td>
</tr>
<tr>
<td></td>
<td>Then <strong>The student in level four</strong></td>
</tr>
</tbody>
</table>
6.1.2 Weakness:

We present here the weakness of Alazhar University website; these weakness are extracted after applied “Automatic Usability Evaluation on University Websites using Data Mining Methods” approach by using questionnaire experiment, see the following table 6.2:

Table 6.2 the Weakness of Alazhar University website (questionnaire experiment)

<table>
<thead>
<tr>
<th>Rule</th>
<th>Description</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule 1</td>
<td>[Q2]=B --[Q14 = B, Q26 = B, Q27=B]</td>
<td>(confidence: 0.246)</td>
</tr>
<tr>
<td>Description</td>
<td>IF Answer of question 14 (The links at this website are well maintained and updated) = Sometimes And answer of question 26 (This website responds to my actions as expected) = Sometimes And answer of question 27 (It is efficient to use this website) = Sometimes Then answer of question 2 (The topics are up-to-date) = Sometimes</td>
<td></td>
</tr>
<tr>
<td>Rule 2</td>
<td>[Q8]=B --[Q6 = A, \text{STD. CGPA = Good}]</td>
<td>(confidence: 0.318)</td>
</tr>
<tr>
<td>Description</td>
<td>IF Answer of question 6 (I am comfortable and familiar with the used language) = Always And The Student's cumulative rate = Good Then answer of question 8 (Is the vision and objectives and the laws and regulations of the University and programs exist) = Sometimes</td>
<td></td>
</tr>
<tr>
<td>Rule 3</td>
<td>[Q14]=B --[Q1 = B, Q24=B, Q27=B]</td>
<td>(confidence: 0.257)</td>
</tr>
<tr>
<td>Description</td>
<td>IF Answer of question 1 (This website contains most of my interest material) = Sometimes And answer of question 24 (I can easily distinguish between visited and not visited links) = Sometimes And answer of question 27 (It is efficient to use this website) = Sometimes Then</td>
<td></td>
</tr>
<tr>
<td>Rule</td>
<td>Description</td>
<td>Conditions</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>Rule 4</td>
<td>IF answer of question 24 (I can easily distinguish between visited and not visited links) = Sometimes And answer of question 25 (I can access this website any time) = Sometimes And answer of question 26 (This website responds to my actions as expected) = Sometimes And answer of question 27 (It is efficient to use this website) = Sometimes And answer of question 29 (I am able to quickly complete my work using site) = Sometimes Then answer of question 20 (This website has a consistent feel and look) = Sometimes</td>
<td>[Q20] = B --&gt; [Q24=B, Q25 = B, Q26=B , Q29=B , Q31=B] (confidence: 0.291)</td>
</tr>
<tr>
<td>Rule 4</td>
<td>IF answer of question 1 (This website contains most of my interest material) = Sometimes And answer of question 36 (This website suffers from problems during registration process for students) = Sometimes Then answer of question 30 (I can easily access the registration page) = Sometimes</td>
<td>[Q30] = B --&gt; [Q1 = B, Q36=B] (confidence: 0.266)</td>
</tr>
<tr>
<td>Rule 5</td>
<td>IF answer of question 6 (I am comfortable and familiar with the used language) = Always And answer of question 42 (Do you know your financial record by Website) = Always And answer of question 43 (The Online Grades Service) = Always</td>
<td>[Q37]= D --&gt; [Q6=A, Q42=A, Q43=A, Q44=A] (confidence: 0.332)</td>
</tr>
<tr>
<td>Rule</td>
<td>Description</td>
<td>Confidence</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Rule 6</td>
<td><strong>Description</strong>&lt;br&gt;IF&lt;br&gt;Answer of question 37 (<em>I know who I can contact for more information about anything in this website</em>) = Never&lt;br&gt;And answer of question 38 (<em>You can search for a book in the library through the website</em>) = Never&lt;br&gt;Then&lt;br&gt;Answer of question 39 (<em>Can you find out borrowed books through the website</em>) = Never</td>
<td>0.299</td>
</tr>
<tr>
<td>Rule 7</td>
<td><strong>Description</strong>&lt;br&gt;IF&lt;br&gt;Answer of question 49 (<em>Online advising service</em>) = This service is not available&lt;br&gt;And answer of question 55 (<em>Complaints service</em>) = This service is not available&lt;br&gt;And answer of question 35 (<em>I can easily contact with my instructors because this website provides information about instructors’ office location and hours, and e-mail addresses.</em>) = This service is not available&lt;br&gt;Then&lt;br&gt;Answer of question 43 (<em>The Online Grades Service</em>) = Always</td>
<td>0.312</td>
</tr>
<tr>
<td>Rule 8</td>
<td><strong>Description</strong>&lt;br&gt;IF&lt;br&gt;The Student's cumulative rate = Good&lt;br&gt;And The student study in Science colleges&lt;br&gt;Then&lt;br&gt;Answer of question 29 (<em>I am able to quickly complete my work using site</em>) = sometimes</td>
<td>0.254</td>
</tr>
<tr>
<td>Rule 9</td>
<td><strong>Description</strong>&lt;br&gt;IF&lt;br&gt;[Q48=E] --&gt; &lt;br&gt;[Q49=E] &lt;br&gt;(confidence: 0.677)</td>
<td></td>
</tr>
</tbody>
</table>
6.1.3 Conclusions about Questionnaire experiment in Alazhar University Gaza

In this section we discuss the results and give some conclusions about the questionnaire experiment in Alazhar University Gaza:

**Strength:**

1-Most of the university students (203 students) in science colleges and Humanity science colleges see the ease in browsing of Al-Azhar University web site, and had satisfaction of the design, we found this clear in their answers about the questions related to easily use of the website. We can see in the following rules:

- [COL_NAME = Elmi] --> [Q42 = A, Q5 = A, Q6 = A, Q12 = A, Q43 = A] (confidence: 0.279).
- [COL_NAME = Adapi] --> [Q6 = A, Q42 = A, Q43 = A, Q44 = A] (confidence: 0.273).

2-The services that the university website provided:
- The online grades service.
- Exam schedules service.
- Courses schedules service.
- Email for students in the website.
- Evaluate of teacher service.
- Announcements service.
- Personal Site for teachers.
- Scientific conferences.
- Social networks (Facebook, twitter)

We can see in the following rule:
\[ [Q43]=A \rightarrow [Q42=A, Q44=A, Q45=A, Q50=A, Q51=A] \] (confidence: 0.289)

3- The fourth level students at the University are dealing with the website more quickly and efficiently. We can see in the following rule:
- \([\text{STD-Level}=D \rightarrow [Q6=A, Q7=A, Q42=A, Q43=A, Q44=A]] \) (confidence: 0.274)

4- The students of science colleges at the University are seen the reading of content of website is easily always. We can see in the following rule:
\[ [\text{COL_NAME} = \text{Elmi}] \rightarrow [Q42=A, Q5=A, Q6=A, Q12=A, Q43=A] \] (confidence: 0.279)

5- The students of humanity science colleges at the University are seen they are comfortable with Arabic language of website always. We can see in the following rule:
\[ [\text{COL_NAME} = \text{Adapi}] \rightarrow [Q6=A, Q42=A, Q43=A, Q44=A] \] (confidence: 0.273)

**Weakness:**
1- Most university students (in science colleges and Humanity science) believe there are a lack of e-learning requirements such as download of video courses and the materials of courses. We can see in the following rule:
- \([Q6=A] \rightarrow [Q42=A][Q41=E] \) (confidence: 0.339)

2- Most of the students are facing problem in dealing with the library's website (search for books, information on books borrowed). We can see in the following rule:
- \([Q39]=D \rightarrow [Q37=D, Q38=D] \) (confidence: 0.299)

3- Most students do not know who is responsible for the university website to communicate with him to inquire about specific problems. We can see in the following rule:
- \([Q37]=D \rightarrow [Q6=A, Q42=A, Q43=A, Q44=A] \) (confidence: 0.332)

4- The services that the university website not provided:
- Online advising service.
- Graduates gate.
- Complaints service.
We can see in the following rules:
- \([Q48=E] \rightarrow [Q49=E] \) (confidence: 0.677)
- \([Q43=A] \rightarrow [Q49=E, Q55=E, Q35=E] \) (confidence: 0.312)

5- The most students are seen slowly to complete his works sometimes. We can see in the following rule:
- \([Q20]=B \rightarrow [Q24=B, Q25=B, Q26=B, Q29=B, Q31=B] \) (confidence: 0.291)
6.2 Task scenario experiment in Alazhar University Gaza:

In this section we present the results about task scenario experiment in Alazhar University Gaza that include the strength and weakness of the universities websites after applying our approach of “Automatic Usability Evaluation on University Websites using Data Mining Methods”.

6.2.1 Strength:

In this section, we present the strength of Alazhar University website; this strength are extracting after applied automatic usability evaluation on university websites using Data Mining Methods approach by using task scenario, some strong rules are in the following table 6.3:

Table 6.3 the Strength of Alazhar University website (Task scenario)

<table>
<thead>
<tr>
<th>Rule</th>
<th>Description</th>
<th>Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule 1</td>
<td>[Level = d] --&gt; [No.page_2 = rang 1, Task4_time = rang 2, No. Clicks_5 = rang 1] (confidence: 0.250)</td>
<td>The students of level four are complete the tasks quickly</td>
</tr>
<tr>
<td>Description 1</td>
<td><strong>IF</strong> Number of page open for task 2 in rang 1 And number of mouse click in task 5 in range 1 And time task 4 in rang 2 <strong>Then</strong> The students in level 4</td>
<td></td>
</tr>
<tr>
<td>Discussion 1</td>
<td>All students are done complete of task 1</td>
<td></td>
</tr>
<tr>
<td>Rule 2</td>
<td>[confirm1=yes] --&gt; [Task1_time = rang 3, Total_time_tasks/sec = RANGE 3] (confidence: 0.250)</td>
<td></td>
</tr>
<tr>
<td>Description 2</td>
<td><strong>IF</strong> Time task 1 in rang 3 And total time of tasks of student in rang 3 <strong>Then</strong> All students complete task 1</td>
<td></td>
</tr>
<tr>
<td>Discussion 2</td>
<td>All students are done complete of task 1</td>
<td></td>
</tr>
<tr>
<td>Rule 3</td>
<td>[Task3_time = rang 2] --&gt; [No.page_3 = rang 1, No. Clicks_3 = rang 1] (confidence: 0.333)</td>
<td></td>
</tr>
</tbody>
</table>
| Description 3 | **IF**  
Number of open pages for task 3 in range 1  
And number of clicks mouse of task 3 in range 1  
**Then**  
Time for task 3 in range 2 |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussion 3</td>
<td>The students whose complete the time task 3 in range 2, it is in range 1 for (number of clicks mouse and Number of open pages) in the same task</td>
</tr>
</tbody>
</table>
| Rule 4 | [No. Clicks_1 = range 2] -->  
[No. Clicks_4 = range 2]  
(confidence: 0.333) |
| Description 4 | **IF**  
Number of mouse clicks in task 1 in range 2  
**Then**  
Number of mouse clicks in task 4 in range 2 |
| Discussion 4 | The student complete task 1 for number of mouse clicks in range 1, they complete the task 4 for number of mouse clicks in range 1, because the two tasks are from the same position in the web site (student portal) |
| Rule 5 | [Task5_time = rang 2] -->  
[No. Clicks_5 = rang 1, No.page_5 = rang 1]  
(confidence: 0.333) |
| Description 5 | **IF**  
Number of mouse clicks of task 5 in range 1  
And number of page of task 5 in range 1  
**Then**  
Time of task 5 in range 2 |
| Discussion 5 | Task 5 is complete quickly, it does not need more number of mouse clicks and not need more pages open. |
| Rule 6 | Task1_time = rang 3 -->  
[Task4_time = rang 2, conirm4=Yes]  
(confidence: 0.333) |
| Description 6 | **IF**  
Time task 1 in rang 3  
**Then**  
Time task 4 in rang 2  
And conirm4=Yes |
| Discussion 6 | Most of students are done complete of task 4 |
6.2.2 Weakness:

In this section, we present the weakness of Alazhar University website; these weaknesses are extracting after applied “Automatic Usability Evaluation on University Websites using Data Mining Methods” approach by using Task scenario experiment, see the following table 6.4:

| Rule 1 | [Task1_time = rang 3] --\> [No. Clicks_2 = rang 1, confirm 3=yes] (confidence: 0.333) |
| Description | IF Number of mouse clicks for task 2 in rang 1 Then The time task 1 in range 3 |
| Discussion 1 | Task 1 need more time even if student complete the task. |

| Rule 2 | [No.page_2 = rang 1] --\> [Task1_time = rang 3, Task2_time = rang 3] (confidence: 0.333) |
| Description | IF Time of task1 in range 3 And time of task 2 in range 3 Then Number of page open for task 2 in rang 1 |
| Discussion 2 | Task 2 is need more time ,but it need less number of mouse clicks |

| Rule 3 | [Task2_time = rang 3] --\> [No.page_2 = rang 1] (confidence: 0.333) |
| Description | IF Number of page open for task 2 in rang 1 Then Time of task 2 in range 3 |
| Discussion 3 | The task 2 is need less number of pages open, but it need high time for complete the task. |
6.2.3 Conclusions about Task scenario experiment in Alazhar University Gaza:

In this section we discuss the results and give some conclusions about the Task scenario in Alazhar University Gaza:

**Strength:**

1- Most of the fourth level students at the University completed the tasks quickly. We can see in the following rule:
\[-[\text{Level} = d] \rightarrow \begin{cases} \text{No.page}_2 = \text{rang 1, Task4}_time = \text{rang 2}, \text{No. Clicks}_5 = \text{rang 1} \end{cases} \text{(confidence: 0.250)}\]

2- All university students successfully accomplished the first task (By using the University's website, print the banking document for the first semester of 2012/2013). We can see in the following rule:
\[\begin{cases} \text{confirm1}=\text{yes} \end{cases} \rightarrow \begin{cases} \text{Task1}_time = \text{rang 3, Total.time}_tasks/sec = \text{RANGE 3} \end{cases} \text{(confidence: 0.250)}\]

3- Most of university students successfully accomplished the fourth task (By using the University's website, download the study plan for your department). We can see in the following rule:
\[-\text{Task1}_time = \text{rang 3} \rightarrow \begin{cases} \text{Task4}_time = \text{rang 2, confirm4}=\text{Yes} \end{cases} \text{(confidence: 0.333)}\]

4- Most of the students perform tasks related to the student portal successfully. We can see in the precedent points 2 and 3.

**Weakness:**

1- The first task (By using the University's website, print the banking document for the first semester of 2012/2013) took a long time to be accomplished to access the banking document. We can see in the following rule:
\[-\text{Task1}_time = \text{rang 3} \rightarrow \begin{cases} \text{No. Clicks}_2 = \text{rang 1, confirm 3}=\text{yes} \end{cases} \text{(confidence: 0.333)}\]

2- The task 2 is need less number of pages open, but it need high time for complete the task. We can see in the following rule:
\[-\text{Task2}_time = \text{rang 3} \rightarrow \begin{cases} \text{No.page}_2 = \text{rang 1} \end{cases} \text{(confidence: 0.333)}\]
6.3 Questionnaire experiment in Faculty of intermediate college:

In this section we present the results about questionnaire experiment in faculty of intermediate college that include the advantages and disadvantages after applying our approach of Automatic Usability Evaluation on University Websites using Data Mining Methods.

6.3.1 Strength:

We present here the strength of faculty of intermediate college website; these strength are extracting after applied Automatic Usability Evaluation on University Websites using Data Mining Methods approach by using questionnaire experiment, in the following table 6.5:

<table>
<thead>
<tr>
<th>Rule 1</th>
<th>[college = elmi] --&gt; [Q44 = a, Q6 = a, Q4 = a, Q18 = a,Q12 = a] (confidence: 0.283)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>IF Answer of question 44 (Courses schedules service)= Always And answer of question 6 (I am comfortable and familiar with the used language)= Always And answer of question 4 (The content of this website is well organized)= Always And answer of question 18 (I am comfortable with the colors used at this website)= Always And answer of question 12 (I can easily know where can I go from here)= Always THEN The student study in Science colleges</td>
</tr>
<tr>
<td>Rule 2</td>
<td>[Q4 = a] --&gt; [Q18 = a, Q17 = a] (confidence: 0.283)</td>
</tr>
<tr>
<td>Description</td>
<td>IF Answer of question 17 (This website’s interface design is attractive)= Always And answer of question 18 (I am comfortable with the colors used at this website)= Always THEN The answer of question 4 (The content of this website is well organized)= Always</td>
</tr>
</tbody>
</table>
| Rule 3 | \[Q25 = a \] --\> \[Q30 = a, \ Q10 = a, Q12 = a\]  
|        | (confidence: 0.283) |
|        | **Description** | IF  
|        | Answer of question 30 (I can easily access the registration page)= Always  
|        | And answer of question 10 (This website provides useful links for me to get the desired information)= Always  
|        | And answer of question 12 (I can easily know where can I go from here)= Always  
|        | THEN  
|        | The answer of question 25 (I can access this website any time)= Always |
| Rule 4 | \[\text{avg} = \text{range3 } \] --\> \[Q5 = a, Q6 = a, Q16 = a, Q11=a, Q13 = a, Q42=a, Q44=a\]  
|        | (confidence: 0.283) |
|        | **Description** | IF  
|        | Answer of question 5 (Reading content of this website is easy)= Always  
|        | And answer of question 6 (I am comfortable and familiar with the used language)= Always  
|        | And answer of question 11 (I can easily know how did get here)= Always  
|        | And answer of question 13 (It is easy to move around at this website by using the links or back button of the browser)= Always  
|        | And answer of question 16 (Placement of links or menu is standard throughout the website and I can easily recognize them)= Always  
|        | And answer of question 42 (Do you know your financial record by Website)= Always  
|        | And answer of question 44 (Courses schedules service)= Always  
|        | THEN  
|        | The Student's cumulative rate in range 3 |
| Rule 5 | \[Q30 = a, Q43 = a \] --\> \[Q44 = a, Q42 = a, Q45 = a, Q51 = a\]  
|        | (confidence: 0.283) |
|        | **Description** | IF  
|        | And answer of question 42 (Do you know your financial record by Website)= Always |
And answer of question 44 (Courses schedules service) = Always
And answer of question 45 (Exam Schedules Service) = Always
And answer of question 51 (social networks (Facebook, Twitter)) = Always

**THEN**
Answer of question 30 (I can easily access the registration page) = Always
And
Answer of question 43 (The Online Grades Service) = Always

**Rule 6**

\[Q44 = a \rightarrow \]
\[Q42 = a, Q11 = a, Q13 = a, Q12 = a, Q43 = a\]
(confidence: 0.438)

**Description**

IF
Answer of question 44 (Courses schedules service) = Always
THEN
Answer of question 42 (Do you know your financial record by Website) = Always
And answer of question 11 (I can easily know how did get here) = Always
And answer of question 13 (It is easy to move around at this website by using the links or back button of the browser) = Always
And answer of question 12 (I can easily know where can I go from here) = Always
Answer of question 43 (The Online Grades Service) = Always

**Rule 7**

\[\text{level}=b \rightarrow \]
\[Q11 = a, Q3 = a\]
(confidence: 0.600)

**Description**

IF
The students in level b
THEN
Answer of question 11 (I can easily know how did get here) = Always
And answer of question 3 (I can easily find what I want at this website) = Always

**Rule 8**

\[Q4 = a \rightarrow \]
\[Q44 = a, Q5 = a, Q11 = a, \text{college} = \text{elmi}\]

IF
Answer of question 4 (The content of this website is well organized)
THEN
Answer of question 44 (Courses schedules service) = Always
And answer of question 5 (Reading content of this website is easy) = Always
And answer of question 11 (I can easily know how did get here) = Always
And students study in science colleges
6.3.2 Weakness:

We present here the weakness of faculty of intermediate college website; these weakness are extracted after applying Automatic Usability Evaluation on faculty of intermediate college website using Data Mining Methods approach by using questionnaire experiment, see the following table 6.6:

Table 6.6 the Weakness of faculty of intermediate college website (questionnaire experiment)

| Rule 1 | [college = elmi] --
|        | [Q1 = b]
|        | (confidence: 0.320) |
| Description |
| IF Answer of question 1 (This website contains most of my interest material)=sometimes And answer of question 2 (The topics are up-to-date.) = sometimes THEN The student study in Science colleges |

| Rule 2 | [college = elmi] --
|        | [Q23 = b]
|        | (confidence: 0.320) |
| Description |
| IF Answer of question 23 (I need not wait too long to download a file or open a page)=sometimes THEN The student study in Science colleges |

| Rule 3 | [Q36 = b] --
|        | [Q3 = a]
|        | (confidence: 0.320) |
| Description |
| IF Answer of question 3 (I can easily find what I want at this website)=Always THEN Answer of question 36 (This website suffers from problems during registration process for students)=sometimes |

| Rule 4 | [Q49 = e] --
|        | [Q47 = e,Q48 = e]
|        | (confidence: 0.320) |
| Description | IF | Answer of question 47 (The evaluate of teachers service)= This service is not available  
And answer of question 48 (The evaluate of courses service) = This service is not available  
THEN  
answer of question 49 (Online advising service)= This service is not available |
|---|---|---|
| Rule 5 | [Q37 = d,Q38 = d]\(\rightarrow\)  
[Q44 = a, Q45 = a]  
(confidence: 0.320) | |
| Description | IF | Answer of question 44 (Courses schedules service)= Always  
And answer of question 45 (Exam Schedules Service)= Always  
THEN  
Answer of question 37 (I know who I can contact for more information about anything in this website)=Never  
And  
Answer of question 38 (You can search for a book in the library through the website)= Never |
| Rule 6 | [Q41 = e]\(\rightarrow\)  
[Q44 = a, Q6 = a]  
(confidence: 0.782) | |
| Description | IF | Answer of question 41(Can you download lectures and tutorials through the site)= Never  
THEN  
Answer of question 44 (Courses schedules service)= Always  
And answer of question 6 (I am comfortable and familiar with the used language)= Always |
6.3.3 Conclusions about Questionnaire experiment in faculty of intermediate college:

In this section we discuss the results and give some conclusion about the questionnaire experiment in faculty of intermediate college:

**Strength:**
1- All students of faculty intermediate college find it easier to deal with the student portal services. We can see in the following rules:

-\[ Q30 = a, Q43 = a \] --> \[ Q44 = a, Q42 = a, Q45 = a, Q51 = a \] (confidence: 0.283)

-\[ Q25 = a \] --> \[ Q30 = a, Q10 = a, Q12 = a \] (confidence: 0.283)

2- Most students find that the site is very easy to use. we can see in the following rule:

-\[ Q44 = a \] --> \[ Q42 = a, Q11 = a, Q13 = a, Q12 = a, Q43 = a \] (confidence: 0.438)

3- The services that the university website provided are little which are:
- The Online Grades Service.
- Exam Schedules Service.
- Courses schedules service
- Email for students in the site
- Announcements service.
- Social networks (Facebook, Twitter)

We can see in the following rule:

-\[ Q30 = a, Q43 = a \] --> \[ Q44 = a, Q42 = a, Q45 = a, Q51 = a \] (confidence: 0.283)

4- Students in the last level can easily reach for what they want from the website. We can see in the following rule:

-\[ \text{level}=b \] --> \[ Q11 = a, Q3 = a \] (confidence: 0.600)

5- The students study in science programs seen the content of website is well organized always. We can see in the following rule:

-\[ Q4 = a \] --> \[ Q44 = a, Q5 = a, Q11 = a, college = elm+i \] (confidence: 0.782)

**Weakness:**

1- The services that the university website not provided:
- Search in library.
- Evaluate of teacher service.
- Evaluate of courses service.
- Online advising service.
- Graduate gate
- Personal sites for teachers.
- Scientific conferences.
- Complaints service

We can see in the following rule:

-\[ Q49 = e \] --> \[ Q47 = e, Q48 = e \] (confidence: 0.320)
2-Most students do not know who is responsible for the university website to communicate with him to inquire about specific problems. We can see in the following rule:

\[Q37 = d, Q38 = d\] --> \[Q44 = a, Q45 = a\] (confidence: 0.320)

3-Most university students (in science colleges and Humanity science) believe there are a lack of e-learning requirements such as download of video courses and the materials of courses. we can see in the following rule:

\[Q41 = e\] --> \[Q44 = a, Q6 = a\] (confidence: 0.782)

6.4 Task scenario experiment in Faculty of intermediate college:

In this section, we present the results about task scenario experiment in faculty of intermediate college that include the advantages and disadvantages after applying our approach of "Automatic Usability Evaluation on University Websites using Data Mining Methods".

6.4.1 Strength:

We present here the strength of faculty of intermediate college; these strength are extracting after applied Automatic Usability Evaluation on University Websites using Data Mining Methods approach by using Task scenario, see the following table 6.7:

<table>
<thead>
<tr>
<th>Rule 1</th>
<th>[AVG. = BAD] --&gt; [Task5_time = rang 1, Task3_time = rang 1, Task4_time = rang 2] (confidence: 0.300)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description 1</td>
<td>IF Time of task1 in range 1 and time of task3 in range 1 and time of task4 in range 2</td>
</tr>
<tr>
<td></td>
<td>Then The Student's cumulative rate = Bad</td>
</tr>
<tr>
<td>Discussion 1</td>
<td>Even the Student's cumulative rate are Fail, but they complete the tasks (3,4,5) quickly</td>
</tr>
<tr>
<td>Rule 2</td>
<td>[No. Clicks_3 = rang 1] --&gt; [Task3_time = rang 1] (confidence: 0.300)</td>
</tr>
</tbody>
</table>
### Description 2

**IF**
The time of task 3 in range 1  
**Then**
The number of mouse clicks in range 1

### Discussion 2
The task 3 is quickly complete of the time, and need few number of mouse clicks.

### Rule 3
[confirm1=yes] -->  
[Task1_time = range 3, Total_time_tasks/sec = RANGE 2]  
(confidence: 0.250)

### Description
**IF**
Time task 1 in rang 3  
And total time of tasks of student in rang 3  
**Then**
All students complete task 1

### Discussion 3
All students are complete task 1.

### Rule 4
[confirm4=yes] -->  
[Task4_time = range 2, No.page_4 = range 2]  
(confidence: 0.250)

### Description
**IF**
Time task 4 in rang 2  
And number of pages open in rang 2  
**Then**
most students complete task 4

### Discussion 4
Most of students are complete task4 even if they late in time.

### 6.4.2 Weakness:

We present here the weakness of faculty of intermediate college; these weaknesses are extracted after applying Automatic Usability Evaluation on University Websites using Data Mining Methods approach by using Task scenario, see the following table 6.8:

<table>
<thead>
<tr>
<th>Rule</th>
<th>Description</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>[Total_time_tasks/sec = RANGE 2] --&gt; [Task5_time = range 3, Task1_time = range 3]</td>
<td>0.250</td>
</tr>
</tbody>
</table>

Table 6.8 the Weakness of faculty of intermediate college website (Task scenario)
Time of task 1 in range 3 and time of task 1 in range 3

Then
Total time of tasks in range 3

Discussion 1
The time of tasks 1 and 2 are have a high effect of the total time of tasks

Rule 2
[AVG. = BAD] --> [Task2_time = rang 3]
(confidence: 0.350)

Description 2
IF
Time of task 2 in range 3

Then
The Student's cumulative rate = Bad

Discussion 2
The Student have cumulative rate = File is late of complete the task 2

Rule 3
[Task4_time = rang 3] --> [No. Clicks_5 = range 2, No.page_5 = rang 2] (confidence: 0.300)

Description 3
IF
Time number of mouse clicks of task 5 in range 2 and number of pages open of task 5 in range 2

Then
The task 4 time in range 3

Discussion 3
The task 5 needs more mouse clicks and open pages.

6.4.3 Conclusions about task scenario experiment in Faculty of intermediate college:

In this section we discuss the results and give some conclusions about the task scenario experiment in Faculty of intermediate college:

Strength:

1-Most of students perform the tasks required of them quickly, because it does not need a long time and high effort. We can see in the following rules:
- [AVG. = BAD] --> [Task5_time = rang 1, Task3_time = rang 1, Task4_time = rang 2] (confidence: 0.300)
- [No. Clicks_3 = rang 1] --> [Task3_time = rang 2] (confidence: 0.300)
2-All college students successfully accomplish the first task (By using the college website, print the banking document for the first semester of 2012/2013). we can see in the following rule:
-\([\text{confirm1}=\text{yes}] \rightarrow [\text{Task1_time} = \text{rang 3}, \text{Total_time_tasks/sec} = \text{RANGE 2}]\) (confidence: 0.250)

3-Most university students successfully accomplish the fourth task (By using the college website, download the study plan for your department). we can see in the following rule:
-\([\text{confirm4}=\text{yes}] \rightarrow [\text{Task4_time} = \text{rang 2}, \text{No.page_4} = \text{range 2}]\) (confidence: 0.250)

4- The task 3 (By using the college website, Display the academic system of the college) is quickly complete of the time, and need few number of mouse clicks. We can see in the following rule:
-\([\text{No. Clicks_3} = \text{rang 1}] \rightarrow [\text{Task3_time} = \text{rang 1}]\) (confidence: 0.300)

**Weakness:**
1-The fifth task (By using the college website, search in news for college about) is needed late for complete because need more mouse clicks and more open pages . we can see in the following rule:
-\([\text{Task4_time} = \text{rang 3}] \rightarrow [\text{No. Clicks_5} = \text{range 2}, \text{No.page_5} = \text{rang 2}]\) (confidence: 0.300)

2- The time of tasks 1 and 2 are having high effects of the total time of tasks. We can see in the following rule:
-\([\text{Total_time_tasks/sec} = \text{RANGE 2}] \rightarrow [\text{Task5_time} = \text{rang 3}, \text{Task1_time} = \text{rang 3}]\) (confidence: 0.250)
CHAPTER 7

_Recommendations and Future works_
In this chapter we have four sections, in section 7.1 we present my research summary, in section 7.2 we present the useful conclusions about my research, it involves conclusions about two experiments (questionnaire experiment, task scenario experiment) about two universities (Alazhar university – Gaza and faculty of intermediate college), in 7.3 section we present useful recommendation that we extract from thesis about website universities, and finally in section 7.4 we present possible directions of future works.

7.1 Summary

In this thesis, we proposed an approach for automatic evaluation for usability websites. The proposed approach was using Usability Evaluation on University Websites using Data Mining Method. We applied two different experiments the first was questionnaire experiment and the second was task scenario experiment, we applied the experiments on two universities Alazhar University – Gaza and faculty of intermediate college Gaza, the main goal of my research is an automatic evaluation of these two universities by using data mining method. Our methodology in this thesis consisted of several steps: first, we investigated the best metrics of usability test for educational websites, second we used the metrics for testing the site by set of testers (students) using questionnaire approach, third we used other metrics to test website using some tools, forth we collected data set (the answers) from testers, and from the tools, fifth also we investigated data mining methods for extracting useful knowledge from our data set into automatic usability test of the systems, the final step is metrics evaluation.

7.2 Conclusions

The following is our conclusion about this thesis:

1) In this thesis, there is a wide range of metrics that we used to evaluate the usability of university sites, and there were two types of these metrics, they are questionnaire experience and task scenario. But there are some metrics that had high effects for evaluated the usability of universities websites, and a major role in the evaluation, they are:

a) Attributes positively evaluated

The following attributes positively evaluated:
- These website contains most of my interest material.
- I can easily find what I want at this website.
- Reading content of this website is easy.
- I can easily know where can I go from here.
- I am comfortable with the colors used at this website.
- I can access this website any time.
- I can easily access the registration page.
b) Attributes negatively evaluated
The following attributes negatively evaluated:

- This website suffers from problems during registration process for students.
- I know who I can contact for more information about anything in this website.
- Can you download lectures and tutorials through the site.
- Do you know your financial record by Website.
- The Online Grades Service.
- Online advising service.
- Complaints service.

c) The effective metrics about task scenario experiment include:

- Task time.
- Confirm (scenario task).
- Total tasks time.
- Number of clicks.
- Number of pages.

2) In chapter 3 (related works), all the works that touched on evaluating the usability by using automatic tools [43][31][22][3] are evaluated the university website as a general metrics that evaluates technical properties of website as a one object such as (The total number of images, total size of images, browsers compatibility and total number of broken and bad links.) But in our thesis, we evaluated the university websites by a set of attributes for each task performed by the student through the use of the university's website. These automatic evaluating is not used by previews works.

3) Usability testing of universities websites by the (task scenario) experiment is very useful in the process of evaluating the universities websites, because the students are using the website by set of tasks to accomplish what is required. So, we note that of the (task scenario) experiment on faculty of intermediate college that the students completed their tasks easier, because the website of the college does not contain a lot of information and many links that may affect the completion of the task. So we can deduce from (task scenario) experiment that the website of faculty of intermediate college is very easy to accomplish the tasks required.

4) We can note that of the evaluation process, that students who are studying at the last level in the university (the fifth level in the Al-Azhar University and the second level at the faculty of intermediate college) from all colleges at the university (scientific and Humanity science) see the ease of use of websites universities because the students have prior experience in the use of university website. On the contrary, we find the first level students need much more time to complete the required task and have difficulty in dealing with universities sites.
5) There are important notes related to the two universities (Alazhar university –Gaza, faculty of intermediate college) that universities do not support E-learning systems, and it is clear through the university depends directly on traditional lectures between teacher and student. These universities do not use E-learning systems such as (Module, Upinar), just they used only some operations such as sending lectures through the student portal.

6) One of the important standard evaluations in the world for universities website is to have an electronic library in the website that containing researches and electronic research papers. We evaluate Alazhar University website that contains only the search service in the traditional library, but faculty of intermediate college do not have this service. So, there is a lack of evaluation website universities through electronic library.

7.3 Recommendations

We divided this section into three parts, the first is recommendations about the two universities together, the second is recommendations about Alazhar university-Gaza, and the third part is recommendations about faculty of intermediate college.

A) Recommendations about the two universities together:

1- We can conclude from questionnaire experiment for universities websites (Alazhar University –Gaza and faculty of intermediate college) that there is a lack of E-learning services in universities websites. So, we can recommend using open source E-learning programs such as (Moodle or Upinar) to add a lot of E-learning services.

2- One of the most important services offered by universities in the world is electronic library which include electronic research and research papers that helps to increase scientific research for the university, because scientific research is one of the most important metrics rate to evaluate universities. Therefore we recommend a database containing all the research and research papers that’s gives from external and internal experience academic and linked to the university library.

3- It is observable through experiments (questionnaire, task scenario) that there are services offered by the university without the students know they exist, for example in the library search service at Al-Azhar University, there are students do not know the existence of this service on the university website. We can conclude the university must inform students when adding new services on the university website through the announcements or via sending an SMS message to the students.

4- We concluded in this research that the last level of students in universities through experiments (questionnaire, task scenario) find greater ease in completing the tasks
required and greater ease use of the website of the university, and the first level students find it difficult to deal with the website of the university. Therefore we recommend conducting a guideline lecture for the first level students at the beginning of each academic year to clarify and explain the basics of dealing with the site of the university.

5- We note in this research that the students when they open the website of the university from devices such as (Mobile, IPad) need to scroll left and right when they read this website. To resolve this problem, we recommend using a new technique when designing the university website called Responsive web design (RWD) that it is a web design approach aimed at crafting websites to provide an optimal viewing experience—easy reading and navigation with a minimum of resizing, planning, and scrolling—across a wide range of devices (mini desktop computer monitors, mobile phones, Ipad).

6- We note that when students paid the amount of the university money, they printed the banking document from their portal and went to the bank to pay the amount, in the next day the bank sent the students payment record to the university via email. But this way needed more effort, printing costs and time wasting. Therefore, we recommend to development of a new mechanism through design Web between the university and the bank, through this web service the student can pay the amounts directly through the bank without printing the banking document and updating his financial record in the university automatically at the same moment.

B) Recommendations about Alazhar university-Gaza:

1- After questionnaire experiment on Alazhar University -Gaza, we founded that there are important services do not exist in the university websites, so we recommend the following:

-Online advising service: this service is one of the most important services in the university website, that’s the student need to direct help and information’s from the website, that’s by assign a person to make online advising to the student via website.
- Graduates gate: this service is to follow up the students after finish his studies, that to help him to communicate with university for employment, experience, high education and so on.
- Complaints service: when a student needs to make a complaint to the presence of any error, they need to complaints service gate via university website.

2- Al-Azhar University-Gaza used student portal for present important announcements to ensure the reading of the student, but the student must read these announcements to access the portal, by confirm the read by clicking the mouse on each announcement. This leads to the consumption of effort and time during perform any operations on the student portal.
So, we recommend the transfer of announcements to another part on the website (for example college page) for not affecting the student portal.

3- We recommend developing the search library service in Alazhar University -Gaza to add information’s about borrower books in the student portal.

4- We can conclude from task scenario experiment for Alazhar University -Gaza that there are a difficult for students to search about academic staff information in various colleges, so we recommend to restructure college page to ensure easier of search academic staff.

5- We noticed through (scenario task experiment) on Al-Azhar University - Gaza that the website does not contain all academic staff CVs, because the present of the C.V academic staff is optional, not mandatory. Therefore we recommend forcing academic staff at the university to fill and present his C.V by preventing access to the academic portal without fill and present his C.V. Because the present for the academic staff CVs at the university raises Rank in the evaluating universities.

C) Recommendations about faculty of intermediate college:

1- After questionnaire experiment on faculty of intermediate college, we founded that there are important services are not exist in the university websites, so we recommend the following:

In this college we founded there is decrease in the services on the faculty website, here we recommend to add some of important services such as (Search in library, Evaluate of teacher service, Evaluate of courses service, Online advising service, Graduate gate, Personal sites for teachers, Complaints service, Online advising service, Graduates gate). Finally, we recommend adding these essential services for the universities website to increase the efficiency of the website and increase the rank in the evaluation of the universities.

We can recommend for faculty of intermediate college, the lack of provided services for the student is decrease the rank of their website for evaluates the university, so it must add these services and look about recommendations about these services from Alazhar university recommendations.
7.4 Future works

Possible directions for future work include:

- To evaluate all Palestinian universities websites.
- To use other data mining methods to evaluate universities websites such as (decision tree).
- The evaluators of usability testing in my thesis are students; in future work we extent our evaluation of usability of website to include teachers, employees and visitors.
- To develop future work to subjective evaluation of the universities website by using opinion mining techniques.
- In my thesis we used multi tools to automatic evaluate universities websites, so we need to try for design one integrated tool that involve all metrics.
References


[40] Luo Q.; "Advancing Knowledge Discovery and Data Mining", First International Workshop on Knowledge Discovery and Data Mining, 2008.


algorithms in data mining", the IEEEInternational Conference on Data Mining (ICDM) in December 2006.


[57] http://www.the-software-testing.com/what-is-usability-testing/. (last access 20-4-2013).


[60] http://rapid-i.com/content/view/181/ (last access 20-3-2013).


## Appendix 1

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Job title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prof. Dr. Samy Abu-Naser</td>
<td>Dean of the Faculty of Engineering and Information Technology in Alazhar university-Gaza.</td>
</tr>
<tr>
<td>2</td>
<td>Dr. Yousef Abu-Shaaban</td>
<td>Member of Academic staff in (Alazhar university-Gaza and Islamic university-Gaza)</td>
</tr>
</tbody>
</table>

The information’s about academic reviewed