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Design, Development, and Evaluation of a Critiquing-Based Mobile-Web Employment Recommender System

Randy C. Polancos[1], Cenie V. Malabanan, Ph.D.[2]

[1]Faculty, Mindanao State University – Main, Marawi City, Philippines

[2]Professor, Mindanao State University – Iligan Institute of Technology Iligan City, Philippines

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Abstract: With the growing availability of internet connectivity and the widespread use of smartphones and computers across the population, technology presents a powerful opportunity to bridge the communication gap between local household employers and skilled workers seeking employment. In response to this, the present research aims to design, develop, and evaluate a mobile-web application that serves as a platform connecting household employers with skilled workers. The main feature of the application is the use of a critiquing-based recommendation system, which assists employers in efficiently identifying workers who best match their needs and preferences. This mobile-web system is designed based on the Activity Theory Model (ATM) by Engeström (1987), which was utilized during the requirements-gathering phase. The design and development process were guided by the ADDIE model (Grafinger, 1988), ensuring a structured approach. The development process went through three iterative cycles, before producing the finalized version of the application. This version was then implemented and evaluated using the Usability Metric for User Experience (UMUX), a validated instrument by Finstad (2010), to assess effectiveness, efficiency, and user satisfaction. Results indicated strong user agreement regarding the application's efficiency and effectiveness, with high levels of satisfaction reported. The application achieved a UMUX mean score of 94.3, indicating a high level of usability. Additionally, the critiquing feature achieved a weighted mean score of 6.8, indicating high user satisfaction with its functionality and relevance.

Keywords: Activity Theory Model, Recommender System, Critiquing, ADDIE model,.

I. Introduction

The rapid growth of mobile technology and internet creates opportunities for people to engage with each other. Using a mechanism increases the chances for the public to see and be seen (Carroll & Rosson, 2008). The extensive use of mobile devices and the unending increase in the number of web applications have made web searching limitless and is becoming normal (Fatima et al., 2016). But with this abundance comes a downside—information overload. Users are often overwhelmed by too many options, making it harder to find what they actually need.

Recommender systems help solve this problem by recommending content that matches with the preferences and needs of the users (Ricci et al., 2015), saving both time and effort. Among these, critiquing-based recommender systems was commonly used for allowing users to gradually refine their preferences, leading to more confident and accurate decisions even when faced with an overwhelming number of choices (Chen & Pu, 2009).

In the Philippines, unemployment continues to be a major issue. In the first quarter of 2022, the unemployment rate reached 6.2%, affecting around 2.9 million of the Philippine workforce (PSA, 2022). While the government works to create more jobs, many skilled workers—like electricians, carpenters, and plumbers—remain underutilized despite growing demand in local households (Holzer & Danziger, 1998). A key issue is the absence of dedicated platforms that effectively connect skilled workers with potential employers.

This research proposes the design, development, and evaluation of a mobile-web application employing a critiquing-based recommender system. The app aims to connect skilled workers with local households, helping employers find the right worker while giving workers better access to job opportunities.

II. Background of The Study

This study was conducted in Iligan City, Lanao del Norte, and Marawi City, Lanao del Sur, Philippines, which served as the pilot testing areas. Iligan City, known as the "City of Majestic Waterfalls," is home to several industrial companies and has significant tourism potential. Despite these economic opportunities, it recorded a high unemployment rate of 7.6% according to the Philippine Statistics Office Region X (May 2, 2022).

Meanwhile, Marawi City, which belongs to the BARMM region, faces an even higher unemployment rate of 7.8%—the highest in the country, based on data from the United Nations Development Programme (2024). Still recovering from the devastation caused by the Marawi Siege, many of its residents lost not only their homes but also their livelihoods. As the city continues its rehabilitation efforts, there is a growing demand for skilled workers to help rebuild homes and infrastructure.

Both Iligan and Marawi have local government initiatives aimed at promoting inclusive economic growth, decent work, and full employment. However, unemployment remains significantly high in both cities. While households struggle to find skilled

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

workers for home construction, repairs, and other services, many individuals with basic skills also continue to face difficulties in securing jobs.

Statement of The Problem

Household employers seeking skilled workers often rely on referrals and personal recommendations due to limited access to reliable information about worker availability. On the other hand, skilled workers looking for employment tend to search for job opportunities in less visible channels, such as local postings or informal networks through friends and relatives—areas rarely visited by potential employers. As a result, both parties often struggle to connect due to the lack of an effective communication and engagement mechanism. This highlights the need for a dedicated platform that can match employers' needs with workers' skills in a more efficient and accessible manner.

General Objectives

The general objective of this study is to develop a platform that exploits the widespread internet accessibility and the availability of computers and smartphones to help household employers easily find the skilled workers they need, while also enabling skilled workers to promote their services effectively.

Specific Objectives

To design, develop, and implement a Mobile-Web Employment Recommender System employing a critiquing-based recommendation; and

To evaluate the Mobile-Web Employment Recommender System' efficiency, effectiveness, and user satisfaction in assisting local household employers in finding skilled workings that match their specific needs.

Significance of The Study

Firstly, the Critiquing-based Mobile-Web Employment Recommender System may help unemployed skilled workers in finding job opportunities by making them visible online to those who might need their skills and services. Secondly, the local households may also benefit from this study since the application can assist them find easily find qualified individuals for tasks such as house repairs, car repairs and other related needs. Thirdly, this study may also help government agencies such as DOLE, TESDA, and the Local Government Units in fulfilling their initiatives to provide a productive employment to its constituents. Fourthly, Private entities may also find this study helpful. The available pool of workers in the mobile-web application can be used by private entities who might need manpower to supply their demands for workers and boast their businesses operations. Lastly, future researchers can look into this study for future research endeavors about the integration of a critiquing-based recommendation in mobile-web application in augmenting the employment opportunities for disadvantaged workers.

Review of Related Literature

Searching and buying products online is consistently increasing and poses higher risk to the average customer as the task of identifying their choice among many options has become harder. The ratings and reviews from previous customers might be helpful, but they're often not sufficient. Recommender systems were developed to ease this burden by suggesting products, services, or content based on the preferences of the users and behaviors (Park et al., 2012). However, users can still feel lost in the abundance of options.

To address this, critiquing-based recommender systems were introduced. Unlike traditional systems that depend heavily on initial user input, critiquing-based systems allow users to refine their preferences step-by-step. This ongoing interaction helps users make more confident and accurate decisions (Chen & Pu, 2012).

Several studies support the value of this approach. Thompson et al. (2004) developed the Adaptive Place Advisor, a conversational recommender that learns from user interactions. Shimazu's ExpertClerk (2001) mimics a human salesperson, asking smart questions and showing diverse product suggestions to help users narrow down their choices.

McCarthy et al. (2005) improved on earlier systems by using dynamic compound critiques, allowing more flexible and personalized feedback, unlike static systems like FindMe (Burke et al., 1997), which offered only fixed, single-feature suggestions. Pu and Chen (2005) proposed user-initiated critiquing, giving users more control over the process and enabling them to adjust preferences throughout, resulting in more accurate and satisfying choices.

This study employed the user-initiated critiquing technique to give users greater control over the information and recommendations they receive from the system.

While there are already established job-to-worker matching platforms available in the market—mostly privately owned—MoWERS is uniquely designed for use by local government units (LGUs) and government agencies such as DOLE, TESDA, and others that focus on creating job opportunities for disadvantaged skilled workers.

The study by Jing Zhao et al. (2021) introduces job-to-candidate matching system using Embedding-based recommendations, a flatform developed by CareerBuilder. It combines deep learning on resumes and job posts with key information like skills, titles, and location to build detailed profiles. Then, using Faiss indexing, it quickly finds and reorders potential matches to recommend

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

the most suitable candidates efficiently. However, this approach offers employers minimal control over the recommendations, as the results are automatically generated by the system based on the job postings. MoWERS provides employers with more control over the recommended items, as they will be actively interacting with the system while searching for workers that best match their preferences.

Uma, the talent matching platform of Upwork - one of the world's largest digital labor platforms (Kässi, Lehdonvirta, & Stephany, 2021) - is a robust system designed to efficiently connect job postings with the most suitable freelancers. It not only analyzes freelancer profiles and job requirements but also takes into account client preferences, such as freelancer's availability, working hours, and relevant skills. Additionally, Uma aligns freelancer rates with client budgets, ensuring that recommendations reflect both hourly and project-based pricing expectations. **MoWERS** offers the same user privileges but on a smaller scale. However, MoWERS gives employers the opportunity to directly negotiate with workers regarding rates, work schedules, and other important arrangements, a privilege is not explicitly offered in the established platforms mentioned above.

III. Methodology

The system development process began with analyzing the relationship between employers and workers, with a focus on understanding why household employers choose to hire—or not hire—certain skilled workers. To understand this analysis, the Activity Theory Model (Engeström, 1987) was used. In this model, human behavior is part of the activity system, providing a way to understand how different activities develop and influence each other (Kaptelinin, Kuutti, & Bannon, 1995). It suggests that human activities are formed and guided by their intensions, and that these activities change as they interact with other ongoing activities (Kuutti, 1991).

One of the major challenges that needs to be addressed is designing a system that can help average users, who rarely do not know all their preferences when they start using the application. They usually form them at the time they face a situation while interacting with the system, so they should be allowed to revise their preferences during the process and give them another round of interaction with the system. Critiquing-Based Recommender Systems (CBRS) address this by allowing users to refine their preferences while using the system (Ricci & Nguyen, 2007). In CBRS, a critique is a directional preference given by the user in response to a recommendation (Ricci, Rokach, & Shapira, 2015). For instance, when the user is shown a laptop package but wants something similar and cheaper, they can critique the price, and the system will change its recommendations accordingly. This iterative process helps users discover more relevant options and make better decisions.

Figure 3 illustrates how this model is applied in the Mobile-Web Employment Recommender System (MoWERS), following the CBRS framework by Chen and Pu (2012).

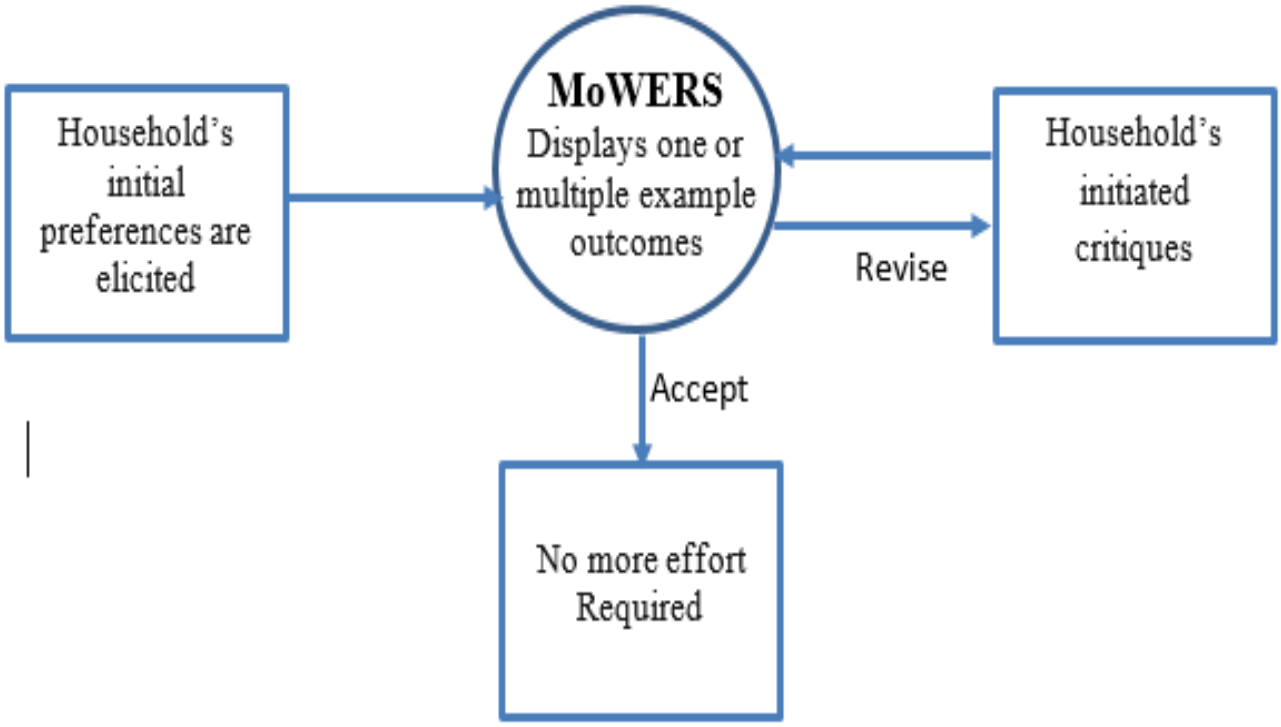

Figure 3 Interaction model between users and MoWERS

The design and development of the Mobile-Web Employment Recommender System (MoWERS) followed the ADDIE Model, as shown in Figure 4. The ADDIE framework offers a systematic approach to identifying user needs, designing and developing effective solutions, implementing them, and evaluating their effectiveness (Gagne, Wager, Goals, & Kelle, 2005).

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

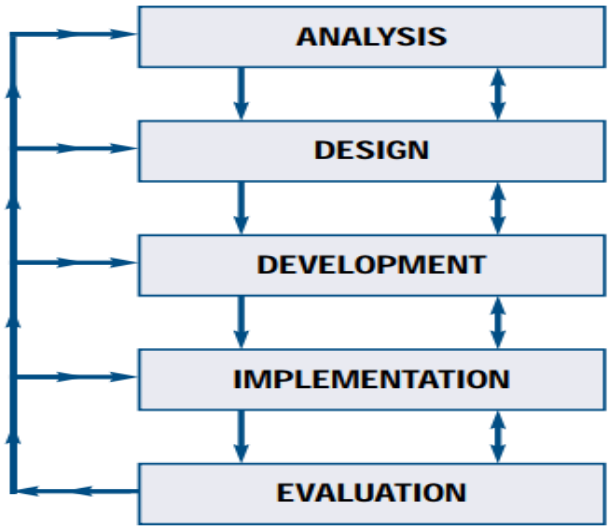

Figure 4 The ADDIE Model Phases based on Grafinger (1988).

This model follows the following key phases: Analysis, Design, Development, Implementation, and Evaluation, based on Grafinger (1988). As shown in Figure 4, these phases are connected, with each one influencing the next. The beauty of the ADDIE model is that it is versatile —it allows the researcher to revisit any phase, making adjustments along the way to address any missing elements or improve the system as needed.

IV. Results and Discussion

In this study, the following phases were carried out:

Analysis Phase

This phase commences with the requirements-gathering process, which involved conducting personal interviews. Prior to the interviews, ethical approval was secured and informed consent was obtained from all respondents. The purpose of the study was clearly explained, and participants were assured of the confidentiality and privacy of their responses. The interviews were conducted using a guided questionnaire, and the insights gathered played a vital role in shaping and considering the system requirements.

Based on the gathered data, the following system requirements must be implemented as mandatory rules:

Skilled Workers must create an account in the system and provide the following mandatory information:

- Name
- Address
- Skills
- Years of Experience
- Rate
- Latest Picture
- Contact Number
- References
- Police Clearance

Note: Ensuring the authenticity of the data entered by workers is beyond the system's capability.

2. **Household Employers** must also create an account in the system to access worker information. This will help validate their activity within the system, such as posting comments, ratings, and complaints.
3. Once a communication line is established between the employer and the worker (via call or text using the worker's contact number), they may proceed to discuss work details, including rates, payment methods, and other arrangements. These discussions will occur outside the system.
4. **Administrators** must create an admin account, granting them access to view both the workers' and employers' databases.
5. All comments, feedback, ratings, and complaints are visible to all users within the system

Design Phase

During this phase, the application's structure and information flow were determined. The system architecture, shown in Figure 5, guided the design. To use MoWERS, users need an internet-enabled mobile phone or computer. When a user searches for workers or uploads worker details, the app connects to a cloud-based database (powered by MySQL) to either pull information or

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

update the database with new entries. Based on the analysis phase, three user interfaces were designed: one for local household users, one for skilled workers, and one for the system administrator.

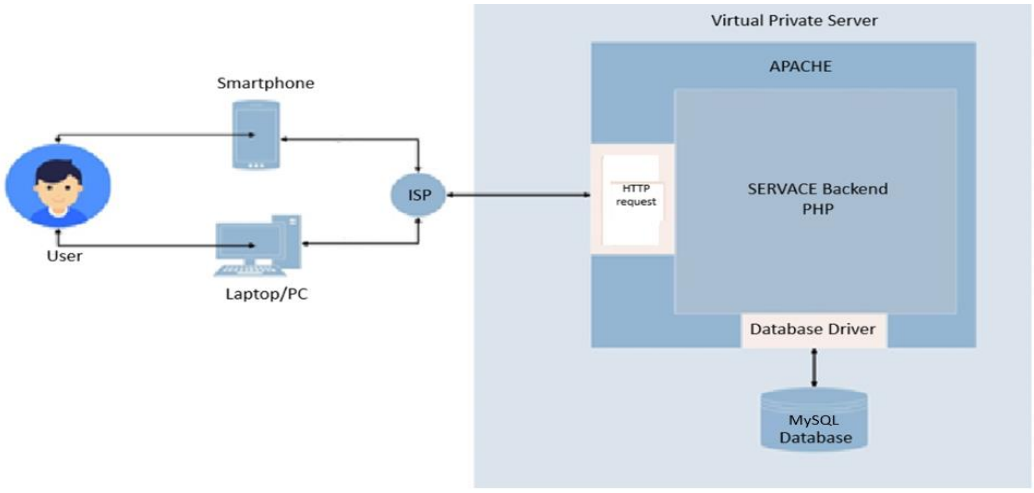

Figure 5 The System Architecture of MoWERS

The Local Household Users' Interface lets users search for skilled workers based on their specific needs. To make this easier, the system uses a critiquing-based recommender approach (Ricci & Nguyen, 2007), which helps users filter out irrelevant information (Hanani, Shapira, & Shoval, 2001) and gives them more control over the recommendations they receive. After hiring a worker, household users can rate the worker's performance, leave feedback, make recommendations, or even file complaints if needed. These actions are then sent to the system administrator for review and proper action.

The Skilled Workers' Interface allows workers to sign in and showcase their personal information, skills, experience, and qualifications. This makes them visible to potential employers, increasing their chances of finding job opportunities.

The System Administrator's Interface lets admins manage worker profiles. They can ban or unban workers, controlling which profiles appear in the worker pool of the application. If an employer's complaint warrants banning based on the severity of the offense, the worker's account will be disabled and removed from the active worker pool. Reinstatement can only be granted by the administrator upon presentation of valid proof that the issue has been resolved with the concerned employer.

To ensure security and build trust, the system requires a password login for all users—workers, employers, and administrators—each time they access the platform.

Development Phase

In this phase, we began building MoWERS. The plans we outlined during the earlier analysis and design phases were brought to life as we developed each component of the application. The web app was built using a combination of web technologies (Sin, Lawson, & Kannoorpatti, 2012). The frontend was crafted with CSS, JavaScript, and HTML, while the backend relied on Linux, PHP (LAMP stack), Apache, and MySQL. To ensure it was mobile-friendly, we also created a mobile-optimized version of the site. Throughout this phase, we made multiple revisions until we arrived at the final version of the app. Figure 6 showed the first User Interface (UI) design of the mobile-web application.

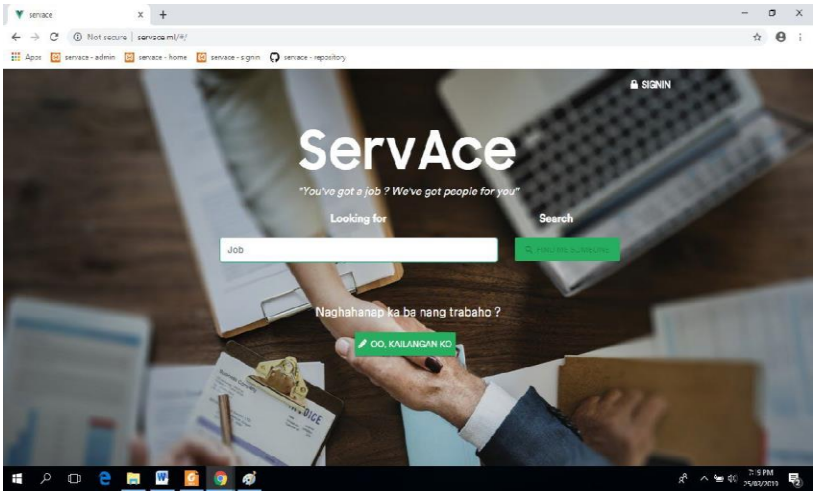

Figure 6 First Home Page of MoWERS

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

The system was deployed and presented for evaluation to ten (10) prospective users. Valuable feedback, including significant comments and suggestions, was gathered and carefully considered in refining the application. The development process went through three iterative cycles before arriving at the final version of the system.

Figure 7 showed the feedbacks, ratings, recommendation, and complaints about the worker given by the previous employers.

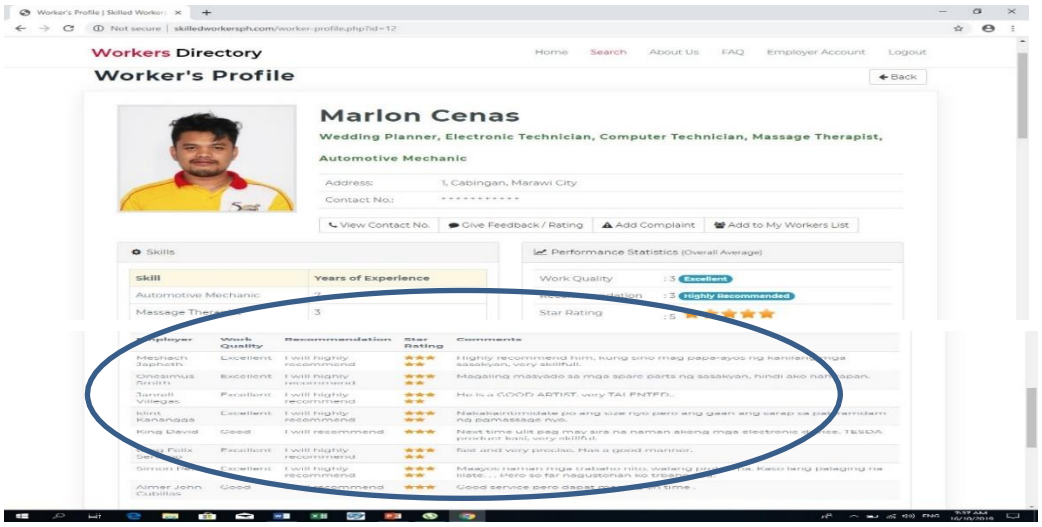

Figure 7 Worker Profile as viewed by household employer

Critiquing Search Criteria of MoWERS

MoWERS is an interactive recommendation application where users actively guide the system by critiquing its suggestions to better express their preferences. Instead of just passively receiving recommendations, users interact with the system by pointing out what they like or what they'd prefer to see differently in the recommendations.

When an employer logs in, the system uses constraint-based filtering (Chen & Pu, 2009) to generate an initial set of recommendations based on their initial requirements. The employer then evaluates the suggestions and provides specific feedback such as requesting workers located in a particular city or barangay nearby. Based on the updated preferences, the system generates a new recommendation. This iterative process continues until the system narrows down to options that closely match the user's preferences. At that point, the employer can either select one of the suggested workers or stop the search when satisfied. The application employed both Unit Critique - change one feature, e.g., “City or Barangay” and Compound Critique -change multiple features, e.g., “years of experience and quality of work.” (Xie et al., 2018).

Implementation Phase

After three rounds of testing and adjustments, the final version of MoWERS, shown in Figure 10, was launched using GoDaddy’s cloud technology. This made the platform accessible to users at any time and from anywhere, providing the flexibility needed for real-time use. Dummy data related to skilled workers was used solely for testing purposes.

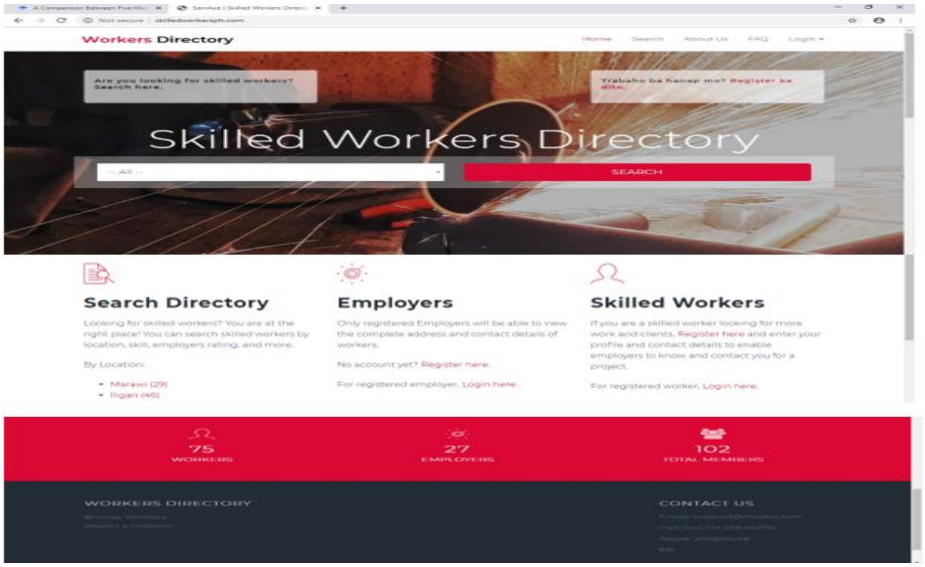

Figure 10 Final Version of MoWERS User Interface

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

Evaluation Phase

This phase assessed how well the mobile-web app helped connect household employers with skilled workers, focusing on its effectiveness, ease of use, and user satisfaction. The evaluation used the UMUX tool (Finstad, 2010, 2013), a simple four-question survey. An additional question (question 5) was included to specifically evaluate the system's critiquing performance.

UMUX Analysis Procedure

Finstad (2010) outlines a straightforward method for analyzing UMUX (Usability Metric for User Experience) scores. Once the survey data is collected, each item must be properly recoded before calculating the overall score.

UMUX consists of four items, with a 7-point Likert scale. To score them:

- **Odd-numbered items** are recoded as **[score – 1]**
- **Even-numbered items** are recoded as **[7 – score]**

This transforms each response to a 0–6 scale. After recoding, the total score for a participant will range from 0 to 24. The participant's UMUX score is calculated as follows:

(Sum of the four recoded item scores / 24) × 100

To compute the **mean UMUX score**, simply average the individual UMUX scores across all participants.

Interpretation of the UMUX mean score is as follows:

- **Above 85**: The system is considered highly usable.
- **70 to 85**: Usability is rated as good to excellent.
- **50 to 70**: The system is acceptable, but there are usability issues that need improvement.
- **Below 50**: The system is regarded as unusable or unacceptable.

The results were promising as presented in Table1. The app scored a weighted mean of 6.7 for effectiveness, showing that users strongly agreed it met their needs. In the area of user satisfaction, the app received a low frustration score as indicated in its weighted mean of 1.23, meaning users were not frustrated while using it. The ease-of-use component scored a higher weighted mean at 6.83, suggesting that users found the app easy to navigate.

Table 1 Result of the MoWERS' Usability Assessment

Components	Question	Weighted Mean	Interpretation
Effectiveness	MoWERS' capabilities meet my requirements.	6.7	Strongly agree
Satisfaction	Using MoWERS' is a frustrating experience.	1.23	Strongly disagree
Efficiency	I have to spend too much time correcting things with MoWERS	1.5	Strongly disagree
Overall	MoWERS' is easy to use.	6.83	Strongly agree
Significance of Critique	Using MoWERS' has given me control to choose the worker I desire to hire.	6.8	Strongly agree

Legends: 1.0 – 1.85 - strongly disagree; 1.86 – 2.71 – disagree; 2.72 – 3.57 - slightly disagree; 3.58 – 4.43 – neutral; 4.44 – 5.29 - slightly agree; 5.30 – 6.15 – agree; 6.16 – 7.0 - strongly agree

One of the app's key components is the critiquing-based recommendation that gives users more control when selecting workers based on their preferences. To assess this feature, a fifth item was added to the UMUX survey questionnaire, which earned a weighted mean of 6.8, indicating that users felt empowered to make their own choices.

For the overall experience of the users, they gave the app a 6.6 weighted mean score reflecting a high level of satisfaction with how the app performed.

MoWERS received a UMUX mean score of 94.3, indicating a high level of usability for the mobile-web application.

V. Recommendation

This study can be used as a useful guide for future research or improvements in similar projects. The following recommendations are suggested to further enhance and evaluate the MoWERS application:

Improve MoWERS Features:

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue IV, April 2025

- Strengthen the monitoring of user comments, feedback, and ratings to make them more reliable and constructive.
- Consider making feedback and ratings a required step for all household employers after service is rendered.
- Apply stricter screening processes to verify the accuracy of workers' skills and qualifications.
- Implement data encryption techniques to strengthen overall data protection and ensure the confidentiality of sensitive information.

2. Enhance the Critiquing-Based Recommendation System:

- Continue refining the system to offer users more accurate and personalized suggestions based on their preferences.

Test in Real-World Settings:

- Deploy MoWERS in an actual community or city using live data to see how it performs in real situations.

Evaluate Impact on Employment:

- Study how the application helps skilled workers secure jobs and whether it improves their employment prospects.

Assess Broader Impact on Unemployment:

- Explore how MoWERS could contribute to reducing the unemployment rate, particularly among skilled workers.

Expand the sample size and incorporate respondent demographic data to enhance the validity and depth of the UMUX evaluation results.

VI. Acknowledgment

I would like to sincerely thank my adviser, Dr. Cenie Vilela-Malabanan, for her incredible patience, guidance, and support throughout this research. Her mentorship played a big role in helping me stay focused and motivated. Her encouragement and belief in my capabilities truly made a difference and helped me complete this study with confidence.

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