Development of a Web-based Recommendation System for Filipino STEAM Educators

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***Abstract* – Technology in education can be seen in the presentations given through the use of projectors, computation of grades in spreadsheets, and implementation of examination of the students online, yet, it is not utilized to its full extent. The development of web-based recommendation system aims to provide learning exemplars for STEAM educators across the Philippines. A web application called RISA (Real-time Intelligent STEAM Analytics) analyzed the proficiency of the educators based on their response in the self-rating proficiency indicator, and then provides a lesson exemplar upon completion. The proponents developed an instrument for complete data and a predictive model for incomplete data using Python software. Several algorithms were constructed for predicting missing values from the user's input data, wherein K-nearest neighbor algorithm was the most accurate among others. Data visualization was also done to show the overall proficiency result of the users based on their self-rating response. This study will help the educators to enhance their teaching capabilities in their respective field. It will also help on future researches involving the application of recommendation system in a web application in the field of education.**

***Keywords* – Web Application, Recommendation System, Pedagogy, STEAM Education, Lesson Exemplar, Big Data Analytics**

I. Introduction

In recent years, technology is prevalent in the field of education in the Philippines. Learners consider technology in education as an effective learning tool that aids them on having a deeper understanding on what they are trying to learn whether they are inside the classroom or not. [1] Some of these learning methods are computer assisted learning, e-learning, and digital game-based learning. [2] Technology based education is beneficial to the learners but also to the educators. With the limited available resources for the educators, the utilization of cloud system has resolved the problems of educational institutions on teaching information system, teaching resources integration, and the development of the teaching system. [3] Thus, various institutions had come up with a sharing model that can provide unlimited resources to the educators.

One of the systems used in the field of education is an online user interface generated for gathering and analyzing data from the educators to assist the employers in choosing the best candidate with the needed skills which uses Big Data analytics in the evaluation of big data. But its primary purpose is for the employment, and not using the materials gathered in the actual learning process. [4] Furthermore, the self-organized intelligent tutoring model from the study of Li and Meng is a cloud-based model that uses the background of the users and study feedbacks to generate a personalized study models and re-organize teaching resource. However, the platform's focal point was in distance education. [5]

The development of STEAM (Science, Technology, Engineering, Agri-Fisheries, and Mathematics) program in the Philippines demands attention of the technological advancement such as an online user interface that provides the flexibility to select teaching materials suited to the proficiency of the educators. The study is centered on developing a web application using HTML, CSS, Javacript, SQLAlchemy and NGINX and a predictive model using Python. The predictive model is used to complete unanswered data if ever the respondents partially fill up the survey. It is then incorporated in the database for recommending pedagogies and teaching strategies for Filipino STEAM educators.

II. Methodology

This research aims to develop a web-based recommendation system which is distributed with the following objectives:

1. To develop an instrument which clusters the proficiency of the STEAM educators for the generation of lesson exemplars.
2. To develop a web application that contains the instrument for an easier access of the STEAM educators.

3. To assess and validate the functionality and acceptability of the developed system.

A. Instrument for Clustering

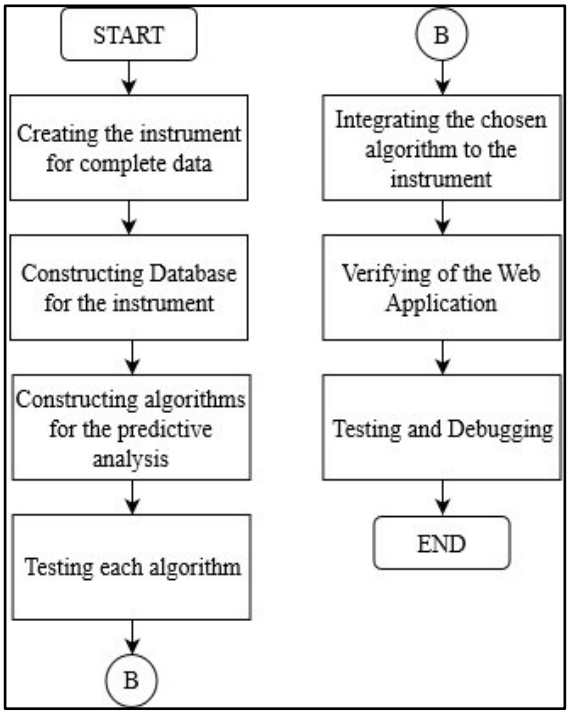

Fig. 1. Software Development of the Model

Figure 1 shows the development of the instrument for the clustering of the proficiency level of the educators. There are two parts needed for the development of the model – the part for complete data and the other one is for incomplete data of the proficiency indicator. The proponents developed an instrument for complete data, similar to the instrument used in the study "Developing STEAM Educators' Proficiency Scoring Framework" [6]. In case the educators provide an incomplete data in the sixty (60) item questions of the proficiency indicator, the proponents constructed several algorithms like K-Nearest Neighbors, Linear Support Vector Classifier, Decision Tree Classifier, Random Forest Classifier, Adaptive Boosting Classifier, Gradient Boosting Classifier, Gaussian Naïve Bayes, and Linear Discriminant Analysis for predicting missing values from the user's input data. Each algorithm was tested to know the most accurate to use for the incomplete data of the proficiency indicator. It was then integrated to the instrument of complete data once the most suited algorithm was determined.

B. Web Application

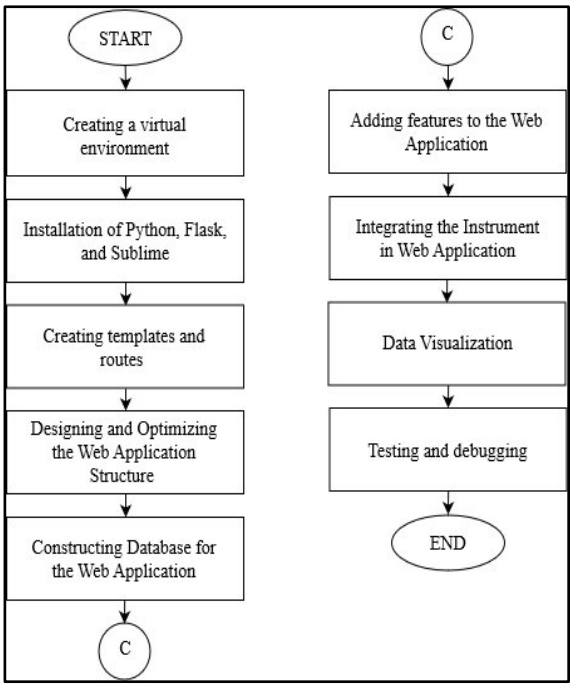

Fig. 2. Flow Chart for the Development of Web Application

Figure 2 shows the development of the web application of this research. Creating of a virtual environment was done to make an isolated environment for all the Python projects and to avoid errors. Python, Flask and Sublime as a text editor was utilized in developing the web application. It was also necessary to create templates and routes for the different pages of the web application. For the design, JavaScript, CSS, and Bootstrap was used. A database was needed in order to store all the data the users will input to the system. Then after the designing and constructing the database, different features was added such as login, logout, registration, admin page, self-rating proficiency indicator, and lesson exemplar. After that, the instrument for the complete and the predictive model for the incomplete data was integrated to the web app. Then, data visualization was done to show the proficiency result of the users based on their self-rating response. Finally, testing and debugging of the web app was done to verify its functionality.

C. Operation of the System

Fig. 3. Registration Page

Figure 3 shows where the users registered at the registration page where the name, e-mail address, password, and a pseudocode were filled up. The pseudocode was given to the educators beforehand to avoid creating multiple accounts for a single user and to make the system accessible to the authorized users only.

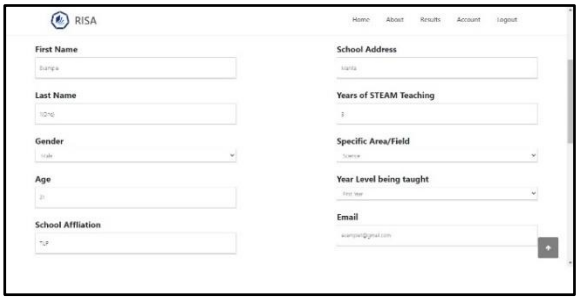

Fig. 4. Account Page

Figure 4 shows the account page where the user filled up or update all the necessary information. The user was redirected here once the e-mail address and password were provided – both should match to the stored data in the database.

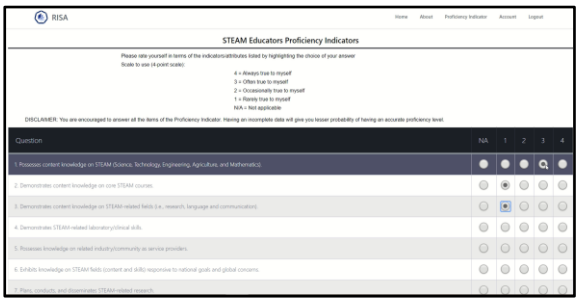

Fig. 5. Self-rating Proficiency Indicator

Figure 5 shows where the user answered the 60-item self-rating proficiency questions. When the user answered all the items, a more accurate result will be generated to the result page. However, if the user did not answer some of the items in the proficiency indicator, these items will undergo imputation and get less accurate result depending on the number of unanswered questions.

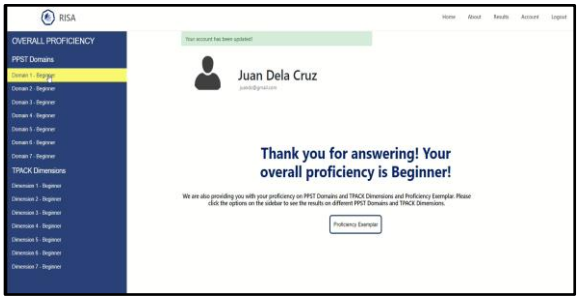

Fig. 6. Result Page

Figure 6 shows the result page where the system displayed the overall proficiency of the educator in each domain and dimension after answering the proficiency indicator. The overall proficiency of the user can be Beginner, Proficient, Highly Proficient, or Distinguish.

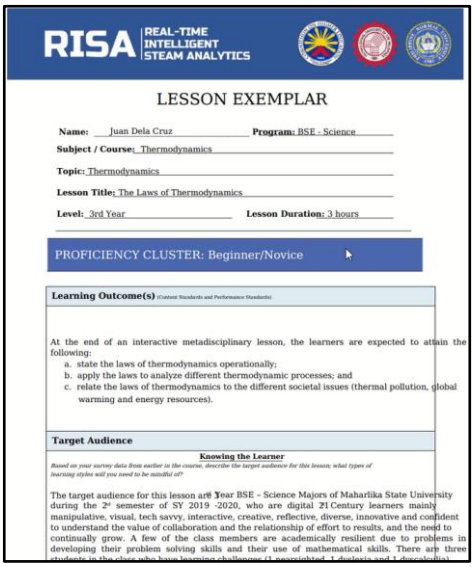

Fig. 7. Lesson Exemplar

Figure 7 shows the Portable Document Format file of the lesson exemplar that matches the educator's overall proficiency. This will only be generated if the proficiency of the educator is Beginner or Proficient.

III. Results and Discussion

The inputs of the system are the data of the educators which was submitted from the registration, update account form, and the data from the proficiency indicator.

HTML, JavaScript, and CSS were used for the structure and appearance of the web application and SQLAlchemy was used for the database. Python was used for the development of instrument which is responsible for the functionality of the overall system.

A. From the Admin Page

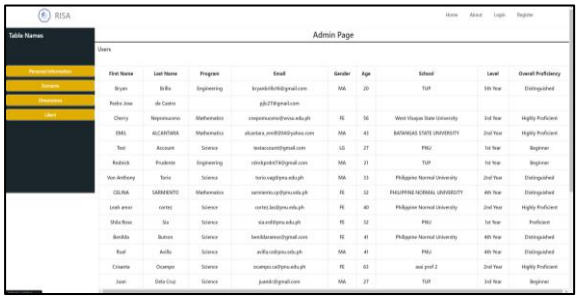

Fig. 8. Users Table

Figure 8 shows the data of the educators who evaluated the system. These data were saved in the database by SQLAlchemy and accessible through the Admin Page of the website where only admin can access.

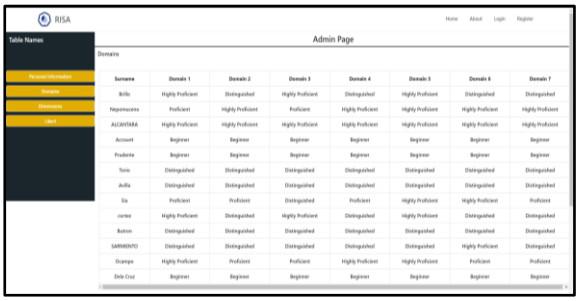

Fig. 9. Result in Domain

Figure 9 shows the results in every domain of the registered educators. The results were based from the answers of the educators on the proficiency indicator. Specific range of questions were clustered into one domain. Total of seven domains encompassed the whole questionnaire. The proficiency of each domain was one of the components for the calculation of the overall proficiency.

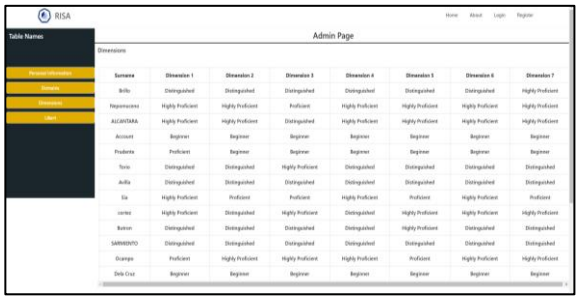

Fig. 10. Result in Dimension

Figure 10 shows the results of the educators in every dimension. Consequently, the table was the same in principle with the results of domain table. The results for the dimensions of the educators was also the other component for the calculation of the overall proficiency of the educator.

B. Evaluation of the Gathered Data

The system was evaluated by seven STEAM educators at Philippine Normal University. They registered their own account, where they were given their own pseudo code. The self-rating proficiency indicator which consists of sixty (60)-item questions was answered by approximately fifteen minutes.

B.1. Convenience of Using the System

The convenience of using the system was evaluated using the following statement:

I.1. The website responded promptly.

I.2. Answering the self-rating proficiency indicator consumes less of my time.

I.3. The system is helpful to obtain a real-time result of my proficiency level

I.4. I experienced errors or bugs while using the system.

	I.1		I.2		I.3		I.4	
	Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**	**Frequency**	**%**
Strongly Agree	6	86%	5	71%	7	100%	0	0%
Agree	1	14%	1	14%	0	0%	1	14%
Disagree	0	0%	1	14%	0	0%	4	57%
Strongly Disagree	0	0%	0	0%	0	0%	2	29%
TOTAL	7	100%	7	100%	7	100%	7	100%

Table 1. Frequency Count for the Convenience of using the System

Table 1 shows that majority of the respondents found the system convenient to use. However, there were few respondents who still experienced errors and bugs.

B.2. Security of the System

The security of the system was evaluated using the following statement:

II.1. Having an account secures my personal information and proficiency result.

II.2. The system is helpful to have my personal pseudocode in creating my account.

	II.1		II.2	
	Frequency	**%**	**Frequency**	**%**
Strongly Agree	0	0%	3	43%
Agree	6	86%	3	43%
Disagree	1	14%	1	14%
Strongly Disagree	0	0%	0	0%
TOTAL	7	100%	7	100%

Table 2. Frequency Count of the System's Security

Table 2 shows that most of the respondents strongly agreed and agreed that having their personal accounts and pseudo codes provide security. However, there were still a few who think that having their own pseudocode is not that helpful to secure their account.

B.3. Design of the System

The design was evaluated using the following statement:

III.1. The overall interface of the website is user-friendly.

III.2. The website is aesthetically pleasing.

	III.1		III.2	
	Frequency	**%**	**Frequency**	**%**
Strongly Agree	4	57%	3	43%
Agree	3	43%	4	57%
Disagree	0	0%	0	0%
Strongly Disagree	0	0%	0	0%
TOTAL	7	100%	7	100%

Table 3. Frequency Count of the System's Design

Table 3 shows that all the respondents strongly agreed or agreed that the overall interface of the system is user-friendly. Also, they found the interface of the system aesthetically pleasing for them.

B.4. Portability of the System

The portability of the system was evaluated using the following statement:

IV.1. I prefer answering the Self-rating Proficiency Indicator in the website.

IV.2. The system can be accessed using other devices.

	IV.1		IV.2	
	Frequency	**%**	**Frequency**	**%**
Strongly Agree	6	86%	3	43%
Agree	1	14%	3	43%
Disagree	0	0%	1	14%
Strongly Disagree	0	0%	0	0%
TOTAL	7	100%	7	100%

Table 4. Frequency Count for the Portability of the System

Table 4 shows that all the respondents strongly agreed or agreed that they prefer answering the proficiency indicator in the website. Also, majority of them find the system accessible in other devices while there were few who were not able to access the system in other devices.

IV. Conclusion

The development of the instrument and predictive model for the functionality of the system was successfully implemented using Python. The accessibility, structure, and appearance of the web application were successfully implemented with HTML, JS, and CSS. Moreover, based on the result of the gathered data from the respondents, the developed web application was convenient, secured, aesthetically pleasing, and portable to use.

This study is limited to STEAM educators only. For future works, it is recommended to consider educators from other disciplines to expand the scope of the project. The application of large-scale integration of the web application for accurate proficiency rating is also recommended.

References

[1] T. Zarra, R. Chiheb, R. Faizi and A. E. Afia, "Cloud Computing and Sentiment Analysis in E-Learning Systems," in *2nd International Conference on Cloud Computing Technologies and Applications (CloudTech)*, 2016.

[2] C. H. Wang and T. Y. Wang, "E-Learning Platform of STEAM Aesthetic Course Materials Based on User Experience," in *1st International Cognitive Cities Conference (IC3)*, 2018.

[3] L. Yao and X. Xiong, "Design a Teaching Resource Sharing System in Colleges Based on Cloud Computing," in *International Conference on Information Technology and Applications*, 2013.

[4] H. Singh and S. J. Miah, "A Cloud-Based Collective Platform: Combined Requirement Perspectives of Learners, Educators, and Employers," in *4th Asia-Pacific World Congress on Computer Science and Engineering (APWC on CSE)*, 2017.

[5] S. Stein, J. Ware, J. Laboy and H. E. Schaffer, "Improving K-12 pedagogy via a Cloud designed for education," *International Journal of Information Management*, vol. 33, no. 1, pp. 235-241, 2013.

[6] C. P. Palisoc, M. P. E. Morales, R. A. Avilla, T. O. Ayuste, B. Ramos-Butron and N. A. Casilla, "Developing STEAM Educators' Proficiency Scoring Framework".

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