A Geospatially-enabled Student Data Management System (Geo-SDMS): A Case Study of Yemen

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Introduction

Group support system (GSS) research has found that for group members to arrive at a "better" decision, information needs to be understandable and shared among all group members (Dennis, Hilmer, and Taylor 1998). One way to make information understandable among group members is by using information visualization, which represents an important tool for decision making. Information can be exchanged using different techniques such as groupware (Hilmer & Dennis, 2000), visualization tools (Miller et al. 2012); (Ko and Chang 2018); (Rivard, Gentili, and Koizumi 2019), and value charts (Bajracharya et al. 2018); (Conati et al. 2014).

Visualization tools for information exchange have been shown to be effective because they increase the possibility that important information will not be overlooked by individuals (Hilmer & Dennis, 2000), it provides easy channels where firms can obtain useful insights from information and use them in their decision process (Ko and Chang 2018); (Lin and Chang 2018); (Rivard, Gentili, and Koizumi 2019), and it allows the decision maker to have a comprehensive view of information that can support decision making (Ko and Chang 2018).

Visualization tools are used to solve a visualization function, such as navigation, filtering, or selection (Conati et al., 2014) and involves a visual or interactive presentation of information in a clear and compelling manner (Miller et al., 2012). They have been used in many fields such as healthcare, information systems, supply chain management, education, and so on (Miller et al., 2012); (Ko & Chang, 2018). These visualization tools have become very popular for decision making, and they can be designed to fit the specific needs of each user (individual or organization) and support users with different backgrounds and abilities (Conati et al., 2014); (Ko & Chang, 2018).

This research gap was identified via stakeholder interaction and a systematic literature review where no current, geospatially-enabled SDMS, was identified that utilizes GIS technology to accommodate and share the information between multi-stakeholders. This research aims to utilize GIS and visualization tools to design, develop, and implement a Geo-SDMS that can help different stakeholders, such as scholarship organizations, employers, and students to improve their decision outcomes. The paper is based on a case study in Yemen to build a Geo-SDMS.

Method

Even though there are many Information System and Technology design approaches that deal with solving a problem by using technology, this project used the design science research (DSR) methodology to guide the platform development and evaluation. DSR was chosen as it is particularity well-suited to solving problems of this type, ones that require close interaction with various stakeholders, is research-based, and allows for rapid, iterative, development cycles.

Over the last decade, the design science research (DSR) methodology has become an important research method in the information systems field (Chatterjee et al. 2018). It is a research method that is concerned with building artifacts to solve human problems. Chatterjee and Hevner defined DSR as an "Iterative process and resulting product that deals with building artifact to solve a human problem in an efficient manner" (Hevner & Chatterjee, 2010). Iteration is an integral part of DSR because it starts with identifying the problem, designs and builds a solution, evaluates the outcome, and then seeks possible improvements. Therefore, the main process cycles of DSR are building and evaluating the artifacts.

This online platform has been designed to solve a problem in the country of Yemen and is related to the education system there and its linkage to market needs. The problem has its roots in the fact that the number of Yemeni students who study abroad has increased dramatically over the past few years. This, coupled with an increase in the number of charitable or non-profit organizations that provide fully funded scholarships to qualified students, has resulted in a lack of coordination between these organizations and the students.

This lack of coordination creates the problem of how to track student academic majors and how to decide on what majors the funding organization, country, or market needs, to ensure that there is a balance among all majors, and without clustering on specific majors. Currently, these organizations are totally isolated from each other, and each one makes their decision based on the information that they have (unique information) without having access to what other organizations are doing or what the market needs. This is also relevant for students who need to decide on what major to study and their professional goals.

Thus, to address this problem, this research is designing a platform that contains data of students from different scholarship organizations. Using GIS-based tools, a web and mobile story map platform was developed that can help stakeholders support their decisions.

This platform has three main objectives:

1- Provide guidance for students who recently graduated from high-school to choose their majors and support that decision-making process,

2- Assist scholarship organizations in focusing their scholarship efforts on specialties in which there is a shortage, and,

3- Assist the public and private sectors in selecting qualified students to recruit, as well as assisting students in obtaining jobs in their area of specialization.

Since the main purpose of this project is to utilize geospatial technology in designing a Geo-SDMS, a search was performed to identify an appropriate platform for hosting a system of this type. Esri's ArcGIS for Insights and Story Maps were found to be the best options that provide the necessary features and functions. These features include the ability to involve different stakeholders in one platform, the opportunity to utilize location features, and the capability to present the data in an interactive manner and visualize it in a way that facilitates the decision-making process.

Results

Data were collected from a Student Association database in Yemen; the name of the association is removed for privacy issue. This association was established in 2013 with the purpose of building a database for the country's students who study abroad. The database includes information about the student's major, country of education, graduation status, academic level, expected graduation date, job status, job details if any, and contact information.

An ArcGIS Story Map (Figure 1) was created that includes embedded content from Insights for ArcGIS displaying the total number of students in each country along with statistical data related to those students (Figure 2). This helps various stakeholders obtain a comprehensive, overall view regarding the students, for instance:

1- Academic levels in each country.
2- Graduated versus enrolled students at each academic level.
3- Graduated versus enrolled students in each country.
4- The number of students in each university in each country.

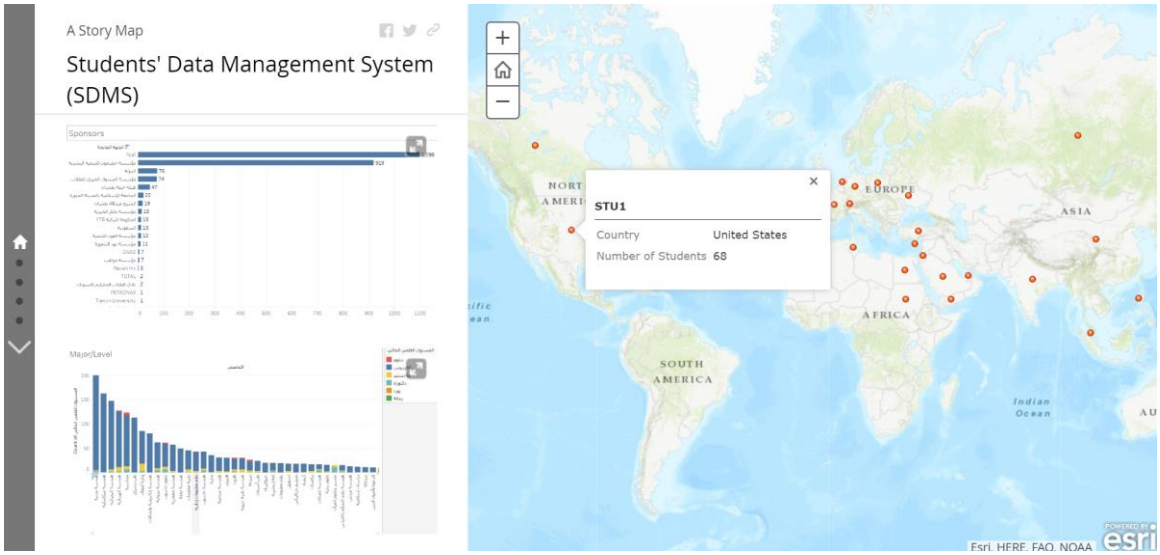

Figure 1: ArcGIS Story Map with embedded Insights data

Figure 2: ArcGIS for Insights displaying detailed statistics

Discussion and Conclusion

This is a work-in-progress and additional user feedback is required to assess the effectiveness of this platform. A focus group discussion was conducted with highly knowledgeable representatives in leading positions from different stakeholders including scholarship organizations, employers from the public and private sector, and students. A total of nine individuals attended the focus group discussion; four from scholarship organizations (including a CEO and Board member), three employers (from government and private sectors), and two students (Ph.D. and Masters). All participants in the meeting verified the value of the platform and were able to appreciate the issues that lie beyond their control when dealing with disparate, and diverse, stakeholders.

All participants confirmed its overall usability and straightforward visualization of information. This gave the stakeholders the ability to see the “big picture” while providing additional detailed insight to consider in their decisions, without communicating directly with one another.

Future assessment steps will include identifying a larger user-base and obtaining their feedback. Future development steps will include an assessment of the suitability of using various dashboard tools, which may have more functionality than embedding Insights into a Story Map and evaluating their functionality and usability.

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