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Integrating Diversity, Equity, and Inclusion into Systems Analysis and Design Education

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Abstract. Diversity, Equity, and Inclusion (DEI) represent the involvement of different groups supported equally and fairly while their differences are acknowledged and recognized. Many organizations, including higher education institutions, have adopted the notion of DEI by introducing the phenomenon through their institutional strategies. However, there is limited evidence of the inclusion of DEI content in information systems (IS) education. The paper aimed to develop a framework to integrate DEI in Information Systems Analysis and Design education and projects. A survey to investigate how organizations actively include DEI content in the different stages of the System Development Lifecycle (SDLC) methodology was administered. Results identified that 23-40% of organizations represented address DEI at some stage of the SDLC. Practical implications for instructors include well-informed and prepared students as well as improved System Analysis & Design (SA & D) curriculum. The practical implications for information systems (IS) practitioners are resulting system designs that are culturally sensitive, end user perspective driven, and accessible for all users. Bridging IS education with industry practice through a framework for DEI in the system design space brings new insights into system design, better preparing students to face DEI content in their careers across all industries. Significantly raising awareness that problem solving and IS solutions should meet the needs of society with different backgrounds and cultures.

Keywords: Diversity, Equity, Inclusion, Systems Analysis and Design

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1. INTRODUCTION

Most organizations apply systems development methodology when designing and developing information systems (IS). The methodology that is commonly used is the system development life cycle (SDLC) [33]. Though this methodology has been modified for a variety of reasons throughout the years, it remains the foundational approach to systems analysis and design taught in most higher education information systems curriculum. The SDLC design methodology is broken down into stages that are executed sequentially [29]. Typically, pedagogy around systems analysis and design also includes a discussion on ethics. However, the focus is more on adhering to the principles and this presents limitations such as a lack of practical guidelines on how to implement these principles in the SDLC [2]. Some authors focus on the fundamentals of systems analysis and design techniques and skills required in the field [30]. While other scholars such as [31] presents systems analysis and design trends, past and current reviews of these phenomena. What isn't commonly found in systems analysis and design is material that covers diversity, equity, and inclusion in each stage of the SDLC. A review conducted by [3] suggest that most studies in systems analysis and design focus more on teams' diversity. Moreso, Inclusivity and equity exist respectively. Their study recommends analysis of DEI as a universal concept in different methodologies.

Diversity, Equity and Inclusion (DEI) is a phrase that represents the involvement of different groups which are supported equally and fairly while their differences are acknowledged and recognized [5], [23]. Though DEI is often viewed as a collective initiative, the study acknowledge that diversity, equity, and inclusion carry their own definitions and thus their own implications. Diversity is a concept that involves factors of social groups that reflect the level at which there are objective or subjective differences within a group [32]. Diversity goes beyond gender, age, race, etc. and encompasses such human aspects as religion, lifestyle, education or even operator skills [21]. Thus, DEI moves beyond ethics drilling down to more specific topics that can be addressed in systems analysis and design.

Equity involves social justice which ensures everyone has equal opportunity to attain their full potential rights regardless of their social position or any social circumstance [19]. Equity involves fairness and giving everyone what they need or deserve [18].

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Inclusivity suggests involving different types of people which may further be expressed as regulating the marginalized groups in all acts of service delivery or solution development [1]. Additionally, meeting the criteria of being democratically participatory leads to inclusivity [10].

The software development lifecycle (SDLC) guides the IS project team through the necessary stages required to develop a solution [13]. Therefore, it is vital to consider DEI initiatives during the stages of system development. In most cases, the SDLC is used to convert an idea into a product or solution. Hence the focus is usually on ensuring the quality of software with a limited emphasis on DEI during the process. The current study will inform the advancement of information systems development with a sense of diversity, equity, and inclusion mindfully embedded throughout the design and development process.

The field of engineering has made strides in weaving DEI considerations into the systems engineering process through the development of the Inclusive Engineering Framework. This framework incorporates eight components at the beginning of the design stage focusing on need, equality, global responsibility, future technology, societal impact, sustainable development, safety/cyber-security, and restoration [8]. Though the Inclusive Engineering Framework is noted on its site as being applied at the beginning of the design stage, within the Systems Engineering Body of Knowledge (SEBoK) the components have been mapped to the ISO/IEC/IEEE 15288:2015 Technical Processes demonstrating how they might be applied [17]. While the framework and mapping are meaningful, they differ from the current project in three ways: (1) the Inclusive Engineering Framework is applied at the beginning of the design stage rather than spanning the SDLC, (2) the Inclusive Engineering Framework covers topics outside of diversity, equity, and inclusion without drilling down into each of the topics, and (3) the SEBoK mapping lists general considerations for each of the technical process and does not delineate between diversity, equity, and inclusion specifically for each stage of the SDLC.

While present literature exists in the realm of software development and education, [34] suggests that little has been studied regarding the embedding of DEI topics within the teachings of the design and development process or stages. To aid in bridging the gap,

the current study explores the questions: (1) how are organizations incorporating DEI in the system design space, and (2) how can DEI content be intentionally incorporated into the SDLC and thus IS education? The objectives of this work are to (1) create a framework for incorporating DEI content into the SDLC, and (2) identify how the framework can benefit both education and industry. The purpose of this work is twofold: (1) prepare instructors to help improve student understanding of diversity, equity, and inclusion within the SDLC, and (2) have a DEI ripple effect through IS design as students with this training advance in their careers. It is important to note that the resulting frameworks are not considered exhaustive. To the authors' knowledge, this is the first attempt at the development of such a framework through exploration. Future work in this space is likely to take place. The remaining sections present a discussion of the extant literature, methodology and results, proposed framework, and a discussion of the findings.

1.1. Background

The presence of DEI concepts in the system development lifecycle and in the teaching of information system development is varied. Regarding its inclusion in the development of systems, studies have addressed product value for customers [21], focusing on accessibility and usability for the end user [28], intentional inclusivity in development [4] as well as accessibility and affordability of information communication technologies (ICT) [6]. Other development studies have focused on value sensitive design [14], [36] and the diversity on IS design teams [9], [24]. As for studies addressing DEI in IS education, studies have looked at universal design [11], responsible computing [28], bridge building between universities and industry [12], as well as the use of chatbots for inclusive learning [16].

1.2. DEI in Information System Development

Intentionally addressing the diversity of humans that will engage with an information system presents a basket of options to be considered. [21] argued that there are two sides of the design coin: the designer's environment and the effective user experience. Emotions and cognition make up the effective user experience. The author acknowledges the long process between intention and behavior, noting that if designers make assumptions about the user needs during that process, they are operating on incomplete information. One recommendation is to consider more silent aspects of user diversity such as culture, affiliation, physical ability, power, creativity, and curiosity [21]. [28] extend these ideas with the concept of community of meaning which includes the linguistic,

socioeconomic, and cultural space where such software users exist. The authors recommend usability testing that includes individuals who are differently abled to allow for a more inclusive system design [28].

Study by [4] discuss intentionality of design through the lens of user needs as well. The authors champion the idea that if the diversity of users is not considered then individuals who do not conform to the included individuals may be unable to use the system. Software intended to improve people's quality of life could unintentionally hinder equity [4]. [6] present a differing perspective on quality of life as it relates to systems, specifically those access via Information and Communication Technologies (ICTs). In addition to the accessibility factor, the authors discuss affordability. Failure to consider diverse populations will result in lack of use [6].

Diversity has also been examined in the make-up of design teams. It is one of the obvious places in software design that diversity can be addressed and a project aspect over which project managers have more control. It is considered essential for good system design [9]. Additionally, the diversity of the team can be built around member knowledge, values, and individual differences such as race, gender, and ethnicity [24]. Individual differences were found to have a mixed effect on team performance which was thought to occur due to how they were measured [24]. Value diversity was considered by [14] in their focus on values in the design of information systems. In this case, "values refer to what persons, either singularly or collectively, consider as important to their lives" [25]. [20] examined how the Scaled Agile Framework (SAFe) encompasses the human value sensitive design and found it lacking. They recommended guidelines for incorporating human value sensitive design into SAFe [20].

The extant literature is helpful in introducing DEI concepts in the information system design process. However, the studies discussed here lack direct application of DEI content into all stages of the system development lifecycle. Rather they either target specific design or development stages or only address one of the three DEI topics [3]. Evaluation of the Value Sensitive Design framework resulted in the recommendation that objective should be to have technology consciously and deliberately designed to include ethical value considerations [25]. The current study addresses this recommendation through the examination of DEI content in recent business IS design projects and presentation of a

framework for incorporating DEI content at each stage of the system development lifecycle.

1.3. DEI in Information Systems Education

DEI in information systems education gravitates toward two topics: increasing diversity in the student body and teaching about ethics around information systems. Regarding a diverse student body, research has found that the information systems field is not only a male dominated space, but those males are predominantly white [22]. The implication there is that programs feeding these career paths are completed by a white male majority. This sets up a myriad of issues when it comes to the depth of DEI considerations in the design and development of an information system. As previously noted, a lack of diversity in the design and development team can have a ripple effect through the information system that is created.

One mechanism for addressing diversity in the student body is the application of universal design for learning to set DEI as the foundation for designing curriculum "to meet the needs of students with a wide range of abilities, learning styles, and preferences" [11]. Additionally, universal design applied across an IS program can positively impact diversity and inclusion for a wide range of stakeholders [11]. This could aid in addressing a particular race and gender-dominated space. Regarding educational software, being mindful of DEI can improve such aspects as input controls, output displays, and documentation which allow the user to enjoy the benefits of the software irrespective of different characteristics.

Looking deeper into the concerns around Information Technology (IT)/IS being male dominated, A window into the issues around white male dominated STEM spaces provides a view of the experiences happening at Historically Black Colleges and Universities (HBCUs). [12] noted that "African Americans employed in STEM can earn $17,000 more per year than their peers trained in but not employed in STEM" and yet HBCUs average retention rates of 66 percent and graduation rates of only 30 percent. The author notes that companies are also lacking diversity in their employment rosters. Thus, partnering corporations with students at the beginning of a student's college experience could lead to success for both the student and the organization (12].

Study by [16] Investigated the opportunities of Artificial Intelligent (AI) technologies such as chatbots to facilitate personalized learning to foster inclusivity in IS education. Through the creation and use of a chatbot tutor, the authors found that they hold the potential to improve inclusivity for students who learn differently, face disadvantages in life, and/or come from different environments [16]. The services of a chatbot could include finding campus resources, understanding educational content in a different language, creating a safe/non-judgmental space, providing mental health support and more [16]. While all these types of services may not be directly related to IS education, support of students in a variety of life aspects improves the possibility of educational success.

Regarding the teaching of ethics, [35] conducted a study on responsible computing through the introduction of ethical thinking around social justice to first year computer science students. The researchers used lectures, cases, group projects, focus groups, and interviews to engage the students around issues of social justice related to data collection, tracking, bias, internet privacy, and competitive "real world" system design and critique activities [35]. This study observed how students are responsive toward ethical content incorporated into their computer science curriculum to instill a culture of social justice. Also, the researchers found that most students' ethical considerations revolve around themselves, family and friends and propose moving future iterations of this content toward "systems of power and inequality that may not be part of their everyday experiences [35].

The studies highlighted provide a glimpse into research around diversity, equity, and inclusion as they pertain to information systems education. While these studies are impactful and informative, we failed to find studies that specifically address diversity, equity, and inclusion individually at each stage of the systems development lifecycle as it is taught in systems analysis and design courses. Thus, the current study finds relevance in filling that gap in literature.

2. METHODS

The study research model examined in this study is the intersection of the stages of the system development life cycle, and diversity, equity, and inclusion. The system

development lifecycle was chosen because it is the foundational method for the design and development of information systems. Although it has been adapted over the years, the basic stages of IS design and development remain the same. Additionally, the SDLC is the initial IS design/development method taught in the majority of undergraduate systems analysis and design courses. We view the stages of the SDLC as follows:

1) Identification and Selection: during this stage, organizations, teams, and/or employees identify potential information system design/development projects. For some organizations there is a formal process by which those potential projects are evaluated and ones selected for the next stage. However, not all organizations have a formal process.
2) Project Planning: during this stage the initial plan for the project is developed. Team members are identified. An initial timeline is developed. The first feasibility discussion is held.
3) Analysis: this is where the heavy work of design begins. During this stage business requirements gathering take place. End users are surveyed/interviewed/focus grouped. During this phase a conceptual model is formed. It includes the development of UML diagrams such as Use Case Diagrams, Sequence Diagrams, Data Flow Diagrams, etc.
4) Design: During this stage the conceptual model is mapped to a database model through the creation of diagrams such as Entity-Relationship Diagrams, Star Models, etc.
5) Implementation: this is when the programmers transform all of the design documents into the information system and deploy it for users.
6) Maintenance: during this stage bugs are fixed, updates are installed, and patches applied.

These basic stages of information system analysis and design provide students with an understanding of how these types of systems move from being an idea to an actualized system. The question we had, though, is if, in industry DEI are being considered during these stages, how can we weave these concepts into the curriculum. To study this idea, we used the following definitions for diversity, equity, and inclusion respectively:

1) Diversity refers to a spectrum of differences which includes and not limited to race, ethnicity, gender, sexual orientation, age, social class, physical ability or

attributes, religious or ethical value system, national origin, and political beliefs [7], [21].

2) Equity ensures that there is fairness, equal opportunities and individuals rights are not disproportionately affected due to their social position and differences [19], [27].

3) Inclusion refers to the acceptance, involvement, empowerment and recognition of all people regardless of their characteristics [15].

Figure 1 shows the research workflow for the project. This workflow shows the stages from survey design to framework development. Each stage is discussed in subsequent sections.

2.1. Survey Development and Dispersion

During survey design, we opted to divide the survey into SDLC stages. For each stage, we first defined diversity, equity, and inclusion. Then we provided a sample question that teams might consider for each, specific to the stage of the SDLC in question. Respondents were then asked to: Select all that they and/or their decision makers consider during the SDLC phase of information system design/development. They were then given seven options to select from. The selection included diversity, equity, inclusion, all the above, none of the above, I don't know, and I'm not involved in this stage of the IS development process. After selecting the appropriate DEI option(s), participants were then asked to: Please discuss why they and/or their decision makers do or do not consider these topics during the SDLC stage. Additionally, if participants selected diversity, equity, inclusion, or all of the above they were presented with the request – "Please discuss how the item(s) you checked above are considered during the SDLC stage. The survey structure provided both quantitative and qualitative questions which enabled us to tell the story of DEI in the SDLC in industry. We believe it is crucial to understand if organizations are considering DEI issues during the SDLC and it is also necessary to indicate why, and how they are doing so. Qualtrics software was used to create the instrument. The study targeted individuals who work in information systems roles primarily in projects that develop IS solutions and innovation. Therefore, the survey was administered through LinkedIn.

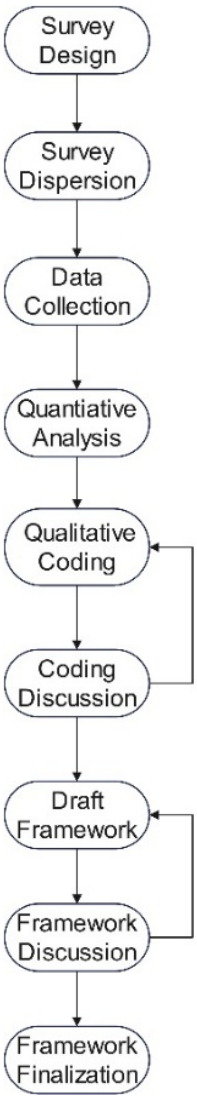

Figure 1. Research Workflow

2.2. Data Collection

Questionnaires were distributed to 87 participants and only 35 were completed resulting in varying depths of qualitative responses. In the review of the IS literature, [26] it is noted that with regards to single case studies, the highest average impacts fell in the interview range of 15-30. Qualitative data collection via software such as Qualtrics provides a virtual means of interviewing. Therefore, we have confidence in the responses that were received. Of course, this number limits the information that was obtained. The limit of information may narrow the representation of industries, projects, or roles as they relate to DEI considerations in the SDLC. While the number of responses may seem concerning, there are two aspects to consider: (1) the purpose of this initial exploration

was not to reach saturation in response. It was to get an idea of what practitioners are doing with regards to DEI during the SDLC, and (2) the questionnaire had open-ended questions which enabled the researchers to collect eloquent data from the respondents. Thus, we believe the data in this study reveals meaningful information about DEI in the SDLC and provides a starting point for researchers to dig deeper and engage further.

2.3. Quantitative Analysis

Questions answered on a scale from one to seven were downloaded into an Excel spreadsheet. The number of each DEI answer for each stage of the SDLC was counted and percentages were calculated. Once the numbers were complete, bar charts were created to represent the results visually.

2.4. Qualitative Coding and Coding Discussion

Qualitative answers were initially downloaded in an Excel spreadsheet. They were then transferred to a Word document and printed for manual coding. Each researcher made notes regarding the themes that emerged from the qualitative responses. After a meeting to discuss the results, a second round of coding was completed during which the researchers considered their unique codes and if or how they fit into the codes identified by both researchers during their initial round of coding. This was completed prior to drafting the framework.

2.5. Draft Framework and Framework Discussion

After coding was completed, an initial framework was drafted that included all three aspects of DEI for each stage of the SDLC. However, upon discussion of the framework, it was determined that each individual aspect of DEI required its own framework. The aspects are distinct and detailed enough that including them all together made the framework less user friendly. After this discussion, a new draft was developed and discussed. This draft included both objectives and example teaching points/questions.

2.6. Framework Finalization

Once the final draft was developed and decided upon, the format of the framework was finalized. During this stage of the project, we determined that the objectives, which are practical for industry, should be the second column in the framework and the educational

practicalities in the third column. The finalized frameworks for diversity, equity, and inclusion concepts in the SDLC were developed during this stage.

3. RESULTS AND DISCUSSION

Table 1 indicates the number of participants who made DEI selections in each stage of the SDLC, along with the percentage of those who answered each selection option. For the stages of project planning through maintenance, 50% or more indicated that their teams consider aspects of diversity, equity, and inclusion. Smaller percentages indicated that they consider one or two of the three topics. The highest percentages of none were in the implementation, maintenance, and analysis stages respectively. Qualitative data in each stage provides even more information.

Table 1. Percentages of Participant DEI Selections

Stage	Diversity	Equity	Inclusion	All	None	Don't know	Not Involved	Responses
Identification /Selection	15.0%		10.0%	45.0%	15.0%		15.0%	20
Project Planning	7.7%	7.7%	7.7%	53.8%		7.7%	15.4%	13
Analysis		6.7%	6.7%	53.3%	20.0%		13.3%	15
Design	10.0%	10.0%	10.0%	60.0%			10.0%	10
Implementation			13.3%	53.3%	26.7%	6.7%		15
Maintenance			7.1%	50.0%	21.4%	21.4%		14

3.1. Identification and Selection

The number of organization representatives who indicated what, if any, DEI content was being considered during the identification and selection stage of projects, as visually represents in Figure 2. Excluding those who indicated they are not involved with this stage of the SDLC, 18% identified that no DEI content was being considered at this stage.

Individuals who selected all the above for identification and selection noted they did so for reasons such as the company's DEI perspective, accessibility, and representation. Those who mentioned the company shared that the "company is very DEI", "global is so important", and "the company prides itself on diversity and equality". Regarding

representation, participants noted that they "do not design for a specific group", that they consider DEI to "promote representation and participation of different groups", and that this is how to "get the best project outcomes". Accessibility was noted by one participant who shared that their company was in the process of improving accessibility in their system design/development. For those participants who selected only diversity and inclusion, they shared that the company chooses to address these because the "company product helps others" and to "prevent users from being hampered by accessibility issues". And for those that selected none it was noted that one company has a "one size fits all" perspective, and for another, "projects are based on business need".

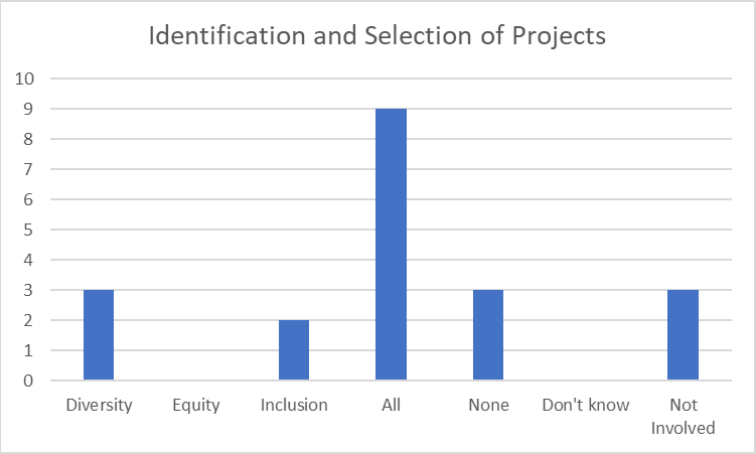

Figure 2. DEI Content Considered in Identification and Selection

In this category, only participants who chose all of the above shared how they try to incorporate these aspects of DEI into the identification and selection of IS projects. One participant noted that "teams are DEI by default due to the company make-up" so extra steps to ensure DEI on teams was not necessary. Other methods for achieving DEI in all aspects of identification and selection of IS projects included the use of "stakeholder/end user surveys" and steering clear of "gender specific terms". Regarding accessibility, companies are focusing "on display configurations and visual impairments" and even adding an "Accessibility Researcher" to the design team.

3.2. Project Planning

Figure 3 breaks down the number of responses regarding DEI content considerations during the project planning stage of the SDLC. Interestingly, of the 13 responses to this question, while three didn't know or aren't involved at this stage, the remaining ten

indicated some consideration with 70% of those ten indicating that all three of the DEI concepts were being considered.

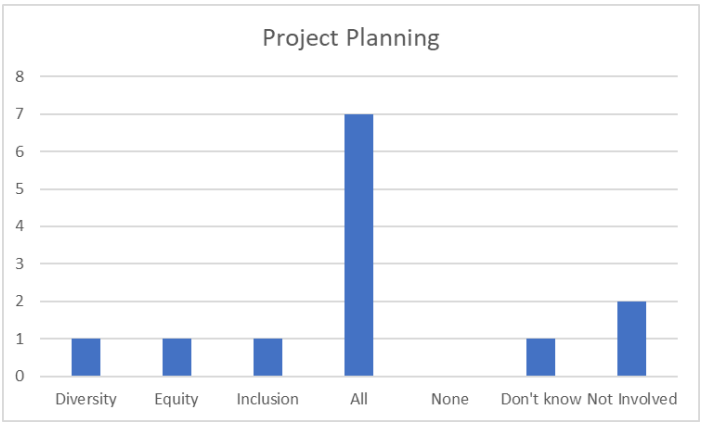

Figure 3. DEI Content Considered in Project Planning

For those who selected all of the above for project planning, the reasons for this choice included the team structure, accessibility, and benefiting the company. Regarding team structure, the why included "team cohesion", and that the company had "employees from around the world". As for company benefits, DEI in project planning was noted as being "important for [the] company to run smoothly and effectively" as well as ensuring that "everyone is heard". Accessibility again was noted as the company's initiative to improve accessibility in system design/development. One participant acknowledged they don't know if DEI is considered in project planning. The reason for this is that the company uses a "global template with deviations based on metrics and supporting material". Those who selected none did so because, from their perspectives, DEI is "not relevant for backend/pipeline projects" and "decision makers are goal oriented, prefer not to talk about DI".

Again, only those who selected all of the above shared how DEI is considered in project planning. Once again, the inclusion of an Accessibility Researcher on the team was noted. One method for including DEI in project planning was for "teams to choose projects from the backlog" thus allowing for the "project [to] develop agnostic to software development teams". Another method was to "align [the project] to company goals". Other participants shared that they relied "on employee experience and backgrounds" while yet another "leverage[s] different knowledge to prevent one-dimensional design".

3.3. Analysis

Figure 4 shows the dispersion of responses for the consideration of DEI content in the analysis of business and project requirements stage of the SDLC. In this stage, no respondents indicated that they only considered diversity. Rather, 53% of respondents indicated that all three concepts of DEI are considered during this stage.

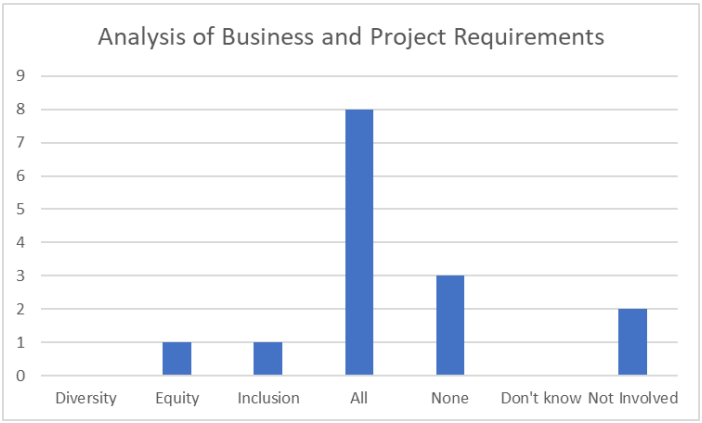

Figure 4. DEI Content Considered in the Analysis of Business and Project Requirements

Participants who selected all of the above for analysis did so for two main reasons: the company, and the end users. Regarding the company one participant noted that DEI is a "company pillar" and thus woven through all business processes while another identified the importance of ensuring that "all voices are heard". As for the end users, participants shared reasons such as the company having a "wide range of clients", the goal to "give the best results to all", and to create systems that are "adoptable by end users". One participant selected diversity, inclusion, and I don't know. Their reasoning for selecting all three of these was:

"I know that my business analysts and product owners are constantly working with end users to ensure they are getting the features they need in our software, but the sample question of "are all end users receiving equitable treatment" made me stop and pause. I'm not sure about that! I am not in a lot of calls where the BA/POs are working with the end users, but I sure hope that they are treating all our users equally!". Another participant selected only equity and said this was considered to ensure "system adoption is easy for all perspective users". None was selected and once again DEI was identified as "not being relevant for backend/pipeline projects".

Participants who selected all of the above shared that DEI in analysis is actualized through "meeting with everyone involved" and "taking feedback recursively". The participant who selected diversity, equity, and I don't know shared that in analysis they "solicit users with different perspectives". Additionally, the respondent who selected equity shared that their teams have "discussion surrounding business versus technical users", make "any request processes as smooth as possible", prepare "ample documentation", and provide "a contact list" all "in the interest of equality".

3.4. Design

Figure 5 shows the spread of responses regarding the consideration of DEI concepts during the design stage. Again, none was not selected and only one individual selected that they are not involved in this stage of the SDLC. This left 90% indicating that some aspects of DEI is considered during design, with 67% of those identifying that all three aspects of DEI are considered.

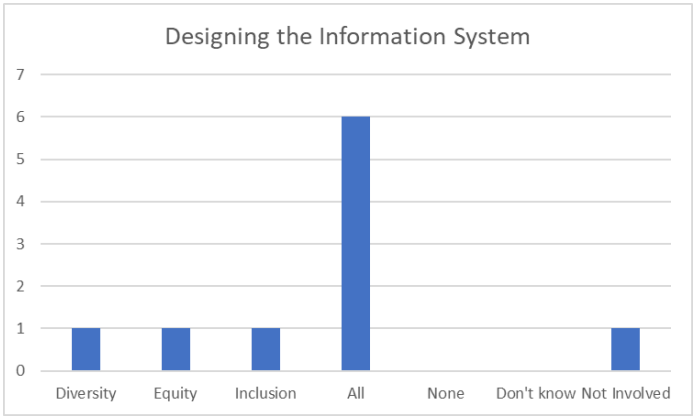

Figure 5. DEI Concepts Considered during Design

Individuals who selected all of the above for DEI in the design phase of the SDLC did so for two reasons: "global products" and "accessibility". Inclusion was selected with regard to trying "our best to make our projects/products accessible". One participant selected diversity but shared: Based on this question, I picked Diversity because I think it's the only one that fits best. The software that my team builds/designs is purpose built for select users, so it's exclusive and not equitable by way of limiting use of the system to only certain people. Again, none was selected and DEI noted as "not relevant for backend/pipeline projects".

Participants who selected "all of the above" for the design phase identified that they consider DEI here through "stakeholder review sessions", as well as considering "region/country nuances", and "color, font, page layout, etc.". The individual who chose diversity shared that they "analyze users and design to accommodate".

3.5. Implementation

The distribution of responses regarding the consideration of DEI concepts in the implementation stage, as shown in Figure 6. Again, the majority of responses indicate that all aspects of DEI are considered. Only 1/3 of the responses indicated that either none are considered, or the respondent didn't know if they were considered.

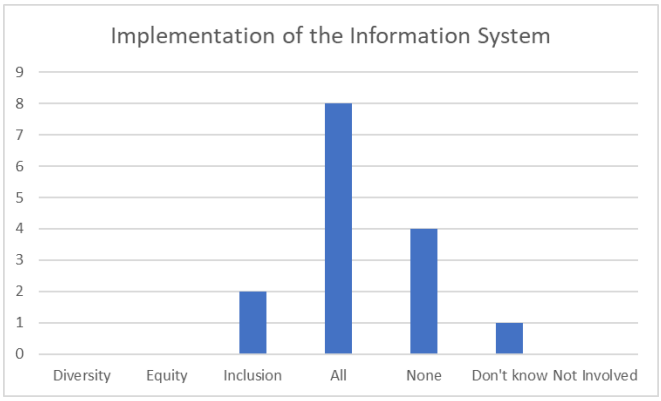

Figure 6. DEI Concepts Considered during Implementation

Respondents who selected all of the above for DEI in the implementation phase shared that they do so for "accessibility" and because "team members are diverse". When inclusion was chosen the respondent noted that nothing is explicitly done when implementing but "there is nothing we do that should hamper anyone's experience around DEI". One participant selected I don't know and shared that "[a]t this point in the project, the scope has been identified and aligned, so [DEI] aren't taken as into consideration in this step as others". None was chosen by two individuals, one who again stated irrelevance to backend/pipeline projects, but another participant shared:

Implementation sees a return to the "my way or the highway" mentality of my team's leadership. Once the system is designed, it becomes the user's problem if they struggle to learn and use the system. As usual, diversity and inclusion do not enter the conversation. Participants who selected all of the above shared that they use "paired

programming", "working sessions", and they "code to the agreed upon design". The individual who shared they do nothing to hamper the DEI experience, also noted that while they don't currently have them, "language translators would aid when language barriers arise".

3.6. Maintenance

Figure 7 displays the results of the final stage of the SDLC and if any DEI concepts are considered in that stage. In this stage, 57% of respondents indicated that all aspects of DEI are considered, followed closely by 43% in which none are considered, or it isn't known.

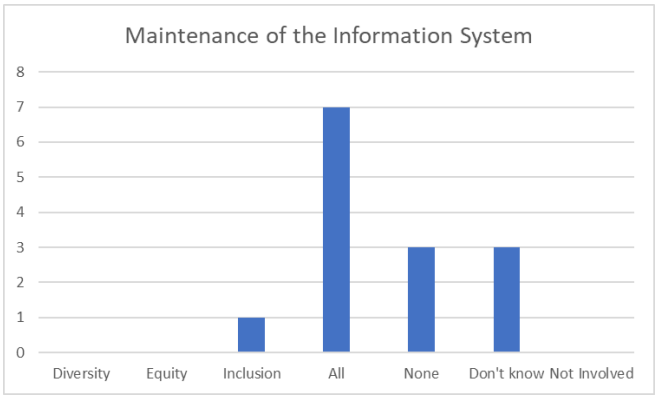

Figure 7. DEI Concepts Considered during Maintenance

One participant who selected all of the above shared that "maintenance and project lifecycle is a big topic of conversation as of late", but that they do "want to be able to support all of our users on new and old systems alike". The only other comment here was once again the lack of relevancy for backend/pipeline projects. Comments here were only from those who chose all of the above and noted that they include DEI in maintenance through a willingness to "fix issues" and "implement new functionality as needed".

Figure 8 shows the percentage of respondents who indicated that all aspects of DEI are considered during each stage of the SDLC. Other than Identification and Selection, at least 50% of respondents indicated that all three concepts of DEI are being considered in each stage of the SDLC when applied in industry to develop information systems. The comments that accompanied choices regarding the consideration of DEI in system design/development stages paint a picture of how organizations are and aren't

incorporating diversity, equity, and inclusion within these types of projects. It is worth noting that respondents indicated that there is limited DEI integration into backend/pipeline projects.

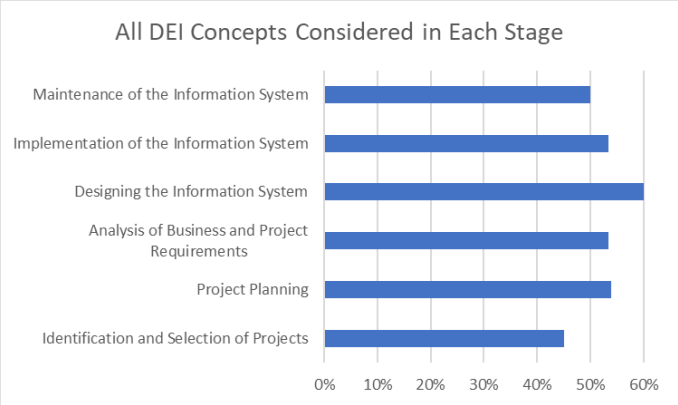

Figure 8. Percentage of Respondents Considering DEI Concepts

3.7. DEI Frameworks for Systems Analysis and Design Education

Equipped with the knowledge that organizations are weaving DEI conversations and initiatives into the process of designing and developing information systems, instructors need to do the same in higher education classrooms. Students can engage in conversations in a low-risk environment, learning to consider DEI content in a safe space where the design/development of a system and/or their job are not at stake. Figure 9 is a visual representation of a summary of the DEI frameworks developed by the researchers. The left-hand side of the visual includes the stages of the SDLC. The boxes on the right indicate the level of analysis for each SDLC stage in which diversity, equity, and inclusion concepts can be considered.

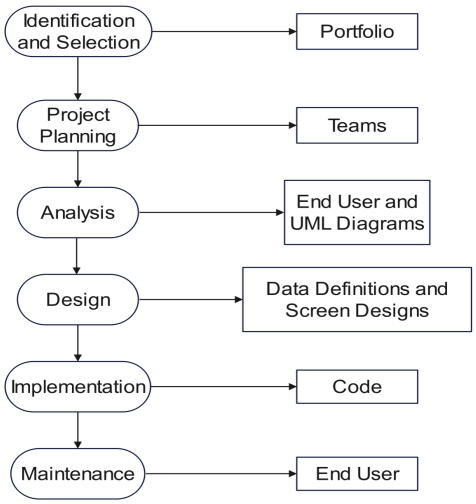

Figure 9. Summary Visual of DEI in SDLC Frameworks

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We have developed a series of frameworks for the inclusion of diversity, equity, and inclusion within the SDLC inclusive of examples of how they are currently considered in industry and how instructors can begin the conversation that bridges the gaps between definitions of DEI, their application in organizations, and the classroom. These frameworks are broken down by DEI topic and SDLC stage.

Table 2 provides examples of how diversity can be integrated into the stages of the SDLC as well as examples of teaching points and/or questions that instructors could use in the classroom. When teaching about diversity within the systems analysis and design process the focus should be on the range of human differences. For example, during design a gender field could include the options of non-binary, queer, choose to self-identify, etc. Another example could be that during maintenance if an individual who identifies as male and an individual who identifies as non-binary both file requests for system enhancements, the decisions around the requests should be made based upon objective criteria, not on the gender of the individuals making the requests. Additionally, whether/when to fix a system bug should not be decided based upon human differences of the individual. Challenging tasks should also not be allocated based on the example gender or race differences. More examples and pointers are included in Table 2.

Table 2. Diversity in System Analysis and Design Education

SDLC Stages	Objective	Example Teaching Points/Questions
Identification & Selection	• Portfolio includes projects that cross the range of human differences.	• Know your stakeholders/end users. • Use stakeholder/end user surveys to identify the range of differences. • Don't make assumptions about your stakeholders/end users. • Avoid gender/race specific projects when possible.
Project Planning	• Team members represent a range of human differences.	• Don't be afraid of team member differences. Include individuals who are non-binary, different races, visually impaired, etc.

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SDLC Stages	Objective	Example Teaching Points/Questions
Analysis	• End users represent a range of human differences. • UML diagrams consider a range of human differences.	• Don't be afraid of end user differences. Consciously design end user groups to include individuals who are non-binary, different races, visually impaired, etc. • UML diagrams documentation takes visual/auditory impairments into consideration. How does a user know how to proceed?
Design	• Data definitions represent a range of human differences. • Screen designs consider a range of human differences.	• Data selection options should include human differences. • Screen design choices consider individuals who are color blind, end user religious value system and/or social class. • How could an Accessibility Researcher inform design?
Implementation	• Code considers a range of human differences.	• What are unconscious biases in computer code? • How do you envision the average user of the system? • Can you picture the system end users as different from yourself or those you know? What do those differences mean for the code?
Maintenance	• Management of bug fixes, updates, and patches considers a range of human differences.	• Requests are handled objectively with no decision made based on a human difference • Bug fix priority is aligned to (a) business need/process, (b) accessibility issue, or (c) software need.

Teaching about equity in the systems analysis and design process should focus on ensuring that people are not disproportionately affected by their differences. Table 3 provides examples of how equity can be incorporated into the stages of the SDLC as well as examples of teaching points and/or questions that instructors could use in the classroom. For example, during project planning, the project manager can ensure that

individuals who have differing religious holidays are not disproportionately affected by the project timeline. Also, during design the employment of an accessibility researcher can aid in ensuring that ability to use the system is equitable for all. Also, the idea that during implementation coding to the agreed upon design assumes that DEI considerations were addressed in the design phase of the project. Table 3 contains more examples and pointers that instructors can consider when teaching about equity within the systems analysis and design process.

Table 3. Equity in System Analysis and Design Education

SDLC Stages	Objective	Example Teaching Points/Questions
Identification & Selection	• A portfolio includes projects that do not disproportionately affect individuals due to their differences.	• Choose projects that help others. • Choose projects that address accessibility issues caused by other projects in the market.
Project Planning	• Team members are not disproportionately affected by their differences in any aspect of the project plan.	• Team members are selected based on skill/fit to the project. • The project timeline does not affect any team members disproportionately due to their differences. • Feasibility of the project is determined based on objective criteria, not team member differences.
Analysis	• End users are not disproportionately affected by their differences in any aspect of requirements gathering. • UML diagrams do not affect individuals disproportionately based on their differences.	• Solicit users with different perspectives. • Make the request process smooth and unbiased. • Prepare thorough documentation for review before proceeding to design.

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SDLC Stages	Objective	Example Teaching Points/Questions
Design	• Data definitions do not affect individuals disproportionately based on their differences. • Screen designs do not affect individuals disproportionately based on their differences.	• Analyze end users and design to accommodate. How might an accessibility researcher benefit from the project at this stage? • Conduct review sessions with stakeholders. • Analyze region/country nuances, language, cultural specifics. • Analyze choices of color, font, page layout, etc.
Implementation	• Code does not disproportionately affect users because of their differences.	• Implement paired programming and working sessions. • Code to the agreed upon design. • Employing language translators.
Maintenance	• End users are not disproportionately affected by the management of bug fixes, updates, and patches.	• Make the request process smooth and unbiased. • Ensure the request process can be accessed by all individuals regardless of visual, auditory or other abilities. • Ensure changes made by bug fixes, updates, or patches do not negatively impact accessibility features.

Inclusion, as taught within the systems analysis and design process, should focus on empowering users to be involved in using the system. It should also consider the worth and dignity of end users. Table 4 provides examples of how inclusion can be fitted into the stages of the SDLC as well as examples of teaching points and/or questions that instructors could use in the classroom. Valuing the worth and dignity of individuals is most strongly done in conversation. However, the design and development of information systems offer a unique opportunity to weave conversation into the systems being used by individuals both inside business and in society. For example, when designing screens, it is important to ensure that using those screens would not exclude digital immigrants

or cause them to feel inferior or insecure. Before designing the screens, it is important to allow end users to share their ideas. When doing so, weaving in inclusion is making sure that those end users feel that their worth and dignity is recognized and valued through genuine consideration of those ideas. Table 4 contains more examples and pointers that instructors can consider when teaching about inclusion within the systems analysis and design process.

Table 4. Inclusion in System Analysis and Design Education

SDLC Stages	Objective	Example Teaching Points/Questions
Identification & Selection	• Portfolio includes projects that empower individuals, preserving the worth and dignity of users.	• Do projects align with business processes and empower employees to be successful in their line of work? • Do projects empower customers/clients to be successful and/or engage with the company? • Does the empowerment created by the project leave end users feeling worthwhile and dignified?
Project Planning	• Team members are involved and empowered, their worth and dignity recognized.	• Are members of the team encouraged to be involved? • Are team members empowered to share ideas to enhance the project? • Are team members made to feel worthwhile and dignified after sharing their ideas?
Analysis	• End users are involved and empowered. • The worth and dignity of end users are recognized. • UML diagrams consider the worth and dignity of end users.	• Identify and understand business versus technical users. • Are end users encouraged to share ideas and feedback to enhance the project? • Are end users made to feel worthwhile and dignified after sharing their ideas? • Do the UML diagrams encapsulate how end users will successfully

SDLC Stages	Objective	Example Teaching Points/Questions
		complete steps so they maintain their worth and dignity?
Design	• Data definitions recognize the worth and dignity of individuals. • Screen designs encourage involvement and empowerment of end users. • Screen designs recognize the worth and dignity of end users.	• Does the wording of data input choices communicate worth and dignity? • Are the screen designs welcoming to empower end user involvement? • Do the screen designs communicate support of end users worth and dignity?
Implementation	• Code encourages involvement and empowers end users. • Code recognizes the worth and dignity of the end users.	• Code is written in a way that empowers end users to be involved in the process supported by the system. • Code is written to allow end users to move through the system easily, supporting their worth and dignity in use.
Maintenance	• End users are involved and empowered to aid solutions to bug fixes, updates, and patches. • End users' worth and dignity are recognized in bug fixes, updates, and patches.	• All end users receive communication regarding the process to submit requests for bug fixes, updates, and patches. • Responses to requests for bug fixes, updates, and patches express recognition of end users' worth and dignity.

Through purposeful and thoughtful consideration of diversity, equity, and inclusion topics instructors could expand students' understanding of how these topics can be a part of system design and development rather than only thinking about how the use of the systems impact DEI. Students can learn about their unconscious biases and adjust their vision before they are in the workforce working on designing and developing systems. They have the chance to learn how the design and development of a system can impact the end users and stakeholders before the system is even coded. Taking time to weave

DEI topics throughout the systems analysis and design course can give students a foundation of understanding that they can carry over into their careers as opposed to learning about them after they enter the industry.

3.8. Discussion

Most organizations use system design methodology when designing and developing information systems. Likewise, most information system educational programs teach system analysis and design. The pervasiveness of information systems across businesses and society has revealed how these systems can impact diversity, equity, and inclusion. As businesses have begun to take these impacts into consideration in their design and development, the information systems curriculum has yet to catch up with business actions. As such, this study presents a potential framework for weaving the concepts of diversity, equity, and inclusion into the teaching of the system analysis and design process. The framework is informed by industry, through the themes that emerged from the qualitative responses. Therefore, its relevancy to current practices is strong. Thus, this work could have implications for both education and practitioners. As the limited DEI integration into backend/pipeline projects could lead to development of IS solutions which are biased and exclude other demographics with different backgrounds and cultures. Furthermore, exacerbate inequality and resistance in the adoption and the use of such solutions. Identifying that other organizations have already integrated DEI shows that there are developments, and with support of this DEI framework other organizations can be empowered to adopt the same approach.

When embedding DEI topics into systems analysis and design curriculum, instructors should engage in conversation with students about being mindful of how the system being designed fits into the culture in which it will be deployed. This holds true whether the culture is organizational or societal. It is important for students to consider the potential global impact when a system is being designed rather than waiting until after it has been released for use.

The overarching purpose of the framework is for instructors to have a mechanism for integrating diversity, equity, and inclusion in all stages of system design and development as part of their curriculum. It provides guidance for instructors to start conversations with students about intentionality in system design. For example, simplifying IT language

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and reducing jargon can improve knowledge, social, and values diversity [9]. Another example is that ensuring your end user testers are from a variety of socioeconomic backgrounds can aid in raising the level of equity of the system. Empowering team members to share their design ideas and acknowledge those ideas as worthwhile may aid in the inclusion factor during design.

Ultimately, utilizing the framework in the classroom requires instructors to engage with students about topics that they may not initially feel comfortable discussing. Conversations about diversity, equity, and inclusion can be difficult and uncomfortable. However, the success of a designed information system could be improved if these aspects are considered. During each stage of the process, students need to remember that individuals are designing the system for other individuals with different backgrounds. Additionally, not only should instructors impart knowledge to students using the framework, but they should also encourage students to share their experiences in information systems, keeping diversity, equity, and inclusion in mind. Students may have experience with these topics that can inform the design of systems. Therefore, instructors should use the recommendations to initiate and support conversations about these topics. Furthermore, instructors should collaborate with industry to understand DEI requirements to include in the curriculum to bridge this gap.

As practitioners work to address DEI topics during information system design and development, the chances of their initiatives being successful could be improved through the hiring of individuals who understand how to engage in conversations about the topics. New employees who have practice in discussing difficult topics like diversity, equity, and inclusion bring added value to information system design teams. Information technology professionals are trained to discuss technology but often not directly trained to discuss soft and fuzzy topics like diversity, equity, and inclusion. Those types of topics are generally outside of a tech professional's comfort zone. Purposefully employing information technology professionals who are capable of successfully engaging in discussions around DEI topics can elevate a company's information system designs.

Additionally, companies could adopt the framework to train current employees tasked with information system design projects as the framework unpacks the topics for all three DEI aspects, The framework could further aid design and development teams to

address each topic individually. This provides a built-in flexibility to allow design teams to align the framework with the business initiatives. If the company is focusing on inclusion, for example, the design team could document how their process aligns with that initiative through the use of the DEI framework for inclusion in system design. This is influencing practice in information system design projects and policy makers may also make use of the framework to guide policy development or adjustments towards integrating DEI in the organization.

The first limitation of this study is the focus on the SDLC. Agile development methodologies have become common place in some organizations. Although the SDLC provides the foundation for agile methods, the stages are executed differently. As such, future research could delve into what and how agile development are integrating DEI initiatives. Questions would differ from those in the SDLC. For example, if the project sponsor drives the user stories, how much control does the team have over those DEI initiatives at that stage of the project? Future research could broaden the framework to include an agile perspective.

The second limitation of this research rests in the anonymity of the respondents. Due to the direct contact nature of the survey, we opted not to collect demographic data as the participants could be easily identified. Therefore, future research could survey a broader audience which could allow data about the demographic to be collected, and more insights could be uncovered to justify the results. Demographics such as industry, organization size, type of dev shop (SDLC, Agile, both), as well as age and race of respondent could provide additional insight into the DEI in system development phenomenon. Comparisons could be made across those demographics that might lead to changes in DEI initiatives.

Additionally, the results from this study indicate the need to include this type of content in SA & D curriculum. As such, we hope to work with authors of these textbooks. We would like to include mini-cases in each chapter focused on different stages of the SDLC and larger cases in an Appendix of the textbooks. The inclusion in textbooks would support the initiative to broaden the knowledge of information systems students who will go into careers in which they are part of information system design teams.

4. CONCLUSION

In this study we opted to query organizations to see if and how they were incorporating the concepts of diversity, equity, and inclusion into the design and development of information systems. The survey administered yielded informative results which was then used to develop the DEI framework for systems analysis and design education. The framework realizes four purposes: (1) it gives specificity tit prepares frameworks like Value Sensitive Design [14] and Inclusive Engineering [8], (2) it can be used within one system analysis and design course or across courses in an IS program for continuity of learning, (3) it prepares students for DEI design conversations and initiatives in the workplaces, and (4) is may be used as a guide for organizations with the intention to include DEI content into their system design and development projects. While students recognize potential biases in and around technology and information systems, they struggle to understand who is responsible for the risks and vulnerabilities created by those biases as well as what to do about them [35]. The DEI framework presented by this study can aid in helping students mitigate those risks and vulnerabilities by learning to address them during the systems analysis and design process. Additionally, the flexibility of the framework allows DEI in system analysis and design curriculum, Moreso, businesses may adapt it to teach employees on how to consider diversity, equity, and inclusion when designing and developing information systems. This study also suggests that collaboration between instructors and industry is paramount to ensure DEI integration into IS curriculum and IS innovations are aligned with the requirements to bridge the gaps and cater for the needs of society.

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