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Curriculum Design: Using the Five Discourses of Design Thinking

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Abstract

Unlike in the past, curriculum is currently dynamic and demands continuous improvisations at different levels such as classroom, teacher expertise, and standards within a curriculum, among others. The dynamism in education is due to various factors including students' changing requirements, industry's changing requirements, changes in the needs of the society, etc. There is a need to better understand which factors must be strategically considered when designing a curriculum such that the curriculum meets the needs of all the stakeholders. This study investigates how elements of design thinking can be integrated into a curriculum to provide appropriate skills that support interdisciplinary and integrative efforts to meet the needs of the 21st century. The 'five discourses of design thinking' model was used as a framework to guide this study. Components of the five discourses of design thinking model include artifacts, processes, experiences, systems, and cultures.

Qualitative research method was used to understand the approaches used to incorporate the five discourses of design thinking when designing a new curriculum or improvising an existing one. To understand from the experiences of individuals with expertise in curriculum design and to get more insights on the research question, 'How can the elements of design thinking be integrated into the curriculum to provide appropriate skills that support interdisciplinary and integrative efforts to meet the needs of 21st-century life?', three semi-structured interviews were conducted using an online platform. Each interview lasted between 45 to 60 minutes. The interviews were recorded, transcribed, and coded and used in the analysis. The deductive coding approach was used in the qualitative analysis and themes developed were 1) integration of education and design, 2) five discourses, and 3) advice for novices. In addition to the interview, two sample case studies focusing on curriculum design from the literature was examined to understand how well they map to the five discourses of design thinking. Studies were selected if they discussed curriculum design or evaluated the application of a new curriculum design. Two studies were selected, and key components related to curriculum design or utilization was analyzed. The beliefs and opinions of participants on integrating the discourses of design thinking in curriculum design are presented along with findings from the comparative case studies. Limitations and future research directions are proposed.

Keywords: curriculum, design, design thinking, discourses

Introduction

Curriculum is defined as a plan which is intended to provide the learning experiences to individuals in an educational setting [1]. It is the most important part of an education system irrespective of the type of education. Although it is critical, curriculum is often criticized for not providing all the

required learning experiences as it is intended to. Curriculum development is a process used to develop and implement the curriculum plan and evaluating it against the set standards [2]. Curriculum planning deals with making choices at different stages in the development process, and planning choices are strongly influenced by the value system(s) of the designers [1]. Curriculum design and development is one of the most stressful aspects of an education system because of differences in opinions of different people involved in designing a curriculum [2]. For a given curriculum to be effective, the designers should understand 1) the students' background and/or current knowledge levels, and 2) the location of the students' institution and availability of resources to impart the knowledge that would make learning feasible [1].

Curriculum design has always been a topic of interest in the research field and a lot of attention has been given in designing rich and meaningful curriculum. When designing a curriculum, different requirements exist, for example as per the accreditation board of engineering and technology (ABET), the different engineering program outcomes include applying knowledge of mathematics, science and engineering, designing and conduct experiments, designing a system, components to meet realistic needs, functioning in a multidisciplinary team, formulating and solving engineering problems, communicating effectively, etc. [3]. Various researchers have made attempts to incorporate these requirements in their courses independently. For example, various research studies exist on related topics such as problem solving [4-8], course or laboratory projects [9-13], technology in classroom [14-17], teamwork [18-21], experiential learning [22-25], design skills [26-28], etc.

Background

Published literature in the past [1-4] presents details about curriculum design, with most of the ideas centered on incorporating existing curriculum models in designing new curriculum. In [2], the author describes three important models of curriculum development: Taba's instructional strategies model, Weinstein and Fantini's humanistic model, and Eisner's systemic-aesthetic model. The author claims that these three models are nonlinear, descriptive, and inductive in nature. Out of these three models, Taba's instructional strategies model is relatively more theoretical than the other two models. As these models are inductive, curriculum development begins with curriculum materials leading towards a more general plan. The curriculum developers can intervene in the process of curriculum development at any point and make required changes as these models are nonlinear in nature. The descriptive nature of these models provides a platform to use the designer's principles/beliefs in developing the curriculum, and during the process of decision making this leads to deliberation which eventually results in curriculum design. On comparing the three models of curriculum design, we found that the Weinstein and Fantini's Humanistic model only concentrates on the learners' needs and interests. However, Taba's Instructional Strategies model and the Eisner's systemic-aesthetic model focus on all aspects that may affect the teaching and learning process. Taba's Instructional Strategies model and the Eisner's systemic-aesthetic models are more

balanced and integrated. They reflect on different dimensions that influence and shape the methodology followed to design a curriculum.

The Queen's University Centre for Teaching and Learning (CTL) has a handbook [29] that layouts a framework to helps its departments enhance the students' learning experience through curriculum. Kolomitro (2017) claims that curriculum is not static, but rather an ongoing conversation. Thus, a multi-step and cyclical process is followed to design an effective curriculum. Furthermore, some principles are considered when following the curriculum redesign process. Collaboration among instructors, evidence-based analysis, focus on student learning, program-level perspective, and continuous improvement are what shape this process. The main framework includes four stages: (1) Set Goals - Making a Plan to Review Your Curriculum (2) Develop or Validate Program Outcomes (3) Gather Evidence (that those outcomes are effectively being taught and addressed) (4) Revise and Reassess. The framework discussed by Kolomitro (2017) makes sense as curriculum design process should always be cyclical and recurrent because of the changing factors of the profession requirements. Therefore, there must be a direct connection between academia and industry to fill any gap that may cause a negative impact on the process of teaching and learning. Through academic research and experimentation that are built on the profession needs, there will be generations who are able to conquer any challenges of humanity in the future.

Let us consider some case studies that outlines or highlights key features and ideas that relevant and should be considered when designing an engineering curriculum to meet the 21st century. In the case study by Garvey & Foley [30], it is emphasized that a curriculum should be more inclusive, not exclusive, because every person in this world deserves a chance to participate in developing and sustaining the future of humanity. Problems cannot be solved from one scenario or angle. We will always need other eyes to explore other ways of solving challenges. The most important qualities of having an inclusive curriculum are to consider flexibility and clarity when designing or developing the curriculum.

Another article [31] talks about a case study of redesigning the engineering curriculum of the school of electrical and electronic engineering at the University of Adelaide. The main goal of this design was to refresh the technical content of the program and ensure that learning outcomes are aligned to Engineers Australia Stage 1 Competency standards, the evolving needs of employers, and research education outcomes. The need to transform from the entrenched content-based approach to a pervasive outcomes-oriented approach has influenced the working group to utilize a structured top-down design approach. Moreover, this process has to assure meeting the system flow where the learning purposes at the degree level (program learning outcomes) are accomplished by the incorporated and aligned interactions of the learning purposes at the course level (course learning outcomes), developed through the learning activities and emphasized through the assessments. Therefore, the design team applied the renowned system engineering 'V diagram' that includes the decomposition and definition stage, and the integration and verification stage. The first phase

focused on the program learning outcomes and technical skills profile that created different themes and which were translated into courses. The second stage was about implementing the design gradually and testing the results by different factors. Two main elements were considered when assessing the new curriculum: the design of the full system, and the outcomes of individual courses. Curriculum outcomes should drive what kind of content to be considered in the teaching and learning process. The outcomes-oriented approach focuses on the real-world demands to prepare students and provide them with the right knowledge and skills. Further, this approach can follow a top-down structure when building a curriculum, starting with the system, and ending with components. However, following the opposite direction may be easier when applying evaluation and assessment.

Finally, in the article [32], the authors discuss the design of a course titled 'Design Engineering' which follows a 'Design Thinking' framework. Design Engineering (DE) deals with asking the right questions rather than just finding solutions. This course aims at sensitizing design driven innovations. The course is designed with an aim to help students develop their skills and thinking process which would be helpful when working on projects. Moreover, it is studied by different engineering disciplines students from third to sixth semester. To meet the course goals and discover creative ideas, students are encouraged to communicate directly with society and the outdoor environment. The DE curriculum has six phases; empathize, define, ideate, prototype, test and implement. The authors present a case study of a sample project discussing this new curriculum. The interdisciplinary curriculum enables students to develop a deep understanding about the complex real-world problems and that they demand creative solutions through integrative methodologies. In addition, the culture of this curriculum builds hidden skills to help students function as teams from various backgrounds. It is obvious that the more we communicate the more we succeed and overcome future obstacles.

In this paper, we build on existing literature by examining curriculum design through the lens of a design model called the "Five Discourses of Design" [33]. Scragg et. al., [33], argue that traditional design in education focuses only on the artifact designed, or designed scenario or experience or process. It glaringly misses the perspectives of cultures and systems of education which if included will provide more meaning/impact to the design approaches in education. Design in education plays significant roles at different levels and each level has its own discourse. With this as the background, Scragg et. al., [33] propose the five discourses of design and the details of the same are presented in table 1. This study makes use of the five discourses model to explore design practices of curriculum designers to find the elements of design thinking that underlie their work. The study explores the following:

1. The curriculum design practices and approaches used by the research participants.
2. Analyzing if the ideas/approaches of the participants match to the five discourses of design framework.

Table 1. Five discourses of Design [33]

#	Discourses of Design	Examples in Education
1	Artifacts	Curricular materials, tools, websites, software, interactive presentations, and videos
2	Processes	Lesson plans, curricular, learner support, instructional design
3	Experiences	Sequencing, spaces, celebrations, events, learning communities
4	Systems	School schedules, school transformation, teacher/student evaluation systems, community partnership
5	Cultures	Perception of the school, of public education, openness vs. closed mentality, values/ways of being, community engagement, policy

To investigate the first point above, we explore design literature to understand aspects of traditional curriculum design and the challenges associated with it. To explore the second point, the five discourses of design framework is used as a guide for (re)designing curriculum to satisfy the requirements of 21st century life, while being grounded in the literature. A qualitative approach is used to answer the question that aims at understanding how the elements of design thinking can be integrated in the curriculum. In addition, two sample case studies [34-35] focusing on curriculum design from the literature have been examined to understand how well they map to the five discourses of design thinking.

Methods

We used a qualitative research method to explore and understand how experts incorporate the five discourses of design thinking when designing a new curriculum or improvising an existing one. First, we conducted an interview with three individuals who have specific expertise in curriculum design. Individuals were recruited from a large public southwestern university in the United States. Individuals were identified through searching the university's database or by referral from other experts. Detail of the study were sent to the identified individuals through email and suitable time was set for the interview. Prior to the interview, a questionnaire focusing on each of the five discourses of design thinking was designed and evaluated by the research team (appendix). The resulting materials were used in the interview that lasted between 45 to 60 minutes on an online platform (Zoom). The interviews were recorded, transcribed, and coded. The resulting code was used in the analysis. A deductive approach was used, and the themes developed were the integration of education and design, five discourses, and advice for novices. The beliefs and opinions of participants on integrating the discourses of design thinking in curriculum design were presented. Secondly, a comparative case study was conducted to explore frameworks and techniques used by previous studies to design a curriculum. Studies were selected if they discussed curriculum design or evaluated the application of a new curriculum design. Two studies were selected, and key component related to curriculum design or utilization was analyzed.

Participants

The research participants selected for the interview are faculty members from a higher institution who have expertise in curriculum design at different stages in their career. Three participants were recruited. Table 2 presents the demographic information of the recruited participants. Participants in the comparative case studies were students and teachers.

Table 2. Demographic information of the participants

Category	**Participant 1**	**Participant 2**	**Participant 3**
Gender	Female	Male	Female
Qualification	PhD	PhD	PhD

Procedures

The interviewees were chosen based on their wide experience in curriculum design and associated projects. The recruitment of these participants was done by email. During the process of taking consent, the participants were informed about this research study in detail. The participants had the option of choosing to be a part or not to be a part of this study. To understand from the experiences of the research participants and to get more details on the research question 'How can the elements of design thinking be integrated in curriculum to provide appropriate skills that support interdisciplinary and integrative efforts to meet the needs of 21st century life?', three semi-structured interviews were conducted. The data collected from the interviews focuses mainly on the perceptions of the usage of the Five Discourses of Design. The data also provides information about how each of the research participants defines education by design, whether education and design are integrated, and what is design thinking. The questions used in the interview are included in the appendix. In addition, two sample case studies focusing on curriculum design from the literature were examined to understand how well they map to the five discourses of design thinking.

Qualitative Analysis

The transcribed interviews were read in detail to ensure no data went missing. The project involves three graduate students working in a team to accomplish a common task of investigating the presence or absence of elements in the five discourses of design model in the curriculum design practices described by the three interviewees. Deducting coding was used to code the interview transcripts. Deductive coding is a form of a qualitative coding method used to analyze the qualitative data. In deductive coding, codes/themes are predefined and assigned to the qualitative data under review. The codes/themes usually come from previous research or based on the goal of the research under study [36]. The five discourses of design were considered as the major themes in this study (artifacts, processes, experiences, systems, and cultures). Each student analyzed one interview and reported the examples listed by the interviewee based on five discourses of design. The other two students reviewed the analysis and based on the feedback; the analysis was accordingly revised. The same process was followed in analyzing all the three interviews, with one student taking the lead for one interview and two other students serving as reviewers. The analysis

also summarized how the interviewees define education by design, how important it is to integrate education and design, and what in their opinion is design thinking. The analysis ends by summarizing the recommendations for novice curriculum designers to shape their work in ways that may yield fruitful results. The same process was used for the two studies selected in the comparative case studies. Two members of the team individually read and summarized the two studies. The summaries were reviewed by the third member. In a team meeting, the summaries were reviewed, and disagreements were addressed accordingly.

Results

Findings of the study are broken down into two sections. Responses of participants in the interviews related to the five discourses of design thinking are presented in first section and the results of the case studies on curriculum design are represented in the second section. Like the first section, the results of the comparative case studies were categorized into the five discourses of education design.

Interviews

In this section, five main questions reflecting the five discourses of design are listed including how participants reacted based on their experiences in curriculum design. These responses will be later compared with the results from the two case studies chosen for this research [34-35].

What are the different artifacts that are required in successfully designing a curriculum?
When asked to give examples of artifacts that are required in successfully designing a curriculum, participants provided a variety of examples (Table 3). Participant 1 reported that faculty interaction, syllabus, pedagogy and projects, student portfolios, among others are instruments needed to successfully design a curriculum. Participant 2 responded that Google docs and emails are important tools used in curriculum design. Some of the artifacts reported by participant 3 were knowledge about the field through literature reviews, field notes from interviews with key stakeholders, etc. Common tools reported by all participants were artifacts that promote collaboration between the design team and the end users. While some participants refer to the traditional face-to-face artifacts used for interacting with and collecting inputs from key stakeholders regarding curriculum design, others refer to modern artifacts like Google docs and emails that can be used asynchronously.

What process do you follow in designing a curriculum?
Participants also provided a variety of responses when asked to share examples of some of the processes they follow when coming up with solutions to designing a curriculum (Table 3). Participant 1 reported using a framework called IDEO, which focused on a user-centered design. Other processes reported by this participant were active learning, seeking feedback from different stakeholders, and using a learning-by-doing approach. Starting with a bigger picture and then narrowing it down to the target population was one process reported by participant 2. Participant 3

reported using a backward design process, where the designer starts with goals and moves backwards towards literature, then seeks feedback from key stakeholders, and incorporates experiences from the learning process. All participants agreed that curriculum design must be based on a framework and should incorporate feedback from stakeholders. Knowing the end users of a curriculum is very key and it helps direct which key stakeholders to engage during development. This point was stressed by all participants in the interview.

Table 3. Summary of opinions on five discourses of the three research participants

#	Discourses	Participant 1	Participant 2	Participant 3
1	Artifacts	Faculty interaction, syllabus, conversations related to course goals, pedagogy and projects, project reports, student portfolios and physical products	Tools like Google Docs or emails	Literature related to the field, field notes, interviews, anecdotal feedback, lesson and unit plans, motivation plan, growth plan, reflection plan
2	Processes	Design process, feedback from different stakeholders, IDEO framework focused on the user centered design process, active learning and Kolb's experiential learning models (learning-by-doing)	Broad picture to getting big ideas to narrowing down to class sessions,	Starting with goals and moving towards literature, stakeholders' feedback, learnings in this process
3	Experiences	Adequate infrastructure, different environments, and dynamic classrooms, engaging learners in the idea generation and discussions, assigning different roles to members in a team and rotating the roles	Classroom infrastructure focusing dynamic setting	Classroom environment, peer support learning, integration of students' interest in curriculum, peer learning for teachers
4	Systems	Navigating through the hierarchy in academia, goals play a major role in assessment, the assessment pattern, and the data to be collected, solid plan of assessment.	Institutional policies, assessment tied with goals	Different policy levels, stakeholder's involvement, evaluation of the design
5	Cultures	Opinions of the different stakeholders (such as students, teachers, society, industry, etc.)	Involvement of stakeholders (students and teachers)	Involvement of stakeholders

Comparative Case Studies

This section will highlight two case studies [34][35], exploring the five main questions used in the previous interviews to compare their results with the current research. The first case study [34] aims to design and implement an experimental approach that is based on the principle of efficient and

independent learning. However, the second case study [35] provides recommendations on designing curriculum for gifted students.

What are the different artifacts that were used in designing the curriculum in the case study?
The first case study [34] used observation, survey-based questionnaires, and focus-group tests to evaluate the learning experiences of the subjects, while the second case study [35] used Google suits and Zoom to collaborate with key stakeholders that are involved in the design (Table 4).

Table 4: Summary of results of the comparative case studies related to the five discourses design [34][35]

#	**Discourses**	**Case study 1** [34]	**Case study 2** [35]
1	Artifacts	Observation, survey-based questionnaires, focus group test, classroom environment, etc,	Zoom, Google suits
2	Processes	Effective learning that promotes critical thinking and cognitive and metacognitive skills	Backward design. Design process changes based on a) environment, b) stakeholders, c) the goal of the design, etc.
3	Experiences	Organization of the learning environment to promote independent and self-directed learning, conducting focus groups to debate on key issues related to school and teachers' role and mission, etc.	Classroom organization is very important to give students the appropriate experiences. However, classroom organization is based on resources availability.
4	Systems	Early design of the study. Overall, less navigation of hierarchical structure of academic leadership since the design and implementation of the curriculum was initiated by the school.	Navigation of political hierarchy is an issue. Having a well-defined standard for assessing the quality of the design is very important. Some parameters that are used in assessing the quality of the design are a) clarity of content, b) alignment of content, c) accuracy of content, d) understandability of content, etc.
5	Cultures	Very few stakeholders were involved in the design and assessment of the curriculum.	Involvement of diverse stakeholders is important, especially during a critical point in the project where key decisions are made.

What process was used in designing the curriculum in the case study?
In the first case study [34], the design team used "Effective Learning" as a framework for designing the curriculum. Effective learning was defined as a learning that is active, is focused on purpose, and that leads to measurable results [34]. Critical thinking was one instrument of effective learning, which was defined as an "instrument which helps a student to guide himself or herself in the world of possible alternatives and to be aware of the mechanisms of his/her own thinking" [34]. Another component of effective learning is metacognition, which was defined as knowledge about

knowledge and it includes knowledge about one's cognitive resources such as one's own type of thinking, one's qualities of memory, the adjustment of knowledge, etc. [34]. The second case study [35] indicated that their design process changes based on a) environment, b) stakeholders, c) the goal of the design, etc. The preferred framework for use in the second case study was a backward design process.

How important was it to integrate the classroom environment into curriculum design in the case study?

Integrating the classroom environment was very essential in designing the curriculum (Table 4). The curriculum in the first case study [34] was designed and evaluated in two stages. The first stage was the organization of the learning environment. The design team wanted to create an environment that provides opportunities for independent and self-directed learning. The team believed that the development of cognitive and metacognitive behavior is carried out gradually, through better monitoring of student involvement in the learning act. The second stage was the direct familiarization of learners with the training of cognitive and metacognitive skills involved in independent learning. The team believed that metacognition can be taught and learned and should be the subject of an explicit and intentional learning and not that of an incidental, implicit learning. Hence, the researchers directly introduced cognitive and metacognitive skills in the study [34]. Classroom organization was also reported in the second case study [35] as an important element to give students the appropriate experiences. Availability of resources was also highlighted from the second case study [35].

How did the study team navigate through the different levels of policy when designing the curriculum?

The school authorized the design of the curriculum in the first case study [34], hence, navigating through the hierarchical structure of leadership in the school was not necessary. However, the design team had a very clear hypothesis and a well-detailed research plan. The team knew what data they needed (which guided the design of their survey and focus group questionnaires), the type of data they needed for evaluating each of their hypotheses, and the environment that would enable them to easily get this data. Navigation of political hierarchies was reported as an issue in curriculum design in the second case study [35]. Developing a well-defined standard for assessing the quality of design was also reported in the second case study [35] as being very important in successfully designing a curriculum. Some parameters that are used in assessing the quality of the design, according to the second case study [35] were a) clarity of content, b) alignment of content, c) accuracy of content, d) understandability of content, etc. (Table 4).

How important was it to involve the opinion of different stakeholders when designing the curriculum?

The curriculum in the study [34] was designed and evaluated using a specific group of students who were learning to become teachers. Navigating through cultural barriers was not necessary as the

curriculum was developed purposely for training future teachers. Involvement of stakeholders in curriculum design was reported as being very important, especially during a critical point in the project where key decisions are made [35] (Table 4).

Results of the interview and comparative case studies revealed the variety of techniques used when designing a curriculum. Overall, frameworks and iterative and non-linear processes were outlined as key to designing a productive and more efficiency curriculum. In the interview, the three experts reported common elements that are important in curriculum design, and they all agreed that the five discourses of designing thinking are essential. In the two comparative case studies, common elements were used in the development and evaluation of curriculum.

Summary

The initial objective of the research was to investigate the five discourses of design within the literature by identifying artifacts, processes, experiences, systems, and cultures in two case studies [34; 35]. Accordingly, in-depth qualitative interviews were conducted with expert faculty members in curriculum design to compare results related to using the five design discourses during their work. It can be noticed that the importance of tools represents the artifacts focused on while thinking about designing curriculum. However, some educational designers may consider plans as artifacts to build their next steps in this formation. Another observation is that the presence of processes is commonly reflected by the particular process or framework followed to shape the pedagogy. Environment plays an essential role in the discourse of experience, which requires the readiness of infrastructure and the availability of resources to promote engagement through all stakeholders of curriculum design. Although most designers observed in this study see the hierarchical structure can cause some complications, having defined goals and stakeholders' involvement is crucial for the design discourse of systems. Finally, the cultures of curriculum design mostly insist on engaging and welcoming all stakeholders to participate for better outcomes.

The present study was designed to determine the effect of the five discourses of design model on curriculum development by investigating how educational experts perceive the role of this model through their work and experiences. Previous studies show that curriculum developers think about several models to help design study plans. The current study's findings are consistent with those of other studies that curriculum design needs to be dynamic [2][29]. However, some of the mentioned curriculum development models lack involving various levels that may influence the process of designing curriculum. Thus, Curriculum development based on the five discourses of design seems to be more inclusive, which focuses on all different aspects that influence this process. This finding agrees with what Garvey & Foley promote to involve all participants during this process [30]. As mentioned in the literature that the model of the five discourses of design highlights the role of cultures and systems in education impact the design approaches to better outcomes [33]. What is surprising is that the educational experts interviewed in this study perceive systems and cultures

that play a significant role in the model of the five discourses of design in a similar way. This observation indicates that pedagogical designers understand the importance of systems and cultures during curriculum design. However, the model examined in this study encourages these designers to become fully aware of these levels while engaged in the process.

Limitations and Future Research

This work has some limitations and there is a scope for potential directions for future research in this area. Although participants interviewed in this study have different expertise in curriculum design, occupied different roles in education and are from different departments, they are all from the same university. This might, to an extent, introduce bias in the analysis because the process followed for similar activities is not much different in a single setting. A future research area could be to include participants from different universities to have more diversity in the responses and analysis. This study focuses mainly on educational curriculum design followed by three research participants and hence it might not be generalizable to other types of educational settings. A potential direction for future work will be to study and present results that can be generalized and applied to different education settings by recruiting participants from different educational backgrounds and institutions. Collecting quantitative data from both students and faculty through surveys intended to understand the perceptions of existence/incorporation of the discourses of design thinking in curriculum is another area for future research [37-39]. In this study, deductive coding was used to analyze the qualitative data, however, different coding techniques (thematic analysis, phenomenological analysis, etc.) could be used to further analyze the data to get a fresh/detailed perspective and insights from the data in addition to the findings from this study [40-42].

Conclusions

Curriculum is one of the most important parts of an education system because it drives what kinds of content are taught and learned. One of the primary goals of curriculum is to guide teachers in providing the right learning experiences to students. Designing curriculum is a tedious task that requires collaboration with diverse stakeholders [1]. Besides collaboration, there are different factors (levels) that are critical in developing an effective and efficient curriculum. Traditional approaches of developing curriculum leave out some of the factors (levels) that play an important role in education. For instance, in their article, Scragg et. al. argues that traditionally design in education focuses only on the artifact designed, or designed scenario or experience or process, but leaves out the perspectives of cultures and systems [33]. The goal of this paper was to explore design practices and approaches through literature review, expert interviews, and case studies to find common elements existing in curriculum and to examine how different experts use the five discourses of education design when developing a curriculum.

Results of the literature review showed that curriculum design should utilize frameworks and processes that are iterative and non-linear to ensure product efficiency. Moreover, the 21-century curriculum should be more outcomes-oriented, inclusive, and interdisciplinary to prepare the next generations for future needs. However, continuous assessment of the curriculum in every stage is the key to maintain developing the curriculum design process until reaching better results.

Results of the interviews revealed that expert designers agreed on the importance of the five discourses of education design, though they used it in different ways. For instance, some experts prefer to use the traditional face-to-face artifacts in collaborating with stakeholders, while others used modern artifacts like Google docs and emails. Similar results were observed from the different case studies regarding the use of the five discourses of education design.

Overall, our study revealed that curriculum design experts do use the five discourses of design in education, but each one uses it in a different way. This result is promising because it shows that curriculum designers are becoming aware of the different factors (levels) that are critical in developing an effective and efficient curriculum for providing the required learning experiences to students.

In the future, it will be insightful to examine an existing curriculum in detail to understand the different elements and/or layers it offers and loopholes (problems and/or challenges). Taking feedback from students and teachers can help get different perspectives about the curriculum and this will provide a holistic view about the curriculum under review. Considering this data and comparing it with the five discourses of design will be helpful in redesigning the curriculum to provide the required learning experiences to students.

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Appendix

Interview Questions

General Question

a. Good morning Professor .X, I am here with my teammates AA and BB. We are doing a study to understand the experiences of a designer in education. We are interested in understanding how people design, plan and create things. We would like to record this interview and use the transcription in our study, and we would like your consent in doing so.
    i. What do you think about education by design? Do you think education and design are integrated? Can you give some specific examples?
    ii. How do you perceive the concept of design thinking? How would the presence/absence of design thinking influence education?
    iii. Can you share some personal experiences on designing a curriculum? Any specific challenges that you have come across during the process of curriculum design?

Discourses

- Artifacts
    - What are the different artifacts that are required in successfully designing a curriculum?
    - What in your opinion is the role of artifacts in designing curriculum? Can you share some examples from your experience?

- Processes
    - Do you follow a process in coming up with solutions to the example you just mentioned? If yes, can you share some details on that?
    - Can you tell us about the specific strategy that you follow in choosing an appropriate process in designing curriculum?
- Experiences
    - How important it is to integrate the classroom environment when designing the curriculum? Could you share some examples?
    - What elements in the curriculum in your opinion would make a classroom interactive?
    - How could these elements help in designing and promoting the environment of an interactive classroom?
- Systems
    - How do you navigate through the different levels of policy in designing the curriculum? (State + Federal)
    - What role does policy have to play in the process of curriculum design?
    - What are the parameters that you use in assessing the designed curriculum?
        - How different is this approach from the conventional approach?
- Cultures
    - How important it is to involve the opinions of different stakeholders in designing curriculum? Can you share an instance where such a thing has happened?
    - Where in the process of the curriculum design it is important to consider the stakeholders opinion? Can you share some examples?

Follow up questions!

1. Considering different stakeholders (students, teachers, society, industry, etc.) in an education system, how important it is to consider the opinions of each of these stakeholders? Can you share some specific examples from your experiences?
2. Question about considering the different learning requirements of different students? Diversity inclusion?