STUDIES ON SOCIAL AND EDUCATION SCIENCES 2023

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PREFACE

In the ever-evolving landscape of education and social sciences, the contributions from scholars worldwide continue to shape our understanding of the complex dynamics within society. As we navigate through another year, this compilation stands as a testament to the dedication and intellect of researchers addressing critical issues and advancements.

In "Intersectionality as a feminist social critique of oppression, power, and agency" (Chapter 1), the exploration of intersectionality provides a profound analysis of oppression, power dynamics, and agency through a feminist lens. The nuanced perspectives presented in this chapter pave the way for a deeper understanding of the interconnected nature of social experiences.

Moving into the realm of professional skepticism and fraud detection, "Assessing Professional Skepticism and Fraud Detection among Management Accountants: The Case of Malaysian Public Companies" (Chapter 2) delves into the intricacies of ethical practices within the corporate sector, offering insights into the challenges faced by management accountants in addressing fraud.

"Art History, Museums, and Inclusion: Student Successes, Empowerment Examples" (Chapter 3) opens a discourse on the transformative power of art history and museums in fostering inclusivity. The chapter showcases student successes and empowerment examples, emphasizing the pivotal role of art education in shaping diverse narratives.

"Producing College Sports for ESPN: A Vygotskian Approach" (Chapter 4) takes a unique perspective by applying Vygotsky's sociocultural theory to the realm of college sports production. This chapter unveils the symbiotic relationship between education theory and practical application in the dynamic sports media field.

The examination of learning management systems and outcome-based assessments is meticulously presented in "Evaluation of Two Sides of the Same Coin" (Chapter 5). This chapter critically assesses the interconnectedness of learning management systems and outcome-based assessments, shedding light on their complementary roles in educational settings.

"Evaluation of Project Based Learning in The Implementation of Indonesia's Curriculum" (Chapter 6) offers a comprehensive exploration of project-based learning within the context of Indonesia's curriculum. The chapter dissects the effectiveness of this pedagogical approach in enhancing student's learning experiences and skill development.

"Project Proposal-Based Learning (PjPBL): A Potential Assessment Method to Develop Innovative Skills among Pre-University Students" (Chapter 7) introduces an innovative assessment method designed to foster the development of creative skills among pre-university students. This chapter advocates for a paradigm shift in assessment practices, emphasizing the cultivation of innovation.

In "Predicting Course Enrollment with Machine Learning and Neural Networks: A Comparative Study of Algorithms" (Chapter 8), the convergence of education and technology is explored. The chapter investigates the predictive capabilities of machine learning and neural networks in forecasting course enrollment, offering valuable insights for educational planning.

"Increasing the Plant Awareness of Prospective Biology Teachers: A Mixed Methods Study" (Chapter 9) takes a botanical turn, unraveling the importance of plant awareness among prospective biology teachers. The mixed methods study provides a holistic view of strategies to enhance botanical knowledge, contributing to the pedagogical landscape.

The exploration of indigenous knowledge takes center stage in "The Indian Knowledge, Western Education Program: An Indigenous Community-Led College Faculty Training Program" (Chapter 10). This chapter narrates developing and implementing an indigenous community-led college faculty training program, highlighting the rich tapestry of cultural exchange in education.

As we embark on the intellectual journey presented in these chapters, we anticipate that this collection will serve as a source of inspiration and knowledge for scholars, educators, and practitioners alike. May these diverse perspectives contribute to the ongoing dialogue in education and social sciences, fostering a global community of thinkers dedicated to positive change.

Ömer Bilen and Eman Shaaban
The Editors

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SECTION I - STUDIES ON SOCIAL SCIENCES

Chapter 1 - Intersectionality as a Feminist Social Critique of Oppression, Power, and Agency

Barbara Dell'Abate Çelebi

Chapter Highlights

- This chapter, Introduces Patricia Hill Collins' intersectionality and matrix of domination theory, revealing how women navigate multidimensional structures encompassing societal, cultural, and interpersonal domains.
- Explores how individual factors such as class, race, religion, and nationality shape a woman's capacity to resist or conform within oppressive systems, emphasizing the importance of recognizing diverse elements influencing agency.
- Incorporates Michel Foucault's insights on power, discourse, and truth regimes to analyze the intricate relationship between oppression and power within the matrix, highlighting the role of discourse in shaping oppressive structures.
- Examines agency through Anthony Giddens' structuration theory, emphasizing the duality of structure. This section explores how individuals contribute to and navigate social structures, revealing complexities in agency within oppressive contexts.
- Concludes by proposing a concise four-step analytical method rooted in Collins' theory, enriched by integrating Foucault's power insights and Giddens' structuration theory. This synthesis offers a robust foundation for understanding and addressing oppression, power dynamics, and agency within a feminist perspective.

Introduction

In the US, it is a well-known and recognized fact that students from underrepresented groups have suffered longstanding inequities in educational settings. This includes entrance into and success within the higher education system (Adwere-Boamah, 2015; National Science Board, 2020; Whittaker & Montgomery, 2012). The enormous growth in the Hispanic population of the United States and the growth of the Hispanic population in the higher education system has made the imbalance more evident (Gramlich, 2017; National Center for Education Statistics, 2020).

This article seeks to reframe the problems of oppression, power, and agency from a feminist viewpoint through an analysis of the methodology of intersectionality and of the matrix of domination. My aim is to understand how power, oppression, and agency are related and investigate women's ability to oppose it, make accommodations, take independent action, or collaborate with it. The issue of gender equality needs to be studied within the context of power, oppression, and agency, and this can be done only by considering each woman in her individual situation, made of specific characteristics and differences, rather than as a generic and homogeneous abstract idea of womanhood. Feminist theory has established in the last decades that gender cannot be detached from a specific context while other aspects remain constant, as gender alone does not have a pure or isolated impact on women's lives. If feminism aspires to free women, then it has to confront almost all types of oppression, because women make up the majority of oppressed people. Only by understanding and individuating the complex dynamic of interweaving multiple oppressions, power struggles, and potential for women's agency, it would be possible to start thinking about concrete actions to fight against specific discriminations affecting women's lives.

In this paper, after briefly introducing intersectionality and the matrix of domination - with a particular focus on the theoretical work of Patricia Hill Collins - I will reflect on the relationship between oppression and power, touching upon Foucault's conception of power, discourse, and regimes of truth. I will then analyze the issue of agency through Giddens' structuration theory and the concept of duality of structure. In conclusion, I will present a four steps methodological approach based on Collins' theoretical framework and

supplemented by Foucault's theory of power and Giddens' insides on agency[1].

Intersectionality and the Matrix of Domination

Women are at the crossroads of various oppressions. This view is shared by the epistemologies of Chicana Feminism, Multicultural Feminism, American Third World Feminism, and Black Feminism. It may be traced back to the late 1970s Chicana criticism of "sexist racism" (Anzaldua, 1987) and their battle against "racial, sexual, heterosexual, and economic oppression, with the aim of developing integrated theory and practice based on the knowledge that the various systems of oppression are interwoven" (Combahee River Collective, 1979: 275).

Similarly, Andre Lorde refers to this reasoning as the "hierarchy of oppressions" (1983), Deborah K. King calls it "multiple jeopardies" (1988), while Elisabeth Martinez the "Oppression Olympics" (1993).

This intricacy of overlapping oppressions runs against a binary logic and generates the possibility of various and opposing experiences of subordination and power, necessitating a broader and more complicated terrain of inquiry. This more complex analytical tool might be found in the Intersectional methodological approach and in the matrix of domination elaborated by Patricia Hill Collins in her seminal text *Black Feminist Thought* (2000).

However, the term "intersectionality" antedates Collins' book and originates within a legal understanding of multiple oppressions. It was, in fact, coined in 1989 by Kimberlé Crenshaw, a law professor, to illustrate the oppression of Black American women. In *Demarginalizing the Intersection of Race and Sex,* Crenshaw examined three discrimination suits brought against corporate employers by Black women, demonstrating that antidiscrimination laws protect Black women only if their discrimination experience "coincides" with that of Black men or white women (143). She created the analogy of discrimination as a traffic intersection. She affirms that if an accident occurs at the intersection of two or more roads,

[1] This article builds on and expands my analysis of intersectionality started in "Dell'Abate Çelebi, B. (2019). *Conceptualizing intersectionality as a methodological tool in the analysis of 19th century western women travelogues*. RumeliDE Dil ve Edebiyat Araştırmaları Dergisi, RumeliDE 2019.Ö6 - Bandırma Onyedi Eylül Üniversitesi Uluslararası Filoloji Çalışmaları Konferansı, 188-196. DOI: 10.29000/rumelide." https://doi.org/10.29000/rumelide.648603

the causes of the accident can be "cars travelling from any number of directions and, sometimes, from all of them" (149). In the same way, if a Black woman is discriminated this can be caused by sex or race discrimination, or by both. Crenshaw as a lawyer was interested in showing the need of revising the legal concepts of discrimination that in her perspective need to be reconceptualized in terms of the concrete experiences of Black women. In her 1991 essay *Mapping the Margins*, Crenshaw further theorizes intersectionality as a threefold discrimination made up of three aspects: *structural*, *political*, and *representational*. By *structural*, she refers to the different ways in which white and black women are considered legally when experiencing domestic violence and rape and she demonstrates the qualitative difference in the remedial reforms applied to them. By *political* intersectionality, she refers to the specific position of women of color in relation to U.S. political agendas that are usually conflicting towards women and towards people of color. Asking women of color to choose between one of these positions she affirms "constitutes a denial of a fundamental dimension of our subordination" (1252). By *representational* intersectionality, she refers to the sexist and racist images of women of color which reproduce their objectification (1283). Crenshaw also identifies intersectionality as a framework for identifying and studying real-world occurrences of multiple discriminations.

Patricia Hill Collins expanded on the topic of intersectionality in the first edition of *Black Feminist Thought* in 1990, defining intersectionality and the matrix of domination as follows:

> "Intersectionality refers to particular forms of intersecting oppressions, for example, intersections of race and gender, or of sexuality and nation. Intersectional paradigms remind us that oppression cannot be reduced to one fundamental type, and that oppressions work together to produce injustice. In contrast, the matrix of domination refers to how these intersecting oppressions are actually organized. Regardless of the intersections involved, structural, disciplinary, hegemonic, and interpersonal domains of power reappear across quite different forms of oppression". (18)

Collins clearly refers here to two different levels of analysis: the *micro* and the *macro* level, or "actor/ structure" (Bilge, 2010: 65). At the *micro* level, the center of the study is the individual, characterized by intersecting factors constructing his/her identity: gender, class, age, race, religion, etc. At the *macro* level the focus is on the system of oppression as race, class, and gender, the previously cited matrix of domination or "interlocking oppressions"

(Dhamoon, 2011: 231). For Collins the *micro* (intersectional) and *macro* (interlocking) processes shape oppression. However, her analysis goes further the two levels of analysis, and she affirms that the intersectional method needs to take into account four domains of power: the *structural* domain made of laws and institutions, the *disciplinary*, i.e. bureaucracy, the *hegemonic*, meant as cultural and ideological and the *interpersonal* domain, influenced by everyday interactions.

Collins' matrix can be reconnected and supplemented by an expanded Foucauldian understanding of power, whose exercise is inextricably linked to the production of discourses of truth and shifts the theoretical analysis away from a binary conception of power (dominant-subordinate), while also questioning dominant universalizing truth claims and recognizing the potential for "resistance strategies. "As affirmed by Collins:

> "Oppression is filled with such contradictions because these approaches fail to recognize that a matrix of domination contains few pure victims or oppressors. Each individual derives varying amounts of penalty and privilege from the multiple systems of oppression which frame everyone's life. (…) Because the interpersonal domain stresses the every day, *resistance strategies* within this domain can take as many forms as there are individuals" (287-8). (*italics is mine*)

As stated by Collins, the issue of oppression is directly linked to "resistance strategies" so envisioning power as not belonging unilaterally to the oppressor but emerging from the synergistic relationship among domains of power. Within this perspective, the complexity of oppression is counterbalanced by a similar complex potential for a woman's agency, i.e., her capacity to react, resist, act freely, or become an accomplice to her oppressor.

The Complexity of Power

As demonstrated by this model, the dialectic relationship between power, oppression, and agency is significantly more complicated than a simplistic model of oppressed and oppressor would imply. Can we consider all women oppressed? Is it true that they are also oppressors? Do they have or can they demonstrate agency? As Patricia Hill Collins points out in her *Black Feminist Thought*:

> "Depending on the context, individuals and groups may be alternately oppressors in some settings, oppressed in others, or simultaneously oppressing and oppressed in still others". (246)

As a result, we cannot think of power in binary terms, but we must replace binary reasoning with a dialectical understanding of power. First, however, we need to clarify what we exactly mean by the term power.

Scholars have differentiated two fundamental understandings of power and divided it into two categories. Within the first category, power is considered as simply the ability to act. According to Weber, power is "the ability of a man or a group of men to achieve their own will even in the face of resistance from others who are participating in the activity" (Weber, 1978: 926). As a result, power in this sense can be employed as a tool of dominance. In the same line for Mann power is defined as "the capacity to seek and achieve goals". (Mann, 1986: 6)

Power, according to a second viewpoint, is intrinsically dependent on the permission of those over whom it is exercised, and hence on its legality. So, for example, Arendt and Parson share this view of power as fundamentally dependent on consent (Hindness, 1996:10). In both viewpoints power is intended as essentially repressive, and within both perspectives, gender disparities are ignored. Moreover, as underlined by Nancy Hartsock (1983), power, or more precisely, the exercise of power as an exercise of domination, has been viewed as a male activity and has been considered by both feminists and antifeminists wholly unsuitable to women. This disinterest in the concept of power has weakened the theoretical feminist understanding of the relationship between oppression and agency. Understanding how power relations are constructed and exercised is necessary to challenge the structural gender inequality characterizing social relations. As affirmed by Hartsock: "Different theories of power rest on differing ontologies and epistemologies, and a feminist rethinking of power requires attention to its epistemological grounding" (1990: 158). In this regard, Foucault's analysis of power has been tremendously valuable to feminism.

Foucault's Conceptualization of Power

According to Foucault, power is not something that people or organizations own, but rather

an ethereal element that circulates within a certain matrix of domination and through which individual subjectivity defines human acts. While most dominant contemporary political theories have been particularly preoccupied with issues of sovereignty and legitimacy, Foucault maintains that the study of power must move away from these concerns. He sees power as a "structure of actions" (1980: 220) that influences the behaviors of people who are free. For Foucault, power and liberty are inextricably linked, and he clearly distinguishes power from domination. He affirms:

> "We must distinguish the relationship of power as strategic games between liberties – strategic games that result in the fact that some people try to determine the conduct of others – and the states of domination, which are what we ordinarily call power. And, between the two, between the games of power and the states of domination, you have governmental technologies." (1997:19)

Power, according to Foucault, is exercised over people who have the ability to choose in order to affect their decisions. Domination, on the other hand, refers to unequal power interactions in which the subordinated individuals have little space for maneuver since their "margins of liberty are significantly circumscribed" by power's consequences. Domination must be separated from power in general if the latter is not to be seen negatively. If such a distinction is realized, the task becomes one of developing conditions "that would allow these games of power to be played with a minimum of domination" rather than one of avoiding or limiting power interactions (1988: 18). As a result of Foucault's difference between power and domination, he is able to criticize states of domination as opposed to "strategic games of power between liberty" (Hindess, 1996:104).

The instruments, strategies, and processes that can be used to influence the behavior of others are manifestations of power. This, too, implies that power structures may be very diverse, with some concentrated and hierarchically organized and others socially distributed. Power, and the resistance and avoidance it elicits, must be considered as a pervasive component of human interaction, according to this viewpoint.

In Foucault's perspective, power is omnipresent, and everyone may access it. To argue, as Foucault does, that the exercise of power necessitates some degree of freedom on the side of the subject is to state, first, that the efficient exercise of power does not always mean the

eradication of liberty. On the contrary, according to Foucault, if there is no potential for resistance, there can be no power relations. As a result, the exercise of authority is usually jeopardized by the obstinacy of its subjects: it always comes at a cost, and the conclusion is rarely definite. To suggest that people who are susceptible to the consequences of authority are free implies, secondly, that they are capable of acting on their own.

Power, according to Foucault, may be not just coercive or disciplinary, but also discursive (productive). It operates by disseminating information from many sectors. For Foucault, knowledge is neither true nor false in itself but is inextricably related to power since it establishes and defines the bounds within which claims are to be deemed true and incorrect for each unique moment and society. According to Foucault's theory of power, a "regime of truth" is the cyclical connection that truth has with the power structures that simultaneously generate and sustain it, as well as the repercussions of power that truth causes, and which extend it. Truth has a long history in Foucault's vocabulary. It is historically rooted and pertinent to the area under consideration. Each civilization has its own truth regime, its own "general politics of truth" - the types of discourse it accepts and accepts as true. These truth regimes co-create and are the outcome of specific discursive formations that comprise a continually moving set of circumstances governing the range of viable articulations at any one time; yet the set of circumstances changes and adapts with each articulation.

Power relations, according to Foucault, cannot be constituted, maintained, or enforced without the creation, accumulation, circulation, and operation of discourse. Power cannot be exercised without a specific economy of truth discourses that function via and on the basis of this relationship. We are subjected to the production of truth by power, and we cannot exert power unless we produce truth. According to Foucault, the subject is progressively and materially formed by a plethora of creatures, forces, energies, wants, thoughts, and so on. This process of “subjectivation” (*assujetissement*) refers to the production of subjectivities and social differences through discourses and practices of gendering, racialization, ethnicization, sexualization, etc.

So, we can say that: “In Foucauldian terms, the focus of analysis is not therefore strictly on an individual, a category, a group, or an institution (although these are not absent either) but on the techniques of power” (Dharmoon, 234). Discourses that produce the subject, according to Foucault's idea of subjectivation, are also the condition of possibility for its empowerment.

Forced reiteration sustains discursive systems, yet it is this reiteration that creates gaps and fissures. These instabilities allow the item to vary from or exceed the norms.

Human behaviors, while impacted by a variety of circumstances and dominance matrices, cannot be regarded as merely located and confined. Human agency must be acknowledged in the link between subjectivity and social structure. The dialectical relationship between oppression and agency is significantly more nuanced than simplistic conceptions of oppressors and oppressed would imply, forcing us to reconsider the relationship between the actors and the framework within which they perform.

Agency: The Theory of Structuration and the Duality of Structure

The theory of structuration, developed in the 1980s by the sociologist Anthony Giddens, can help to provide a solution to this question by introducing the notion of duality of structure, which explains the reciprocal reliance of structure and agency. According to this theory "Social structures are both formed by human action and, at the same time, are the very medium of this constitution" (Giddens, 1979: 121). This suggests that the connection between humans and structures is dynamic since they do not just reproduce existing structures but also change them while being influenced by them. By enabling social agents to develop these structures anew while replicating them, the duality of structure allows us to move away from a solely restrictive forces paradigm:

> “Structure, in this conception, is not only constraining the actions of individuals but also provides resources on which they draw in the course of interactions with others. Correlatively, action is seen as not only expressing the intentions of individual agents but also serving to reproduce the structure in which such action takes place.” (Hindess: 9)

As a result, the structure serves as both an enabler and a constraint. According to the concept of the duality of structure, actors draw on rules and resources in the creation of interaction, but they are also reconstructed through such interaction. It is also vital to remember that structure for Giddens is internal to agents in the form of memory traces rather than external (1984: 25). It is agents who create structure, and it is structure that creates the potential for agency. The possibility of change is renewed at each point of structural reproduction since

individuals might adjust the conventional "rules" that have governed their previous encounters. There is a double involvement of individuals and institutions. We create a society at the same time as we are created by it.

This concept is also elaborated by R.W. Connell in his 1987 seminal text *Gender and Power*. In his discussion on the relationship between structure and practice, Connell affirms:

> "It is this vulnerability of structure to practice that is what makes us agents of history. As structures become modified by human practice so the experiences and options for people these emergent structures generate, change. The cultural 'limits and pressures' that bound people's practices change, what counts as 'commons sense' changes." (Connell, 1987: 95)

Both Giddens and Connell agree on the idea of an active presence of structure in practice and an active constitution of structure by practice. So, if practice constitutes structure why, we could ask, doesn't change happen more frequently and abruptly? Why is routine maintained? Giddens answers these questions by introducing the concept of ontological security, which he borrows from R.D. Laing. Ontological security is a psychological condition that is like feeling "at home" with oneself and the environment around you. It is also linked to low or controllable levels of anxiety, and it impedes the pursuit of an overly consensual and immobile social world. Social change will occur as a result of a mix of gradual change, which occurs as an unforeseen outcome of social reproduction, reflexive monitoring of their conduct, and unintended consequences. Structuration theory acknowledges the potential of the social actor for self-reflection and critique, providing a theoretical framework for varying levels of opposition, resistance, and the possibility of change. As a result, we may infer that each woman is the product of hegemonic discourses that ground and articulate disciplinary and structural control mechanisms. Yet, she is impacted by a variety of interpersonal factors. With her actions, by reproducing or denying reproducing the "performance" expected from her specific position within society, she will eventually be able to confirm, repeat, or modify the framework.

By combining the theoretical instruments discussed above I will try now to elaborate a feasible method of analysis that combines intersectionality with the Foucauldian theorization

of power and subjectivation and Giddens's concept of the duality of structure. This method envisions a four-step analysis.

Intersectionality: Proposal for a four-step Method Analysis

As affirmed above, each woman is located at the intersection of several individual and societal circumstances and power relations. Intersectionality supports the concept that everyone is placed in multiple, overlapping ways and that each woman is unique or equal to other women or to other men in certain aspects. Intersectionality as a paradigm of analysis of oppression has originated within Black feminism with the aim to foster African American women's empowerment. However, it offers critical instruments to analyze any condition of social injustice and can help create coalitions between minority groups sharing similar oppressions. As affirmed by Collins, "Reading Black women's intellectual work, I have come to see how it is possible to be both centered in one's own experiences and engaged in coalitions with others. In this sense, Black feminist thought works on behalf of Black women but does so in conjunction with other similar social justice projects" (x).

Intersectionality as a feminist critical social theory tries to highlight the multiple oppressions that foreground each woman's specific identity, and its aim is not only descriptive but political as its final objective is to change the unequal structure of society, especially in relation to the system of stratifications oppressing different women in different ways.

Intersectionality is envisaged by Collins as a feminist "interpretative framework" that can be "used to explain social phenomena" (252). It investigates oppression both at macro and micro levels. At the macro level, the matrix of domination is divided into four interrelated domains of power:

a) **structural power**
b) **disciplinary power**
c) **hegemonic power**
d) **interpersonal power.**

Collins is very clear on the strong interconnection of the four domains: "The structural domain organizes oppression, whereas the disciplinary domain manages it. The hegemonic

domain justifies oppression, and the interpersonal domain influences everyday lived experience and the individual consciousness that ensues" (276).

The interrelation of the domains of power has been clearly discussed by other critics who have underlined how these systems of domination need each other to function (Dhamoon: 235) and this interrelation is defined as "interlocking". Fellows and Razack state:

> "Systems of oppression (capitalism, imperialism, patriarchy) rely on one another in complex ways. The "*interlocking"* effect means that the systems of oppression could not be accomplished without gender and racial hierarchies: imperialism could not function without class exploitation, sexism, heterosexism, and so on." (cited in Dhamoon: 235) (italics is mine)

While at the macro level, we can talk of "interlocking domains of power", at the micro level Collins takes into consideration the intersecting characteristics, or "various dimensions of individual subjectivity" (285) that characterize women's personal and social standing and their lived experiences. Within the intersectionality framework, Collins refers to them as "intersecting oppressions". These intersecting oppressions may produce social injustice by the way they are organized, and this can vary from country to country and era to era. I have selected for this study seven representing factors:

1) **class**
2) **race**
3) **gender**
4) **religion**
5) **marital status**
6) **age**
7) **nationality**

On the basis of Collins' intersectionality framework and supplementing it with Foucault's and Giddens' insights on power and agency, we can design a basic template of analysis of women's oppressions. This approach can be thought of as a four-step method analysis, as follows:

Step 1: Identification of Intersecting Oppressions

In the first step, we need to identify the multiple factors characterizing each woman. As outlined before, each woman is located at the intersection of multiple factors that make up her identity and that intersectionality reads as intersecting oppressions. Factors such as race, class, gender, sexuality, religion, citizen status, etc. can be significant markers of group difference and are accompanied by discriminatory practices. As affirmed by Collins each individual woman is at the intersection of specific oppressions that change as historical conditions change and, as a consequence, "the challenges that each woman experience produce different patterns of experiential knowledge that in turn shape individual reactions to the core themes" (27).

Taking into consideration the factors selected above we can represent the point of intersection in a Venn diagram as follows:

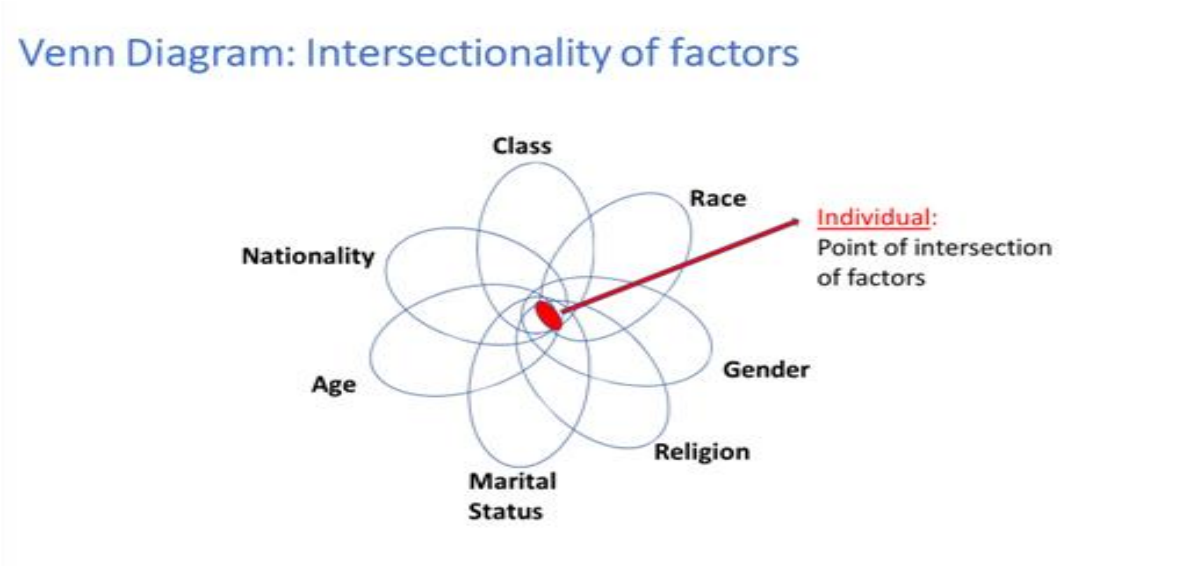

Figure 1. Step 1: Venn Diagram

Step 2: Identification of the Matrix of Domination and of the Domains of Power

As a second step, we look at the disciplinary, structural, and hegemonic domains that characterize the country and historical period in which the woman is located. The disciplinary and structural domains are connected and accepted by the individuals through the work of the hegemonic domain, which is responsible for tying the woman to the society to which she belongs and whose ideas/values are supported or rejected in accordance with her personal

biography. By interpersonal domain of power, Collins means the discriminatory practices of everyday lived experience, like the strategies of everyday racism and everyday resistance.

We can imagine the domains of power as a construction of various interlocked levels that surround the individual, the woman in our case. At the basis of the construction is the structural domain that in Collins' definition are "interlocking social institutions organized to reproduce Black women's subordination over time" In the United States, she continues, these are "the policies and procedures of the U.S. legal system, labor markets, schools, the housing industry, banking, insurance, the news media, and other social institutions (that) as interdependent entities have worked to disadvantage African-American women" (277). In a more general sense, we can understand the structural domain as the "organized practices that work to maintain an unequal and unjust distribution of social resources" (301). Examples are racialization, classism, patriarchy, femininity, religion, gender, etc.

The further level is the disciplinary domain which "relies on bureaucratic hierarchies and techniques of surveillance and manages power relations. It does so not through social policies that are explicitly racist or sexist, but through the ways in which organizations are run" (Foucault, 1979). By interpersonal domain, Collins intends the level of everyday social interaction that "functions through routinized, day-to-day practices of how people treat one another" (287). The construction is kept together - like cement would keep together the bricks of a house - by the hegemonic domain that deals with "ideology, culture and consciousness" (284). The hegemonic domain is of critical importance for Collins as it represents the place where hegemonic and counter-hegemonic knowledge is produced, the place of oppression but also of resistance. "The significance of the hegemonic domain lies in its ability to shape consciousness via the manipulation of ideas, images, symbols, and ideologies. (…) The hegemonic domain becomes a critical site for not just fending off hegemonic ideas from dominant culture, but in crafting counter-hegemonic knowledge that fosters changed consciousness" (285).

The matrix of domination and the domains of power can be represented graphically as follows:

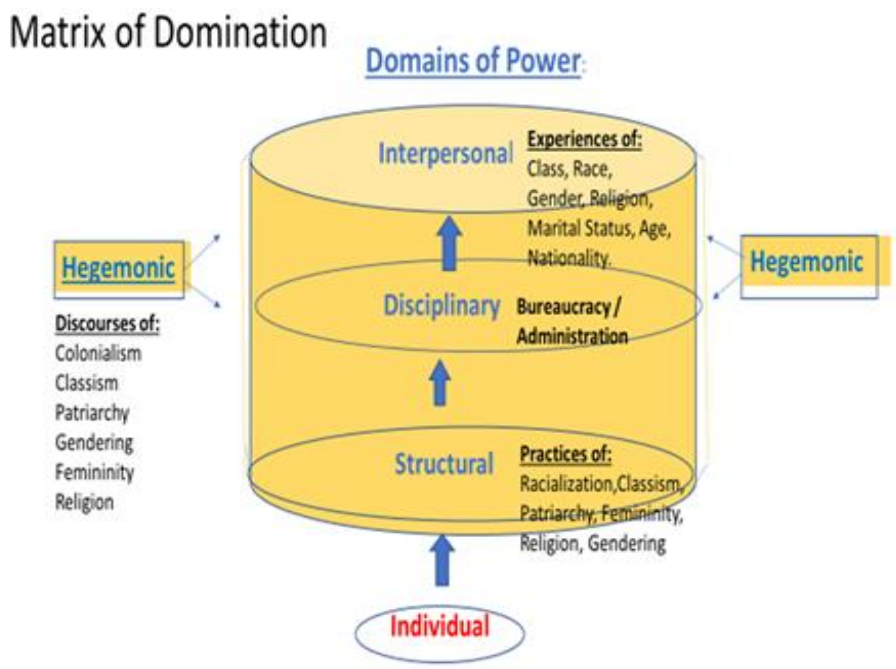

Figure 2. Step 2: Matrix of Domination

Step 3: Coalescence of Intersecting Oppressions and Matrix of Domination

In the third phase of analysis, we proceed to merge the interpersonal characteristics that define the single woman, as provided by the intersecting oppression analysis, with the matrix of domination. Each individual woman is part, at the macro level, of a "system of domination", but, as the Venn diagram shows, her unique identity is grounded, at the micro level, in specific personal and social characteristics - as her gender, class, race, religion, marital status, age, nationality, etc. - which define her distinctive living experience, but also provide a unique placement at the intersections of multiple oppressions.

Each micro and macro level oppression plays a crucial part in the construction of her identity and gives rise to a specific matrix of oppression and resistance, unique to each woman, as some factors may be more prominent than others in different contexts and times.

The merging of the intersecting factors of oppression and the matrix of domination can be represented as follows:

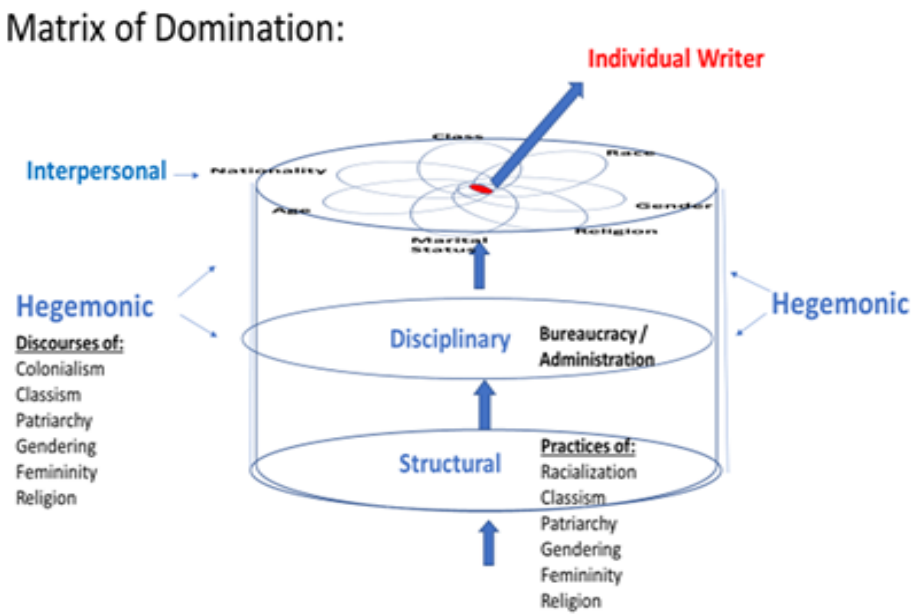

Figure 3. Step 3: Intersecting Factors of Oppressions and Matrix of Domination

Step 4: Diachronic Analysis

In the fourth phase, the synchronic analysis is substituted by a diachronic perspective. By inserting within the analysis, the factor 'time', the analysis focuses now on the potential for agency which any woman disposes of.

As claimed within the structuration theory and the duality of structure discussed above, "every act which contributes to the reproduction of structure is also an act of production, a novel enterprise, as such may initiate change by altering that structure at the same time as it reproduces it" (Giddens, 1976: 134). Within this perspective, each woman can confirm, repeat, or modify over time through her actions the structure that frames her life. This final phase includes, as a consequence, the possibility of agency.

In order to investigate reiterations or modifications in social practices as a result of the changes brought about by the single woman over time – for example through activism, group-based consciousness, or development of oppositional knowledge - we add a diachronic viewpoint. By rejecting the fixity of identities and highlighting the ability that each woman has for agency, this fourth step of analysis foresees the potential for modification of the structure of domination. This diachronic representation relies also on the Foucauldian concept of power as it focuses on the potential that subjectivities have, through their practices, to

produce new discourses of truth, and by resisting or challenging existing "truths", produce new discourses.

This diachronic perspective can be represented as follows:

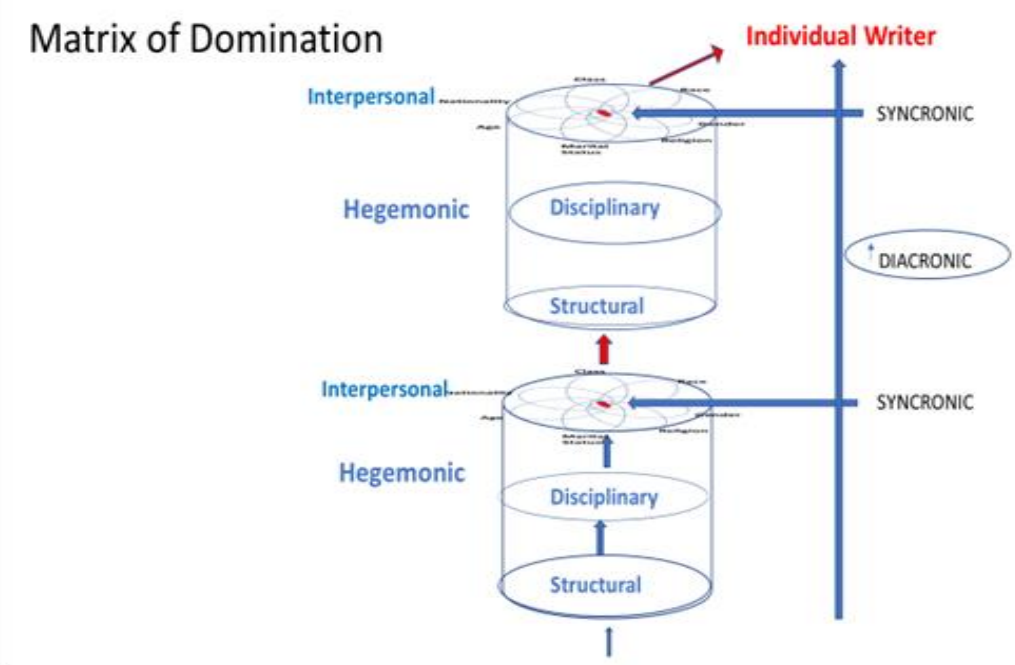

Figure 4. Step 4: Diachronic representation

Conclusion

This paper has tried to review the relationship between oppression, agency, and power and show how the methodology of intersectionality, integrated with a Foucauldian conception of power and Giddens' reciprocal reliance of structure and agency can help investigate the multiple oppressions experienced by women and can be a powerful instrument of feminist social critique. An intersectional approach unambiguously reveals that each person, in this case, each woman, is culturally and historically located at the intersection of several personal and social factors (class, race, gender, nation, etc.) and is subject to interlocking systems of oppression named by Collins as the matrix of domination. This allows for a range of contrasting experiences of subordination and power, needing an intricate terrain of investigation.

As stated in this article, this link is far more intricate than a basic model of eternal oppressors

and unending victims. By recurring to a Foucauldian perspective, we can think of power not simply in terms of having or not-having it, within a hierarchical understanding of society, but we intend power more as a continuous potential for actions and for change. If we accept that power is productive, discursive, and diffused we can start questioning any essentialized power hierarchy as historically constructed. This can prompt a shift in the victim-oppressor dichotomy and offer a new epistemological grounding to investigate the power relations that are at the basis of complex discriminations and oppressions experienced by women both at the micro and macro levels.

Within this perspective, the feminist methodology of intersectionality can provide a practical instrument of analysis. Intersectionality, like feminist epistemology, conceptualizes power relationally rather than in a binary fashion through the usage of the matrix of domination. While mainstream feminist theory has debated for decades the significance of identity and experiences founded in identity, intersectionality theory relies on situational contingency to recognize and acknowledge the permeability of the oppressed-oppressor dichotomy.

Intersectional contingency contrasts with the notions that context matters, but that individual identity is all that matters. Using a scenario as a lens does not reify personal experience since people might experience a situation in a variety of ways. It also does not reify the structural components that cause such situations, which aids in holding individuals accountable for their actions in such a scenario. The choice of two analytically dissimilar multiple identities does not usually imply two warring souls. It might demonstrate the consistency of an integrated identity as opposed to an analytically fractured multiple-category identity. This feature of contingency is a continuation of intersectionality's philosophical goal, in which the ontological links between categories are mutually constitutive.

Both the liberal idea of a universal "Woman" representing all others and the perspective theory of a woman being able to speak for all others in the name of a particular characteristic like being black, lesbian, white, and so on are rejected by intersectionality. By placing any individual woman at the intersection of several personal and societal circumstances and power relations, intersectionality supports the concept that everyone is placed at the crossroad of multiple, overlapping oppressions The centrality of different oppressions in establishing the overall structure of a particular matrix of dominance is highlighted by seeing dominance as including cross-cutting oppressions of race, class, gender, sexual orientation, and

nationality.

The goal of this paper was to show how the frameworks of intersectionality and of the matrix of domination elaborated by Collins, supplemented by Foucault's conception of power and Giddens' theories of structuration and duality of structure, can be valid instruments for a feminist social critique of oppression, power, and agency through the investigation of the complexity of intersecting oppressions and individual identity at the micro and macro levels. This paper has also tried to translate the theoretical concepts discussed in this study in a four-step method analysis that can foster new applications of the framework of intersectionality in different domains of knowledge. As a literature scholar interested in the analysis of women's texts, the aim of my paper was also to disentangle the practice of intersectionality from an automated sociological research application and show that the study of literature, especially literature by women, can be enriched by a critical intersectional approach that can be applied to both the authors and the characters of a fictional text. Intersectionality as a broader concept teaches us that it is at the intersection of crossing roads that new potentials can be created. Cross-fertilization between previously separated disciplines can make us all reflect on the a-priory given category of woman and make us muse on the exclusions, reductions, and power differentials that are produced and re-produced when we use the category 'woman'.

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Chapter 2 - Assessing Professional Skepticism and Fraud Detection among Management Accountants: The Case of Malaysian Public Companies

Sharifah Nazatul Faiza, Nur Quratun 'Aini Haron, Maslinawati Mohamad

Chapter Highlights

- The purpose of this research explores the impact of the tone at the top (TATT) on management accountant (MA) fraud detection, examining whether detection is biased towards management based on TATT being either positive or negative. Emphasizes the significance of MAs in upholding corporate governance.
- Utilizes the Hurtt Skepticism Scale to categorize MAs as high or low skeptics, considering six key characteristics: questioning mind, search for knowledge, suspension of judgment, interpersonal understanding, self-confidence, and self-determination. Investigates whether these traits enhance fraud detection.
- Investigates the connection between professional skepticism and the ability of MAs to detect and prevent fraud. Finds that higher levels of skepticism contribute to improved fraud detection, emphasizing the role of skepticism as a valuable tool in MA practices.
- Reveals findings from a study involving 237 management accountants, indicating that a positive TATT is associated with a higher reported risk of fraud detection by MAs. Highlights the nuanced relationship between organizational culture (TATT) and fraud detection outcomes.
- Identifies four key skepticism traits—questioning mind, desire for knowledge, self-confidence, and self-determination—as significant predictors of professional skepticism in management accountants within public businesses. Emphasizes the relevance of these traits in shaping MAs' approach to fraud detection.

Introduction

Fraud has become an increasingly pervasive problem in the business world, posing significant financial and reputational risks to companies. The bankruptcy of large companies because of fraud has deteriorated public confidence in the role of management accountants (Chambers, 2015; Tabuchi, 2012). Management accountant function as the first line of defence in an organisation has come under scrutiny due to numerous financial scandals reported in the media, such as the PT Jiwasraya case in Indonesia and the Toshiba case in Japan (Juhari, 2021). These cases resulted in a significant loss of funds, with IDR 37.4 trillion and USD 1.8 billion of markup profit lost in the respective cases.

Management accountants play an important role in ensuring the accuracy and integrity of financial records (Ascani et al., 2021). One of their key responsibilities is to maintain accurate and complete journals, which are used to record all financial transactions that occur within an organization. When management accountants fail to properly manage journals, it can create opportunities for fraud and financial misconduct. For example, a dishonest employee may be able to manipulate journal entries to conceal the misappropriation of funds or artificially inflate revenue or profits.

There have been many high-profile cases of financial fraud in which the failure of management accountants to properly manage journals was a contributing factor. One notable example is the accounting scandal that engulfed Enron Corporation in 2001. In this case, Enron's management accountants were found to have made numerous fraudulent journal entries in order to manipulate the company's financial statements and conceal its true financial position (Dibra, 2016). The fraud ultimately led to the collapse of the company and resulted in billions of dollars in losses for investors and employees. Other examples of financial fraud that have been linked to journal mismanagement include the accounting scandals at WorldCom, Tyco, and HealthSouth (Dibra, 2016). In each of these cases, management accountants were found to have made fraudulent journal entries to inflate revenue or profits or conceal financial misconduct. It's worth noting, however, that fraud and financial misconduct can occur for a variety of reasons, and that the failure of management accountants to properly manage journals is just one possible contributing factor.

Professional skepticism is one of the core concepts that should be practiced by the profession of accountants, and if it is not practiced, it is difficult for the organization to reach reasonable assurance about the fairness of the financial statements (IAASB). In addition, the tone set by top management is often the most significant influence on the ethical culture of the organization (Knauer et al., 2022). If top management demonstrates a commitment to ethical behavior, it sends a clear message to employees that unethical behavior will not be tolerated, thereby improving fraud detection and prevention. Being employees of the organization, management accountants make ethical judgments within the framework set by the tone at the top. It is yet unknown how tone at the top affects the decisions of management accountants. This research addresses a gap in the literature by examining how management's attitudes about integrity and business ethics influence the objectivity of management accountants' assessments in detecting and preventing fraud. By shedding light on this important topic, this paper aims to provide insights that can help companies develop effective strategies to manage fraud risk and safeguard their financial health. Overall, the article emphasizes the importance of professional skepticism, setting the tone for ethical behavior within organizations, and creating an environment in which fraud is less likely to occur.

This paper aims to explore the influence of professional skepticism on fraud detection among Malaysian companies' accountants, examining the extent to which higher or lower levels of professional skepticism can better detect and prevent fraud. The study also seeks to investigate the influence of tone at the top on fraud detection.

Literature Review and Hypothesis Development

Fraud Theory

The Fraud Triangle theory, developed in the 1950s by criminologist Donald Cressey, proposes that fraud occurs when three factors are present: opportunity, rationalisation, and pressure.

The ability of an individual to commit fraud, such as having access to company funds or information, is referred to as opportunity. The thought process that an individual goes through to justify their fraudulent behaviour is referred to as rationalisation. Pressure refers to

an individual's motivation or need to commit fraud, such as financial difficulties or the desire to meet performance targets (Homer, 2020).

The Fraud Triangle can help explain why professional skepticism is important in the prevention and detection of fraud. Auditors and other professionals such as management accountants who adopt a skeptical attitude are better able to identify red flags and anomalies that may indicate fraud. The fraud diamond model, which expands on the fraud triangle by adding a fourth element, capability, is another theory that underpins the topic Sanusi et al., 2015. The ability of an individual to carry out a fraud scheme, including their skills, knowledge, and access to resources, is referred to as capability.

Overall, these theories suggest that fraud prevention and detection necessitate a combination of factors, such as a strong control environment, effective monitoring and reporting systems, and a professional skepticism culture.

Role of Management Accountant in Fraud Detection

Management accountants are responsible for preparing and presenting financial reports to senior management teams to ensure growth and profitability. They combine financial, analytical and management skills to aid senior management with decision making and promote long-term financial success. Key financial data and reports are used by senior management to make informed business decisions (Jones, 2021).

Management accountants are on the front lines of fraud, and their skill sets make them ideal for fraud detection. Jeff Thomson, CEO of Institute of Management Accountants, expands on how these professionals can play an integral role in combating fraud (Thomson, 2019). He said management accountants are essential for detecting and preventing fraud, establishing a zero tolerance for unethical behavior, and taking a "big picture" view of risks. Management accountants utilize frameworks such as COSO's Internal Control — Integrated Framework (ICIF) and ERM to prevent fraud. These controls aim to prevent fraud stemming from the most common motivations, such as meeting market earning expectations, concealing financial condition, increasing stock price, increasing management compensation, and misappropriating assets for personal gain. These insights into motivators of illegal or unethical behavior form a unique competency for management accountants. The management

accounting profession cultivates and instills a code of ethics that guides professional conduct, making ethics education integral to its signature certification program. It also maintains a Committee on Ethics and a Statement of Ethical Professional Practice that holds its members to the standards of maintaining an appropriate level of competence, applying accepted rules of confidentially, behaving with integrity, and communicating with credibility.

Management accountants should adopt a higher level of skepticism to spot fraud within their firms, even if they are not subject to the same requirements as external auditors. Management accountants frequently have insights into things that external or internal auditors would miss or neglect to audit. They undoubtedly have a thorough understanding of business operations, corporate culture, and employee behaviour. They may be able to spot several signs of fraud that might not be as clear to an outsider, such as a worker who never takes vacations or bills from unidentified organisations, thanks to their insider perspective. Given that the typical fraudster might not offer clear-cut indicators of fraud, this is very crucial. Most white-collar criminals are middle-aged males who are highly educated, have worked for the company for several years, are in a position of trust, and have no prior criminal records. However, there are observable differences in these people's behaviour at work. (6) Thus, management accountants would be better equipped to spot some of these behavioural indicators than an outsider with little interaction (Charron and Lowe, 2008).

Professional Skepticism

Professional skepticism refers to the attitude that involves questioning and critically evaluating evidence, assumptions, and assertions made by others which was often interpreted as neither assuming managerial honesty nor dishonesty (Dharmasiri,2023). The concept of professional skepticism is particularly important in the context of auditing, where auditors are tasked with detecting fraud and errors. The auditing profession has recently been forced to re-evaluate and highlight the significance of maintaining a healthy level of skepticism throughout an audit engagement. As a result, auditors are now required to "raise" their level of skepticism (Ta, 2022). These requirements imply that if an auditor is more skeptical about the possibility of fraud within a company, fraud detection will improve. Management accountants, even though they are not subject to the same regulations as external auditors, should still maintain a high level of suspicion because they are the first line of defence for discovering fraud within a company.

Several studies have been conducted to understand the impact of professional skepticism on fraud prevention and detection. Noch (2022) conducted a study which examine the effect of auditor competence and auditor's independence on fraud detection moderated by professional skepticism. They found that auditor competence and independence positively and significantly affect fraud detection. Moreover, auditor competence has a positive and significant effect on fraud detection, moderated by professional skepticism. However, independence has a negative and significant effect on fraud detection, moderated by professional skepticism.

Hamshari et al (2021) conducted a study to examine the relationship between professional skepticism of the external auditor and the detection of fraud and errors in financial statements. They found that there is a statistically significant correlation between professional skepticism and the detection of fraud.This is in line with Johari (2021) which investigate the relationship between professional skepticism, and fraud risk judgment on Internal auditor. The findings revealed that professional skepticism and fraud risk judgment was positively significant. It is also supported by Fullerton & Durtschi (2004) who found the positive influence of professional skepticism on fraud detection performance. Fullerton & Durtschi (2004) & Johari (2021) also found that internal auditors who have high professional skepticism are more effective in making fraud risk judgments/detect fraud.

It may be useful to comprehend how effectively management accountants apply professional skepticism as it is the expected conduct for fraud detection. The goal of this study is to assess management accountants' professional skepticism and compare it to that of internal and external auditors. This is the first study that we are aware of that measured management accountants' degrees of skepticism objectively. The management accounting profession can create standards to utilise professional skepticism more successfully by having a better grasp of it. Additionally, we examine other demographic traits that can be associated with higher levels of professional skepticism. Finally, we use the literature to make recommendations on how organisations might encourage people who may already be less suspicious to behave more skeptically (Charron and Lowe, 2008).

Philosophers have debated the idea of skepticism for a very long time. However, despite all the worries about skepticism in the accounting industry, there is no common method of

gauging the concept. There are several ways that skepticism is defined in accounting literature. For instance, Jeffrey J. McMillan and Richard A. White argue that an auditor who explains doubtful evidence using errors (rather than natural occurrences) is more skeptical. The results of skepticism have also been used to characterise it, such as having to confront a client or put in extra effort. Additional investigations back up the idea that skepticism can be generated. Researchers discovered that auditors who were instructed to emphasise professional skepticism were more likely to increase the number of audit hours they put in and produce a higher-quality audit than those who were urged to be efficient or objective. There is no doubt that research efforts and the accounting profession's capacity to put results into practise have been impeded by the inconsistent measuring of skepticism.

To specifically measure someone's level of skepticism and provide a thorough measurement of this construct, Kathy Hurtt created a skepticism scale. Hurtt's skepticism scale (Hurtt, 2003) is based on accounting and other academic studies as well as philosophical analysis. Her assessment is based on traits and conduct that have historically been connected to skepticism. It assumes that professional skepticism is a multifaceted construct made up of six distinct traits falling into three broad categories: evaluating the evidence, appreciating the sources of the evidence, and acting on the evidence.

Management Accountant and Professional Skepticism

Professional skepticism is a fundamental attribute for auditors; however, the International Federation of Accountants has stated that there is a shared responsibility for skepticism, which extends to all professional accountants, not just auditors (IFAC, 2018). Particularly, preparers must exercise skepticism themselves before providing information to external auditors. Outdated practices of attempting to manipulate auditors to test their limits are no longer acceptable. Audit committees and internal auditors should challenge themselves, the controls they implement, and the quality of the information they generate before submitting it to external auditors. It is not the auditors' role to prove management wrong; instead, it is management's responsibility to substantiate its assertions. The following points illustrate why professional skepticism is crucial for management accountants:

i) Decision-Making and Risk Assessment: Enslin et al (2023) hold management accountants accountable for providing accurate and reliable financial information to support

strategic decision-making. They can examine the quality and trustworthiness of evidence, question assumptions, and confront potential biases by employing professional scepticism. Professional scepticism allows management accountants to evaluate risks objectively, ensuring that choices are based on good financial analysis and reducing the possibility of errors or misinterpretations.

ii) Ethical Behavior and Compliance: Professional skepticism is closely linked to ethical behavior in the accounting profession. Management accountants with a high level of professional scepticism are more likely to adhere to ethical standards, maintain neutrality, and act in the best interests of stakeholders (Schuster, 2022). They are better equipped to spot ethical quandaries, assess the impact of decisions on stakeholders, and promote financial openness and responsibility.

iii) Quality of Management Accounting Information: Professional scepticism adds to the dependability and accuracy of management accounting information. Management accountants rigorously assess data sources, check the accuracy of information, and challenge assumptions or potential biases by adopting a sceptical mindset (Afrinanda et. al, 2022) This strategy improves the quality of management accounting reports, resulting in better informed decision-making by stakeholders such as executives, board members, and investors.

In a nutshell, increasing professional scepticism is critical for management accountants because it allows them to detect and prevent fraud, make informed decisions, maintain ethical behaviour, improve the quality of management accounting information, strengthen risk management, and build trust with stakeholders. Management accountants can efficiently accomplish their obligations and contribute to the success of the organisations they represent by adopting professional scepticism.

Hypotheses Development

Hurtt (2010) developed a model of professional scepticism based on skepticism's philosophical elements. In this theoretical model, professional scepticism is comprised of three dimensions; which is examination of evidence, understanding evidence provider and acting on the evidence.

Examining Evidence

Hurtt's scale is based on the theoretical growth of skepticism contained in Hurtt, Martha Eining, and David Plumlee's book "Professional Skepticism: A Model with Implications for Research, Practice, and Education" (HEP). HEP claim that a questioning mind, suspension of judgement, and a thirst for knowledge are the three aspects of skepticism that deal with scrutinising evidence. Skeptics have a critical mindset; therefore, they are unlikely to take information at face value and instead demand evidence or reason. Skeptics can see all sides of an argument and frequently take pleasure in playing "devil's advocate." It has also been suggested that sceptics reserve judgement to conduct further research and gather proof. Skeptics are slower to judge and less inclined to jump to conclusions since they have put their judgement on hold. And finally, seeking information is the same as being inherently interested. People who appreciate studying and seek information for its own sake are called sceptics. Thus, the proposed research hypotheses were:

H1a: There is a significant relationship between Questioning Mind and management accountant’s ability to detect fraud.
H1b: There is a significant relationship between Search for Knowledge and management accountant’s ability to detect fraud.
H1c: There is a significant relationship between Suspension of Judgement and management accountant’s ability to detect fraud.

Understanding Evidence Providers

This part of skepticism, sometimes known as "interpersonal understanding," involves a person's curiosity about the intentions and moral character of the sources of the evidence. According to HEP, a sceptic can understand that several people would view the same event from their own unique perspectives. Even when a person looks to be perfectly trustworthy, skepticism helps people look past the obvious and question the source of information. Auditors are cautioned in public accounting to be wary of management claims. The assumption is that managers will intentionally mislead the facts to further their own (or the company's) interests. They might just have different perspectives. A sceptic can conduct research well since they are aware of the opposing viewpoint.

H1d: There is a significant relationship between Interpersonal Understanding and management accountant's ability to detect fraud.

Acting on Evidence

The final skepticism scale category focuses on the individual's initiative to act on information. Self-assurance and self-determination are the traits that HEP identify in this section. A sceptic is more likely to take the initiative to act on the information he or she considers dubious by displaying higher levels of self-confidence. A sceptic with strong degrees of self-determination will probably keep gathering data until satisfied that there is enough of it. The sceptic is better equipped to appreciate his or her own personal insights and have the guts to disagree with others when they possess self-assurance and self-determination.

H1e: There is a significant relationship between Self-confidence and management accountant's ability to detect fraud
H1f: There is a significant relationship between Self-determining and management accountant's ability to detect fraud

Hurtt's scale consists of a series of 30 questions designed to elicit respondents' self-assessments of their skepticism qualities. Hurtt's scale bases its measurement of professional skepticism on these traits (see Figure 1). To get to its ultimate state, the scale underwent extensive pilot testing. To demonstrate the validity of intrasubject test-retest reliability, it was also tested and retested a few weeks later. The Hurtt scale's reliability has been consistently demonstrated by researchers utilising data from internal auditors, external auditors, and accounting students. Studies linking the degree of skepticism with the expected actions associated with skepticism have also supported the use of the skepticism scale. This study focuses on management accountants' levels of professional skepticism in fraud detection and prevention.

Tone At the Top

Fraud is a major concern for organizations worldwide. It can result in significant financial losses, damage to reputation, and loss of stakeholder confidence. Tone at the top is a critical

component of fraud prevention efforts, as it sets the ethical tone for the entire organization. Johari (2021) conducted a study to investigate the relationship between tone at the top and fraud risk judgment. The findings revealed that the tone at the top had no significant relationship with fraud risk judgment. On the other hand, Hamshari (2021) found a strong and statistically significant correlation between professional skepticism and internal control, indicating the extent of accuracy and the extent to which it is affected by the internal control if the auditor exercises professional skepticism.

Klaus (2022) reported that a weak tone at the top may have permitted serious ethical and legal violations to take place. On the other hand, Wang (2022) showed that internal auditors report a higher risk of intentional misstatements when the tone at the top is poor compared to when it is good. The study further suggested that the existence of coordination between internal and external auditors can be an effective mechanism to mitigate any influence of a poor tone on internal auditors' fraud risk assessments.

Abri (2019) highlighted that the tone at the top-level management and corporate culture has a direct impact on financial statement fraud. Additionally, Noviyanti (2015) found that a high tone at the top of the partner's style played a critical role in maintaining and improving auditors' professional skeptical behavior, particularly for auditors who had a weak skeptical attitude. Finally, Onesti (2023) proposed that the tone at the top is one of the main drivers of corporate governance sustainability to prevent fraud. The study also highlighted the positive influence of a high tone at the top on the preparation of accounting procedures, the reliability of financial statements, and auditing processes, with undoubted advantages in terms of efficiency, cost savings, and corporate sustainability. Thus, the proposed research hypothesis was:

H2: Tone at the top positively influences management accountant’s fraud detection.

Research methodology

This study used a quantitative research design to test the relationship between professional skepticism, tone at the top and management accountants’ fraud detection. Partial Least Squares Structural Equation Modeling (PLS SEM) was adopted as the statistical analysis method to test the research hypotheses. This study used primary data collection and the target population of this research is management accountants with Malaysian Institute of

Accountants (MIA) membership. An online questionnaire survey was disseminated among management accountants and a total of 267 management accountants responded to the survey. The self-administered questionnaire was designed based on a comprehensive review of the literature.

The questionnaire comprises nine distinct sections, each with a specific focus. Section A pertains to the respondent's demographic profile, while sections B through G are designed to elicit information on the independent variables related to professional skepticism adopted from Hurtt (2010). Section H focuses on the independent variable of tone at the top, which was extracted from PWC, (2010) and section I is dedicated to the dependent variable of fraud prevention and detection extracted from Oommen (2015) with a slight modified version.

Demographic profile of the respondents

This study involved 237 respondents. 152 individuals (64.1%) identified as female while 85 individuals (35.9%) identified as male. According to the results, 39 individuals (16.5%) were aged between 21 to 30 years old, 155 individuals (65.4%) were aged between 31 to 40 years old, 36 individuals (15.2%) were above 41 years old, and only 7 individuals (3.0%) were below 20 years old. In addition, the finding indicates that 92.0% of the 237 respondents surveyed identified their ethnicity as Malay, while the remaining 8.0% identified themselves as Punjabi, with a total of 19 individuals falling under this category. The highest education completed by the participants varied, with 60 individuals (25.3%) having completed a Bachelor's degree, 138 individuals (58.2%) having completed a Master's degree, and 18 individuals (7.6%) having completed a PhD. Additionally, 20 individuals (8.4%) completed their professional qualifications, while only one person (0.4%) completed a Diploma. Out of the total respondents, 39 individuals (16.5%) held an ACCA (Association of Chartered Certified Accountants) license, while the majority, 198 individuals (83.5%), did not hold any of the listed professional licenses. The result shows the distribution of respondents according to their working experience as an accountant. 95 of them (40.1%) had 2-5 years of experience, while 64 individuals (27.0%) had 6-10 years of experience. Additionally, 59 individuals (24.9%) had less than 1 year of experience, and 19 individuals (8.0%) had more than 11 years of experience. Furthermore, 8.9% are auditors, 7.6% are chief financial officers (CFOs), 0.4% are housewives, 17.7% are junior accountants, 8.0% are lecturers, 24.9% are managers, and 32.5% are senior accountants. Out of the 237 individuals surveyed, 162 of them, which is 68.4%, work in the private sector, while the remaining 75 individuals, which

is 31.6%, work in the public sector. Next, 175 (73.8%) reported that they were in a permanent employment status, while 62 (26.2%) indicated that they were on a contract basis. Most respondents (59.1%) work in organizations with more than 1,000 employees. 16.5% work in organizations with 500-1000 employees, 15.2% work in organizations with 100-500 employees, and 9.3% work in organizations with 51-100 employees.

Table 1. Demographic profile

Variables	Category	Frequency (n=237)	Percentage (%)
Gender	Female	152	64.1
	Male	85	35.9
Age	Below 20 years old	7	3.0
	21 to 30 years old	39	16.5
	31 to 40 years old	155	65.4
	Above 41 years old	36	15.2
Race	Malay	218	92.0
	Punjabi	19	8.0
Highest education	Bachelor's degree	60	25.3
	Diploma	1	0.4
	Master's Degree	138	58.2
	PhD	18	7.6
	Professional Qualifications	20	8.4
Professional license	ACCA	39	16.5
	None of the above	198	83.5
Working experience	Less than 1 year	59	24.9
	2 – 5 years	95	40.1
	6 – 10 years	64	27.0
	More than 11 years	19	8.0
Current position	Auditor	21	8.9
	CFO	18	7.6
	Housewife	1	0.4
	Junior accountant	42	17.7
	Lecturer	19	8.0

Variables	Category	Frequency (n=237)	Percentage (%)
	Manager	59	24.9
	Senior accountant	77	32.5
Sector	Private Sector	162	68.4
	Public Sector	75	31.6
Employment status	Contract	62	26.2
	Permanent	175	73.8
Number of employees	51-100	22	9.3
	100-500	36	15.2
	500-1000	39	16.5
	More than 1,000	140	59.1

Measurement of Variables

For this study, the items for measuring the independent and dependent variables were fully adapted from previous studies. The dependent variable includes fraud detection, while the professional skepticism characteristics and tone at the top acted as an independent variable. Fraud detection and prevention is based on the study done by Oommen & Buys (2015). The study also adapted Hurtt's (2010) thirty statements to measure their level of professional skepticism characteristics and PWC (2010) to measure the tone at the top. Table 2 summarises the operationalisation of variables.

Table 2. Summarises of the Operationalisation of Variables.

Variables	Operationalisation	Source
Interpersonal Understanding	Five instrument items identify the understanding of management motivation and integrity in providing audit evidence. The respondent's scores on a 5-point Likert scale ranged from one (strongly disagree) to five (strongly agree).	Hurtt (2010)
Questioning Mind	Three instrument items identify the management accountant's curiosity in questioning and seeking an explanation. The respondent's scores on a 5-point Likert scale ranged from one (strongly disagree) to five (strongly agree), which is based on	Hurtt (2010)

Variables	Operationalisation	Source
	Hurtt (2010).	
Search for Knowledge	Five instrument items identify the level of the management accountant's curiosity in seeking more information. The respondent's scores on a 5-point Likert scale ranged from one (strongly disagree) to five (strongly agree).	Hurtt (2010)
Self-confidence	Six instrument items identify the trust level in its abilities. The respondent's scores on a 5-point Likert scale ranged from one (strongly disagree) to five (strongly agree).	Hurtt (2010)
Self-determining	Five items identify the ability to decide on the adequacy of the information as evidence, which renders an audit decision. The respondent's scores on a 5-point Likert scale ranged from one (strongly disagree) to five (strongly agree).	Hurtt (2010)
Suspension of Judgement	Six instrument items identify the management accountant's behaviour level in delaying judgement. The respondent's scores on a 5-point Likert scale ranged from one (strongly disagree) to five (strongly agree).	Hurtt (2010)
Tone at the top	Seven instrument items identify the management accountant perception on their tone at the top. The respondent's scores on a 5-point Likert scale ranged from one (strongly disagree) to five (strongly agree).	PWC (2010)
Fraud Detection	Three instrument items identify under procurement, five instrument items identify under payables, six instruments' items identify under receivables and Nine instruments items identify under General financial and payroll. The respondent's scores on a 5-point Likert scale ranged from one (strongly disagree) to five (strongly agree).	Oommen & Buys (2015)

Results

Data Analysis

Partial least squares (PLS) structural equation modelling was performed using the SmartPLS software version 4.0 (Ringle et al., 2022). This statistical tool permits to analyze the proposed measurement and structural model, since survey research is normally not normally distributed and has the advantage of allowing for small sample sizes without relying on the assumption of data normality (Chin et al., 2003). Multivariate normality was tested by following Webpower website as recommended by Cain et al. (2017). The results showed that multivariate skewness was 5425.856 ($p < 0.01$), while multivariate kurtosis was 5523.454 ($p < 0.01$), suggesting that the data was not normal. As such we ran the bootstrapping procedure to generate the standard errors when testing the structural morel. As recommended by Kock and Lynn (2012), we first examined the potential for Common Method Bias by assessing full collinearity. This approach involves regressing each variable against a common variable and if the variance inflation factor (VIF) is less than or equals 5, then, there is no bias resulting from the single data source. As shown in Table 3, the analysis produced a VIF less than 5, thus, common method bias is not a serious issue in our study.

Table 3. Full collinearity analysis

Constructs	VIF
Questioning mind	1.173
Search for knowledge	2.331
Suspension of judgement	3.202
Interpersonal understanding	1.250
Self-confidence	1.630
Self-determining	2.860
Tone at the top	1.890

Measurement model Assessment

In the assessment of reflective measurement model (stage 1), there are specific measures that include indicator reliability, internal consistency, convergent validity, and discriminant validity. Reliability was assessed by first checking the indicator reliability based on outer loadings of at least 0.708 or higher however loadings higher than 0.5 is adequate if other items have the highest scores of loadings to complement AVE and CR. For AVE, it is suggested that AVE should be higher than 0.5 and CR should be higher than 0.70-0.90 (0.95)

to be considered as satisfactory (Hair J. F., Sarstedt & Ringle, 2019). Table 4 reveals the measurement validity and reliability.

Table 4. Convergent Validity and Reliability

First Order Constructs	Second Order Constructs	Item label	Loadings	CR	AVE
Fraud detection				0.954	0.564
	Procurement			0.912	0.777
		PRO1	0.951		
		PRO2	0.788		
		PRO4	0.897		
	Payables			0.884	0.609
		PAY1	0.853		
		PAY2	0.743		
		PAY3	0.943		
		PAY10	0.601		
		PAY11	0.717		
	Receivables			0.974	0.862
		REC1	0.699		
		REC2	0.952		
		REC3	0.958		
		REC4	0.971		
		REC5	0.982		
		REC6	0.974		
	General financial and payroll			0.983	0.866
		GFP1	0.989		
		GFP2	0.888		
		GFP3	0.979		
		GFP4	0.926		
		GFP5	0.958		

First Order Constructs	Second Order Constructs	Item label	Loadings	CR	AVE
		GFP6	0.969		
		GFP7	0.929		
		GFP8	0.987		
		GFP9	0.722		
Professional skepticism	Questioning mind			0.796	0.572
		QM1	0.900		
		QM2	0.599		
		QM3	0.740		
	Search for knowledge			0.966	0.905
		SFK2	0.989		
		SFK3	0.872		
		SFK4	0.988		
	Suspension of judgement			0.877	0.707
		SOJ1	0.856		
		SOJ2	0.701		
		SOJ5	0.946		
	Interpersonal Understanding			0.909	0.670
		IU1	0.943		
		IU2	0.845		
		IU3	0.666		
		IU4	0.867		
		IU5	0.741		
	Self-confidence			0.903	0.816
		SC1	0.792		

First Order Constructs	Second Order Constructs	Item label	Loadings	CR	AVE
		SC2	0.936		
		SC3	0.979		
		SC4	0.907		
		SC5	0.893		
	Self-determining			0.829	0.556
		SD1	0.615		
		SD2	0.736		
		SD3	0.939		
		SD4	0.649		
	Tone at the top			0.907	0.591
		TT1	0.726		
		TT2	0.960		
		TT3	0.921		
		TT4	0.584		
		TT5	0.819		
		TT6	0.710		
		TT7	0.567		

In this study, fifteen items were removed due to low factor loading (< 0.5). Consequently, the AVE for all constructs have met the satisfactory level of AVE result of 0.5. Furthermore, all constructs have also achieved the composite reliability acceptable values of 0.7. The discriminant validity using the new suggested method by Henseler et al. (2015) through the Heterotrait-Monotrait ratio of correlations (HTMT) values are lower than 0.90. This confirmed discriminant validity. (Refer Table 5).

Table 5. Discriminant validity (HTMT)

	1	2	3	4	5	6	7	8	9
Fraud Detection									

	1	2	3	4	5	6	7	8	9
Interpersonal Understanding	0.260								
Professional Skepticism	0.253	0.687							
Questioning Mind	0.533	0.390	0.776						
Search for Knowledge	0.368	0.382	0.516	0.452					
Self-confidence	0.503	0.174	0.481	0.488	0.489				
Self-determining	0.465	0.359	0.566	0.359	0.364	0.426			
Suspension of Judgement	0.569	0.300	0.650	0.875	0.878	0.689	0.399		
Tone at the top	0.547	0.551	0.553	0.680	0.496	0.486	0.313	0.704	

Structural model Assessment

Path coefficients, standard errors, t-values, and p-values for the structural model using a 10,000-sample resample bootstrapping approach were presented in accordance with Hair et al. (2019) and Ramayah et al. (2018). Table 6 shows the summary of the criterions used for hypotheses testing. As shown in Table 6, professional skepticism had a significant positive effect on the management accountant's ability to prevent and detect fraud ($\beta = 1.699$, $p < 0.01$), while, providing support to hypothesis H1. This result demonstrates that for every unit increase in professional skepticism will contribute 1.699 significantly towards accountant's ability to prevent and detect fraud. In addition, questioning mind had a significant negative effect on accountant's ability to prevent and detect fraud ($\beta = -0.785$, $p < 0.01$). This result explains that for every unit increase in questioning mind will reduce 0.785 significantly towards accountant's ability to prevent and detect fraud. Search for knowledge shows significant negative effect towards accountant's ability to prevent and detect fraud ($\beta = -0.623$, $p < 0.01$), suggesting that for every unit increase in search for knowledge will reduce 0.623 significantly towards accountant's ability to prevent and detect fraud.

Next, suspension of judgement has nonsignificant effect on accountant's ability to prevent and detect fraud ($\beta = -0.206$, $p > 0.05$). This finding is consistent with interpersonal

understanding (β= -0.389, p > 0.05). Self-confidence, on the other hand, demonstrates significant positive effect on accountant's ability to prevent and detect fraud (β= 0.256, p < 0.01). The finding suggests that for every unit increase in self-confidence will increase 0.256 in accountant's ability to prevent and detect fraud. Self-determining demonstrates significant negative effect on accountant's ability to prevent and detect fraud (β=-1.504, p <0.01), suggesting for every increase in self-determining will reduce 1.504 accountant's ability to prevent and detect fraud. Finally, tone at the top, reveals significant positive effect on accountant's ability to prevent and detect fraud (β= 0.473, p <0.01). The finding suggests that for every unit increase in tone at the top will increase 0.473 in accountant's ability to prevent and detect fraud.

Through these analyses, hypotheses H1, H1a, H1b, H1e,H1f and H2 were supported, while H1c and H1d were not supported. According to Hair et al. (2019), R^2 values of 0.737 reveal that 73.7% of total variation in accountant's fraud prevention and detection is explained by all variables in the model. The Q^2 value for business success is larger than 0, indicating that the model has sufficient predictive relevance. After examining the structural model, six hypotheses were supported in this study. Table 5 summarises the hypotheses testing in this study.

Table 6. Hypotheses testing

	HYPOTHESIS	STD BETA	T-VALUE	P-VALUE	LL	UL	F^2	DECISION
PS -> FPD	H1	1.669	4.993	0.000***	1.033	2.143	0.389	Supported High Effect
QM -> FPD	H1a	-0.785	3.877	0.000***	-1.519	-0.727	0.321	Supported Low Effect
SFK -> FPD	H1b	-0.623	4.333	0.000***	-1.225	-0.510	0.319	Supported Low Effect
SOJ -> FPD	H1c	-0.206	0.875	0.191	-0.405	0.565	0.014	Not Supported
IU -> FPD	H1d	-0.389	0.736	0.231	-0.650	0.692	0.117	Not Supported
SC ->	H1e	0.256	2.377	0.009***	0.175	0.521	0.146	Supported

FPD								High Effect
SD -> FPD	H1f	-1.504	7.055	0.000***	-2.034	-1.328	0.736	Supported Low Effect
TATT-> FPD	H2	0.473	4.836	0.000***	0.273	0.600	0.347	Supported High Effect

Note: Significant at **5%, ***1% level

PS= Professional skepticism, QM= Questioning mind, SFK= Search for knowledge, SOJ= Suspension of judgement, IU=Interpersonal understanding, SC= Self-confidence, SD= Self-determining, TATT= Tone at the top, FPD=Management accountant's fraud prevention and detection.

Findings and Discussion

Increasing professional skepticism causes accountants to be less likely to accept information at face value and more likely to challenge assumptions, consider alternative explanations, and investigate discrepancies. This method aids in the detection of errors, omissions, or inconsistencies that may indicate fraudulent activity. A strong and supportive tone at the top can serve as a driving force for management accountants to improve their ability to prevent and detect fraud. Conversely, A weak tone at the top can significantly increase the risk of intentional misstatements and financial statement fraud.

The study conducted by Hurts (2010) identified six items that affect the accountant's ability to prevent and detect fraud, out of which four items, including questioning mind, search for knowledge, self-confidence, and self-determination, were found to have a significant influence. However, among these four attributes, questioning mind, search for knowledge, and self-determining have a low effect on preventing fraud, while self-confidence has a high effect on the accountant's ability to prevent and detect fraud. Furthermore, the study revealed that two items, suspension of judgment, and interpersonal understanding, are found to be irrelevant in maintain professional sceptisim attitude and had no significant impact on the accountant's ability to prevent and detect fraud.

Examining Evidence

H1a: Questioning mind

Hypothesis 1a (H1a) suggested that there is a significant relationship between the questioning mind and the management accountant's ability to detect fraud. The variable questioning mind had a significant relationship with low effect. As a result, hypothesis 1 was accepted. This illustrates that if management accountants have a higher trait of a questioning mind, they will be unable to spot any abnormalities in financial statements produced by error or deceit. Ciolek (2018) discovered that students with professional qualifications possess a stronger level of a questioning mind compared to bachelor and master students, and work experience significantly influences the level of a questioning mind. In this study, only 8.4% of the respondents hold a professional qualification (ACCA), while the majority have worked as accountants for 2-5 years. This may explain why an increase in the questioning mind variable leads to a significant reduction of accountants' ability to prevent and detect fraud.

H1b: Search for Knowledge

Hypothesis 1b (H1b) was supported. It had a significant relationship with a low effect between the search for knowledge and management's ability to detect fraud. This is supported by prior study conducted by Syed Mustafa Nazri et al. (2023). Westermann et al. (2014) noted that auditors will sometimes process only the data they have prepared within the time allotted to complete their tasks. This is also applicable to management accounts, where they have a tendency to simply follow the objectives to complete their work as quickly as possible and to adhere to the given timeline, despite using their behaviour to seek out more information to make sound judgements or evaluations of an audit. In addition, searching for more information may result in an excess of review evidence and a decrease in productivity (Glover & Prawitt, 2014).

H1c: Suspension of judgement

Hypothesis 1c, which suggests that there is a significant relationship between suspension of judgement and management accountant's ability in detect fraud was rejected. This is consistent with the findings of Sayed Hussin et al. (2015) (Mohamed & Ismail, 2011; Agoglia et al., 2007) . The attribute of suspension of judgement may be irrelevant, as respondents are required to devote more time to management decision-making, which may delay the MA's work. This suggests that the respondents are unlikely to possess such a

characteristic because they are overburdened with numerous MA duties that must be completed by a specified date (Sayed Hussin et al. (2015). The findings suggest that environmental differences may account for differences between nations.

Understanding the Evidence Provider

H1d: Interpersonal Understanding

Hypothesis 1d, which suggests that there is a significant relationship between interpersonal understanding and management accountants' ability to detect fraud, was rejected. This finding is consistent with Cheot et al. (2018). Detecting fraud frequently necessitates a strong focus on financial research, data interpretation, and meticulous attention to detail. While interpersonal awareness is important for creating relationships and understanding others, it may not directly contribute to the technical skills and knowledge needed to spot financial abnormalities or anomalies that suggest fraudulent activity.

Acting on Evidence

H1e: Self-Confidence

Hypothesis 1e (H1e), which suggests that there is a significant relationship between self-confidence and the accountant's ability to detect misconduct on behalf of management, was supported with high effect. Self-confidence is required for management accountants to maintain their independence while performing their services. In fact, it is a trait of professional scepticism among management accountants, as it enables them to resist persuasion and challenge the perspectives of others (Hurtt, 2010). Our findings are parallel to those of the other studies by Bogdan et al. (2017) and Su et al. (2016). This demonstrated that self-assured MAs are capable of carrying out their duties and enhancing the exposure of extortion, as they appeared to challenge the assertions or defences received by them. In other words, auditors with a high level of self-confidence are confident in their ability and competence to carry out audit duties and enhance the detection of fraud. (Cheot, 2018).

H1f: Self-Determining

Hypothesis 1f (H1f), which suggests that there is a significant relationship between self-determining and the MA’s ability to detect misconduct on behalf of management, was supported with low effect. Auditors will conduct extra research and collect evidence until

they are satisfied and confident in forming their own opinions (Syed Mustapha Nazri et al., 2023). However, according to the findings of this study, this is not the case for accountants. Despite utilising their behaviour to seek out additional information to make accurate judgements or evaluations of an audit, management accountants have a propensity to merely follow the objectives to complete their work as quickly as possible and to adhere to the set timeframe. Furthermore, looking for more information may result in an overabundance of review evidence and a decline in productivity (Glover & Prawitt, 2014).

H2: Tone at the top

Hypothesis 2 (H2) suggests that tone at the top positively influences management accountants' fraud detection, which was supported with high effect. The findings are similar to those of Schwartz et al. (2005) but differ from Whang (2014) in that when the tone at the top is positive, management accountants indicate an enhanced risk of fraud detection. This suggests that management accountants are more skeptical when it is supported by a positive tone at the top and that a negative tone at the top is a warning sign for financial misstatements.

Since employees pay close attention to the behaviour of top management, their judgements and decisions are influenced by the tone at the top generated in the workplace by top management (Wang, 2014). The overall control environment is influenced by the leadership's tone. As employees of the organisation, management accountants make decisions based on the organisation's ethical climate, work environment, and leadership tone.

Conclusion

In conclusion, professional skepticism and tone at the top are crucial factors that positively impact the ability of management accountants to prevent and detect fraud. Employees' levels of professional skepticism are likely to differ. These variations, however, do not suggest that people who are less skeptical are incapable of developing their skills. People who score low on the skepticism scale can be trained to display behaviours consistent with those who score higher, even though researchers have discovered that higher levels of skepticism are related to people questioning facts and gathering more evidence to back conclusions (Durtschi and Fullerton, 2006).

Businesses can develop their training approach by having a better understanding of the variations in levels of skepticism. The types of skills required to spot fraud may need to be reinforced periodically for staff members who are less skeptical. Employees may be better able to recognise risk factors and develop increased sensitivity to cues and red flags that point to fraudulent activity with ongoing fraud training. According to research, even inexperienced fraud detectors who train and receive feedback display higher levels of skepticism and are more adept at spotting fraud when it occurs (Durtschi and Fullerton, 2008).

Management accountants are not required to explicitly consider fraud in every engagement, as auditors are required to do. But it's vital to remember that raising fraud awareness can make fraud detection easier. Through newsletters or other types of communication, accountants can be made aware of fraudulent practises that are found both within the company and in other companies. Giving all staff members knowledge of the typical behaviours of fraudsters can aid them in spotting probable fraud activities. Even subliminal reminders that stress the value of approaching situations with skepticism during staff meetings or company-wide gatherings may help prevent fraud (Carpenter, Durtschi, and Gaynor, 2008).

Organisations may want to encourage their finance and accounting staff to obtain certification as another fraud protection and detection method. Studying for certification broadens an accountant's knowledge base, which may raise their skepticism and make them more aware of inconsistencies when they come across them. Additionally, obtaining a certification may boost one's self-confidence, giving one the courage to challenge events, business dealings, or coworkers' conduct.

This study is one of the few that addresses the dearth of literature focusing on management accountants in Malaysia, as well as the lack of reliable literature on Hurtt's professional scepticism and the detection of fraud, particularly in the Malaysian context.

Future Study

In conclusion, measuring and administering research on professional skepticism has proven to be challenging. But it is possible to measure skepticism objectively according to the Hurtt Skepticism Scale. This study is the first to look at management accountants' degrees of

skepticism. Future research should build on these findings even if it presents some preliminary findings and conclusions. Research should, for instance, look into whether highly sceptic management accountants also score highly on behaviours like information search, contradiction spotting, alternative generation, and enhanced scrutiny of interpersonal information. To put it another way, does management accounting's enhanced skepticism result in better fraud detection? Are more sceptic management accountants similarly more prone to operate more slowly than their counterparts? And finally, which teaching and training techniques have the best chance of fostering the capacity for displaying the right amounts of skepticism?

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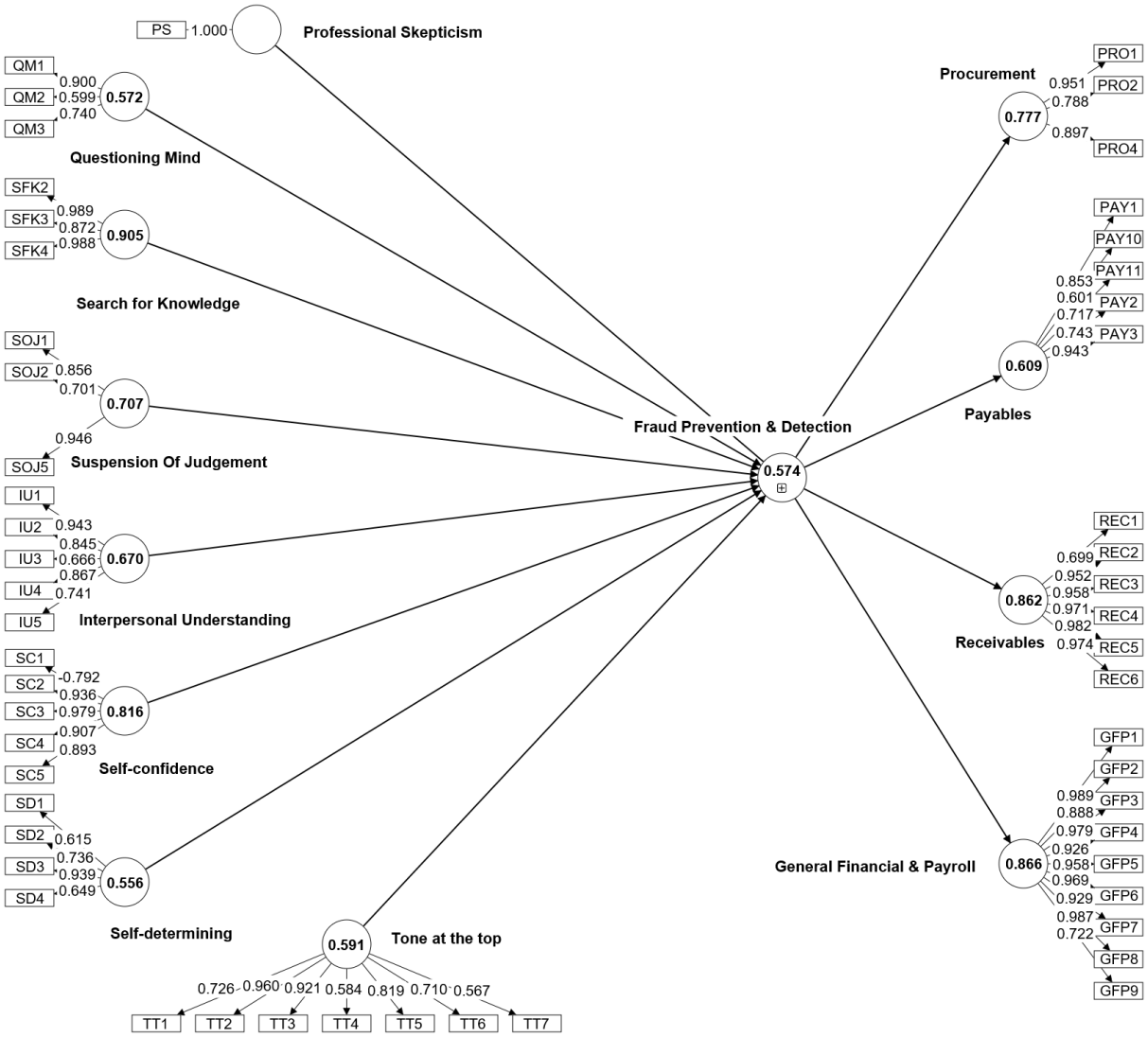

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Chapter 3 - Art History, Museums, and Inclusion: Student Successes, Empowerment Examples

Stephanie Chadwick

Chapter Highlights

- The purpose of this research explores the necessity for innovative pedagogical strategies in universities, emphasizing the goal of engaging diverse student bodies. Seeks to introduce students to global cultural production and empower them in both virtual and real-world learning environments.
- Examines the intersection of contemporary pedagogy, art exhibition, and visual-cultural production. Highlights the importance of these elements in creating meaningful connections between local and global practices, offering insights into broader social practices and concerns.
- Explores strategies for meaningful connections between historical and contemporary art practices. Illustrates this through case studies from Lamar University's Art & Design program, focusing on graphic design for cultural heritage, studio art for social justice, and art and museum engagement for gender equity.
- Discusses how the investigation of art and its histories empowers students. Emphasizes the role of art education in encouraging students to explore, engage, and chart their own success pathways, fostering creativity and critical thinking.
- Examines undergraduate and postgraduate successes at Lamar University, showcasing the practical application of art education. Highlights the impact in three specific areas: contributing to cultural heritage through graphic design, advocating for social justice through studio art, and promoting gender equity via art and museum engagement. Demonstrates how these success stories reflect the broader societal contributions of art and design education.

Introduction

James Elkins (2006) and other scholars have expounded upon the many ways that what we call “art” is not a set of coherent practices but instead varies according to both cultural and historical context. In our globally connected era, a period during which we see and interpret a profusion of images and objects on a daily basis—we have reached a point where objects of all kinds, not merely those deemed to be artistically or archeologically significant for the insights they can provide into past practices, warrant study.

Seeking to examine a broader array of human artistic production and to include more work by artists and cultures that have been under or misrepresented in the art historical canons, art historians have embarked upon explorations of history, gender, the body and other thematic inquiries. Addressing inclusion and diversity of representation is not unique to art history or even to the arts and humanities in general. Indeed,the quest to develop inclusive teaching methods that resonate with diverse twenty-first century students has been taken up across disciplines. In my art history classes, which serve undergraduates in art studio, design, and art education, as well as students pursuing history, communication, or any number of undergraduate degrees, we acknowledge and discuss these concerns.

Many of my students are learning the skills to embark upon graduate studies, teach in primary or secondary schools, or pursue museum or other educational roles. Moreover, since visual literacy is becoming a crucial component of critical engagement with a variety of media, many students will apply their visual and art historical analyses skills in seemingly unrelated fields. It seems reasonable, then, to consider the impact of image- and object-related pedagogy on their successes in both art history courses and in their future learning, teaching, and career contexts.

Method

Inspired by Grant P. Wiggin’s and Jay McTighe’s (2008) ideas on *Understanding by Design*, in which the end goals are the driving factors in course development, I began rethinking my approach and asking key questions. “How can we engage students earlier on with the relevance of visual analysis, history, and discourses on the impact of art produced in both local and global contexts?” “How can we apply active and significant learning experiences in

the spirit and methods outlined by Dee Fink (2003) and other pedagogical scholars to art history that connects students of diverse backgrounds with art, its practices, and its histories in ways that include close looking and cultivating an appreciation of art and its exhibition as social practices. Finally, how can I foster appreciation of art's empowering role models and resources?

With these questions and concerns in mind—and in an effort to connect with and inspire new generations of students who might not (yet) understand the value of engaging with the art and cultural production of the past—I began backing into art history through the lens of global contemporary art. Given the propensity of contemporary artists to explore critical social, political, and historical issues, analyzing contemporary art provides a refreshing window into the art of the past and the ways in which it still resonates today. This approach is combined with using updated interactive resources, such as Smarthistory, an expanded online art history encyclopedia, and the Chadwick and Meeks (2020) textbook *Art as Living Practice: Southeast Texas and Beyond* and its online edition written by our Department of Art & Design faculty in collaboration with students, alumni, and community art professionals.

Backing into art history and its issues through the lens of contemporary art has emboldened me to experiment with multiple approaches within the same course, even on the same day. One example is having a breakout session on portraiture and politics within an otherwise temporal coverage of art, revolution, and empire since the Enlightenment—indeed to examine the very term *Enlightenment* and to consider how artists have represented, responded to, and critiqued related discourses. The work of Kehinde Wiley and the Brooklyn Museum of Art (2020) exhibition *Jacques-Louis David meets Kehinde Wiley* has been one way to do this; as is eloquently stated on the museum's website, "Seen together, the works by David and Wiley reveal how race, masculinity, power, and representation layer onto portraiture and shape the writing of history." What better way to get students looking at art and talking about its history and continued relevance to today's art and cultural concerns.

Results

Backing into the exploration of art and its history through the lens of contemporary art and bringing the work of successful students and alumni into our class discussions provides a format to investigate artworks in local and regional collections that students can easily access

in terms of proximity and cultural connections. We discuss these in relation to the internationally acclaimed artworks in our course readings and videos. Embracing the idea that "local is the new global" –the title of a recent *Art Newspaper* webinar – including exhibitions and works such as these in classes elevates students' understandings about the different ways of thinking about art as culturally valuable. Indeed, this approach empowers students by paying attention to the diversity that can be seen at different points in the history of art and the kinds of treasures that can be appreciated right around the corner in addition to those that can be seen by travelling or virtually accessing the great museums of the world.

Discussion: Backing into Art History

The first time I started my Asian art learning module with photos and video of contemporary artist Ai Weiwei dropping priceless Chinese urns I could tell I had gotten my students' attention. The energy was palpable as they put down their phones and leaned forward in their chairs, whispering to each other their surprise or indignation at the transgression they were seeing on the screen. With that one PBS (2016) *The Case for Ai Weiwei* clip I not only got students' attention but also introduced that our topic would be Asian art and that it would include discussion of colonialism, commodification, and globalist consumerism as well as the politics of collecting and display. Starting class by watching the short video on Ai Weiwei together and discussing his art also prompted my students to make connections between Weiwei's work and artists such as Andy Warhol and to see in nearly real-time the relevance of art history to contemporary practices. I knew I had found a winning strategy for my studio and design majors, who seemed to appreciate the interventionist nature of both the artist and of our revitalized art history class.

Following on the heels of the Weiwei success, we began our intro to Art of the Americas with photos and videos of Guillermo Gomez-Peña and Coco Fusco (1992-1993). Images of these politically active performance artists, with Gomez-Peña in the attire of a Mexican wrestler and matador with text scrawled on his bare chest pleading "Please don't discover me!" struck a chord. This was particularly so among my LatinX students who were starting to engage in political activism on campus and in their own art. At once we knew we were in a discussion not only of the history of art in the Americas but also the history of colonialism – and *its* histories and politics in the Americas as well. Plus, students saw again that history is not only relevant but an integral part of the practice of contemporary artists making both artistic and

political statements. The stakes were high—art history was not a class that students simply had to take to fulfill their requirements for their studio, design, art education, or other degrees—it was a site in which they could investigate art's potential.

Figure 1. Gonzalo Alvarez *Borders*, 2017. Photo Credit, Lamar University Department of Art & Design. Image included with the permission of Gonzalo Alvarez and the Lamar University Department of Art & Design.

Case Study One: Graphic Design for Cultural Heritage, Graphic Designer Gonzalo Alvarez, Lamar University Alumnus, 2017.

Increasing relatability and the visibility of diversity in our own classroom and university, I started showing the work of our art, graphic design, and art education graduates who are working successfully to promote comparable objectives, I also began inviting alumni to come and talk about their challenges and successes and, importantly, how their interest in these

concerns helped maintain the motivation necessary to pursue them to successful pathways. A particularly compelling example is 2017 graphic design graduate Gonzalo Alvarez. As a participant in the McNair Scholarship Program for first generation college students while at Lamar University, Alvarez created *Borders*, a nationally and internationally acclaimed video game installation that draws attention to border crossing deaths (Schmidt, 2017). More recently, Alvarez is completing a series of graphic novels collectively titled *The Legend of Pollo Man* (2023). These graphic novels, for which he creates the narrative and illustrations, are based on work he began for his graduating senior thesis re-envisioning Mexican folklore that he believes warrants more attention in American popular culture and that could be particularly important to promoting cultural awareness. Alvarez has been invited to speak from coast to coast and has studied abroad in Mexico and Japan (home of the anime that also inspired his art). At our invitation, he also regularly reconnects with our students, visiting our classes and demonstrating the significance of using contemporary work as lens through which to investigate the art and culture of the past, to explore cultural borders, and to promote celebration of cultural heritage. He also serves as a role model for our students, who become both interested and empowered when they learn that someone they could have been classmates with a short while ago has gone on to create and publish locally and globally relevant art. Recently students have become excited that Alvarez is also developing a board game based on Aztec culture and has joined the rush to create engaging games for educational use in classrooms.

Museums, Art, and Learning

In addition to exploring the connections between past, present, and future, art history seems to be particularly suited to promoting higher order thinking in the areas of the human dimension, caring, and learning how to learn. Moreover, as re-envisioned by Anderson & Krathwohl. (2001), creativity—a main component of museum and art history exploration—tops the revised chart of Blooms' Taxonomy of learning. Studying art and its histories benefits from various forms of research, including in person image and object analysis, which in turn bolsters creative thinking. These claims are supported by a National Art Education Association and Association of Art Museum Directors (2018) study of the museum experience on primary school students. Synthesizing looking and learning with investigating history and representation, museum learning creates a context in which skills can be combined and applied to real world and academic experiences and concerns, letting students

see also that museums are spaces in which expanding diversity and access have become paramount objectives. It stands to reason, then, that exploring contexts of display, which are their own forms of representation, can enrich the undergraduate experience.

With these ideas in mind, my students and I are excited by the many ways being explored to utilize campus and community museums and galleries. These spaces highlight topics that are relevant to not only my students planning for visual art and art history careers but also to visitors who thrive when making meaningful connections between diverse contexts of production at home and abroad. There is no substitute for seeing art in person, but since most of these venues provide both on-site and virtual access, they have opened up worlds of possibility even to smaller communities that lack such resources, or when travel is not an option. Building upon work conducted in many of our art history classes, a new museum course at Lamar University will explore local and global connections, foster collaboration, and promote communication and critical thinking through object- and context-based experiences. These activities help students prepare for internships and postgraduate positions, but also foster community engagement and social responsibility. Since we have already begun implementing these strategies in existing courses and in combination with peer mentoring activities by senior students and alumni, it is no surprise that when two alumni interviewed for a university museum position each of them enthusiastically outlined their plans to make the museum a more accessible and collaborative space that serves as a bridge between our campus and the community.

Student responses to using recent or well-known exhibitions to begin, enliven, and refocus our class discussions of art history and its relevance today have been encouraging. A great example of this has been *Making Africa*, an exhibition curated by the Vitra Design Museum (2015) and the Guggenheim Bilbao (2015-2016) that traveled in the United States and that many of our faculty saw at the Blanton Museum of Art at the University of Texas in Austin (2018). Inserting even press releases and critical reviews of key exhibitions into our discussions of art history has been an effective way to get students thinking about museums as sites of representational practices. Such inquiries consider the ways in which museums and art history can address issues that resonate with contemporary life and investigations of Colonialism, commodification, and social justice, reinforcing the idea that art plays a crucial role in informing—and transforming—beliefs and practices. Exhibitions such as *Making Africa* get my students' attention.

Figure 2. David McGee paintings in the Art Museum of Southeast Texas (AMSET) exhibition *Black Paintings*, winter 2019-2020. Image included with the permission of David McGee and the Art Museum of Southeast Texas.

Combining these different approaches, I have also adapted museum visits and online research guides to show how our local and regional museums tackle these same issues of providing access to art histories and diverse cultural representations. A notable example was the Art Museum of Southeast Texas (2019-2020) exhibition *Black Paintings*, which highlighted some key works by Houston-based artist David McGee. With characteristic deftness McGee's many works in the show created a visual context that combined recognizable elements of formalism with political activism drawn from his experiences and identities as both an African American and a contemporary visual artist. It thus highlighted for my students the power of drawing upon a rich repertoire of historical sources and contemporary experiences to create culturally and politically impactful art. McGee's work is internationally renowned. Yet, examining the work of this Houston-area artist in our regional Art Museum of Southeast Texas gave students insights into the diversity and significance of art produced and exhibited in our region, empowering students to take up that charge.

Case Study Two: Studio Art for Social Justice, Artist André Ramos-Woodard, Lamar University Alumnus, 2017

Recently impactful has been highlighting the work of another 2017 graduate of Lamar

University. Alumnus André Ramos-Woodard went on to earn his Master of Fine Arts in 2021 at the University of New Mexico, where he combined his pursuits of drawing and photography with his interests in race and queer studies in the drawings he made on self-portraits and other photographs. His large-scale digitally printed photo with drawing titled *Boom Shakalaka*, which deals with youthful memories and the ways in which they can be surreptitiously impacted by stereotypes, was installed at the Museum of Fine Arts, Houston in February 2022. It gives visuality and voice to these issues, demonstrating the ability of regionally produced art to resonate and empower both locally and with wider impact. According to the Museum of Fine Arts, Houston (2023), the museum receives hundreds of thousands of visitors each year.

Figure 3. André Ramos-Woodard, *Buds*, 2020, Mixed media with artist's frame. Image included with the permission of André Ramos-Woodard and the ***Museum of Fine Arts, Houston.***

The fact that Ramos-Woodard wants to pay it forward, has returned to serve as a guest

speaker and mentor, and was invited and accepted a position to teach for us as visiting instructor in spring 2022 has kept him in touch with our students. The fact that he has already sold two of his photographs that interrogate racist stereotypes in American cartoons to an institution of the caliber of the Museum of Fine Arts, Houston, where he has already exhibited, is exemplary. It is also empowering to students seeking to expose the history of racism in visual culture and to promote inclusion, success, and social justice in cultural practices. Ramos-Woodard shows students in Southeast Texas that they too can be productive artists who exhibit meaningful and impactful art.

Figure 4. Mackenzie (Mac) Cumpian hanging art at the Dishman Art Museum, Lamar University. Image included with the permission of Mac Cumpian and the Dishman Art Museum.

Case Study Three: Museum Engagement for Gender Equity Mackenzie (Mac) Cumpian, Museum Educator, Lamar University Alumna, 2020

Accessibility to not only art but to education itself became a paramount concern within the pandemic context. Recent Lamar University art education graduate Mackenzie (Mac) Cumpian was nevertheless able to make connections between art and community and to serve as a role model for struggling students. Combining her love of art education and art history with a campus internship at the Dishman Art Museum (2020), Cumpian created a series of informative videos guiding virtual museum experiences of the historical works in the university collection. Even in ‘lockdown,’ the videos she produced allowed her to gain

valuable looking and speaking experience while helping the university museum reach viewers on our campus, in our community, and beyond.

This engaged and versatile approach served Mac well, helping guide her path toward graduate work in museum studies, acceptance to a Master's program at New York University (graduating class of 2023), and a number of graduate-level internships at internationally renowned museums, including the Whitney Museum of American Art and the Metropolitan Museum of Art, that expand the field of possibilities beyond the expectations that many female students in Southeast Texas might otherwise envision. She too stays connected as an alumni mentor who visits Lamar University Art & Design classes and is teaching art education for us online while working as the New York assistant of John Alexander, a renowned visual artist and another notable Lamar University alumnus who hired Mac after seeing the videos she made for the university's Dishman Art Museum. Mac's work serves as yet another example of the ways that engagement with art, history, and museums—and highlighting student engagement and successes at regional museums—can empower students to create success pathways.

Conclusion

As these case studies demonstrate, bringing the work of successful students and alumni into our classes provides a lens through which we can look at art in a new light as significant and impactful cultural production that impacts current and future generations. Examining the history of art in tandem with the work of these and other contemporary artists demonstrates the importance of access to not only research resources, such as books, articles, artworks, and internet content, but also to university resources and museum spaces and collections that by their very access can promote a sense of empowerment to achieve. Finally, these examples demonstrate the diversity that can be seen at different points in the history of art and the kinds of treasures that can be appreciated right around the corner in addition to those that can be seen by travelling or virtually accessing the great museums of the world.

Recommendations

There is still much to be done. Yet, the forward-thinking work of artists, curators, and educators have opened up worlds of possibilities to reconfigure and revitalize undergraduate

learning and mentoring experiences. The work of such artists and of backing into art history through the lens of contemporary art and museums also provides contexts for thinking through new or hybrid pedagogical possibilities to meet the needs of today's diverse students. In many ways, we have just begun. Yet, empowering students to create strong work, to become exemplary role models, and to serve as mentors has the potential to not only revive classroom activities; it can also inspire and motivate the students of today and potential graduate students and professionals of the future to investigate and apply success strategies that embrace and promote diversity, inclusion, and empowerment.

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Chapter 4 - Producing College Sports for ESPN: A Vygotskian Approach

Michael Quinn

Chapter Highlights

- Explores the collaboration between the Mid-Atlantic Athletic Conference and ESPN, leading to the streaming of men's and women's basketball games. This chapter highlights the transformative agreement and its implications for sports media production education.
- Details the response of the Manhattan College Communication Department to the ESPN agreement, leading to the creation of a Sports Media Production program. The chapter examines the objectives and outlines the fundamental aspects of this initiative.
- Discusses the program's goals, focusing on teaching undergraduate students the intricacies of live sports production, including shooting, editing, replay generation, graphic insertion, and audio mixing. The chapter delves into the practicalities of curriculum design and the hands-on experience provided to students.
- Explores the application of Vygotsky's Scaffolding theory in the program. Describes how students are immersed in a dynamic learning and teaching environment, actively participating in the production process from the outset of each new season.
- Evaluates the successes and challenges encountered over the past three years, as approximately eighty students engaged in live sports productions with varying audience sizes. The chapter provides insights into the multifaceted outcomes and experiences of this unique educational approach, intertwining sports media production and curriculum-driven exploration of Sport and Media Studies.

Introduction

In 2016, the Mid-Atlantic Athletic Conference (hereafter MAAC) signed an agreement with ESPN to stream men's and women's basketball games on Disney's subscription streaming channels ESPN+ and ESPN3 (Mulholland, 2022). The MAAC is a Division 1 conference made up of eleven mid-sized private colleges and Universities in the Northeast, including Iona, Fairfield, Quinnipiac, and Marist. One member of the MAAC, Manhattan College, responded to the new agreement by developing an undergraduate Sports Media Production program (hereafter SMP) as a concentration in its Communication Department (Donohoe, 2020).

Students within the concentration are entirely responsible for the technical side of the live productions: shooting, editing, replays, graphics, and audio mixing for approximately forty games per year. Coursework covers the basics of video production and editing, while a faculty member with live sports experience acts as the producer-director of the streams. Since the program's inception in 2019, approximately eighty students have participated, with audiences ranging from a few hundred to over ten thousand unique viewers.

ESPN requires that each basketball game utilize multiple cameras, a sound mix with both live and recorded sound, graphics, replay, and live editing. Meeting this demand necessitates a crew of a minimum of eight students: four on camera, one on replay, one on sound, one on graphics, and one technical director (ESPN, 2018). The games also require a central location to edit the camera and audio feeds, the ESPN-branded graphics, and replays. In the case of Manhattan College (and other MAAC schools) this is a Mobile Production Unit, or MPU. The four-student camera crew works in the arena, either extremely close to the court, or on an elevator lift high above it, while the remaining four students work in the MPU immediately adjacent to the arena. The student crew is managed by a professor who interfaces with ESPN, functions as producer/director of the production, and teaches the Advanced classes.

To train students in each aspect of the productions, SMP includes four courses out of a required six that focus on technical practice and in-game performance: an introductory course where students learn and build upon basic skills, and three increasingly complex advanced courses. There are in-class and homework assignments given in each course to ensure that students become familiar with the equipment in lower-stakes environments before

participating in the live productions. The "carrot" of the program is the chance to work on games that are streamed live on ESPN3 or ESPN+: students gain experience in a professional working environment, on productions that are seen by thousands of viewers, and may even make highlight reels on network television.

Figures 1 and 2. Manhattan College ESPN Mobile Production Unit

Since Manhattan College students essentially operate as a crew for a major cable and streaming network, their technical training in sports production is a priority. Due to the public/private nature of the concentration, its Learning Goals cannot be exclusively educational; the program could succeed in one respect, such as teaching production to college students, while failing to generate adequate content for ESPN in terms of quantity or quality. The program thus requires a clear pedagogical approach, as well as continual student and programmatic assessment within courses, to ensure that the students are up to the task. Beyond this, SMP exists within Manhattan College's School of Liberal Arts, and assignments and courses must be designed to ensure that students are not only learning specialized technical skills, but are also developing critical thinking, research skills, and problem-solving abilities.

This paper is a small case study of the Sports Media Production concentration at Manhattan College, exploring how pedagogical concepts from Lev Vygotsky were used both in specific assignments and the overall journey through the program. I will concentrate on how students are prepared to work in a live production environment and conclude with a discussion of how SMP is linked to the concerns and needs of the Humanities.

Method

Theory and Pedagogy

Lev Vygotsky was an early 20th Century Soviet psychologist known for arguing that learning occurs via social interaction, thus tying individual cognitive development to the sociocultural realm. Because of Vygotsky's focus on the sociocultural, his theories are often contrasted to Jean Piaget's. While both theorists maintained the notion of relatively distinct developmental stages, Piaget foregrounded the child's attempt to understand the world via independent exploration, while Vygotsky emphasized the role of collaboration and socialization, using the image of a child interacting with a pre-existing social structure (see Vygotsky, 1978; Piaget, 1971). Piaget's work remains crucial to critiquing pedagogical models where teacher/lecturers are depicted as filling student brains with knowledge, but Vygotsky's emphasis on the importance of student-teacher interaction and peer collaboration has made his theories increasingly popular (Crain, 2010). Yuriy Karpov analogizes Vygotskian-influenced pedagogy through the idea of a tool: "an adult presents to the child a new psychological tool in the form of an external device and orchestrates and monitors the process of the child's use and mastery of this tool. As the child masters the tool, it gets internalized and turns into an internal mediator of the child's mental process" (Karpov, 2014, p. 18). In the case of film and video production, Vygotsky's theories are extremely useful, as the production process is most often collaborative, and "tools" are applied within settings that combine authority with extensive peer contributions.

The major Vygotskian technique allowing for student development within such a setting is the notion of scaffolding (see Bruner, 1997; Cole & Wertsch, 1996). Scaffolding is the practice of providing substantial initial support to the learner, and then, in stages, fading or finding alternate modes of support as the learner becomes more independent in the task. A common example is learning to ride a bicycle. Young learners often begin with the use of training wheels, which are removed when the learner becomes comfortable. Usually, an adult then takes over the role of steadying the bike. Eventually, if all goes well, the adult teacher removes their physical help, replacing it with verbal instruction and encouragement. Eventually the child learns to ride without any aid, although motivated children and adults can continue to learn advanced cycling techniques from experienced peers, mentors, books and magazines (Crain, 2010). It is possible to learn to ride independently outside of this structure, but early improvement is faster and later improvement far more productive if one

considers the sociocultural aspects of bicycle riding. Racing, riding in traffic, efficient practices in group riding, high-speed downhills, and the like, are learned more efficiently - and more safely - collaboratively rather than through independent exploration.

Scaffolding does not necessarily require this shift from physical to verbal to written, although it is appropriate in learning physical skills such as riding a bicycle or operating a camera. Nor is it limited to young children, as college students and adults can both benefit from a pedagogy that offers slowly diminishing levels of support and ends with independence (see Davydov & Kerr (1995); Vasileva & Balyashnikova (2019), and Zhang (2010)). For example, Faizah Majid writes about using adult experiences as a means to scaffold the learning process, as a student group from diverse backgrounds and levels of familiarity with various aspects of education were provided scaffolds throughout a postgraduate teaching diploma (Majid, 2010).

Scaffolding is linked to another concept from Vogotsky known as Zone of Proximal Development (hereafter ZPD), defined as, “the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peer” (Vygotsky, 1978, p. 86). When using scaffolding, knowledge of a student’s present ability is insufficient; one also needs to understand the next level attainable by each student. This not only allows students to develop more systematically, but also enables collaborative learning among students at different levels. Using ZPD within scaffolding thereby opens up the learning process, making it possible for a student to learn from more advanced peers, while in turn offering help to students at a lower developmental stage. As Shabani et al. states, “the focus of teaching is on tasks inside the ZPD which the learner cannot do by him or herself but has the potential to accomplish with the guidance of others. As the learner accomplishes the task, his or her ZPD, or the gap between what he or she can do on their own and what he or she can only accomplish with assistance shrinks.” (Shabani, et al., 2010).

The idea of collaborative learning is directly tied to Vygotsky’s focus on the social nature of cognition; he argued that learning is more effective when engaging with more knowledgeable or skilled peers. Ibrahim et al. states, “learning is initially mediated on social levels among kids and the people in her/ his surroundings before being internally processed by them on personal levels… entail[ing] mentorship from more experienced people, whether they be

peers or adults, who interact with less proficient people in the guiding or cooperation process." (Ahmed Abdel-Al Ibrahim et al., 2023). The idea of the "group project" must become integrated into such a system, making it ideal for disciplines, such as production or theater, where groups are required to work together.

The role of the educator within this system is threefold. First, the teacher must develop modules and assignments with appropriate scaffolds that emphasize collaborative learning (Rojas-Drummond & Mercer, 2003). Second, the teacher must actively encourage students to learn from the experiences of those who are further in the program. Finally, teachers must ensure that each student is regularly assessed, so that they are met in their ZPD, and can be matched with peers from whom they can learn or assist at a particular task. Regular assessment is also vital due to how students fluctuate between zones as new skills and concepts are introduced. Students may simultaneously be a peer mentor at one task while being an inexperienced learner at another.

Application

In using scaffolding to construct the program at Manhattan College, I focused on three aspects: a) relatively clear stages of learning, b) collaborative learning involving learners at different stages, and c) continuing assessment of each student's level. Live video production, in a concentration that combines classroom exercises with intense group experiences, can be adapted to fit all three of these requirements. For the stages of learning, I begin with the five pieces of equipment students need to learn at the five different positions. There are developmental goals to meet before a student can go live, and classroom activities are devised to allow students to work on the skills they will need on the games. For example, students usually begin with camera operation; each camera operator learns what to shoot while also controlling different aspects of the camera, including focus, white balance, composition/framing, and exposure. Assignments and classroom activities, based on those from more traditional remote and studio video production classes, were rewritten to push each student to the next stage of development in each area.

For b) collaborative learning, each production uses students from four different classes taught by two faculty members. Having students at different levels, in the classroom and in each game's crew, allows for instruction to come from one of the instructors, an advanced peer, or

a peer at a similar level. One of the early advocates of scaffolding, David Wood, referred to this as "intersubjectivity," a "temporary shared collective understanding or common framework among learners or problem-solving participants" (Doo, et al. 2020, p 62). Here, the “common framework” is the general goal of producing the games, and this framework motivates the information and technique sharing even outside of the game context.

For c) continuing assessment at every level, the small classroom and homework assignments are regularly assessed individually and in group critique. These assessments do not necessarily impact their grade, which is based on multiple factors, but instead structures their movement through the program. This process continues until students reach the Advanced courses and begin working the games, at which time they are solely assessed on their in-game work.

The goal of the program is known as "transfer of responsibility," where learners take ownership of their present skills and further improvement, allowing them to perform and improve independently while becoming peer mentors themselves (Wood, 1976). For SMP at Manhattan College, transfer of responsibility takes place in at least two different ways. First, when students become advanced enough to become mentors at a particular position, which happens at varying times based on the complexity of the equipment and the talent and motivation of the student. Second, when students achieve a high level of competence on the equipment, often by showing they can correct errors with automaticity during a game, which implies that they no longer need faculty mentorship but can function with occasional peer help. More significantly, transfer of responsibility is crucial for students in becoming lifelong learners, a major objective of college Humanities programs (Atchoarena, 2021).

Assessment Vehicles and Scaffolds

While there are five student positions - camera operator, replay, sound, graphics operator, and technical director - the introductory class focuses on the camera. Camera operation is the least stressful of these positions due to the four-camera set-up of our games; only one camera operator is “live” at a given time, so, unlike with other positions, the other three operators can take short breaks where they briefly drop their attention or reset various camera functions. In

their first class of the Introductory course, camera operation is explained and demonstrated, after which students complete a quick in-class assignment. Upon returning to the classroom, students engage in analysis, refereed by the professor but including peer and self-critique; generally, students are ready to give at least a few examples of what went wrong with their short clips. During this process, the instructor notes each student's general level and assigns them a position on the ZPD, after which individual and group homework assignments are given based upon these results.

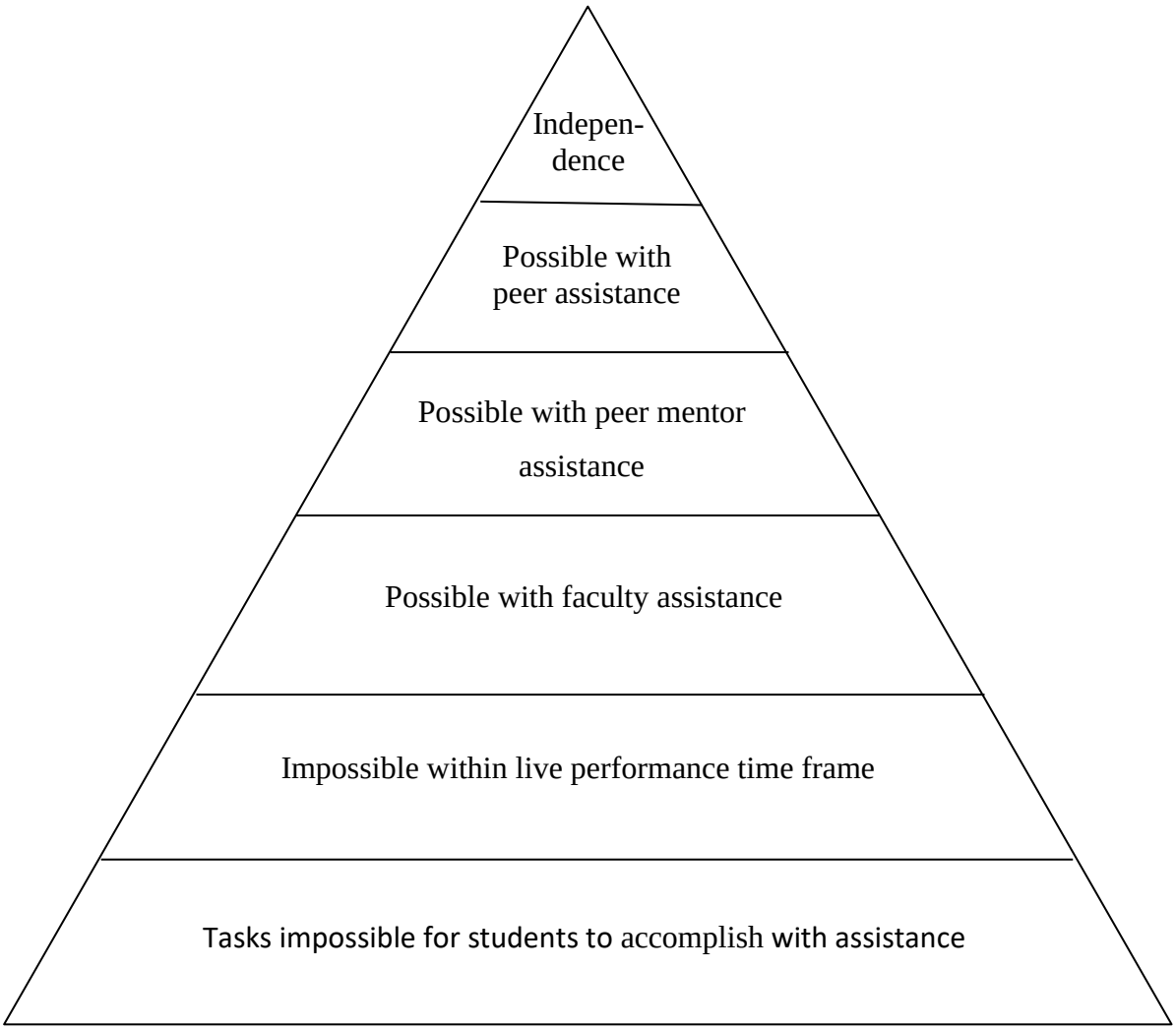
At each position student tasks vary greatly. For camera operation, these include set-up: unpacking the equipment, attaching the battery, mounting the camera on a tripod, cabling, and the like. There are also start-up tasks, based on lighting and camera position, that may need to be modified during the game: white balance and exposure. Lastly, there are performance tasks that require a live game to practice fully, including focus, camera movement, and composition in following in-game events. The initial set-up tasks usually involve only a few repetitions, so we did not include those in the study. The start-up and live performance tasks can be further divided into levels; repetition is not enough, particularly for the live tasks, as improvement requires critique and conscious practice of the skills. At the highest level, movement and composing shots for live sports are high-order performance activities and are arguably their own kind of art form; this level was infrequently discussed, and not assessed among the students.

Students may be better at some skills than others; this is noted on internal assessment and shared verbally during individual meetings. Since the most difficult of these skills tends to be composition and movement, initial homework includes work with their phones rather than the much-larger game cameras. Exercises involve the creation of smooth pans and tilts, using traditional composition rules such as the rule-of-thirds, and similar short assignments. These mini-exercises are also done as groups and work as scaffolds; if a student hits lower than expected on an assignment based on their ZPD, they are given remedial help or encouraged to repeat the assignment.

Zone of Proximal Development

The basic concept of ZPD can be graphed by the following pyramid, adapted from Kiruthika Ragupathi (Ragupathi, 2014):

Table 1. ZPD pyramid



We divide the tasks into 5 levels, from work that is doable independently, to tasks that are impossible for students to replicate live; the "impossible with assistance" level is skipped in assessment. When, at a given skill, students achieve the level of "possible with peer mentor assistance," they are ready to shadow a camera operator and possibly participate directly in the production.

Table 2 shows our division of camera operation into a set of skills that go into each student's Zone of Proximal Development. Five skills are included, with "camera movement" divided into two, depending on how the camera is mounted: rig or tripod. For each, advice and modeling activities are given before an assignment or a game, again according to their ZPD.

Table 2. ZBD camera operation (shared with students)

	A	B	C	D	E
1 Focus	Locate	Set Pregame	Half Court	Focus Pull: still	FP: moving
2 Exposure	Locate	Set Pregame	Full Court	Fast Break	Sudden change
3 WB	Locate	Set Pregame	Lighting Change	Rapid Reset	Live Reset
4 Composition	Find Ball	Follow ball	…half court	…full court	…sudden action
5a Tripod	Pan/tilt	Smooth p/t	…maintain	…fast action	…sudden action
5b Rig	Steady…	…wide	…medium	…close up	…sudden action

Assessment discussion – rubric

Table 3 is based on the zones from table 2 and is the primary rubric used for camera operation assessment. As with table 2, camera operation is again broken down into five skill areas: focus, exposure, white balance, composition, and camera movement. Each of these areas consists of five levels, from beginner to advanced. Once students reach an average "satisfactory" level on the skills, they are allowed to operate a camera during a game; by this point they have usually shadowed a peer camera operator at least once. Once students reach the "accomplished" level on three of the four skills, they can become a peer mentor. Ideally, "accomplished" students can also begin working on another position so they learn the entire production suite.

Each of these five skill areas has its own set of practice routines that are based on scaffolding, with homework assignments given at each level. For example, a beginner student will be asked to perform the five skill areas at a basic level in creating a short video of a person walking. An intermediate student might be asked to mentor a beginner student, while performing the five skill areas at a higher level, with a more complex subject such as a person running randomly. These homework assignments are critiqued as soon as possible, since immediate feedback allows students to link their physical movements to the video results. If a student finds a homework assignment difficult or otherwise seems stuck at a level, the instructor will give advice or demonstrate specific movements or camera settings, or a peer might demonstrate the entire process. Since these skills are all utilized during the games, student improvement links directly to their ability to perform live.

Table 3. Camera Operation Assessment/ZPD placement

	0	1	2	3	4
Focus	Out of Focus (OOF)	Sometimes OOF	Occasional OOF	OOF Movement only	Consistent focus
Exposure	Too Dark/Light (TD/TL)	TD/TL, adjustments	TD/TL, Moving shot	Moving adjustments	Proper exposure
WB	Off, no reset	Off, minimal reset	Off, some reset	Good WB	Good WB during change
Composition	Lost ball consistently	Minimal adjustments	Regular adjustments	Solid composition	In sudden changes
Movement	Ball not followed	Followed infrequently	Generally followed	Consistently followed	Smooth movement

Assignments

Students begin the Introductory class with limited ability to use the camera; they are taught the basics in the classroom, and then immediately taken to the court to shoot practice footage: short assignments that replicate what they will do during the productions. For camera operation, there are two assignments that are repeated twice, for a total of six assessments. Weeks 1, 4 and 9 place the student under and behind a basket to shoot two minutes of practice footage; this replicates cameras 3 and 4 (see Figure 3 for the position and Figure 4 for the shot). This is the most difficult camera position, since students are very close to the action and it is easy to lose sight of the action.

Figures 3 and 4. Camera 3 position and shot

The assignments for weeks 2, 3 and 7 are from a camera above the action, replicating cameras 1 and 2 (see Figure 5 for the position; Figure 6 is the shot).

Figure 5. Camera 1 position and shot

For both assignments, students set up the camera (either on a rig or tripod), set the white balance and exposure, and attempt to follow a practice shoot-around while maintaining focus and good composition while following the ball. After each assignment is completed, students head to the classroom and watch the assignment as a group, for the purpose of in-class critique. After Week 1, students are grouped into pairs, which accelerates set-up time and gives each student someone to bounce ideas off. At some point during the semester, after the games begin, the introductory students are unofficially paired with a student mentor from the Advanced class.

Results

For this project I followed four students over two years, all of whom took the introductory Sports Media Production class in Fall 2021, moved onto the Advanced course, and became regular crew members by Fall 2022. The results are based on the assessments made during the semester of the in-class assignments and game footage. The project concluded with a questionnaire about each student's experience approaching graduation. This enabled students to self-identify their level of achievement and understanding of live production upon entering the program, along with their views of their experience upon graduation.

Introductory class Results – Camera

For the assessments, a 2.0 average - the "satisfactory" level - was deemed sufficient to allow students to work the games on the equipment, the equivalent of "possible with peer mentor assistance" from the ZPD graph. For this class, the two weaker students were paired with the stronger students based on initial assessment (see Table 4 for results); here, "weaker" and "stronger" are relative terms, as all of the students were still considered beginners.

Table 4. Week 1 results (Camera 3)

	Student A	Student B	Student C	Student D
Focus	1	1	1	0

Exposure	1	1	2	1
WB	1	1	1	1
Composition	0	1	0	0
Movement	0	0	0	0
Mean	.6	.8	.8	.4

Key:
0 = Beginner
1 = Developing
2 = Satisfactory
3 = Accomplished
4 = Advanced

By exercise 3, as shown in Table 5, the students had made significant progress. Working together they were able to set the camera functions more quickly, thus enabling them to improve their shot composition during live action. The immediate in-class critique during Week 1 had also allowed them to analyze their errors shortly after making them. Student A had made significant progress and was already deemed ready for game action on camera. Student D had made the least progress, and their ZPD was adjusted accordingly, meaning simply that they needed an intermediate scaffold - and more help - to complete the work at a satisfactory level.

Table 5. Week 3 results (Camera 3)

	Student A	Student B	Student C	Student D
Focus	2	2	2	2
Exposure	2	2	2	1

WB	2	1	2	1
Composition	2	2	2	1
Movement	2	2	1	1
Mean	2	1.8	1.8	1.2

By week 9 all four students had worked as shadows for students in the advanced class. As shown in Table 6, this had pushed them all to another level: three of the four students were deemed ready for game action on camera 1, while the more advanced student was moved to cameras 3 and 4. The fourth student's improvement was slower but ongoing.

Table 6. Week 9 results (camera 3)

	Student A	Student B	Student C	Student D
Focus	3	2	2	2
Exposure	3	3	3	2
WB	3	3	3	2
Composition	3	2	2	2
Movement	2	2	2	1
Mean	2.8	2.4	2.4	1.8

Advanced class results – Camera

All four students took the Advanced class the semester after the introductory class. All four were also immediately placed in the crew and were given students from the Introductory class

to mentor. Assessments for other equipment either began or continued, most notably the replay system and the switcher. Table 7 is the camera assessment from in-game footage for each student, showing that all four students had improved significantly by their second semester. Student A was on camera for a sequence that was shown on ESPN Sportscenter. Student D had also significantly improved, something they attributed in their questionnaire to the peer instruction during the games.

Table 7. Advanced Class In-Game analysis

	Student A	Student B	Student C	Student D
Focus	3	2	2	3
Exposure	3	3	3	3
WB	3	3	3	2
Composition	4	3	3	2
Movement	3	2	2	2
Mean	3.2	2.6	2.6	2.4

Exit Questionnaire Results

The exit questionnaire allowed the four students to self-report their own opinions about the learning process after they completed the concentration. The first two questions relate to how comfortable they felt on the equipment; before in-class training, after training but before shadowing and peer mentorship, and after their production experience was over. Table 8 shows the numerical results; the students felt themselves to be improving via the pedagogical system implemented in the courses. (Note: Graphics and Switcher results use a sample of 3 rather than 4).

Table 8. Questionnaire results

	Camera	Sound	Replay	Graphics	Switcher
Before training	2.5	2	1.5	0	2
After Intro course	3.5	2.75	2.5	3.67	3.33
Program completion	5	4.25	4	4.33	4.33

Key:
0 = never trained on position
1 = least comfortable with position
5 = most comfortable with position

The "before training" numbers are significantly higher than those reported in the in-class, teacher-response rubrics; the implication is that the graduating students exaggerated, or have perhaps forgotten, their level at the beginning of the course. Note that "graphics" and "switcher" positions were taught in the Advanced class, so these were not part of this project. "Sound" was trained outside of the mentor system, using a one-on-one student-professor interaction; perhaps surprisingly students felt least prepared after this style of training, as opposed to the combination of peer and professor instruction.

When asked to describe the most effective teaching method, all four of the students self-reported that the peer system was the most effective. One student replied, "I primarily learned from my fellow peers/students. If I had questions, I usually went to one of them first before I considered going to one of my professors," while another answered, "The great thing about the program is how close all of us students are, it allows for a great atmosphere where we all feel comfortable teaching the younger students. A specific example was during my senior year I taught two of the first-year students how to operate the baseline cameras [aka, camera 3 and 4] during a basketball game. We went over how to set the camera up, how to properly adjust the settings (white balance, etc.), and how to shoot during the game."

Discussion of Results

The results – both our rubrics and the successful implementation of the program - show that the students were able to learn quickly using techniques devised from Vygotsky: collaborative learning and scaffolding based on regular assessment of their Zone of Proximal Development. Our students generate approximately 120 hours of streamed video content for ESPN yearly, all of which at least approach a reasonable level of competence and is in most cases indistinguishable from other MAAC productions done by professional contractors. Our evidence for this is threefold. First, in 2020 and 2021, producer-director Joe Ruggiero was invited to take four students and the production truck to Atlantic City to produce and stream games for the MAAC tournament. Second, in 2023, Manhattan College was named a finalist in the "Collegiate Student – Championship" division of the College Sports Media Awards. Lastly, to date, two of the four students are working professionally in the sports production field; both received job offers before graduating and began their careers while finishing their degrees. A third is headed to graduate school.

This is not to say that there were no issues in designing and implementing the project. Most obviously, it goes without saying that a sample of four is extremely limited. For the 2019-2020 year the program was still in development, and we engaged in only minimal assessment. 20-21 was a lost year due to the pandemic; while games continued, the restrictions made hands-on instruction extremely difficult. This project began with the small 2021-2022 cohort of introductory students; as the program grows, our data set will grow substantially.

Beyond the small number of students is the lack of a control group who is learning production in more traditional ways. As my department teaches TV Studio and Advanced TV Studio using more traditional top-down instruction, unlinked to ESPN or any other media companies, this is the next phase of my project: comparing the scaffolding and peer mentorship pedagogies of my program to a more traditional TV studio curriculum.

There are also concerns with the design of the program as it grows. First is the amount of time devoted to assessment and critique. The weekly assignments, in-class projects, and continual assessment generated substantial paperwork that is simply not sustainable as we

scale up the program. However, from my perspective, the workload was validated by the novelty of the program; in Fall 2022 the introductory course contained nine students, and some of the assessment was done via immediate verbal feedback instead of written rubric. Second, scaling up the program will greatly complicate the peer mentorship aspect. For example, it is possible that only a handful of the top students will function as peer mentors given the difficulty of managing mentorship among dozens of students. These advanced peers may eventually function as de-facto teaching assistants, being responsible for filling out rubrics and possibly receiving a stipend for their work.

At a meta level, a common critique of using scaffolding is that it can excessively rote, that students worry more about reaching assessment milestones, as articulated in assignment rubrics, rather than developing independence in their skillsets. For example, Kate Wilson and Linda Devereux discuss the pitfalls of an excessive reliance on skills, arguing that, "a 'skills' interpretation of the ZPD which reduces and simplifies learning to a lock-step process can have a constraining effect on student development...teacher support should make the task accessible (rather than simplifying); emphasize engagement and participation (rather than task completion); accept partially correct answers (rather than perfection); and make the task explicit so as to avoid pitfalls." (Wilson & Devereux, 2014, p A93). I would argue that, at least in this case, the goal-driven nature of the program prevents any potential obsession with the assessment process. While they can receive a great deal of help from instructors and peers in getting there, students are aware that independence is the goal, and that the various assignments are the way to achieve it. However, this is a concern for which we are on the lookout; we do not want accidentally to limit student creativity in an attempt to foster it.

Conclusion: Vygotsky and bridging the STEM-Humanities divide

As of the end of the 2022-23 basketball season Sports Media Production at Manhattan College, while still a quite small program, has been successful by every measure: in-class outcomes, student achievement, post-graduation employment, awards, and not least our streaming partner's satisfaction. However, one of the more complex aspects of the program lay outside the purview of the study. Sports Media Production operates as part of a department and School that emphasizes the liberal arts, with the assumption that traditional liberal arts and Humanities principles - critical thinking, historical contextualization, problem solving, research skills - are part of all concentrations within each major. Students in the

sports media concentration must develop skills sufficient for ESPN's streaming services, while continuing more traditional courses and projects within the liberal arts and Humanities traditions both in and out of the Communication Department. This is an ongoing concern in the program, and I will conclude by discussing how it is addressed.

The Liberal Arts and Vygotsky

There is much debate on the purpose of Humanities education in the 21st century, and how a skills-based education might provide an easier path to a career. As Christopher Rim puts it in Forbes Magazine, "A failure to recognize the methodology at the heart of liberal arts education results in mutual misunderstandings between those in the liberal arts and in STEM-related disciplines. Liberal arts colleges and their faculty often cannot articulate to prospective students the value of liberal arts education as a pedagogical approach rather than simply a disciplinary focus, which produces graduates who also struggle to relay to prospective employers this value" (Rim, 2023).

While University administrators and commentators on higher education are often encouraging a shift to more skills-based coursework, there can be faculty resistance within colleges that have traditionally focused on the Arts and Humanities (Shelton, 2020). Donald Gleason offers five approaches for the Humanities in dealing with STEM: from serving STEM departments in an instrumental relationship with classes such as "Science Writing" to ignoring STEM altogether and continuing in the most siloed manner possible (Gleason, 2020). While SMP would seem to be meeting the most instrumental version of Gleason's five, an instrumentality accentuated by the public-private partnership aspect, this is not the case. Instead, the games are the skills-based carrot that allows students to leverage their love of sports into a discipline that requires a number of different approaches. SMP faculty strive for what John Carrell, et al., refer to as humanities-driven STEM, emphasizing "humanistic, often artistic, creative problem-solving and innovative thinking" (Carrell, et al, 2020). SMP at Manhattan College is an attempt to bridge this STEM-Humanities divide by including more traditional Humanities-driven coursework and assignments: interviewing athletes and producing videos on racial justice and gender equity, assignments that combine writing and presenting in explorations of the historical and cultural significance of sport, or research assignments that ask students to assert and defend ethical arguments. We also plan on collaborating with our Digital Arts & Humanities program to bring data analysis and digital

representation to areas within sports studies: analytics, explorations of sport history, emerging sports such as pickleball, and e-sports. While students leave the program with a marketable set of skills and a good interview story that begins, “I worked camera for ESPN,” we want students who can ask questions that require varied types of solutions, and we offer a number of different tools to answer them. While the Vygotskian techniques we have implemented are ideal for teaching skills, there is research suggesting that techniques of collaborative learning, iterative assignments, and clear steps for development based on their ZPD, are all useful for broader pedagogical outcomes.

Collaboration

Historically students are uncomfortable with “group projects,” likely because of the differing amounts of work produced by individual students, leading to a sense of unfair workloads and grading. One solution is individual grading of a group project, but this can be difficult in practice and does not necessarily solve the common student perception of unfairness. However, based on our program completion questionnaire, students appreciated, rather than resented, that they functioned as part of a group, offering both mentorship and requesting help. I attempt to replicate this in our studies-based courses through weekly reading reports, where students choose and report on readings on topics they select as a group, combined with peer mentorship, where the previous week’s student chooses a reading for the following week’s student and offers notes and advice. As M.A. Nguyen argues, "This activity gives the copying student an opportunity to achieve a higher performance when working with a more capable one and as a result, everyone in the group would contribute greatly to the collective success, by sharing their past experiences and prior knowledge, and thanks to these experiences make sense of new situations, as Vygotsky repeatedly stressed in his approach." (Nguyen, 2017).

Iterative Assignments

One of the common techniques used in writing classes is the draft: student papers are commented on by a teacher or peer, after which they are rewritten based on the comments. Combining this with the notion of collaboration, students can rewrite and build upon each other’s drafts, a technique Gen Z students are perhaps more familiar with due to the crowd-sourced nature of social media, where users continuously build upon pre-existing memes and

media content. This addresses the unfairness problem, as students can point to their own work through comparison with earlier drafts, while maintaining the notion of a group collaboration.

As SMP continues to develop, the notions of collaboration, iterative assignments, and scaffolding will remain crucial in the creation of projects that move away from production-based skills towards more traditional Humanities projects.

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Chapter 5 - Evaluation of Two Sides of the Same Coin (Learning Management Systems & Outcome based Assessments)

Muhammad Adnan Ayub, Shahzad Shabbir, Farman Ali Khan

Chapter Highlights

- Explores the increased demand for accountability in Higher Educational Institutes (HEIs) from accreditation bodies, particularly in measuring student learning outcomes. Examines the labor-intensive nature of current practices and the need for improvement in meeting accreditation criteria.
- Investigates the capacity of Learning Management Systems (LMSs) to meet the requirements set by accreditation bodies. Analyzes the existing landscape of LMSs and their potential to streamline the administration and collection of course materials and assessment data.
- Establishes connections between the mandates of Higher Education Accreditation Bodies and the functionalities of Learning Management Systems. Explores how LMSs can be aligned to assimilate and support program and course-level assessments, bridging the gap between accreditation requirements and technological solutions.
- Introduces a framework and integrated module designed to facilitate course-level outcome assessment. The chapter outlines how this automated tool minimizes the effort required from HEIs and accreditation bodies, providing a more efficient and convenient process for program assessment and accreditation.
- Emphasizes the transformative impact of the proposed automated tool, highlighting how it streamlines the complete process of program assessment and accreditation. Discusses the potential for efficiency gains and improved convenience for both Higher Education Institutes and accreditation bodies.

Introduction

In the contemporary technological era, the necessity for information technology knowledge is paramount in every life sphere to address emerging educational challenges by making it purposeful and quality-oriented. The growth of nations is largely contingent on the performance of computing professionals and young individuals in this field. As for Pakistan, computing is an emerging phenomenon that is being developed and requires patronage in every aspect, from direction to mechanism, to compete with the modern world (Memon, Demirdöğen, & Chowdhry, 2009). Accreditation processes offer reliable means to achieve these standards. This is a cyclical evaluation process to ascertain if programs offered by Higher Education Institutes (HEIs) meet predefined criteria to meet quality standards. Accreditation achievement is a continuous process; once an HEI is accredited, it must undergo this process periodically for quality assurance in the respective discipline. Accreditation processes not only ensure quality but also facilitate advancement in these standards when necessary.

The incorporation of learning outcomes in higher education is one of the primary tools to attain qualifications, competences, and excellence with transparency. Enhancing higher education learning outcomes (HELO's) is the most relevant part of Human Asset development. The development of HELO's is a relatively new paradigm, which has piqued the interest of higher educational stakeholders, accreditation bodies, and university administrators. As previously mentioned, the introduction of HELO's is a visible part of broad international development and is implemented in every education sector worldwide. The implementation of HELO's comprises two main parts. The first is the identification and clarity of the content that students should have learnt by the end of the course or degree, also considered as predefined outcomes. The second part involves measuring these predefined outcomes in terms of student learning as achieved outcomes (Khan, Buhari, Tsaramirsis, & Rasheed, 2021). Learning Outcomes Assessment (LOA) provides tangible evidence of what individuals have learnt and achieved, which is equally important for all stakeholders of Higher Educational Institutes, Industry, and students. As a cornerstone for higher education, LOA stimulates the need for innovation in Assessment procedures (Powers & Henderson, 2017).

Over the past decade, the Higher Education Commission (HEC) has increasingly focused on Student Learning Outcomes' assessment (Memon, Demirdöğen, & Chowdhry, 2009). This is partly due to increased demands for more accountability in higher education by programs Accreditation Bodies. Additionally, it also indicates a growing understanding on the part of Higher Education Institutes (HEIs) about the importance of outcomes assessment for both determining the student learning experience and defining the curriculum of academic programs (Mazur & Walczyna, 2020).

In response to the growing requirement for accountability, Accreditation Bodies have incorporated assessment standards into the accreditation process. Considering Pakistani Universities' Computer Science and Engineering programs, accreditation is achieved when they meet the standards established by the National Computing Education Accreditation Council (NCEAC accreditation) and Pakistan Engineering Council (Pakistan Engineering Council, 2023) respectively. The aim of these Accreditation Bodies is to develop an outcomes-based continuous improvement process where course outcomes are evaluated at the end of the course, and the course curriculum is redesigned based on this evaluation. This process includes several challenges for HEI's faculty and administration. Among these challenges, the manual process of monitoring learning outcomes within the courses and degree programs is typically paper-based and labor-intensive, also includes subsequent visits from Accreditation Bodies and time constraints. During this accreditation process, HEI's faculty is required to demonstrate outcomes that are being addressed by certain course activities along with the students' achievement assessment. Additionally, this data includes course folders maintained by course instructors, which are also required to be submitted to the accreditation team. Administering, collecting student course materials, and organizing the breadth of assessment data with the classification of course-level and program's objectives for reporting, remains a laborious and time-consuming task. This situation necessitates an automated and integrated tool that brings course-level activities, such as coursework, exams, and projects, including the program's objectives and goals, to a common interface for assessment.

The utilization of Learning Management Systems (LMS) for outcome assessment is still in its early stages from both a technical and organizational perspective (Marks, Al-Ali, & Rietsema, Learning management systems: A shift toward learning and academic analytics, 2016) (Marks & Al-Ali, Analytics within UAE higher education context, 2016). Custom-built

LMS's use their specific methodologies and data types for the storage and coding of student assignments, complicating the process of extraction and reporting student assessment data (Hussain, Al-Mourad, Mathew, & Hussein, 2017). Furthermore, multiple tools are required for the extraction, classification, and reporting of student assessment data. In this regard, Law et.al. (Tello & Motiwalla, 2010) noted that within LMS's, the tools or plug-ins to cater to outcome assessment are not properly implemented. Supporting this fact, the PEC in its Accreditation Manual (Pakistan Engineering Council, 2023) set a deadline for all HEI's to transition from traditional education to Outcome-based Education (OBE) by 2018, and for affiliated institutes by 2020.

To optimize the learning outcome assessment strategy while adhering to the requirements of accreditation bodies, a four-step process is proposed. Firstly, an effective learning outcome assessment strategy should be defined by examining the guidelines and expectations of accreditation organizations, ensuring alignment with institutional goals and objectives. Secondly, data relevant to learning outcome assessment should be collected and organized systematically, implementing methods such as surveys, rubrics, and performance-based evaluations to gather reliable and pertinent information. The third step involves selecting an appropriate Learning Management System (LMS) that encompasses the necessary features for Learning Outcome Assessment capability. This involves comparing various LMS platforms, considering factors such as ease of use, integration capabilities, and customization options. Finally, the measurement of program and course-level learning outcomes should be automated, employing data-driven techniques and analytics tools to ensure accurate and consistent evaluation. This streamlined approach will ultimately facilitate a comprehensive understanding of students' learning progress and support continuous improvement in teaching and learning practices.

This study aims to provide valuable insights into the development and implementation of an effective learning outcome assessment strategy that aligns with the expectations of accreditation bodies. The paper is organized into four sections, beginning with a comprehensive literature review that explores existing research and perspectives on learning outcome assessment, accreditation standards, and Learning Management Systems. The third section details the methodology and development process, outlining the specific steps taken to define, collect, organize, and measure learning outcomes. Finally, the conclusion and future work section offers a synthesis of the key takeaways from the study and proposes

directions for further research, ultimately aiming to contribute to the advancement of educational practices and the enhancement of learning experiences for students..

Literature Review

This section of the study provides an in-depth analysis of the existing body of knowledge related to learning outcomes assessment, learning management tools, and accreditation standards. Initially, the review focuses on the three main categories of learning management tools, namely Learning Management Systems (LMSs), Continuous Program Improvement (CPI), and Content Management Systems (CMS), and examines their compatibility with accreditation bodies for Learning Outcome Assessment reporting. The discussion then shifts to specific accreditation bodies such as ABET, with an emphasis on the Computing Accreditation Commission (CAC) and its requirements. Furthermore, the review delves into the landscape of Computer Science Program Accreditation in Pakistan, along with the evaluation requirements set forth by the National Computing Education Accreditation Council (NCEAC). Lastly, the literature review explores various open-source LMSs, evaluating their technical requirements and specifications in relation to approximately 30+ features to provide a comprehensive understanding of the available options.

In the context of Learning Outcomes Assessment, (Kaupp, Frank, & Watts, 2013) evaluated some commercial and open source LMS's, Continuous Program Improvement Systems (CPIs), and Content Management Systems (CMS's). Regarding CPI's, the LiveText, eLuman, and Waypoint Outcomes were considered. Similarly, Moodle and Canvas were considered from the LMS's category, where Moodle was declared a CMS as well, and Desire2Learn was declared justifying the attributes of all categories i.e. the LMS, CMS, and CPI. Furthermore, they highlighted some major weaknesses of these evaluated outcomes assessment software tools. For example, LiveText, was reported with lack of graphical data representation, multi-stage data entry and reporting mechanism, as well as non-customizable reporting mechanism. Moreover, LOA generated reports are not compatible with Accreditation Bodies' requirements. Similarly, the eLuman doesn't have any type of Application Programming Interface (API) / Learning Tools Interoperability (LTI) support thus causing non-integration and compatibility issues with the LMS's. Therefore, manual data import is implicated for the generation of LOA reports (Pakistan Engineering Council, 2023). Furthermore, the Waypoint Outcomes weaknesses deal with its reporting and

analytical feature that is in the initial stages of development. The measures of outcomes assessment are not fully reported and are available only at few key assessment points. This tool provides limited integration support with few of the LMS's (Kaupp & Frank, 2014).

Regarding the LMS's category, Moodle and Canvas were reported with lack of their own LOA reporting and analytical feature. Therefore, for reporting, either different plugins or third-party software tools such Excel are used. These third-party software tools limit LOA reporting and analytical abilities. Similarly, the plugins designed for reporting purpose are either not reliable or lack usability. By conclusion, Desire2Learn leans behind with a key weakness of LOA reporting and analytical support of customization and graphical representation.

In addition to this research, (Kaupp & Frank, 2014) evaluated further LMS's tools in their evaluation study, and highlighted strengths and weaknesses centered on LOA. The list of evaluated tools comprises (Entrada), (Chalk and Wire Student Brochure - University Of South Florida), (Data Management: Iseek Supercrunche), and (The Leading Curriculum Management System, 2023). The results of evaluation reported that Entrada has limited analytics and rubrics assessment capabilities, which only includes a feasibility of summary reports and lacks the measures of student performance. CoursePeer's weakness is the absence of rubric grading and in-line feedback of student evidence. Chalk & Wire, supports multi-stage LOA, but facilitates API/LTI for LMS's which is not desirable for users looking single solution. iSeek Supercruncher have external dependency over LMS's or CMS's for LOA data, which is an unorganized process, and requires additional payment for accreditation support. The evaluation (Kaupp & Frank, 2014) of Atlas Curriculum Mapping revealed limitations as Standalone nature and LOA format of reporting with no provision of feasibility with other LMS's. Consequently, in case of Atlas Curriculum Mapping all relevant data from LMS's or CMS's is to be manually populated into Atlas Curriculum Mapping.

Further, El_Rahman and Shabanah developed Course and Student Management System (CSMS) that supports HEI's for addressing program and course assessment matrix (El Rahman & Shabanah, 2016). This web-based, effort saving system empowers educational institutes to meet the accreditation board mandate. But their research work is limited to satisfy only the Accreditation Board of Engineering and Technology, Inc (ABET) criteria, and completely custom built, with no feasibility of integration with any other open source

LMS's. Furthermore, they exploited the tools for the direct and indirect assessment, that are locally developed exams, simulations, oral exams, interviews, written surveys and rubrics.

Acquiring academic accreditation for degree programs is a top priority for HEI's across the world. Accreditation bodies on international level is self-motivated, decentralized and mostly worked by independent no-government organizations. A team from industry and academia plays vital part in quality review during accreditation process. Internationally, one respectable body that has the mandate to accredit computing programs is the Accreditation Board for Engineering and Technology (Shafi, et al., 2019). ABET is an alliance of professional and technical societies (Eaton, 2012). ABET Accreditation criteria is defined standards of quality by these societies and their individual members' collaboration through ABET. These defined standards are the basis on which program evaluations is being carried out by the review team.

The ABET accreditation criteria may differ from one cycle to the next. We're targeting computing programs, which are accredited by sub section of Computing Accreditation Commission (CAC). There are two versions approved by Computing Area Delegation on October 20th, 2017. HEI's targeting for ABET Accreditation have choice to have their program(s) reviewed either by CAC Criteria (V. 1.0) or CAC Criteria (V. 2.0). For 2019 – 2020 Accreditation Cycle, Computing program(s) is being evaluated based on CAC Criteria (V 2.0) (ABET CAC - Computing Accreditation Commission). Computer Science has been developed as emerging professional field and academic discipline in the world, as well in Pakistan in the last decade. Several HEI's offer computing related degree programs in both private and public sectors. It is, therefore, more important that these degree awarding HEI's should be subject to viable and internationally recognized set of standards. Therefore, a concept of accreditation authority was proposed and setup with the intention to occasionally assess, analyze, and have a check on the academic standard and values followed in various HEI's. The authority was named as the National Computing Education Accreditation Council (NCEAC), Pakistan (NCEAC accreditation).

The purpose of accreditation was to make sure that HEI's follow strict quality standards in Computer Science programs. For this, a certain defined criterion is established requiring every HEI to follow. The accreditation was designed for computer science programs specifically and not for the institutions. Moreover, accreditation process and certification are two different things in this aspect (Hussain, Al-Mourad, Mathew, & Hussein, 2017).

Generally, HEI's are accredited for programs, whereas certification is awarded to individuals. Accreditation ensures and facilitates the interest of all stake holders i.e. parents, students, faculty, academic administrators, employers, and taxpayers. It notifies the parents and prospective students about the program that has met the least standards; Highlights the strengths and gray areas to Deans, Faculty and HEI's Administration of the program and suggests the potential changes for the improvement of the program. It also ensures employers that graduates are fully equipped to jump into their professional practice; Guarantees taxpayers of their funds being expended meaningfully.

During accreditation process NCAEC visit HEIs for field audit. This field audit is based on criteria defined by NCEAC field audit guidelines and critically important for HEIs accreditation. NCEAC audits the HEIs based on 13 categories, which are Program, Effectiveness of overall program and Student evaluation of course and instructor, Class schedule, Lab schedule, Senior design / graduating project, Alumni data collection, Faculty contracts, Admission and eligibility, Annual budget, Labs, Rules & Regulations Statutes with procedures, and Financial profile (NCEAC accreditation). Program paradigm is sub-categorized in Curriculum documentation and Curriculum implementation. Our research study complies with these audit categories are Program, its effectiveness and student evaluation for automation. Although other could also be automated but our primary object is outcome-based assessment in accordance with requirements of NCEAC.

A learning management system (LMS) helps HEI's to create, track, and manage their learning programs (Aydin & Tirkes, 2010). However, most LMS's come with a set pricing model that can be expensive for private ventures and institutions. During finalizing budget for LMS software, HEI's should consider these factors such as installation cost, charges or fees (license, fee per user / course), and maintenance. Open Source LMS is the best solution for HEI's due to easy installation and it involves no licensing cost (Sumangali & Kumar, 2013) (Awang & Darus, 2012). Several open source LMS's have been developed during the last decade (Law, 2018). These all LMS's are provided with different features based on new learning models.

Moodle (Modular Object-Oriented Dynamic Learning Environment) is one of the most trusted worldwide Open-Source Learning Management System, that facilitates educational-institutes with a single robust, secure and integrated system to meet their education requirements (Conijn, Snijders, Kleingeld, & Matzat, 2016). Moodle provides educators and learners with powerful tools for managing, delivering, and assessing educational programs (Alia, 2022). Moodle is incorporated with a powerful set of collaborative learning environment, including learner-centric tools that empower learner as well as the teacher. Due to interoperable and modular design setup, Moodle enables plugins development and other application integration. Moodle's structural design is capable of extension, so it has potential to add Program and Course Level Assessment Module to serve the needs of Accreditation Councils. Similarly, because of its high cohesion and low coupling the system is effectively manageable to programmers.

Methodology and Development

The process begins with the accreditation requirement generalization followed by careful selection of an appropriate Learning Management System (LMS) that caters to the specific needs of learning outcome assessment and accreditation standards. Following this, the development of a customized plugin tailored to address accreditation requirements is undertaken, ensuring seamless integration and enhanced functionality within the chosen LMS (see Figure 1).

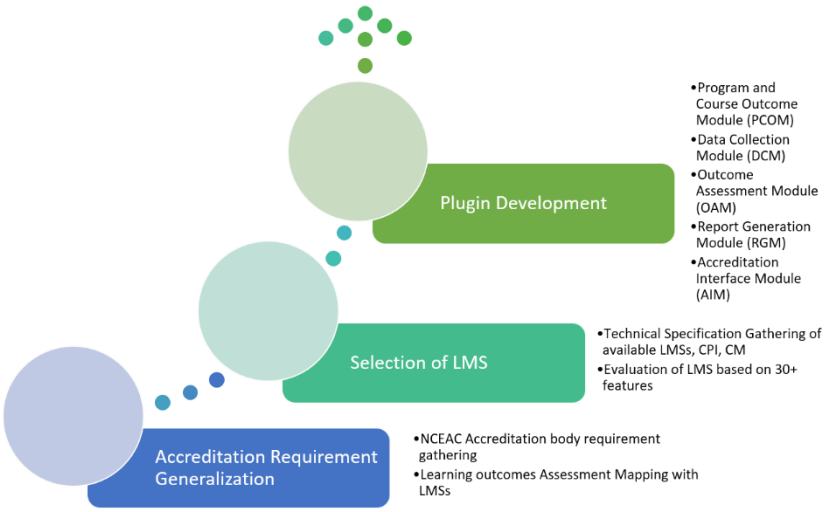


Figure 1. Methodology and Development

Accreditation Requirement Generalization

The important question is how would we select the most reasonable LMS for our evaluation and dependent on which criteria do we pick the adequate LMS? In any LMS selection process, its usefulness and ability to different non-uniform systems must be examined and compared with other LMS's. Technical requirements of selected Open source LMS are elaborated in Table 1.

Table 1. Technical Requirement for the Open Source LMS

S. No	Open Source LMS	System Requirements				
		Application Server	Database	Operating System	Programming Language	Webserver
1.	MOODLE	PHP 4.3.3+	MySQL, Oracle, Postgress	any	PHP 4.3+	any
2.	ATUTOR	PHP 4.3.0+	MySQL 0.2+	Linux, Mac	PHP4+	Apache
3.	DOKEOS	Apache	MySQL	any	PHP, XML, Java Script	any
4.	OLAT	Tomcat	MySQL, mSQL Postgres	any with JVM	Java	Apache
5.	ILIAS	Apache 2.4.18	MySQL 5.6+ MariaDB 10.2	Linux Ubuntu	PHP 7.1	Apache
6.	CAROLINE	Apache	MySQL/MariaDB >=5.0	Any	PHP 7	Apache
7.	LNR	AOLServer 4.0.	PostgresSQL 7.4.3	Unix Linux	DotLrn 2.2.0 OpenACS	AOLServer 4.0.

Selection of Learning Management System (LMS)

Considering requirement of HEI's and Accreditation bodies, this research selected following evaluation categories of open source LMS: General aspects, Productivity tools, Didactic functionality, Extendibility, Modularity, Activity Tracking, Communication tools and Usability. These evaluation categories established by CMS community of practice and also subject to extendibility of LMS for Accreditation plugin. Additionally, these categories are subdivided into sub-categories and each category has evaluation features. Evaluation of selected open source LMSs against these features are shown in Table 2.

Table 2. Features of Learning Management Systems

Category	Sub-Categories	Feature	Learning Management Systems						
			1	2	3	4	5	6	7
General Aspects	Support and Compatibility to	Scorm & IMS support	x	x	x	x		x	x
	Backup Support	Automatic backup	x					x	
		Manual backup		x	x	x	x		x
	Modular Support	Content Editor (HTML)	x	x	x	x			x
	Development Integration	Modular Structure	x						
		Adaptation/UM	x	x					
		Activity Tracking	x	x				x	
		Extendibility	x	x					
	User information security	Data stored on multiple servers	x						
		Password save in localdb		x	x	x	x	x	x
Didactic Functionality	The follow-up of learning processes	Student activity recorded by timestamp	x			x		x	
		Logs maintainability for analysis		x	x				x
	Online Exam	More than 10 types of question support	x	x					
		Less than 6 types of question support			x	x	x	x	x
		Secure window option	x						x
Productivity Tools	Tracking feasibility	Project Tracking	x	x				x	
		Time Tracking	x	x				x	
		Tests / Quizzes	x	x	x	x	x	x	x
		User contributions	x	x	x				
		Link management	x	x	x				
Communication Tools	Survey, Discussion and Forum support	Blogs Feasibility	x	x	x		x	x	
		Chatting & Discussion Tools	x	x	x	x			x
		Mail Support	x	x	x	x		x	
		Dashboard	x	x					x
		File Distribution	x	x	x	x	x		x
Usability	Graphic User Interface	Interface design (Good)	x	x	x		x		
		Interface design (Complicated)				x		x	x
		Upload Content	x	x					
		Text Customization	x	x			x		x
	Interoperability	FTP Integration	x	x				x	
		WAI Feasibility	x	x				x	
		WebDAV support	x	x		x			x
		XHTML compliant	x	x	x		x		
		Instr Standard compliant	x	x				x	

This evaluation reveals that the LMS's considered for analysis in perspective of plugin development for accreditation support, Moodle scores the max features. Moreover,

classification of the considered LMS's has been discussed with selection of best suitable option for Accreditation plugin development.

Moodle plugin for NCEAC Accreditation (MPNA)

The proposed plugin is divided into five sub modules, namely Program and Course Outcomes Module (PCOM), Data Collection Module (DCM), Outcomes Assessment Module (OAM), Reports Generator Module (RGM), and Accreditation Interface Module (AIM). The complete process can be summarized as program objective and learning outcomes saved in system by the course coordinator and mapped to course learning outcomes. The next step is the data collection of direct and indirect assessment tools from LMS repository. Subsequently, Outcome Assessment reports are being generated based on the mapping and data collected in previous stages. After that data is available at one place for the provisioning to accreditation bodies. Finally, based on accreditation report, the course and program objectives are revised to include recommended changes by accreditation bodies. Framework and processing of the proposed plugin as shown in Figure 2

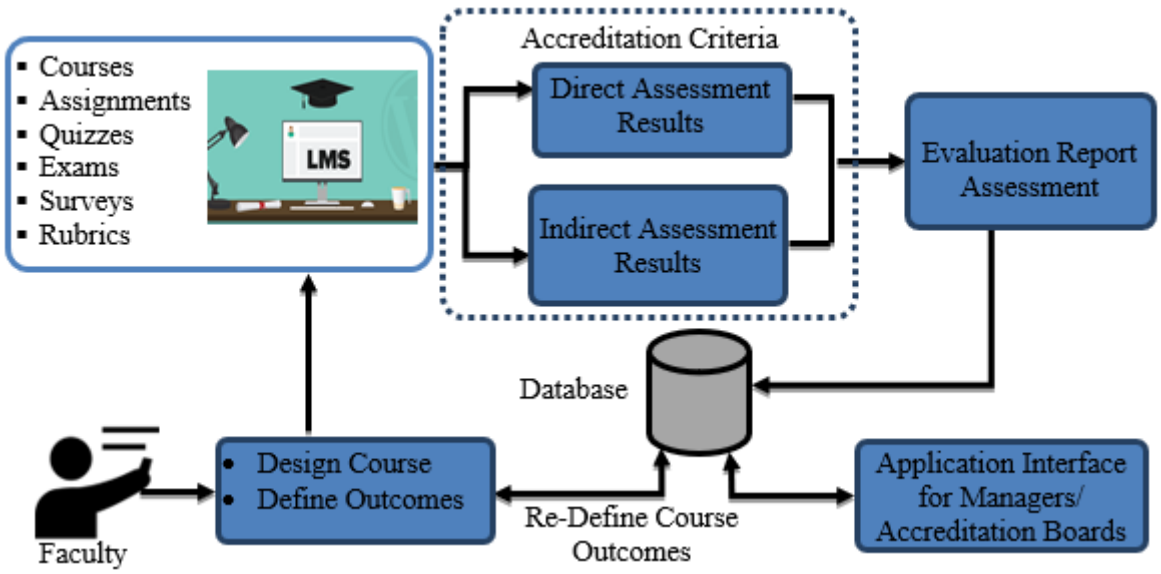


Figure 2. Proposed Moodle Plugin Structure

Program and Course Outcome Module (PCOM)

Program and Course Outcome Module is combination of different sub-modules that work together to define program learning objectives and outcomes, courses objectives and then use

mapper to map defined objectives to outcomes for programs, and program outcomes to course learning courses.

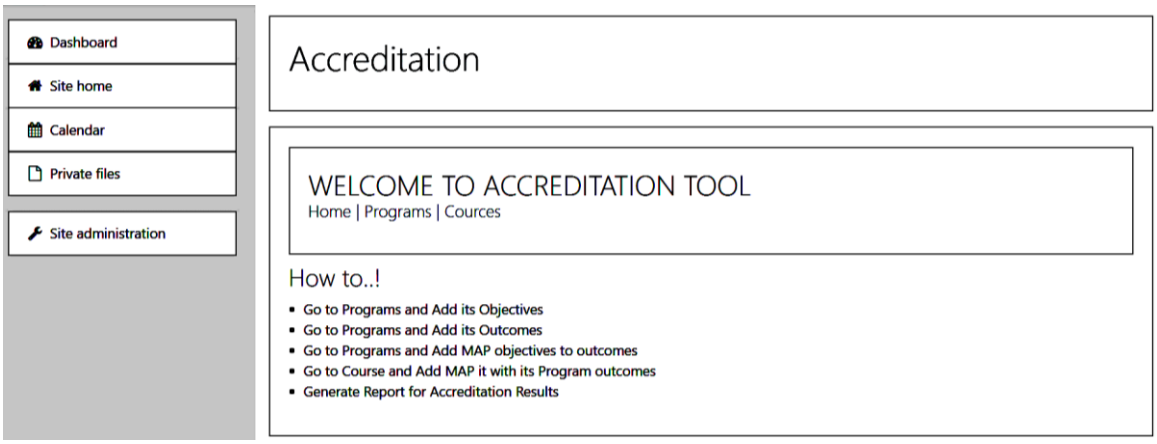


Figure 3. Accreditation Module Dashboard

This module can be considered as starting module for the entire accreditation process, main interface shown in Figure 4. PCOM modules is incorporated with sub-modules. These modules and their corresponding functionality details are provided below:

Program Defining Interface sub-module is responsible for creation of new program. The existing category term of Moodle LMS can irreplaceably be used for a program under accreditation scenario. This is exactly the first step of Moodle where a new category or program is created. The category defined is referred as program in accreditation context. Program defining interface is shown in Figure 4, in which BS (Hons) Computer Science program is created. After creation of program, objective and outcomes links are enabled.

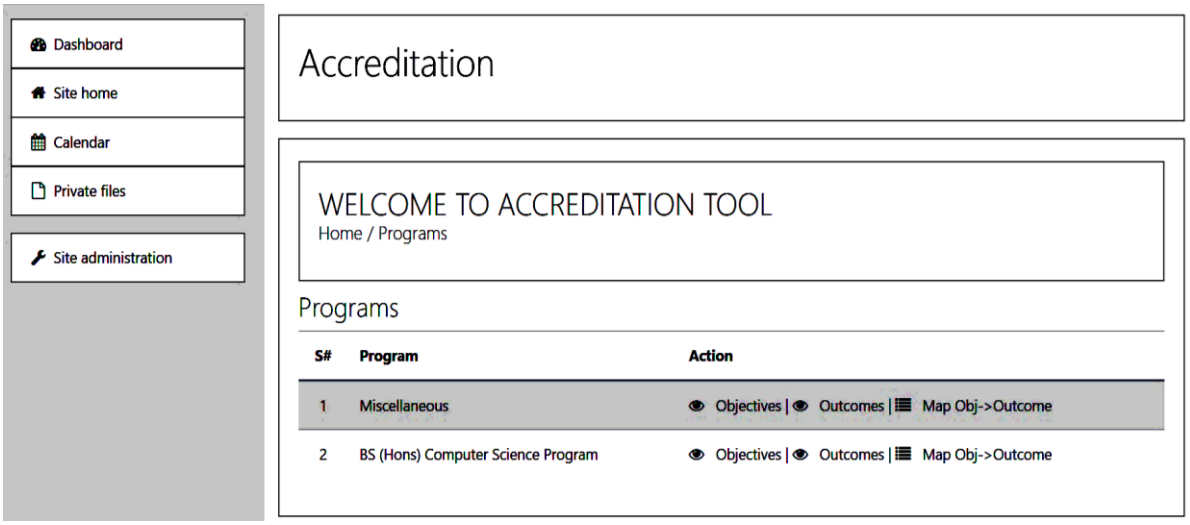


Figure 4. Program Defining Interface

Course Defining sub-module is responsible for creating new course. The existing course creating module in Moodle is being utilized without any change for this accreditation process. Courses created under this interface is accessible to our defined programed. This process is already automated and used by the other modules.

Defining Program Objective sub-module is responsible for defining program objectives for existing program or category. The programs' list is fetched, and an interface is provided to define objectives of selected program. There is one-to-many relationship between programs and its objectives. Figure 5 shows the process of defining program learning objectives.

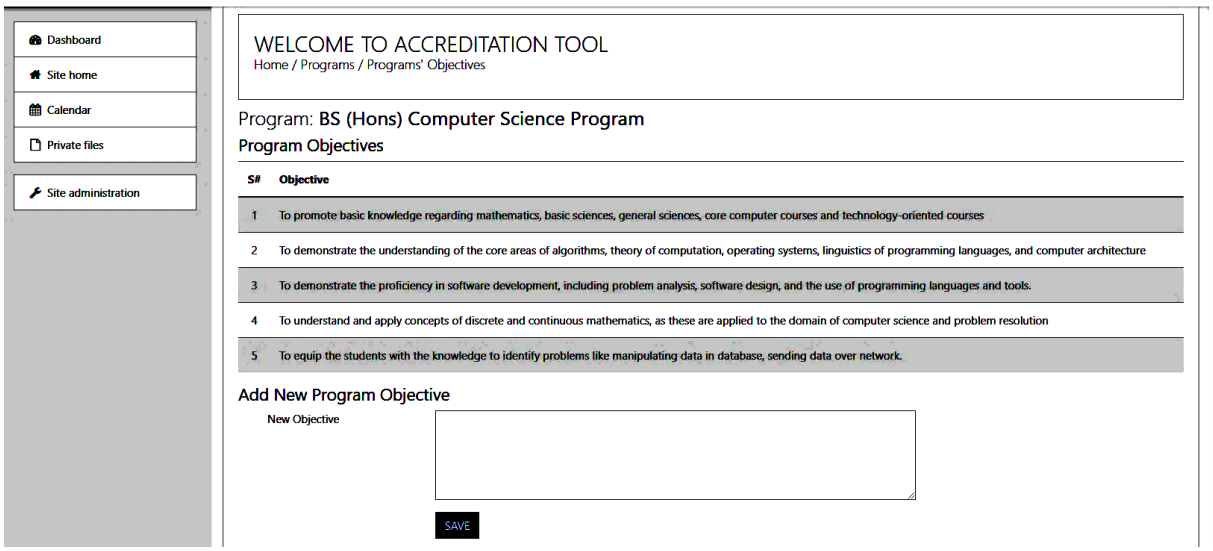


Figure 5. Defining Program Learning Objectives

Defining Program Outcomes for Program Objective sub-module is responsible for defining Program Learning Outcomes (PLOs) and accessible to program coordinator. PLOs defined at this stage are stored in Moodle database. This interface displays previously defined and saved PLOs and enables user to save new PLO if required. These PLOs are saved against defined Program also known as category. Interface is shown in Figure 6 with three samples Program Learning Outcomes.

Mapping Program Objective to Outcomes sub-module enables users and course coordinators to map program objectives to program outcomes for existing program. Program objectives and Outcomes are defined in previous stages. The program objectives list is fetched, and an

interface is provided to map one program objective to multiple program outcomes against selected program as required. There is one-to-many relationship between these mapping entities. Interface of this mapper module is shown in Figure 7.

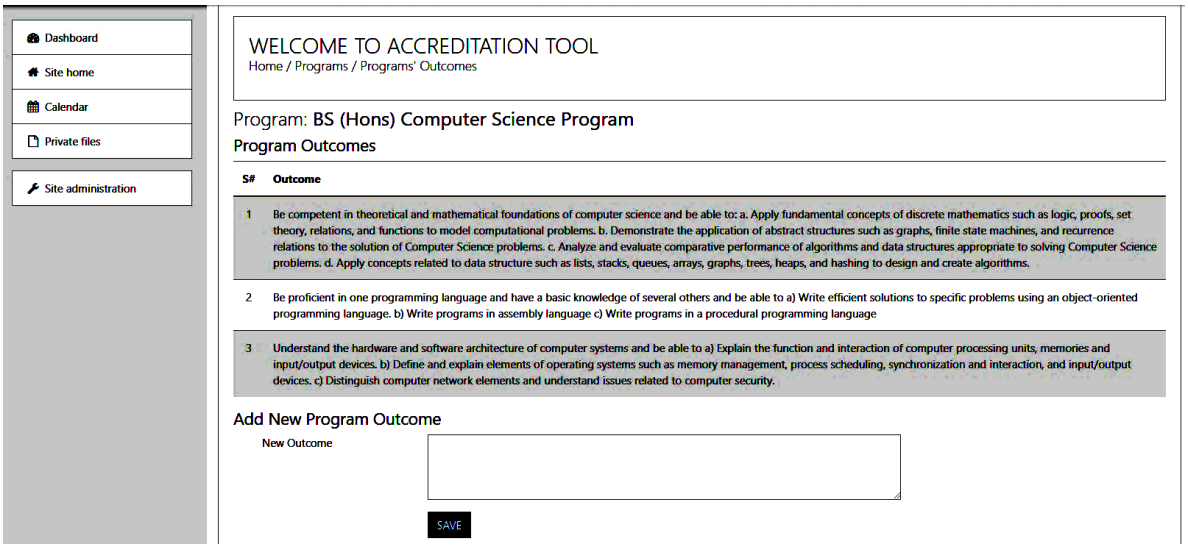


Figure 6. Defining Program outcomes for program objectives

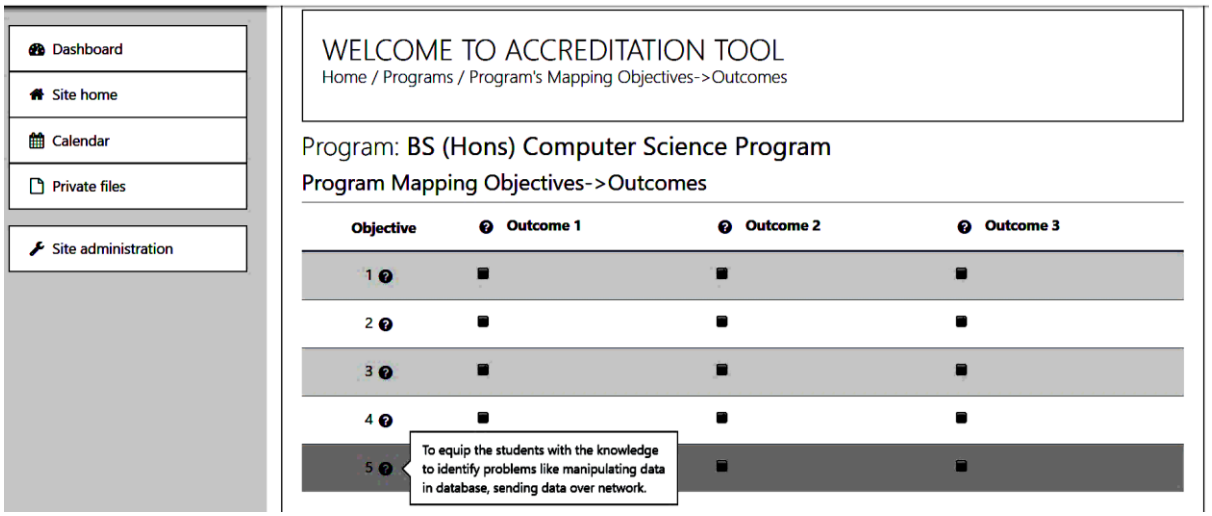


Figure 7. Program Learning Objectives to Program Outcomes Mapper

Mapping Course to Program Outcomes Module provides an interface to map program outcomes on the previously available courses in the Moodle. The courses listed in Moodle database are fetched, and an interface shown in Figure 8, is provided to map one course to multiple program outcomes defined in previous stage. There is one-to-many relationship between mapping entities.

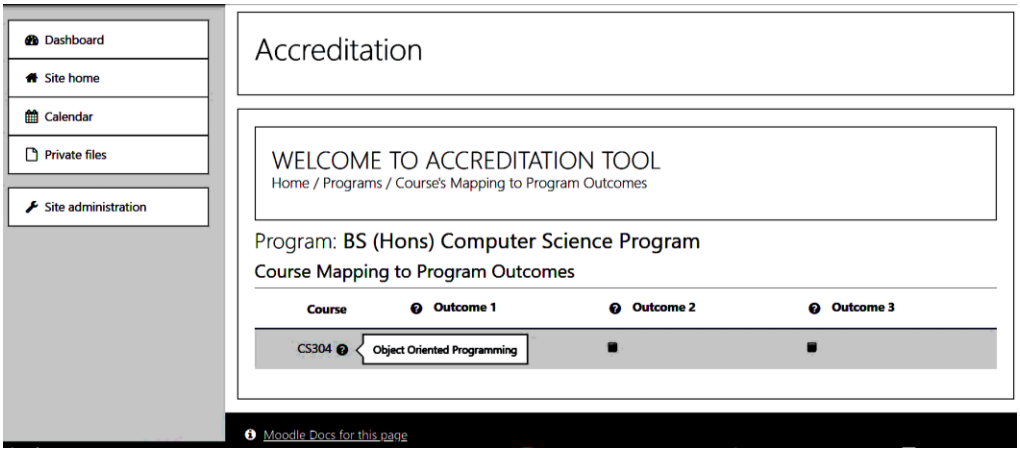


Figure 8. Course Objective to Program Outcomes Mapper

Data Collection Module (DCM)

Data Collection Module is integral part of our plugin, that is responsible for automatic collection of required data from the Moodle databases of respective programs, courses, students and their assessments (see Figure 9).

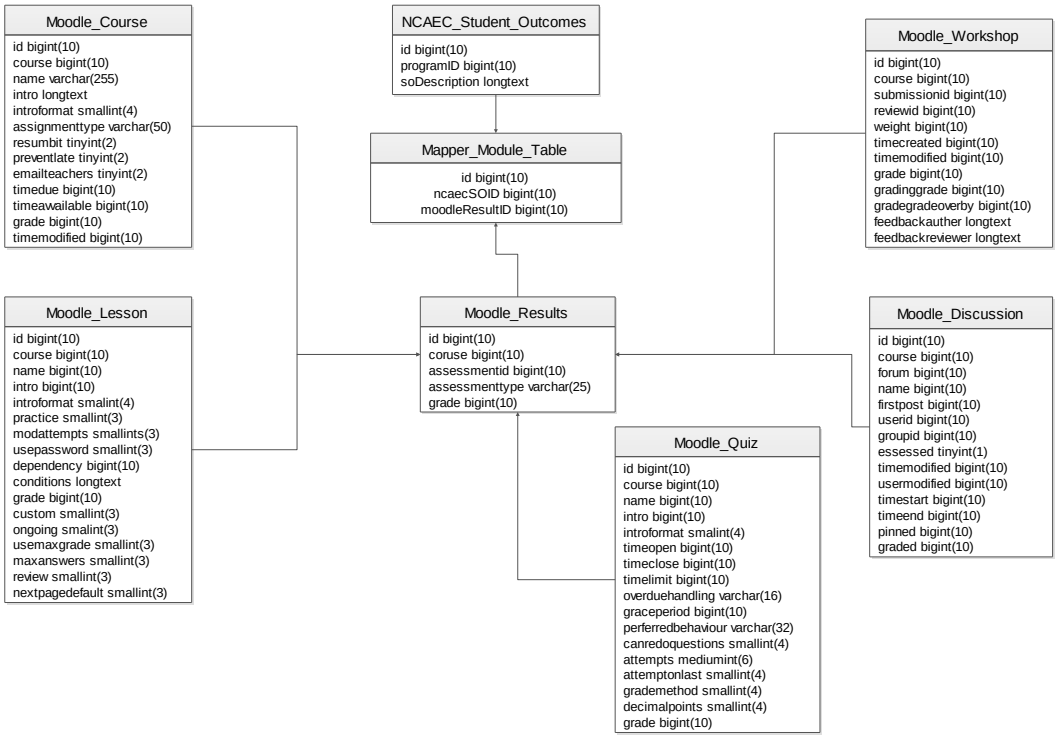


Figure 9. Moodle Database Design with Mapper Table

This module would act like a bridge between our plugin and Moodle for accessing the required data in real time. Moodle database diagram shown in Figure 9 is complex database

with multiple tables and attributes. Only data tables, that are relevant to our system are shown. Moreover, for complete understanding, data tables created by our plugin script are also included.

All the collected data is mapped in centralized table with defined course and program outcomes and Mapped to selected assessment tools results. Which is further utilized for report generation and presentation to Accreditation bodies during accreditation process.

Outcome Assessment Module (OAM)

The Outcome Assessment Module (OAM) is being used to assess the outcome as defined earlier for courses and programs. It uses DCM for collection of data from the Moodle and then use students' course performance data along with the outcome defined earlier to assess the degree of course outcomes that have been met. Assessment of outcomes for the courses according to the performance of students provides a true picture of degree of outcomes that have been achieved. Outcome Assessment report generated during evaluation is shown in Figure 10.

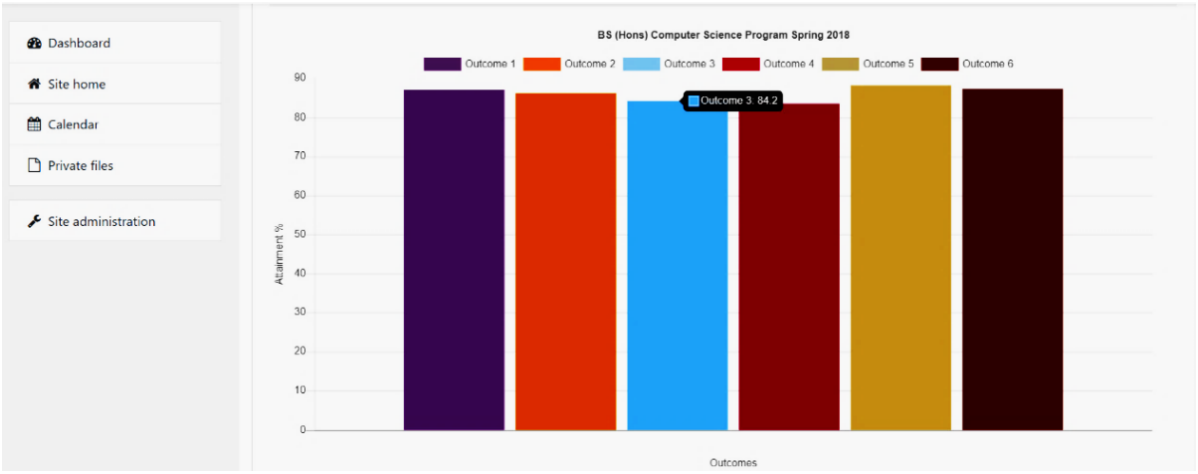
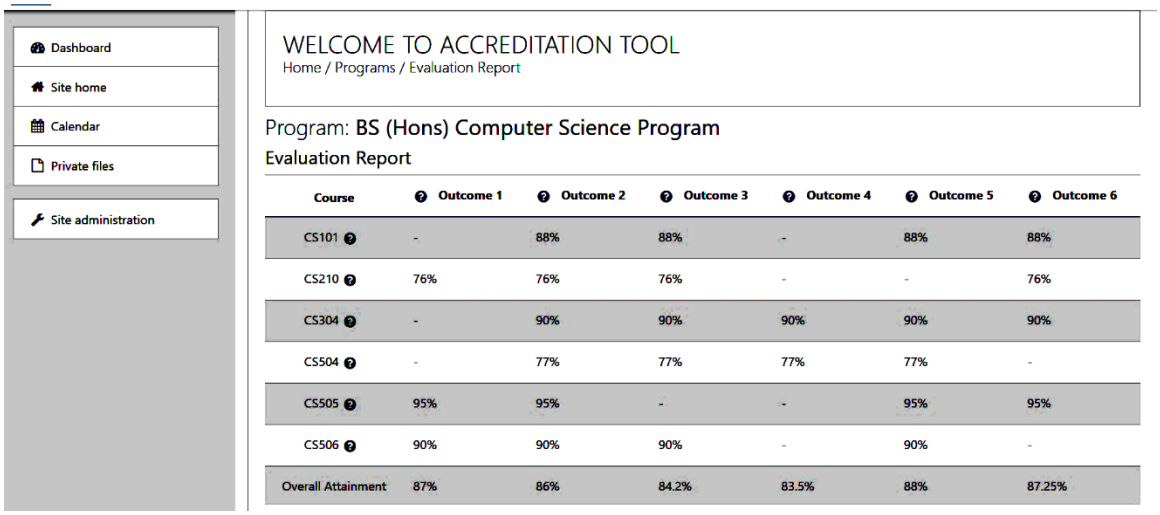


Figure 10. Outcome Assessment Report

Outcome assessment against each course is calculated based on passing student percentage. Presently, MPNA calculating uses 50% passing marks criteria for evaluation, that can be editable if any HEI required. There is also flexibility to display the outcome assessment report in other dimension e.g. this Interface displays outcom assessment data report in matrix,

so that each outcome results can be analyzed against each course and over all achievements (see Figure 11).



Course	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5	Outcome 6
CS101	-	88%	88%	-	88%	88%
CS210	76%	76%	76%	-	-	76%
CS304	-	90%	90%	90%	90%	90%
CS504	-	77%	77%	77%	77%	-
CS505	95%	95%	-	-	95%	95%
CS506	90%	90%	90%	-	90%	-
Overall Attainment	87%	86%	84.2%	83.5%	88%	87.25%

Figure 11. Outcome Assessment Report Matrix Report

Report Generation Module (RGM)

Report Generation Module (RGM) provides the final output of entire accreditation process. It provides an overall picture of assessments and report is generated for defined course objectives along the results we have obtained by considering students' performance according to those objectives.

Accreditation Interface Module (AIM)

Accreditation Interface Module is responsible for providing an interface to carry out accreditation. Accreditation bodies can access outcomes assessment reports generated by system. It takes students' performance data for courses along the required objectives for that particular course and perform accreditation after performing calculation for degree of achieved objectives.

This module provides all the accreditation process at single point and hence provides considerable ease to accreditation bodies during accreditation visits. This interface also facilitates accreditation personnel to view requisite data against each course. This will replace the paper-based course folders, by utilizing already available data in Moodle database repository.

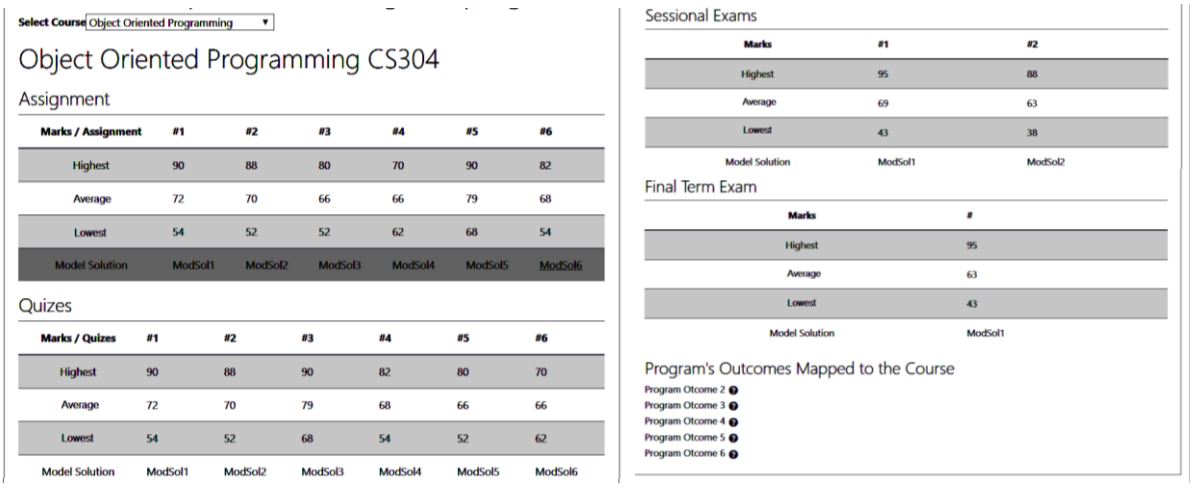


Figure 12. Accreditation Module Interface

Conclusion and Future Work

Accreditation for specialized program of Computer Science and Information Technology is exceptionally desirable. This demonstrates that the program meets specific prerequisites and that the graduated students' have a significant amount of expertise and knowledge. The prerequisites for accreditation from accreditation bodies such as NCEAC for computing programs are rigorous. It takes a lot of time on reporting and documentation details for confirmation of certification. Evaluations of courses are a noteworthy segment of this reporting and documentation, and practically every employee of the institution is included.

A need exists to automate the procedure utilizing learning management systems for created NCEAC course evaluation. A thorough research was conducted including detail investigation, prerequisite development, design of a comprehensive framework to build accreditation assistant module, MPNA, for the facilitation of the program accreditation. A prototype of MPNA was developed keeping in view the usability and accreditation bodies requirements in design. It provides support to the user to enter least input and utilizing previously available data for the accreditation process. The tool was made available on web server of University of Wah for assessment by the teachers. To measure the satisfaction with the usefulness of MPAN, a survey was conducted using Usability study approach. Faculty and participating students briefed about the usage of tool and given time to interact with LMS installed with MPNA. Faculty gave feedback based on their experience with the tool, and evaluation dependent on the Computer System Usability Questionnaire (CSUQ).

A usability study will be conducted in future to evaluate the effectiveness of the developed module, MPNA, in the context of learning outcome assessment and accreditation. This study will focus on assessing user satisfaction, ease of use, and overall efficiency of the module, providing valuable insights to further refine and enhance the MPNA's functionality and user experience.

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Chapter 6 - Evaluation of Project Based Learning in The Implementation of Indonesia's Curriculum

Mia Roosmalisa Dewi

Chapter Highlights

- Explores the significance of learning evaluation as a key factor in improving the quality of education. Highlights the focus on Project-Based Learning (PjBL) within the Indonesian secondary school curriculum, emphasizing the need for effective evaluation methods.
- Introduces the use of the CIPP (Context, Input, Process, Product) evaluation model in assessing the implementation of PjBL in the biology subject of Indonesian secondary schools. Emphasizes the comprehensive nature of this evaluation approach.
- Investigates the implementation of PjBL in the biology subject, specifically focusing on the process and product variables. Explores how the learning process unfolds and evaluates the tangible outcomes, providing insights into the strengths and challenges of PjBL.
- Describes the research methodology employed, utilizing a descriptive evaluative method with a quantitative approach. Discusses the data collection techniques, including questionnaires and observations, involving 25 high school students and 2 high school biology teachers.
- Presents the findings of the evaluation, indicating that the PjBL learning process followed proper syntax, yet faced some implementation challenges. Discusses the student-generated artificial ecosystem illustration products and teacher feedback, suggesting improved understanding compared to conventional learning. Emphasizes how the evaluation process informs ongoing improvements in PjBL implementation and provides a comprehensive assessment of learning objectives.

Introduction

The quality of education is a significant indicator of a country's well-being. Quality education is intended to provide quality human resources that are capable of handling natural resources. Quality human resources are believed to promote a nation's productivity, which can improve the well-being of society and global competitiveness. The government has made various efforts to develop and improve the national curriculum, develop teaching materials, improve the evaluation system, provide books and learning tools, improve facilities and infrastructure, improve teacher competence, and improve the quality of school leaders in order to improve the quality of national education (Depdiknas, 2001). The demand for high-quality education in line with the advancement of science and technology forces the government to take a strategic approach. The demand for high quality education in line with the development of science and technology forces the government to take strategic steps in making changes, one of them is through curriculum development.

The results of this PISA test show that there has been no significant improvement in the last 10-15 years, there are 70% of 15-year-old students in Indonesia are below the minimum competency in reading and math. The PISA results show that the quality of education in Indonesia is still low, therefore the curriculum implemented must be able to improve the quality of education in Indonesia. Improving the quality of education in Indonesia is characterized by the implementation of the 2013 curriculum which aims to prepare Indonesian human resources to have the ability to live as individuals and citizens who are morally good, productive, creative, innovative, and detective and contribute to social, national, domestic, and global development. The quality of the 2013 curriculum is expected to improve Indonesian education for the better and can provide solutions to existing education issues. In the process of implementing the 2013 curriculum, students are subjects who have the ability to actively seek, process, construct and apply knowledge. In this way, it is expected that in learning the teacher can facilitate the learning process, so that students' abilities can develop optimally. According to Abdulmajid (2017), learning activities carried out by teachers are still limited to delivering material through conventional methods, which ultimately makes students passive and less explorative, so the development of student learning outcomes cannot be maximized.

The learning model recommended for use in the 2013 curriculum is a student centered learning model, one of which is a project-based learning model. project-based learning is learning that focuses on student activities to be able to understand a concept by doing an in-depth investigation of a problem and finding a solution by making a project. Project-based learning is designed to be used on complex problems that require students to investigate and fully understand. (Ministry of Education and Culture, 2013). The project-based learning model provides an opportunity for teachers to manage learning in the classroom by involving project work. The main characteristics of project-based learning aim to foster student-centered learning, teamwork, interdisciplinarity, development of critical thinking, and competencies related to interpersonal communication and project management (Helle, Tynjälä & Olkinuora, 2006). These characteristics of project-based learning are in line with the educational philosophy of John Dewey (1916), who initiated learning by doing, which is the process of obtaining learning outcomes by doing certain actions in accordance with the objectives. By using project-based learning, students' creativity and motivation will increase. Project-based learning focuses on the core of the curriculum, facilitating learners to investigate, problem solving, assigning tasks, student centered, and producing real products (Wahyu, 2016). Project-based learning models have very important and beneficial advantages for students, but project-based learning models are rarely used by teachers because their implementation requires sufficient preparation and takes a long time.

One of the important factors in improving the quality of learning is the implementation of evaluation. In order to improve the quality of learning, the implementation of evaluation must be an important part and should be done on a sustainably basis. Evaluation in the teaching and learning process is an activity to determine whether the teaching and learning process achieves the predetermined goals. The learning process cannot know its effectiveness until an evaluation is conducted. Evaluation does not focus only on assessing learning outcomes, but must also be based on the learning process itself. Based on the results of preliminary observations and interviews with one of the high school biology teachers in East Java Indonesia, it appears that the implementation of the 2013 curriculum with a project-based learning model has not been implemented optimally. This can be seen from the biology learning process where students do not understand the material presented by the teacher causing teaching and learning activities to be not optimal and student learning outcomes in the subject do not fulfill the Minimum Completeness Criteria which is 70. Based on this, it is necessary to evaluate the project-based learning process in biology subjects in high school to

see the effectiveness of the learning process. In this evaluation study, researchers used the CIPP (Contex, Input, Process, Product) evaluation model. The material that is the focus of the study is ecosystem content. Class X SMA in the 2021-2022 academic year Curriculum 2013. Assessment of learning outcomes in the 2013 curriculum process assessment, namely knowledge, skills and social (attitudes and spiritual), so in this case the researchers evaluated the implementation of project-based learning to determine the success of learning carried out by high school biology teachers in East Java Indonesia.

Method

Research Design

The type of research used in this study is evaluation research. Evaluative research is used to describe, record, analyze, and interpret the conditions that occur in the field related to the suitability of curriculum implementation in biology subjects at the high school level class X curriculum 2013 with existing standards. This research uses a quantitative approach. The use of quantitative approach in this research is used as a method in calculating and analyzing data in the form of numbers collected through questionnaires. The research instruments used in this study were questionnaires and observations. Data analysis in this study was carried out quantitatively based on questionnaire instruments using descriptive statistics, calculating the average percentage and compared with evaluation criteria. The population in this study were all high school class X students in the 2021-2022 academic year as many as 98 people and 2 high school biology teachers in East Java Indonesia. Sample selection in this study using purposive sampling technique. Where the student sample is taken by purposive sampling with consideration of the teaching hour schedule. The student sample consists of all high school class X students totaling 25 students and 2 biology teachers.

Evaluation Model

In this evaluation research, researcher uses the CIPP evaluation model developed by Stufflebeam. The CIPP evaluation model is used in this research as a theoretical basis in data collection, so this research has a research focus on the two aspects of CIPP that will be evaluated as follows:

- **Evaluation of the of project-based learning implementation in the process aspect**

In evaluating the process aspect of project-based learning implementation, the researcher explores the implementation process that occurs in the field. In the process aspect, the researcher evaluates how teachers implement the 2013 curriculum with project-based learning based on the guidelines that have been made in line with the learning objectives.

- **Evaluation of project-based learning implementation in the product aspects**

Product evaluation is an aspect that measures the intended results or impacts and unpredictable impacts that appear when implementing project-based learning in the 2013 curriculum.

Results

Data and information related to the research findings in evaluating the implementation of the Project-Based Learning program in Curriculum 2013 in biology subjects in high school will be presented using a quantitative approach. In addition, in the discussion, the research will use descriptive evaluative methods in interpreting, explaining and assessing the findings presented based on the results of distributing questionnaires to high school students in East Java Indonesia and observing the biology learning process using project-based learning models.

Results of Evaluation of Project-Based Learning Implementation in the Process Component

Evaluation of project-based learning implementation in the process component is conducted using two instruments, namely observation and questionnaire. The observation of the project-based learning process in class X biology learning focuses on the learning process carried out by the student teacher with students during the activity in the classroom. The results of these observations can be seen in Table 4.1 below.

Table 1. Observation Results of Project-Based Learning Implementation

No	The aspect that is being observed	Accomplised		Notes
		Yes	No	

1	Performing apperception and opening the session in the classroom	√		The teacher does not give motivational words at the beginning of the lesson
2	Giving essential questions	√		
3	Designing and planning the project	√		Teacher does not properly guide students in developing project action steps.
4	Set up a timeline	√		
5	Monitoring the project progress	√		
6	Assessing the results and conducting evaluation		√	The teacher did not give students the opportunity to present the results of the project so there was no feedback obtained by students (due to time limitations).

Based on the the observations above, the teacher has done most of the steps in project-based learning. However, in the process of implementation, from the observations made, the teacher did not provide motivation at the beginning of learning, besides that the teacher did not guide students in compiling steps in project work. At the end of learning there is no feedback given by the teacher regarding the development of the project results done by students due to lack of time. So that students also do not get the opportunity to present the progress of their project results. The results of the evaluation of the process component with a questionnaire instrument filled out by students are the results of the students' response perceptions of the implementation of project-based learning. The data obtained from the question items were converted into the average score table, the average score was calculated using descriptive statistics, and the category of respondents' answers. The average score of students' perceptions can be seen in Table 4.2 below.

Table 2. Score of Learners' Perceptions of the Project-Based Learning Process (N: 25)

Indikator	Skor
Students interest in project-based learning on the ecosystem topics	61,33
Students' attitudes when implementing learning by using project-based learning on the ecosystem topics	75,47
students have ability to ask opinions or questions to the teacher and friends	66,93

Based on the results of the questionnaire that was filled out by students of class X SMA majoring in science, it can be seen that the students' perceptions of the project-based learning implementation process. Based on the table above, it is known that the indicator of student interest in project-based learning obtained a score of 61.33 in the good enough category.

Where some students feel excited to learn by carrying out activities to make projects rather than learning in conventional way, although there are some students who are not too excited about project-based learning. Most students like project-based learning because the knowledge that they obtained is not much different from learning in the classroom. Then students feel more motivated in learning by involving project activities. Meanwhile, in the indicator of students' attitudes that arise when implementing learning by using project-based learning on ecosystem topics, the results are 75.47 in the good enough category. Students feel that project-based learning can make them actively involved in learning activities. So, it's improve students' ability to work together with partner in the group while making projects. In the collaboration aspect, students feel more able to appreciate the opinions of other people in their group so they can work well together. Furthermore, in the indicator of have ability to ask opinions or questions to teachers and friends, the score is 66.93 in the good enough category. By doing project-based learning, students are have more courage to ask teachers or group partner when they find problems in implementing project-based learning activities. Students have more courage in expressing their opinions when working in groups to make a projects. So, it can be seen that by studying in groups to make a projects, students practice collaboration skill and ability to express their opinions.

Results of Evaluation of Project-Based Learning Implementation in Product Aspect

Evaluation of project-based learning implementation in the product aspect is conducted by students and the questionnaire is given to the teachers. The results of students' scores on the product aspect using project-based learning are shown below.

Table 3. Students' Scores on the Product aspect of Project-Based Learning

Indikator	Skor
Develop critical thinking and creative thinking skills	57,7
Students can work collaboratively in groups	72,27
Students understand the topic easier by using project-based learning	66,2

In the evaluation of the product aspect by using project-based learning, in this research, it can be seen whether project-based learning on ecosystem topics can improve students' skills. In the indicator of developing critical thinking skills and creative thinking of students, the score was 67.67 with a quite good category. In this case, students' creative thinking and critical thinking skills increase with project-based learning compared to learning in conventional

way. This is because when students find problems in learning, they are not just silent and students try to find the solution. Thus, students are more able to improve their thinking skills through learning by making projects. Then in the indicator of working together in groups, the score is 68.93 with a fairly good category. Based on the results, it can be seen that students' ability to work collaboratively increases so students' thinking skills also increase. Students tend to prefer working in groups rather than working individually because it can improve students' thinking skills and ability to work in groups. In terms of mastery of the content, most students find it easier to understand the content using project-based learning. Based on the results, the score is 67.28 in the good enough category for the level of student understanding using project-based learning. It is because learning with project making tasks makes students' knowledge increase because it is associated with the actual situation in the real world. However, there are still some students who feel it is not easy to understand the learning content using this model.

Evaluation of the product aspect in the implementation of project-based learning is also done using a questionnaire instrument. This questionnaire was filled out by biology teacher in class X high school who implemented project-based learning. The results of the questionnaire can be seen in Table 4.3 below.

Table 4. Score of Teacher Assessment towards Project-Based Learning Product aspect (N=2)

Indikator	Skor
Project-based learning can improve learning outcomes, critical thinking skills and students' creative thinking.	80
Student interest in participating in the learning process	90
Students' level of mastering the subject	90
Project-based learning promotes student learning achievement based on minimum criteria.	70

Based on the questionnaire results above, it is known that teachers understand well the essential competencies that must be accomplished in learning. Teachers strongly agree that project-based learning can be used to improve critical thinking and creative thinking skills. According to teachers, with this project-based learning, students understand the material more quickly than conventional learning. However, based on the questionnaire, teachers do not think that the level of achievement of students' understanding of the content has increased by using project-based learning. The level of critical thinking skills and learning outcomes of students increased with project-based learning that was implemented.

Discussion

Evaluation of the Process Component of Project-Based Learning

In this research, the process evaluation aspect of project-based learning implementation is focused on students' response to project-based learning, project-based learning can improve critical thinking and creative thinking skills, the implementation of project-based learning based on the Syntax, and the obstacles in implementing project-based learning. Data were collected using questionnaires as a research instrument in measuring students' responses and improving students' thinking skills. Then the process evaluation is completed with the results of observations of the implementation of project-based learning as additional information so the information is more complete and comprehensive. The evaluation carried out in line with this process dimension is a fact that explains the evaluation includes an assessment of the teaching curriculum. Then, the product dimension in this study is to examine the results of the implementation of project-based learning 2013 curriculum achieved through the perspective of the process and product dimensions. Oliva (2005) states that the overall implementation of the curriculum goes through an evaluation process to see the progress of the curriculum implementation in the learning process.

The research results presented in this study concern three main things, namely the implementation of project-based learning in biology subjects in terms of process aspects, the achievement of the results of the implementation of project-based learning in biology subjects in terms of product aspects, obstacles in the implementation of project-based learning in biology subjects. Evaluation of the process aspect attempts to describe and specify the implementation of project-based learning.

Evaluation of Implementation Project Based Learning in the Process aspect using observation

A general description of the implementation of project-based learning is obtained through researcher observation to see the suitability of the stages in the implementation of project-based learning carried out by the teacher. When the project-based learning process begins, students pray together, then they go into learning by reviewing a bit of the subject matter that has been given before, in this case the researchers saw the enthusiasm of the students when working on and answering the questions given by the teacher. When there is a group

discussion assignment there are many patterns that can be seen from student's attitudes, there are student who are silent, joking, some are seriously working, and discussing. In implementing this project-based learning, teachers use a scientific approach. The scientific approach when project-based learning is more visible when there are assignments given by the teacher, students carry out activities to observe, question, process, and talk back to their groupmates about the new findings they have obtained. In line with the explanation presented by Armandi (2017) who said that the scientific approach is an activity in looking at a problem by conducting a scientific investigation through a series of activities such as observation, questioning, gathering information, processing, and communicating.

Researchers saw the course of project-based learning in class X had gone well, starting from the activeness of students, the explanation of the material, the learning atmosphere built between teachers and students. Students have also brought tools and materials that will be used to make their projects. Students make media pictures that will illustrate the kinds of artificial ecosystems according to the students' interests. However, unfortunately in observing this learning process, the researcher has not seen several things such as the teacher has not given students the opportunity to present the results of their project work related to the content material that already discussed and connect the content with the conditions or potential that exist in the surrounding environment.

Then in the process of preparing the project, the teacher does not guide students in preparing the steps for carrying out the project. Project preparation is a process that is carried out after designing the project. In this process students make illustrations (pictures) from the project that will be made by them. In this process the teacher should guide students in compiling project work steps. This is in accordance with The George Lucas Educational Foundation quoted by Sabar Nurohman (in Sutirman, 2013) which states that students assisted by the teacher design a plan for the stages of the project. The next process is project implementation. Not all projects are carried out during the learning process in the classroom due to lack of time in each meeting, so the project must be completed outside the classroom and continued at the next meeting. During this process, students work together to implement what has been designed to find a problem solution in the form of a product. The successful of implementing project-based learning on the teacher as a learning facilitator. According to Sitorus and Harahap (2009) the teacher's role in project-based learning should be as a facilitator, trainer, advisor and intermediary to obtain optimal results in accordance with the imagination,

creativity and innovation of students. According to Dewey, the role of the teacher is not to deliver information to passive students, but to act as a facilitator of the learning process, guiding students as they progressively develop as independent learners (Fernandes, 2014). Thus, the role and guidance of the teacher is key to the successful implementation of project-based learning. Various management, assessment and mentoring strategies are also needed to ensure that project-based learning is implemented as it should be.

Based on the discussion above, the implementation of learning at High School in East Java Indonesia which includes preliminary activities, core activities, and closing activities is in accordance with the guidelines for implementing the 2013 curriculum project based learning model. According to Permendikbud Number 22 of 2016 states that the implementation of learning is the implementation of the Lesson Plan which includes preliminary, core and closing activities. However, in closing activities the teacher does not reflect or reviewing what has been done. This is not in accordance with Permendikbud Number 22 of 2016 which states that in closing activities, teachers and students, both individually and in groups, reflect to evaluate (Andyana et al., 2017).

Evaluation of Implementing Project-Based Learning in the Process Aspect with a questionnaire instrument

In evaluating the process of implementing project-based learning using questionnaire instruments given to students. This aims to see how students' perceptions of project-based learning, both student responses and whether students feel that with this project-based learning the ability to think, work together, collaborate increases. Although the evaluation of the process of implementing project-based learning based on the perceptions of these students may not provide definite numbers quantitatively, they do allow for providing feedback that can stimulate improvements in learning. Every good evaluation or judgment will provide some feedback (Wiggins, 1993). Evaluating students using standardized assessments (ie, exams) is the most common form of evaluation, but this method does not provide many opportunities to understand students' perceptions of the content material that have been taught (Perrone, 1991).

Based on the results of the questionnaire that has been filled in by students which can be seen in Table 4.2, generally individual students feel the advantages of implementing this project-based learning. Students feel that project-based learning can help them understand the content

better. Project-based learning helps students in solving problems in their real life. This is in line with Boaler's (1999) opinion that students tend to acquire different types of knowledge when taught using project-based learning compared to conventional learning. According to Boyle (1997) this is due to the fact that project-based learning gives them the opportunity to integrate the knowledge they acquire with real life experiences.

In terms of working together in groups, students feel that project-based learning can improve their ability to work in groups. When it is referred to the basic theory of socio-constructivism, project-based learning is able to encourage students to do social interaction and group collaboration, which works for a certain period of time, producing a product, presentation, or performance (Moursund, 2009). Although there are some learners who feel more comfortable learning individually. However, students continued to discuss and respond to each other. In addition, they were able to investigate together in making products. Students' collaboration skills in managing group work improved. Students play an active role in managing group work in project completion (Putri et al., 2016). In addition, from the results of the questionnaire, it is also known that students do not look at other groups' worksheets in completing their work. This happens because each group member has actively completed their own project so that they no longer see the situation and conditions in other groups.

In relation with the level of student activeness in participating in project-based learning, it also increased. Students feel more courageous to ask questions and are more active in learning. This is because this project-based learning provides a wide discussion space for students. In addition, the learning motivation of students in implementing project-based learning also increased. It can be seen from the results of the questionnaire which states that this project-based learning model makes students more enthusiastic in participating in learning. In line with the opinion of Sumarni (2019) project-based learning is able to involve students actively in learning and the process of obtaining information based on new experiences they have. Effective learning is learning that involves students directly in the learning process. Furthermore, according to Insyasiska (2017), students play a big role in project-based learning because students can solve problems independently. Project-based learning increases learners' motivation. When teachers successfully implement project-based learning, students can become highly motivated and feel actively involved in their own learning. Then they will produce better results. The students who learn using project-based

learning model will have higher motivation level than the students who use conventional learning (Sumarni, 2013).

Through the questionnaire results, it can also be seen that students feel that using this project-based learning improves their critical thinking and creative thinking skills. Students' critical thinking skills using a project-based learning model can increase (Putri et al., 2021). This statement is in line with the results of research conducted by Sastrika, et al (2016) which states that project-based learning involving student activities can improve students' critical thinking skills to solve problems, make decisions, research, present, and make reports. Rauziani, et al. (2016) also stated that students who are given the opportunity to develop ideas and find solutions to problems in everyday life can train students' creative thinking skills. Critical thinking, creative thinking, collaboration, and communication skills have been formed when making projects because students are trained to search for information, face problems, and collaborate. Redhana (2019) also stated that the project-based learning model is one of the models that can be used to improve critical thinking, creative thinking, collaboration, and communication skills. This is because indirectly through projects carried out by students, students' activities increase because students are free to apply their knowledge and skills. This learning focuses more on concepts that involve students in problem-solving activities.

Based on the results of the questionnaire, students have also carried out project-based learning according to the syntax. Starting from planning, implementing, and reporting projects. Meanwhile, according to Cahyono (2017) the steps for project-based learning are as follows: () Start With The Essential Question, determining fundamental questions; (2) Design a Plan for The Project, preparing a project plan; (3) Create a Schedule, arrange a schedule for teachers and students to arrange a schedule for project completion activities; (4) Monitor The Student and The Progress of The Project, monitor students and project progress; (5) Assessment of the Outcame, testing the results; (6) Evaluate The Experience , evaluate experience.

Evaluation of Project Based Learning in Product Aspect

On the product evaluation aspect of project-based learning, it can be seen from the questionnaire filled out by the teacher. Project-based learning brings a tendency to increase students' understanding of learning materials. However, it turns out that according to the

teacher the level of material achievement of students is still not too much improved from the previous conventional learning. This indicates that there are still some weaknesses in the evaluation process of project-based learning in class X MIPA III SMA Nuris Jember. Based on the follow-up interview with the teacher, it is known that the weakness is related to the less optimal process in organizing learning. This is due to the content that is too much with the time that is too short. So that the achievement of students' mastery of the subject has not been in line with the learning objectives or outcomes that are expected to be achieved.

In addition, based on observations, the teacher has not conducted an preliminary assessment or evaluation regarding the results of the project carried out by students. This result contradicts with Cahyono's (2017) opinion that assessment of project-based learning must be carried out thoroughly on the attitudes, knowledge, and skills obtained by students during learning. Furthermore, Wajdi (2017) analyzes that teachers need to assess the project, reflect and evaluate the project. The project in this learning model is an assessment activity of a task that must be completed within a certain period of time. The task is in the form of an investigation undertaken from planning, collecting data, organizing, processing, and presenting data. Project assessment can be used to determine the understanding, ability to apply, ability to investigate and ability to inform by students.

Besides this, teachers agree that project-based learning can improve students' critical thinking skills. According to Khoiri et al. (2013) project-based learning not only aims to equip students with knowledge but also improve problem-solving skills, critical and creative skills, learning time, communication skills, teamwork, adaptation to change, and self-evaluation. In project-based learning, real-world problems are used to motivate students through problem solving (Farhan & Retnawati, 2014). When solving problems, there will be an exchange of information between students and other students so that the problem can be resolved. The teacher acts as a facilitator to direct the problem so that student discussions are focused on the solution (Anazifa & Djukri, 2017). Furthermore, Hartini (2014) explained that there was a significant effect on creative thinking when project-based learning was applied.

The obstacles found in the implementation of project-based learning, namely first there are group members who are active in working on projects and there are group members who are less active. So it is difficult to see objectively which students contribute to the project and which students do not actively contribute. Second, the limited time for implementing project-based learning. This affects the implementation of project presentation, assessment, and

evaluation of learning implementation. Third, the inequality of students' abilities. Differences in student characteristics cause inequality in student abilities. When group formation is not appropriate, there will be a gap in project completion between groups. Fourth is student skills. Students act as implementers who will prepare and carry out the project. Therefore, students need skills that will be used in completing the project, including: discipline, teamwork, and activeness. Conversely, student indiscipline will be a factor that inhibits project completion.

From the discussion of the research results above, several conclusions can be drawn. Further improvement of project-based learning can be done by prioritizing on improving the relationship between learning components, learning objectives, materials, media, strategies, and learning evaluation. so that learning can provide meaningful and varied learning experiences in improving learning outcomes, motivation, activeness, creativity, critical thinking skills, and problem solving of students. Project-based learning processes have been associated with the development of much deeper learning, greater understanding and higher motivation to learn, improved implementation capabilities, and increased learning effectiveness (Bell, 2010). Furthermore, to achieve positive outcomes from project-based learning, it is crucial to ensure that a suitable environment is available for students to experience both the knowledge they wish to acquire and the development of skills (Chang, 2018).

Conclusion

Based on the research findings and discussion, it can be concluded that in general the implementation of project-based learning in class X at one of the high schools in East Java Indonesia runs in accordance with the syntax that should be. Although there are some things that are not implemented by teachers such as initial evaluation of project development. However, with this project-based learning, students feel more able to understand the material well, improve the ability to work together, collaborate, be more active in participating in learning, improve critical thinking skills, creative thinking, and problem solving skills.

The results of this project-based learning are in the form of artificial ecosystem illustration products made by students. Product evaluation is done by filling out a questionnaire from the teacher's perception. Teachers consider that with project-based learning, students' understanding is more improved compared to conventional learning. However, the level of

mastery of the material by students has not reached the target of learning objectives due to time constraints. Teachers agree that project-based learning is good for improving students' critical thinking, creative thinking, and problem solving skills. However, it takes extra time to solve complex problems in implementing project-based learning.

Recommendations

Based on the findings and discussion, there are several suggestions that can be given, namely the implementation of the CIPP model program evaluation shows that the project-based learning program is proven to be effective and can be used as a reference in improving the quality of learning for educators to improve the quality of learning biology subjects. The process and product evaluations show that implementing project-based learning requires sufficient time and preparation from the teacher. So that the implementation can be more effective and efficient. To implement project-based learning requires teachers who are also creative. Having the ability to solve problems and improve content knowledge and skills, especially to deal with low-ability students, lack of motivation and lack of focus, teachers must be more patient and must try to improve the ability of teacher relations with students.

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Chapter 7 - Project Proposal-Based Learning (PjPBL): A Potential Assessment Method to Develop Innovative Skills among Pre-University Students

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Chapter Highlights

- Explores the pressing need for innovative approaches in higher education to align with 21st-century skills, as outlined by the Malaysia Education Blueprint and OECD.
- Proposes Project Proposal-Based Learning (PjPBL) as an innovative assessment method, emphasizing its student-centric approach in developing programming skills and fostering innovation.
- Details the successful implementation of PjPBL with 379 pre-university students, showcasing its scalability across various disciplines.
- Presents significant skill enhancement among students, with 92% showing improvement in research, 78% in creativity, and 86% in critical thinking, based on survey results.
- Highlights sustained impact, with student groups continuing to excel in innovative competitions. Discusses the potential expansion of PjPBL beyond programming to foster innovation skills in diverse subjects.

Introduction

In the 21st century, students need to develop a range of skills to thrive in a rapidly changing world. These skills, often referred to as "21st century skills" or "future-ready skills," go beyond traditional academic knowledge and include a combination of cognitive, social, emotional, and digital competencies. Some of the key 21st century skills important for students to develop are critical thinking and problem solving, creativity and innovation, communication and collaboration, initiative and entrepreneurship, cultural and global awareness and lifelong learning (Trilling, B., & Fadel, C., 2009). These skills are interconnected and mutually reinforcing, and these abilities need to be developed right in the classroom (Partnership for 21st Century Skills., 2009).

Innovation skill is among the most challenging skills to develop in the classroom as the commonly structured curriculum will focus on the established knowledge and standardized assessment. This can limit the opportunities for students to explore alternative or creative solutions to problems. Some efforts have been done by the researchers to encourage creativity and innovation in the classroom (Runco and Jaeger, 2012; Facione and Facione, 2007; Mwasalwiba, 2010; Ku, 2009; Arora & Chander, 2020). A collection of practical tips and strategies for educators to foster creativity and innovative thinking in the classroom has been proposed by Craft, Jeffrey, and Leibling (2001). Zhu and Zhang (2017) on the other hand proposed a new teaching assessment such as problem-based learning (PBL), project-based learning (PjBL) open-ended assignments (Helle, Tynjälä, and Olkinuora, 2006; Thomas, 2000; Barron, 2003).

PjBL is one of the commonly used approaches to develop students' innovative skills. It is an instructional approach that centers on students completing an extended project or task that addresses a complex, real-world problem or challenge (Buck Institute for Education, 2018). In PjBL, students engage in active inquiry, investigation, and collaboration to explore the project's topic, create a meaningful product or solution, and present their findings (Dabbagh & Bannan-Ritland, 2008; Beri, 2018; Beri & Stanikzai, 2019; E. A. Linnenbrink & Pintrich, 2003b, 2003a; E. a Linnenbrink & Pintrich, 2003; DeMink-Carthew et al., 2020). However, it hinders the students from proposing their own project, as the teachers will usually narrow the perspective to facilitate students who may struggle with the uncertainties that come with innovative thinking.

This paper therefore proposes a new teaching assessment called Project Proposal-Based Learning (PjPBL) which helps students develop their innovative skills by providing a broader scope of projects and empowering them with the opportunity to propose a project of their own. The next section describes the steps in PjPBL implementation together with the proposed proposal and rubrics to assess creativity and innovative skills. Then, the following sections describes implementation of PjPBL in a Programming course at the Pre-University, results obtained and discussion. Concluding remarks are provided in the last section of this article.

The Proposed Project Proposal-Based Learning (PjPBL)

The Organization for Economic Cooperation and Development (OECD) and Malaysia Education Blueprint 2015-2025 (Higher Education) (Blueprint, 2015) has outlined the needs to groom our educational system that equipped our students with 21st century skills (Geisinger, 2016) and to create an innovation ecosystem. Project Proposal-Based Learning (PjPBL) is an initiative aimed at fostering research and inquiry, creativity, and critical thinking among pre-university students. PjPBL is a continuous assessment activity to create an innovation ecosystem in classrooms. It is an initiative aimed at fostering research and inquiry, creativity, and critical thinking among pre-university students. The program is designed to provide students with the opportunity to participate in a hands-on, project-based learning experience that encourages them to think critically, solve problems, and develop their skills in programming and coding. Through PjPBL, students will have the opportunity to work on real-world projects, collaborate with peers and mentors, and gain valuable experience in the field. Additionally, the program emphasizes the importance of research and inquiry skills and creativity in the field of computer science and technology.

There are seven steps in PjPBL (Figure 1) which are identifying problem, group discussions, drafting a proposal, group presentation, improvement of project, preparation for innovation competition (students are encourage to participate), and survey by teachers. Identifying a problem involves being observant and critical about your academic or personal circumstances. Some of the steps to help students' identify a problem are by reflecting on own's experiences, brainstorm for potential issues, gather feedback, research and explore, prioritize and narrow down, define the problem and seek guidance. Once a student have a clear understanding of the problem, they need develop a plan of action. Students need to

break down the problem into smaller, manageable steps and set goals for the group. Students need to disccuss in a group to implement the necessary strategies and monitor their progress. They need to draft a proposal with relevant informations such as problem statement, objectives, and suggestions. A group presentation to the supervisor is required to analyze if the proposal is viable and need further improvement.

Figure 1. Seven Steps in Project Proposal-Based Learning

An improved and approved proposal can be proceed with a prototype that can be used to participate in an innovation competition. In the end a survey is conducted on the students to get feedback on their experiences and for future improvement. PjPBL is designed to provide students with the opportunity to participate in a hands-on, project-based learning experience that encourages them to think critically, solve problems, and develop their skills in programming and coding. Through PjPBL, students will have the opportunity to work on real-world projects, collaborate with peers and mentors, and gain valuable experience in the field. Additionally, the program emphasizes the importance of research and inquiry skills and creativity in the computer science and technology field. Beside the seven steps in implementing PjPBL, two important innovations have been designed to guide the whole process.

Innovation in PjPBL #1: Proposal Template

The proposal template serves as an important tool in guiding the teachers and students in

conducting PjPBL (Table 1). The proposal template gives a clear guidance on the important aspects that must be fulfilled by the students to achieve the objective of developing their creative thinking. This proposal template design is customized to suit the programming subject. The proposal template includes the project name, category and subcategory, team organizational chart, supervisor, abstract, introduction, problem statements, objectives, solutions, product platform, equipment and devices required, mockup design, estimated cost, impact on stakeholders, conclusion and references. The project name, category and subcategory, team organizational chart, supervisor, abstract, introduction, problem statements and objectives, emphasizes the students on the objectives and gives the project overview. In the solution part, the students must use the problem solving techniques in programming. These include problem analysis chart, input process output chart, flowchart and pseudocode. At this stage, students are not required to produce a full-fledged programming code. Students however, are required to plan on the product platform, equipment and devices required, mockup design, estimated cost and impact on stakeholders. By doing this, students, will have experience on the basic process of developing a commercial product. The proposal ends with conclusion and references.

Table 1. Proposal Template

Project name:	
Category/Sub-category:	
Team organizational chart:	
Supervisor:	
Abstract:	
Introduction:	
Problem statements:	
Objectives:	
Solutions	

1) Problem Analysis Chart (PAC)	
2) Input Process Output Chart (IPO)	
3) Flowchart	
4) Pseudocode	
Product Platform:	
Equipment/ Devices required:	
Mockup design:	
Estimated cost:	
Impact on stakeholders:	
Conclusion:	
References:	

Innovation in PjPBL #2: Evaluation Rubrics

Two outcomes from the students will be measured. The first is the project proposal. A rubric has been designed (Table 2) to measure the contents of the proposal in terms of subject matter, creativity or ambition, solutions, final product and conclusion, and use of references. The score of each item is given from a minimum of 1 point to maximum of 4 points. The subject matter measures student understanding of the subject matter. Creativity and ambition measures the students' originality, creativity and ambition in proposing the project. Solutions measure how the students utilize the problem solving techniques in programming (Problem Analysis Chart (PAC), Input Process Output Chart (IPO), and flowchart) to create a logical structure and flow of a solution. The final product and conclusion measures student ability to propose a complete product. It also measures how students' considers any adnavantage and disadvantages of the proposed product. Use of references measures whether the students refer to any existing resources in developing their proposal.

Table 2. Rubric for project proposal

	Excellent (4 points)	**Proficient (3 points)**	**Basic (2 points)**	**Poor (1 point)**
1) Subject Matter	Students show a deep understanding of the subject matter and its greater implications. Proposal or plan shows integration of some advanced or researched concepts.	Students show an understanding of the subject matter and it is evident in the execution of the proposal or plan.	Students show some understanding of the subject matter but confusion is evident in some aspects of the proposal or plan.	Students show very little understanding of the subject matter and thoroughly misinterprets the requirements for the class.
2)Creativity / Ambition	The project proposed is very original, creative and ambitious. The student is highly motivated, and the project has a good potential for success.	The project proposed is original, creative and somewhat ambitious. The student is motivated about the project, and the project has a good potential for success	The project proposed is somewhat creative, original or ambitious. The student is not very excited but not bored, the project has some potential for success.	The project proposed is not creative, original or ambitious, the student is uninspired, and the project has a low potential for success.
3)Solutions (PAC, IPO & Flowchart)	Proposal or plan is clear, concise, and has a logical structure and flow. Work shows deep consideration of the execution of the project after the proposal's approval.	Proposal or plan is well organized, and has a sensible flow and structure. Minor elements may need clarification but otherwise well-made and ready for execution.	Proposal or plan makes general sense but requires some work to organize and structure in a logical and sensible manner.	Proposal or plan is vague, disjointed, and shows no sense, structure, or flow. Confusing to read, difficult to understand.
4)Final Product & Conclusion	Shows excellent effort, care and creativity. Final product is complete and well-presented. Shows excellent research, careful planning, and excellent execution.	Shows good effort, care and creativity. Proposal or plan is finished and turned in on time. Shows good research, some planning, vision, and good execution.	Shows some effort, care and creativity. Proposal or plan is finished and turned in, but is rushed and is poorly presented.	Shows little or no effort, care or creativity. Project proposal is sloppy, illegible, crumpled, unfinished or incomplete.
5)Use of references	Compelling evidence is given to support claims and attribution is clear and fairly	References to support claims are generally present.	Although occasional references are provided, the writer over relies on	References are not cited to support claims.

	represented.		unsubstantiated statements. The reader is confused about the source of the ideas.	

The second important outcome of this project being measured is the students' proposal presentation. A rubric has been designed to measure important aspects which are visual appeal, comprehension, presentation skills, content and preparedness, participation and group dynamics (Table 3). The score of each item is given from a minimum of 1 point to a maximum of 4 points. The visual appeal mesaures student ability to present the proposal in a presentation format using platforms such as PowerPoint or Canva, with minimal errors in spelling, grammar and punctuation, concise and engaging. Comprehension measures student understanding of the subject matter. Presentation skills measutre the students ability in presentation which includes eye contact, control of audience and body contact. Content measures the students level of coverage of the subject and the ability to answer all the questions from the audience. Preparedness, participation and group dynamics measure how the whole team members work together as an organization.

Table 3. Rubric for proposal presentation

	Excellent (4 points)	**Proficient (3 points)**	**Basic (2 points)**	**Poor (1 points)**
1)Visual Appeal	There are no errors in spelling, grammar and punctuation. Information is clear and concise on each slide. Visually appealing /engaging.	There are some errors in spelling, grammar and punctuation. Too much information on two or more slides. Significant visual appeal.	There are many errors in spelling, grammar and punctuation. Too much information was contained on many slides. Minimal effort made to make slides appealing or too much going on.	There are many errors in spelling, grammar and punctuation. The slides were difficult to read and too much information had been copied onto them. No visual appeal.
2) **Comprehension**	Extensive knowledge of the topic. Members showed complete understanding of the assignment. Accurately answered all questions posed.	Most showed a good understanding of the topic. All members were able to answer most of the audience questions.	Few members showed a good understanding of some parts of the topic. Only some members accurately answered questions.	Presenters didn't understand the topic. Majority of questions answered by only one member or majority of information incorrect.

3)Presentation Skills	Regular/constant eye contact, The audience was engaged, and presenters held the audience's attention. Appropriate speaking volume & body language.	Most members spoke to the majority of the audience; steady eye contact. The audience was engaged by the presentation. Majority of presenters spoke at a suitable volume. Some fidgeting by member(s).	Members focused on only part of the audience. Sporadic eye contact by more than one presenter. The audience was distracted. Speakers could be heard by only half of the audience. Body language was distracting.	Minimal eye contact by more than one member focusing on a small part of the audience. The audience was not engaged. Majority of presenters spoke too quickly or quietly making it difficult to understand. Inappropriate/disinterested body language.
4)Content	The presentation was a concise summary of the topic with all questions answered. Comprehensive and complete coverage of information.	The presentation was a good summary of the topic. Most important information covered; little irrelevant info.	The presentation was informative but several elements went unanswered. Much of the information is irrelevant; coverage of some of the major points.	The presentation was a brief look at the topic but many questions were left unanswered. Majority of information is irrelevant and significant points are left out.
5)Preparedness / Participation/ Group Dynamics	All presenters knew the information, participated equally, and helped each other as needed. Extremely prepared and rehearsed.	Slight domination of one presenter. Members helped each other. Very well prepared.	Significant control by some members with one minimally contributing. Primarily prepared but with some dependence on just reading off slides.	Unbalanced presentation or tension resulting from over-helping. Multiple group members not participating. Evident lack of preparation/rehearsal. Dependence on slides.

Implementation of PjPBL in classroom

This research has been conducted in a pre-university in Malaysia. The program offered here is foundation studies in science. There are two major programs which are Life stream and Physical stream. In this study we have implemented our innovation into the Programming 1 subject, which is a compulsory for Physical stream students. This subject was conducted in the first semester of session 2022/2023. There were about 379 students participating in this

study. The PjPBL was conducted as part of the student's assessment after 7 weeks of lectures. The lectures cover topics on the introduction of programming which includes computer software and hardware, numbers representation, mathematical logic & truth table, logic gate & boolean expression, an overview of programming languages and module programming & problem-solving techniques.

Based on this new knowledge, PjPBL requires students to propose a solution to solve real-life problems using programming language techniques. Students were formed into a small group guided by a teacher and were given two weeks to complete with and present their proposal. To measure the effectiveness of this method, a questionnaire was developed to measure students' innovative skills based on three variables which are research & inquiry, creativity, and critical thinking. This questionnaire was validated by three teachers who teach the programming and education subjects. We used Google form to collect feedback from the students after they have completed the project and presented it. There were 115 students participated in the survey.

Results and Discussions

In this section, we discussed the results from the survey on students' research & inquiry, creativity, and critical thinking skills that they have developed from PjPBL. We also summarized the proposals proposed by the students in terms of field of studies and project proposals participated in innovative competitions.

Results on research & inquiry skills

Three questions had been posed to students regarding research and inquiry skills. First question was "I identify problems by asking myself what I know and what I need to know". The second question was "I search for information from multiple resources and authorities". The third question was "I find the main points, audience and connections before I make a conclusion." Some . 103 out of 115 (90%) agreed that they search to find the main points, audience and connections before they make a conclusion; 105 out of 115 (91%) respondents agreed that the program has helped to identify problems by asking myself what I know and what I need to know while 110 out of 115 (96%) respondents agreed that the program has motivated them to search for information from multiple resources and authorities, The results

show that PjPBL has helped students to develop their research and inquiry skills. Figure 2 shows the results for research and inquiry skills.

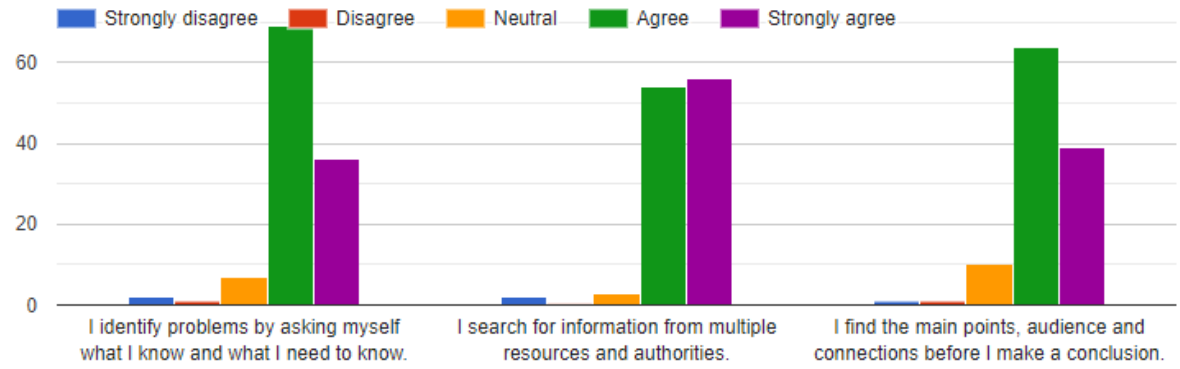

Figure 2. Results for Research & Inquiry Skills

From the open-ended questions, we received feedback and perceptions from the students. Most students show creativity and positive thinking in completing the tasks. The followings were some of the feedback given by students:

Plan the research strategy and diversify the research source

Find the keyword to look up for information and compare the finding to determine which one is more trusted.

This forces student to actively learning the material as well as implementing inquiry-based learning to properly learn about the research

Think outside the box and do read from many kinds of resources

Apart from that, we also received feedback that students require more guidance in solving the task given. Below are some of the feedbacks received:

Make sure students are clear about the main objective of the project in order for them to carry out the research accordingly

Give guidance to students by giving scope of learning

Teach students how professionals research

Provide reliable sources for searching relevant information, especially ebooks

This shows that PjPBL has helped the students to develop their research and inquiry skills. However, the level of development varies depending on the existing skills and attitude of the students.

Results on creativity skill

Three questions had been posed to students regarding creativity skills. these were “I let my mind flow freely to witness surprising results, “My creativity is not limited to my past experience and prior knowledge only” and “I always strive to be unique in my endeavor”. Some 81 out of 115 (70%) respondents agreed that they let their mind flow freely to witness surprising results. 93 out of 115 (81%) respondents agreed that their creativity is not limited to their experience and prior knowledge only. 95 out of 115 (83%) respondents agreed that they always strive to be unique in my endeavor. The results show that the majority of students have developed their creativity skills. Figure 3 shows the results for creativity skill.

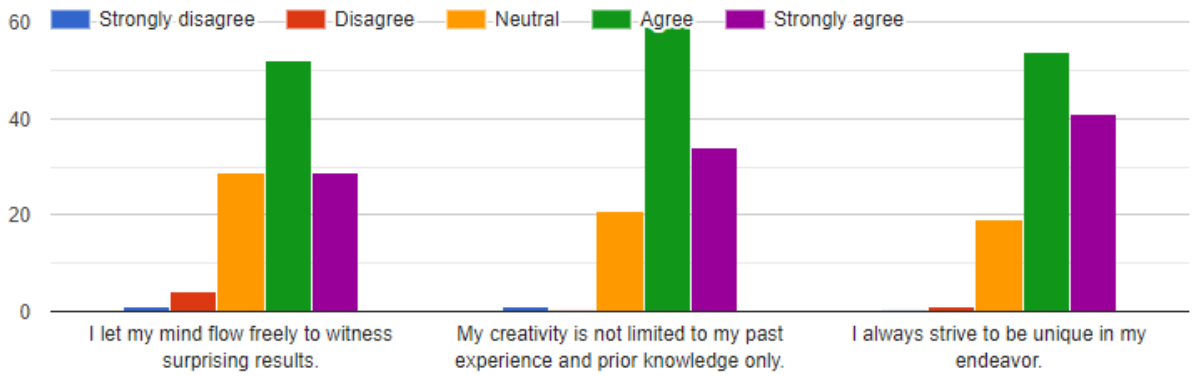

Figure 3. Results for Creativity Skill

Majority of the students gave a positive response. The followings were some of the feedback given by students:

Encourage students to think outside of the box

Everyone should give their own idea so that we can work on which is the best.

Explore more and use imagination

Try to make your own plan, do not only rely on others and technologies.

Expose students to the how real world problems is being solved (such as how the big company actually work on their clients demand)

Only few students gave negative response as shown below: (students still need guidance)

Give more examples of real-life problems that has been successful

Give idea to student

Provide students with many creative and innovative products so they will get more inspiration

We also received many good suggestions as shown below:

Let students use more applications other than PowerPoint and Word.

Allow students to use more applications to present their ideas

Do more grouping task

Give more time discussion especially the dateline after exam week

Overall, this shows that PjPBL has helped to develop students' creativity skills.

Results on critical thinking skills

Three questions have been posed to students regarding critical thinking skills: "I am open to new concepts and ideas", "I always argue in a constructive manner with my team members" and "I make a decision based on information and discussion with team members". Some 109 out of 115 (95%) respondents agreed that they are open to new concepts and ideas, 79 out of 115 (69%) respondents agreed that they always argue in a constructive manner with their team members, while 108 out of 115 (94%) respondents agreed that they make a decision based on information and discussion with team members. The results show that the majority of students have developed their critical thinking skill. Figure 4 shows the results for critical thinking skill.

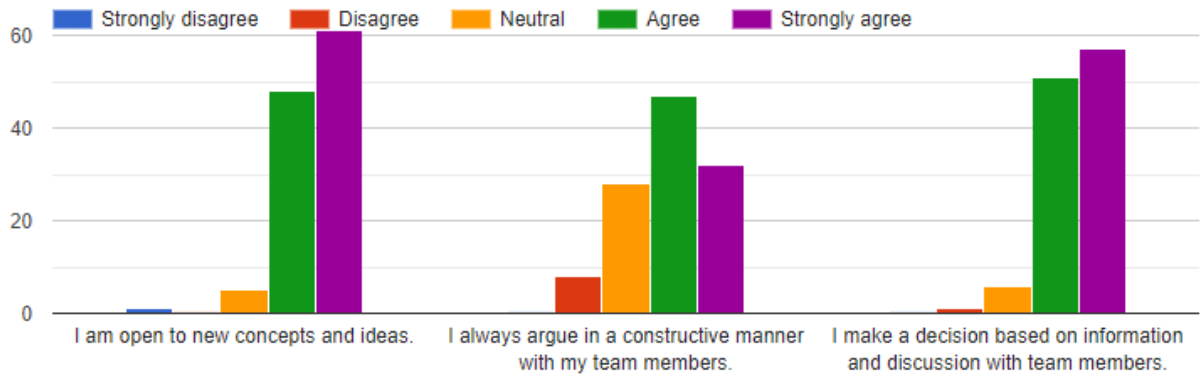

Figure 4. Shows the results for critical thinking skill.

A lot of feedback received from students show that they have developed their critical thinking from participating in this PjPBL activity. The followings were some of the feedback given by students:

Explore a lot of things, eg:watch YouTube videos

Students should know how to ask the right questions

This can make students brainstorm more ideas and improve their critical thinking.

Encourage students to research more about the topic of our research which not limited upon only

Google or already available information

From this activity, students also will realize their weaknesses and try to improve. The following are some of the feedback on this:

Students have to [be[exposed more

Participate in group discussion

Always ask why before accepting an idea/proposal

Think of varying angles. Your point of view isn't always true for others.

Be more open minded

The survey result showed that the students have increased their skills in research and inquiry, creativity, and critical thinking skills.

Project Proposals Proposed by the Students

Some 92 proposals were submitted by the students. We have categorized these proposal into 6 themes which are engineering, health, environment, services, food and beverage, and management. For examples, in engineering, students proposed on designing an application to help engineers to choose the best material for making roundabouts hence reducing potential accidents and application to rent scooters. In the field of health, students developed a program that can monitor and calculate calories burnt during any specific activities. Another example is a system that provides time for responsible authorities to act to avoid significant loss due to forest fire. In the field of environment, students developed a program that can sort and manage wastes. Another example is an application to detect water droplets of rain. Users will be notified and able to take action. In the field of services, students developed a parcel delivery service to track received parcels at the hostel. Another application is a program that

compiles all membership in one place. The program will generate barcodes similar to the barcode on the membership card. In the field of food and beverage, students developed a program for an automated machine that can customize instant coffee. Another example is a program that allows the students to make food orders from stalls available in the hostel cafe. In the field of management, students developed an application for students to manage money and attendance at school. Another example is an application for money currency converter. Table 4 shows selected proposals from various fields. These demonstrate the students' awareness of their surrounding needs or problems and ability to find the solutions.

Table 4. Selected proposal from various fields

No.	Field	Project Title & Descriptions
1	Engineering	**Roundabout Materials Specification** Description: An application to help the engineers choose the best material for making roundabouts hence reducing potential accidents.
2	Health	**Calories Burnt Calculator** Description: Develop a program that can monitor and calculate calories burnt during any specific activities.
3	Environment	**Recycling Machine** Description: To develop a program that can sort and manage wastes
4	Service	**Parcel Delivery Service** Description: Solutions to reduce students losing their parcels, save time and opportunity to generate income.
5	Food & Beverage	**Caffeine Booster** Description: Develop a program on an automated machine that can customize instant coffee
6	Management	**Universal Matric. Card** Description: Application for students to manage money and attendance at school.

Furthermore, 5 proposals have participated in the innovative competition at the intra university (IVY EXHIBITION, 2023) and national level (Pre-University Matriculation

Innovation Competition, PIITRAM 2023) and won medals. Table 5 shows the achievement of the students in the competition.

Table 5. Project proposal participated in innovation competition

Project Proposals	**Achievements**
SecondMind Description: AI assistant for the innovative mind	Pre-University Matriculation Innovation 2023 (GOLD AWARD)
Universal Matric Card Description: Personal information, e-wallet, etc.	IVY EXHIBITION 2023 (GOLD AWARD) & Pre-University Matriculation Innovation 2023 (GOLD AWARD)
Si Bingus Description: Your personal study pal	IVY EXHIBITION 2023 (GOLD AWARD) & Pre-University Matriculation Innovation 2023 (BRONZE AWARD)
Caffeine Booster Description: Order coffee and delivery	Pre-University Matriculation Innovation 2023 (GOLD AWARD)
Hotmeal Description: Application for ordering food.	Pre-University Matriculation Innovation 2023 (SILVER AWARD)

Conclusion

Past studies have shown that the project-based and inquiry-based learning methods are effective in promoting student engagement and motivation. This has been integrated as one of the key aspects of the Project-Proposal Based-Learning (PjPBL). Through programming projects, students are given the opportunity to apply their knowledge and skills in a real-world setting, which can be a powerful motivator for them. Additionally, the use of technology and programming in education can foster creativity and critical thinking among students, which are essential skills for success in today's fast-paced and constantly changing world. PjPBL also provides students with the opportunity to compete with their peers, which can be a powerful motivator for students and helps to build a sense of community and camaraderie among them. The program is designed to be flexible and adaptable, allowing teachers to tailor it to student needs. This is important because it ensures that students are able to receive the support and guidance they need to succeed in the program.

Recommendations

The PjPBL as a new assessment method has increased the student's research inquiry, creativity and critical thinking. Additionally, the use of technology and programming in

education can foster creativity and critical thinking among students, which are essential skills for success in today's fast-paced and constantly changing world. It has huge potential to be implemented in subjects other than programming and is a great tool for developing innovation skills among the Pre-University students that will help the nation to move forward in the future.

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Chapter 8 - Predicting Course Enrollment with Machine Learning and Neural Networks: A Comparative Study of Algorithms

Bahgat Ayasi, Mohammed Saleh, Ángel M. García-Vico, Cristóbal Carmona

Chapter Highlights

- Explores the role of digitization and big data in higher education institutions, focusing on how these technologies can inform resource allocation, particularly in the context of enrollment management.
- Discusses the application of machine learning and neural network algorithms to predict future student enrollments in courses. Highlights the significance of these advanced computational techniques in handling data-driven decision-making processes.
- Presents the methodology of the study, utilizing real data from the Arab American University in Palestine (AAUP) for predicting student enrollments. Emphasizes the relevance of applying these techniques in a practical educational setting.
- Analyzes the results, indicating that ensemble-based and bagging algorithms, notably the Random Forest algorithm, outperform other classifiers, including neural network models, in predicting individual-level student enrollments. Recommends further research for developing a generalized model applicable to any course at AAUP.
- Emphasizes the practical implications of the study, showcasing the potential for improved resource allocation and student support through the effective use of machine learning techniques in enrollment management. Concludes by highlighting the broader significance of these findings for enhancing decision-making processes in higher education institutions.

Introduction

Course enrollment predictive techniques using machine learning and neural networks can predict the number of students who will enroll in a course or program. These techniques help educational institutions and businesses make informed decisions about resource allocation, staffing, and capacity planning. Machine learning and neural networks identify patterns and relationships based on academic historical data. These techniques optimize operations and better meet the needs of students. The current enrollment prediction methodology at Arab American University in Palestine (AAUP) involves a manual model based on statistical methods. Academic department heads use a Cohort survival model to forecast student enrollment based on historical data from the past two or three academic years. The boundary level is set at 10% plus or minus the average rate of registration in the same course in the same semester. Additionally, there is a traditional programming application based on fixed logic used to expect the number of students at the course level.

The current enrollment prediction tool performs well for courses with specific conditions but is poor for free elective and general education courses due to unexpected student numbers and transfers/withdrawals between majors. The tool requires manual tuning and updates and gives different results at different times of the year. This calls for unconventional methods and techniques for courses like “Palestinian Studies” (PS), which have no fixed prerequisites and face uncertainty in enrollment numbers every academic semester.

The study aims to investigate the effectiveness of different machine learning and neural network techniques for predicting course enrollment at the individual level for all new intakes and continuing students in AAUP. Real data from students who have already registered from 2018 to 2022 will be used as a case study. AAUP is the first private university in Palestine that offers academic services for both national and international students in various disciplines and degree levels. AAUP represents a diverse range of national and regional universities and higher education institutes, making the findings of this research widely applicable to other similar institutions.

The objective of this research is to predict individual-level enrollment in a particular course using machine learning and Neural network techniques. The study uses real data from AAUP and explores the effectiveness of eight different classification models and a multilayer

perceptron (MLP) neural network model for individual enrollment prediction. Specifically, we use the logistic regression algorithm (LR), Stochastic Gradient algorithm (SGD), K-Nearest Neighbors algorithm (KNN), Decision Tree algorithm (CART), Gradient Boosting algorithm (GB), Bagging Classifier (BG), Support Vector Machine algorithm (SVM), Random Forest algorithm (RF), and the multilayer perceptron (MLP) Neural network algorithm to predict individual course enrollment using students' historical academic data extracted from AAUP's student information registration database. Because of the imbalanced nature of the dataset, we implement under-sampling techniques to address imbalanced datasets, which reduces the skew from a 10:1 to a 3.5:1 for the majority negative class 0 to the minority positive class 1. We evaluate the performance of our model using the F1 score with recall, precision, and accuracy metrics.

Our study builds upon previous work in the field of enrollment management. For example, (Shao et al., 2022) modeled course enrollment prediction by applying two tree-based algorithms, while (Esquivel & Esquivel, 2020) used logistic regression and support vector machines were used to predict enrollment at the individual and cohort level for applicants admitted to the University of New Mexico (UNM). Additionally, (Kardan et al., 2013) a neural network was used for course selection. Another study by (Doleck et al., 2020) conducted a comparative analysis of deep learning frameworks for predicting student performance in an undergraduate course. The authors use four deep learning frameworks (convolutional neural network, recurrent neural network, long short-term memory, and deep belief network) to predict student performance. The results showed that all four deep learning frameworks outperformed a traditional machine learning algorithm (logistic regression) in predicting student grades. The deep belief network had the highest accuracy among the four deep learning models tested. Overall, the paper provides a useful overview of the current state of predictive analytics in education and highlights the potential of deep learning for improving student outcomes.

Furthermore, Wanjau et al. (2016) aimed to develop a data mining model to predict student enrollment in STEM courses in higher education institutions. The author emphasized the importance of feature selection and data preprocessing in improving the accuracy of predictive models. To develop the data mining model, the authors collected data on student demographics, academic performance, and course history from a public university in Kenya. The author used Decision Tree (CART),

Naïve Bayes, k – Nearest Neighbor, Artificial Neural Networks (Multilayer Perceptron), Support Vector Machine (SMO), and Logistic Regression algorithms to predict student enrollment in STEM courses for the next academic year. The results showed that the decision tree algorithm (CART) had the highest accuracy in predicting student enrollment, with an overall percentage of correct classification of 85.2%
To address the imbalanced nature of the dataset, we employ under-sampling techniques and evaluate the performance of various classification algorithms, including linear classifiers and tree-based and bagging classifiers, and MLP algorithms. The F1 score with recall, precision, and accuracy metrics is used to evaluate the model's performance, especially on the minority positive class 1. We found that the literature is lacking in related research on predicting enrollment in a particular course, whereas there is much study on general enrollment at the institutional level.

Our study demonstrates that we can accurately predict course enrollment at the individual level using machine learning and neural network techniques. By utilizing these techniques, we were able to develop models that can effectively predict course enrollment with high precision and recall metrics. Furthermore, by implementing various data preprocessing techniques such as under sampling using the imbalanced-learn Python library, we were able to address the issue of imbalanced datasets and improve the F1 score, which is a more robust metric compared to accuracy when dealing with imbalanced datasets. Our study's contributions to the literature on imbalanced datasets and classification problems are noteworthy as it provides valuable insights into the development of effective models for predicting course enrollment in higher education institutions. The insights gained from our study have practical implications for academic and administrative decision-makers in higher education institutions. Finally, the development of a generalized model for all university-offered courses is a significant challenge for higher education institutions. Our study's success in developing accurate models for predicting course enrollment can pave the way for the development of generalized models for all university-offered courses.

The remainder of this paper is organized as follows: Section 2 gives the related works, Section 3 describes the Research Methodology, Section 4 Experimental Studies, and Section 5 discusses the results. We conclude in Section 6.

Related Works

There is a lack of research in predicting student enrollment at an individual level using machine learning and neural networks. However, there have been several studies that have explored the use of machine learning and neural network algorithms to predict student enrollment at an institutional level based on historical admission applications and student academic characteristic features. We present here most of these studies that demonstrate the potential of machine learning and neural network algorithms in predicting student enrollment at an individual level.

The study (Shao et al., 2022) focused on using tree-based models, namely CART and random forest, to predict course enrollment at San Diego State University. The study used historical data in the form of student demographic information and academic performance. The authors also determined which factors were the most influential in predicting enrollment using a variable importance metric derived from tree-based algorithms. The authors found that the proposed decision tree approach was able to improve upon the current state-of-the-art conditional probability analysis slightly, and the proposed random forest model was able to further improve upon both methods. One limitation of the study is that it did not address the issue of imbalanced datasets, which is a common challenge in predicting course enrollment. Imbalanced datasets can result in biased models and misclassification errors. Furthermore, the study did not discuss the effect of hyperparameter tuning on the proposed models. Hyperparameter tuning is a critical step in model development as it can significantly affect the model's performance. In our study, we address these limitations.

Slim et al. (2018) focused on using a Support Vector Machine (SVM) algorithm and logistic regression with a classification approach to predict the enrollment of applicants at the University of New Mexico (UNM). The study found that a small set of factors related to student and college characteristics were highly correlated to the applicant's decision to enroll. The study also used the confusion matrix precision and recall metrics in addition to accuracy to test the performance of a classifier. The results showed that the SVM algorithm outperformed logistic regression, achieving an accuracy of 91.25%.

The neural network approach used in the study by Kardan et al. (2013) was able to predict class enrollment in online courses with high accuracy based on the experimental data. The

study focused on identifying potential factors that affect student satisfaction with the online courses they select. The samples collected for this research included 714 courses over 16 academic terms. The findings revealed that the proposed model outperformed three well-known machine learning techniques. However, the study did not provide information about the specific neural network architecture used or the hyperparameter tuning process.

(Mia* et al., 2019) applied seven popular classifiers on a data set of more than a thousand students of a private university in Bangladesh. The classifiers used were SVM, Naive Bayes, Logistic, JRip, J48, Multilayer Perceptron, and Random Forest. Each record in the dataset contains five attributes. The authors computed six performance metrics, including accuracy, sensitivity, specificity, precision, false positive rate (FPR), and false negative rate (FNR), for each of the seven classifiers. The results indicate that SVM outperforms the other models in terms of prediction accuracy, achieving 85.76% accuracy. Random Forest achieved the lowest accuracy at 79.65%.

The researcher Shilbayeh and Abonamah (2021) also focused on predicting student enrollment behavior and identifying students who are at risk of dropping out using machine learning approaches. The study used data from the Abu Dhabi School of Management (ADSM) and developed a student enrollment model using Boosted regression trees. The model was able to identify student characteristics that influence enrollment decisions and those who are at risk of dropping out. The boosted regression model was tested using 10-fold cross-validation and achieved an accuracy of 89%, outperforming a single regression decision tree that achieved only 76% accuracy using the same validation method.

The researcher Saini and Jain (2013) used decision tree algorithms like ID3 and J48 for student enrollment in a specific stream, such as MCA. The study focused on using past academic performance as a predictor for enrollment suitability, which could help in identifying students who may not perform well in MCA. Also, the study reported the accuracy of the models, which can be useful for future research and implementation.

Another study by Akinode and Bada (2021) used a survey research approach to analyze factors influencing student enrollment in a Federal Polytechnic in South-West Nigeria. The dataset consisted of 560 students enrolled in various courses from 2017 to 2018. The study employed machine learning methods such as the decision tree algorithm (ID3) and support

vector machine (SVM) to analyze the correlation of different factors on student enrollment. The results showed that the ID3 algorithm outperformed other ML algorithms, such as Artificial Neural Network and Logistic Regression, with the highest accuracy of 97%, while SVM, KNN, and Naïve Bayes had an accuracy of 95%, 85%, and 88%, respectively. In our study, we will also use these algorithms in addition to other boosting and ensemble algorithms to compare their performance in predicting student enrollment.

Esquivel and Esquivel (2020) a Logistic Regression model was developed to predict the likelihood of an admitted student enrolling in a Philippine university. The dataset was obtained from the university admissions office, and a descriptive research design was used to mine students and the university's characteristics. The study aimed to identify the relationships between the features or variables and the dependent variable of whether the student will enroll or not. Logistic Regression, a binary classification algorithm, was implemented to predict the enrollment decision of a student. The model achieved an accuracy rate of 80% using the selected attributes, indicating that machine learning techniques can aid Higher Education Institutions in making management decisions and providing estimates of class sizes with limited information about prospective students.

In summary, machine learning and neural network algorithms have shown promise in predicting class enrollment at the individual level. Additionally, under-sampling methods have been employed to address the issue of highly imbalanced datasets. Evaluation metrics such as accuracy, F1 score, precision, and Recall have been used to assess the effectiveness of these predictive models.

Research Methodology

This research focuses on predicting future student enrollment in a particular course based on historical academic data in the context of AAUP. To achieve this goal, we used eight binary classification machine learning algorithms in addition to a multilayer perceptron MLP neural networks algorithm. The objective was to predict which students would enroll in one of the high-demand mandatory courses named Palestinian Studies (PS) in the next semester. The models were compared based on accuracy, precision, recall, and F1 score metrics.

Data Collection

The AAUP student registration database provided the real data for this research, which was organized into a dataset. It contained individual registration information for nearly 9,000 undergraduate students enrolled in the high-demand mandatory course (PS), between Fall 2018 and Summer 2021. It included around 137,000 student registration records and was used for classification algorithms to predict the likelihood of students enrolling in PS in the upcoming semester based on historical registration data.

Dataset Description

The dataset contains nine independent features and labels (dependent variable) that will be utilized for forecasting course enrollment at the student registration level. These features as shown in Table 1 include student characteristics, while the dependent feature indicates the enrollment status of the student in the PS course per student semester level.

Table 1. Student Registration Data

Feature	Description
STUDENT_ID	A numeric variable that represents a pseudo-unique ID for each student.
STUDENT_STATUS	A categorical variable that indicates the student's academic status at the specified semester, one of 11 statuses (e.g., regular, dismissed, discontinued, graduate, etc..).
SEMESTER	A numeric variable that indicates the academic semester the student registered for the PS course
STUDENT_LEVEL	A categorical variable that indicates the student's academic level at the specified semester.
GENDER	A binary variable that indicates student gender possible outcomes Male or female
FACULTY_NO	A categorical variable that indicates the student's college that semester.
MAJOR_NO	A categorical variable that indicates the student's major at that semester.

Cum_GPA	A numeric variable that represents the student's GPA for that semester.
EARNED_HRS	A numeric variable that represents the number of successfully earned credit hours up to that semester
LABEL	A binary variable indicating the student registration status of the course encoded as two classes, 0 for the negative class (not enrolled in the course) and 1 for the positive class (enrolled in the course).

The categorical variables, such as STUDENT_STATUS, STUDENT_LEVEL, and GENDER were converted into numerical continuous variables using a one-hot encoding technique.

Dataset preprocessing

In a binary classification problem, the targets or labels in the dataset are binary random variables that take on values of either 0 or 1. The Bernoulli distribution is a common way to model this type of problem, where the model predicts a probability distribution for each example indicating the likelihood of it belonging to class 1 “enrolled” or class 0 “not enrolled”. To train a machine learning model on this data, we typically need to encode the class labels as numeric values. One common approach is to use label encoding, where we map the two class labels to 0 and 1, respectively, before providing them to the algorithm for modeling. This is a type of ordinal encoding, and sci-kit-learn provides the LabelEncoder class specifically for this purpose, in our example, the two class labels are "enrolled" and "not enrolled", which need to be mapped to binary values of 1 and 0, respectively. Once this encoding is done, we can use the data to train a binary classification model that predicts the likelihood of a student enrolling in the PS course in the specified semester. after the encoding, several preprocessing steps have been made, such as:

1. Random under-sampling is a technique used to resample imbalanced datasets where the number of examples in the minority class is much smaller than that in the majority class. In this technique, we randomly select examples from the majority class and delete them from the training dataset until a more balanced distribution is achieved. The imbalanced-learn Python library provides an implementation of the RandomUnderSampler class for performing random undersampling. This class can be used to randomly remove examples from the majority class until the desired balance between the two classes is achieved.

The dataset we are working with exhibits severe class imbalance, with a ratio of approximately 10:1 To address this issue, we conducted numerous experiments with oversampling and under-sampling techniques. Using accuracy, F1, and cross-validation metrics to evaluate model performance, we determined that under-sampling was more effective for our dataset. Undersampling mitigated the risk of overfitting and was preferable since the majority class contained a substantial number of instances, and removing a portion of them would not compromise data quality or Model performance. We selected the random under-sampling method provided by the imbalanced-learn Python library resulting in a ratio of approximately 3.5 to 1 for class 0 to class 1. This technique helped to mitigate bias towards the majority class and enhance the overall performance of the model.

2. To ensure the performance of our model is not affected, we identify and remove outliers using an automatic outlier detection method called the Local-Outlier-Factor model, which is available in the Python sci-kit-learn library. We prefer this method over statistical techniques because of the complexity and unknown inter-relationships between input variables. After applying this approach, our dataset is moderately imbalanced, with a total of 50,476 records. Class 1 has 11,128 records, while class 0 has 39,348 records, resulting in a ratio of approximately 3.5 to 1 for class 0 to class 1.

3. After evaluating the impact of missing data on the analysis, where the dataset is relatively large, we have determined that removing about 2000 records with missing values is the best approach.

4. There is a significant difference between the data points of the input variable according to the standard deviation measurements. So, we perform data normalization scaling on the input data (input features) and convert it from the original range into a new range between 0 and 1. We use the Python sci-kit-learn library object called "MinMaxScaler" which can be used for this purpose.

Data Analysis

In analyzing student enrollment in a particular course, our approach is to use binary classification machine learning algorithms to predict whether a student will enroll or not. The

first step in this process is to split the historical data into a training set and a testing set. The training set is used to train the algorithm to identify patterns in the data and make accurate predictions, while the testing set is used to evaluate the accuracy of the predictions on unseen data.

We use the "train_test_split" object from the Python Scikit-learn library to split the dataset into training and testing sets. We set the "test_size" parameter to 0.2 to allocate 20% of the data to the testing set, and the "train_size" parameter to 0.8 to allocate 80% of the data to the training set. We also set the "shuffle" parameter in the train_test_spilt object to "True" to randomize the order of the data samples. Furthermore, we use the "stratify" parameter to ensure that the distribution of the target variable is represented in both the training and testing sets. As we are building a classification model to predict whether a student will enroll in the PS course or not, we use the stratify parameter on the target label to ensure that the distribution of the target variable is represented in both the training and testing sets. This helps to prevent bias in the model and improves its accuracy.

Because our dataset has a numerical input and categorical output, we used the ANOVA F-value correlation statistics technique in the feature selection process and applied it to our classification problem. Specifically, we used the f_classif () function from the Scikit-learn library to compute it. By selecting the top k most relevant features using the SelectKBest class, we were able to identify the 5 most significant features: STUDENT_STATUS, SEMESTER, STUDENT_LEVEL, FACULTY_NO EARNED_HRS. We excluded the irrelevant ones.

Additionally, plotting a correlation heatmap Figure 1 below is a helpful way to visualize the relationships between features and identify which ones are most strongly correlated with the target variable. The correlation heatmap identified the most correlated features, which matched the results obtained using the ANOVA F-value correlation statistics technique.

When training an MLP neural network for binary classification, we employed similar techniques and methods as we did for other machine learning models. However, we deviated from our usual data normalization approach used with machine learning algorithms in this study and instead opted to use the Standard Scaler in the case of MLP. Our decision was

based on experimentation, which revealed that the Standard Scaler slightly outperformed the MinMax scaler in terms of model performance.

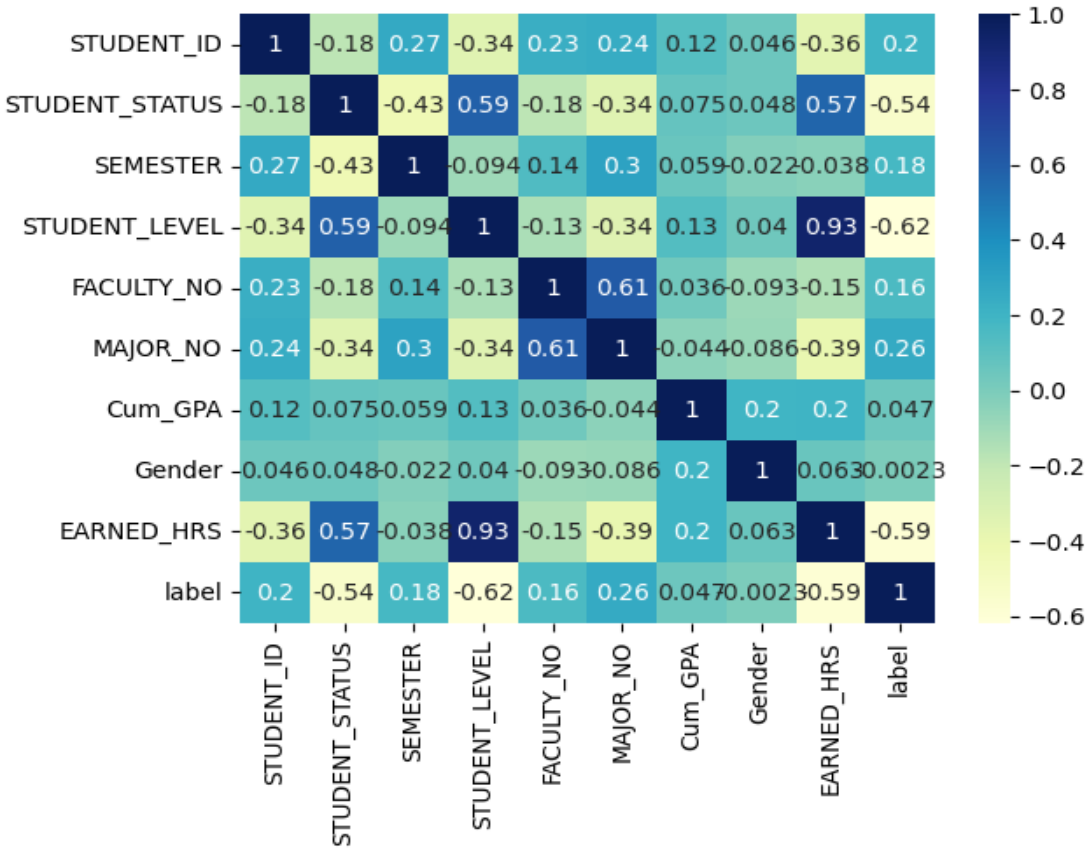

Figure 1. Correlation heatmap

To split the data into training and testing sets, we used the train_test_split object with a 20% testing set and 80% training set of dataset size. We set the shuffle parameter to true and the stratify parameter to ensure that the target variable's distribution is represented in the sample. Additionally, we removed outliers and selected the 5 most significant input features using the same methods as in the machine learning analysis above. We noted an improvement in the accuracy and performance of the model during experiments with and without data preprocessing.

Models Evaluation methodology

The evaluation methodology involves using stratified k-fold cross-validation with k=10 to prevent overfitting. Eight classifiers are trained on the training dataset, and their predictions

on the test dataset are evaluated using accuracy, precision, recall, and F1 score metrics. The focus is on minimizing false negatives since missing a case or misclassifying the minority class is costlier than the majority class.

For imbalanced classification, accuracy may not be optimal since they are insensitive to skewed domains. Instead, the F1 score which is the harmonic mean of precision and recall, is preferred since it considers the model's performance for each class. In this particular highly imbalanced dataset, and after using under-sampling techniques we have a moderated imbalanced class distribution, where about 65% of instances belong to the negative outcome class, representing "Not enroll," and 35% of instances belong to the positive outcome class, representing the "enroll" status for the PS course.

In this specific problem, the majority class represents students who did not enroll in the PS course, and the minority class represents those who did. TN and TP are the cases correctly classified, while FN and FP are the cases misclassified by the model. we consider the following Confusion matrix analysis

	Negative prediction 0	**Positive Prediction 1**
Negative Class 0 (Student Not enrolled in PS course)	True Negative (TN)	False Positive (FP)
Positive Class 1 (student enrolled in PS Course)	False Negative (FN)	True Positive (TP)

Accuracy = number of corrected predictions/total number of predictions made.

Accuracy = TN+TP/TN+TP+FN+FP

Precision summarizes the fraction of examples assigned to the positive class that belongs to the positive class.

Precision = TP / (TP + FP)

Recall summarizes how well the positive class was predicted and is the same calculation as sensitivity.

Recall = TP / (TP + FN)

F-Measure is the harmonic mean of precision and recall.

F-measure = (2 * Precision * Recall) / (Precision + Recall)

Experimental Studies

Experiment 1: Predicting using the original Dataset before under sampling

A model was designed to gather historical enrollment records of students who enrolled in a particular course (PS) from Fall 2018 to Summer 2021. Nine input features were used, and the labeled column was named "enroll in PS course." The label was then converted using one-hot encoding to represent the positive class (minority class). Similarly, students who had not registered for the course in the same semester were labeled as "Not enrolled in PS course" and converted to 0 to represent the negative class (majority class).

The scikit-learn library was used to validate models using stratified k-fold cross-validation with k=10 splits to avoid overfitting. Since the problem is a classification problem, stratified k-fold cross-validation is preferred over regular k-fold cross-validation, as the splits are not completely random, and the ratio between target classes is maintained in each fold, similar to the full dataset.

Before validating the models, the model's parameters were tuned using the Grid search technique with the help of scikit-learn's GridSearchCV function. The goal was to find the optimal hyperparameters for the eight machine learning models used in the study, based on the F1 score and accuracy metrics.

The Grid Search technique was used to find the best hyperparameters for the original severely imbalanced dataset, which had about 137,000 records before resampling it to moderate imbalance. The dataset was split into an 80% training set and a 20% test set using stratified cross-validation with kfold=10. The eight classifiers were then trained and validated with the tuned hyperparameters on the training dataset, Table 2 shows the tuned hyperparameters for all algorithms.
and the best model was selected for prediction purposes based on performance metrics such as accuracy, F1 score, precision, and recall. Finally, the trained classifiers were tested on the test set, and their performance was recorded for comparison as in Table 3. The results of the experiment show that the best algorithm for the positive class 1 is the Random Forest algorithm,

Table 2. Best hyperparameters for the original dataset before resampling.

Model name (Classifier)	Best Hyperparameters
Random Forest Classifier (RF)	{'bootstrap': True, 'max_features': 'sqrt', 'min_samples_split': 12, 'n_estimators': 1000}
Logistic Regression (LR)	{'C': 100, 'penalty': 'l2', 'solver': 'newton-cg'}
Stochastic Gradient Descent (SGD)	{'penalty': 'l2', 'loss': 'modified_huber', 'learning_rate': 'constant', 'eta0': 10, 'alpha': 100}
K-Nearest Neighbors (KNN)	{'metric': 'Manhattan', 'n_neighbors': 3, 'weights': 'uniform'}
Super vector machine (SVM)	{'C': 50, 'gamma': 'auto', 'kernel': 'poly'}
Decision Tree Classifier (CART)	{'criterion': 'entropy', 'max_depth': None, 'max_features': 10, 'min_samples_leaf': 6}
Gradient Boosting Classifier (GB)	{'learning_rate': 0.1, 'max_depth': 9, 'n_estimators': 1000, 'subsample': 0.7}
Bagging Classifier (BG)	{'n_estimators': 1000}

The best F1 score achieved was about 55%, and the best accuracy was 94%, with a recall of 43% and a precision of 75%. The Random Forest algorithm is considered a bagging algorithm, which is a type of ensemble machine learning algorithm called Bootstrap Aggregation or Bagging.

Table 3. Comparison of algorithm performance with accuracy, F1 score

	The Original Data Set before resampling		
Algorithm name	**Accuracy on Train Set%, Accuracy on Test Set %**	**Precision%, Recall%, F1 score%**	**Precision%, Recall%, F1 Score%**
		class 0	**class 1**
Random Forest (RF)	94,93	94, 98,96	75,43,55
Logistic Regression (LR)	90,90	90,100,95	33,0,0
Stochastic Gradient	90,90	91,95,99	43,5,8

(SGD)			
K-Nearest Neighbors (KNN)	92,92	94,97,96	62,45,52
Decision Tree (CART)	92,90	94,95,95	49,44,47
Gradient Boosting (GB)	93,91	94,97,96	68,42,52
Bagging Classifier (BG)	93,92	94,97,96	61,47,53
Super Vector machine (SVM)	90,90	91,100,95	84,3,6

Furthermore, the results indicate that all classifiers are unstable (high variance) and have poor performance for this type of problem with a highly imbalanced dataset.

Experiment 2: **Predicting using the Dataset After under sampling**

By applying under-sampling techniques on the negative class in the Dataset, resulting in a ratio of approximately 3.5 to 1 for class 0 to class 1. Then, we used Grid search techniques again to find the best hyperparameters for each classifier. The results are summarized in Table 4. It appears that the best hyperparameters for the resampled dataset are different from the ones for the original imbalanced dataset for some algorithms. This is expected since the data distribution has changed after applying the under-sampling technique.

Table 4. Best hyperparameters for the resampled dataset

Model name (Classifier)	**Best Hyperparameters**
Random Forest Classifier(RF)	(bootstrap=True,max_features='sqrt',min_samples_split= 8,min_samples_leaf= 8,n_estimators=1000)
Logistic Regression (LR)	{'C': 100, 'penalty': 'l2', 'solver': 'newton-cg'}
Stochastic Gradient Descent (SGD)	{'penalty': 'elastic net', 'loss': 'squared_hinge', 'learning_rate': 'in scaling', 'eta0': 10, 'class_weight': {1: 0.3, 0: 0.7}, 'alpha': 100}
K-Nearest Neighbors (KNN)	{'metric': 'Manhattan', 'n_neighbors': 3, 'weights': 'uniform'}
Super vector machine	{'C': 50, 'gamma': 'auto', 'kernel': 'poly'}

(SVM)	
Decision Tree Classifier (CART)	{'criterion': 'entropy', 'max_depth': None, 'max_features': 8, 'min_samples_leaf': 6}
Gradient Boosting Classifier (GB)	{'learning_rate': 0.1, 'max_depth': 9, 'n_estimators': 1000, 'subsample': 1.0}
Bagging Classifier (BG)	{'n_estimators': 100}

We evaluated the performance of the classifiers on both training and test sets using cross-validation and recorded the performance metrics such as accuracy, F1 score, precision, and recall recorded as shown in Table 5. It has been found that the Random Forest classifier (RF) performed the best, according to the F1 score, for positive class 1. The model achieved an 84% recall, 88% precision, and 94% accuracy. The box plot in Figure 3 provides a visual comparison of the algorithms in terms of accuracy after the evaluation of the training set. Additionally, Figure 4 displays a comparison of the same algorithms in terms of F1 score after evaluation on the test set (unseen data). Finally, the confusion matrix for the selected RF model with tuned hyperparameters after predicting the test set can be found in Figure 2.

It is important to note that the F1 score has improved for all models compared to the original dataset, indicating that the resampling has helped to improve the performance of the classifiers. Overall, it seems that the RF model with the tuned hyperparameters provides the best performance for this kind of problem.

Table 5. Comparison of algorithms performance with accuracy, F1 score

	The Data Set After Resampling		
Algorithm name	**Accuracy on Train Set%, Accuracy on Test Set %**	**Precision%, Recall%, F1 score%**	**Precision%, Recall%, F1 score%**
		class 0	**class 1**
Random Forest Classifier (RF)	94,94	95,97,96	88,84,86
Logistic Regression (LR)	88,86	89,93,91	75,64,70
Stochastic gradient Classifier	87,86	93,88,90	68,79,73

(SGD)			
K-Nearest Neighbors (KNN)	91,90	93,95,94	83,77,80
Decision Tree Classifier (CART)	91.5,89	94,93,93	78,81,79
Gradient Boosting Classifier (GB)	94,93	95,95,95	84,83,83
Bagging Classifier (BG)	94, 93	94,96,95	84,83,84
Super vector machine (SVM)	90,88	92,94,93	76,71,74

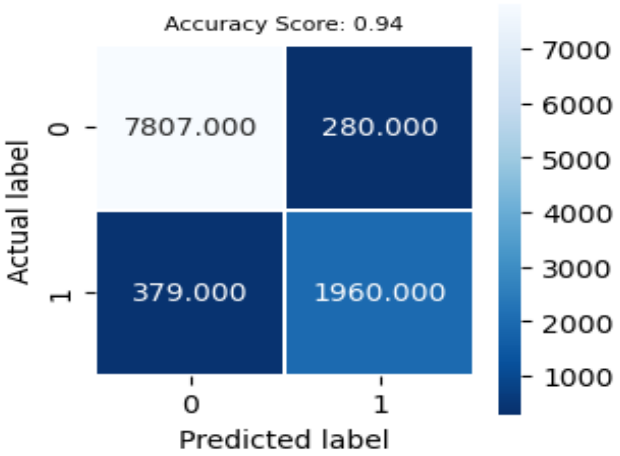

Figure 2. Confusing matrix of random forest on the testing set

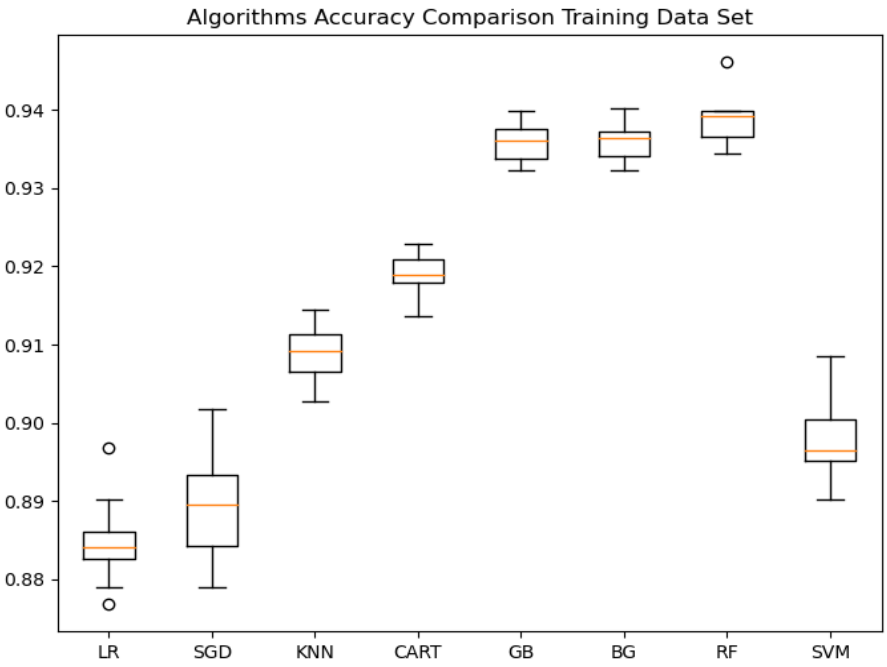

Figure 3. Algorithms Accuracy Comparison on Training Set

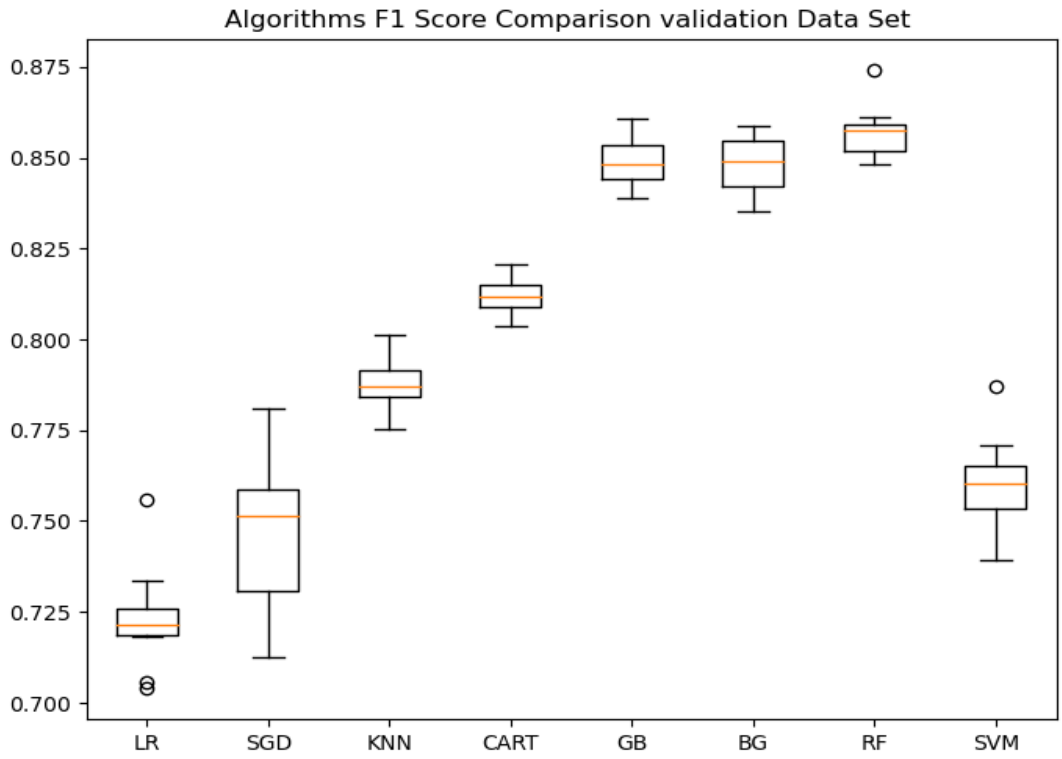

Figure 4. Algorithms F1- measure comparison on test set

Experiment 3: Construct an MLP neural network model using the original dataset, before any resampling.

We performed hyperparameter tuning using Bayesian optimization on an MLP neural network model. The hyperparameters optimized included the number of neurons, activation function, optimizer, learning rate, batch size, dropout rate, epochs, number of layers, batch normalization, and dropout layers. The optimization was carried out on the original dataset, which had 137,000 records, and the model was optimized for F1 scoring. The best hyperparameters and neural network structure were found to be *{'activation': LeakyReLU, 'batch_size': 472, 'dropout': 0.65, 'dropout_rate': 0.28, 'epochs': 50, 'layers1': 3, 'layers2': 3, 'learning_rate': 0.62, 'neurons': 39, 'normalization': 0.37, 'optimizer': Adagrad}.*

The neural network has 39 neurons in each hidden layer, with three hidden layers before the output layer. The first hidden layer is not followed by batch normalization because the normalization value is less than 0.5. The dropout rate is set at 0.28, meaning that 28% of the neurons are randomly dropped before the values are passed to the next three hidden layers. The output layer has one neuron containing the probability value.

As shown in Table 6 below, The MLP neural network model achieved an accuracy of 91% on the testing dataset and an F1 score of 30% for the positive class 1. This indicates relatively poor performance compared to the other classifiers used in experiment number 1. The precision was 65%, and the recall was 19%. These results suggest that the MLP neural network may not be the best model for this particular imbalanced dataset.

Table 6. Evaluation results of Experiment 3

	The original Data set before resampling		
Algorithm name	**Accuracy Train set /Test set**	**Precision/Recall/F1 score**	**Precision/Recall/F1 score**
		class 0	**class 1**
MLP Neural network	91%,91%	92%,99%,95%	65%,19%,30%

Experiment 4: Construct an MLP neural network model using a resampled dataset.

In this experiment, we implemented Bayesian Optimization on a prepared and under-sampled dataset of about 51,000 records to optimize F1 scoring. A function was used to check different combinations of hyperparameters and neural network structures, including activation functions, optimizers, learning rate, batch size, number of epochs, number of neurons in each layer, dropout rate, and normalization value. The best result was achieved using the following hyperparameters and neural network structure: *{'activation': 'soft plus', 'batch_size': 999, 'dropout': 0.14, 'dropout_rate': 0.18, 'epochs': 59, 'layers1': 2, 'layers2': 2, 'learning_rate': 0.33, 'neurons': 86, 'normalization': 0.32, 'optimizer': Ftrl}.*

After preparing the dataset, we split it into training and testing sets using the train_test_split function from the scikit-learn library, with 80% of the data used for training and 20% for testing. We then implemented a neural network model using Keras and TensorFlow, with the best hyperparameters and neural network structure obtained through Bayesian Optimization. The model had 3 hidden layers, with the first layer having 86 neurons, followed by 2 hidden layers with 2 neurons each. We used the common practice " normal" weight initialization technique and early stopping technique to avoid overfitting. The output layer had a single

node with a sigmoid linear activation function, predicting a value between 0 and 1 for binary classification.

We used Ftrl optimizer and binary_crossentropy as the loss function to train the model, which was trained for 59 epochs with a batch size of 999 samples. The model was evaluated on the test dataset using various metrics like Accuracy, Precision, Recall, and F1 score. The model was cross-validated with a k-fold equal to 10, the result in Table 7 shows that the model achieved an accuracy of 91%, precision of 81%, recall of 78%, and F1 score of 79% on the train set. We also tested the model on an unseen dataset, achieving the same accuracy of 91% and the same F1 score of 79%.

Table 7. Evaluation Results of Experiments 4

	The Resampled Dataset		
Algorithm name	**Accuracy Train Set/Test set**	**Precision/recall/F1 score**	**Precision/recall/F1 score**
		class 0	class 1
MLP Neural network	91%,91%	94%,94%,94%	81%,78%,79%

Binary Cross-Entropy Loss

Binary cross-entropy is a widely used loss function for binary classification problems because it is effective, easy to compute, and encourages the model to output probabilities that are close to the true labels. In Figure 5, we created two-line plots. The top plot shows the learning curves of the cross-entropy loss over epochs for the train (blue) and test (orange) sets.

The bottom plot shows the classification F1 score over epochs for the train and test sets for experiment 4. In this case, we can see that the model learned the problem reasonably well, achieving about a 79% F1 score on the training dataset and about 79% on the test dataset. The scores are reasonably close, suggesting the model is probably not over or underfit. The plots suggest that the model has a good fit for the problem and that the training process converged well.

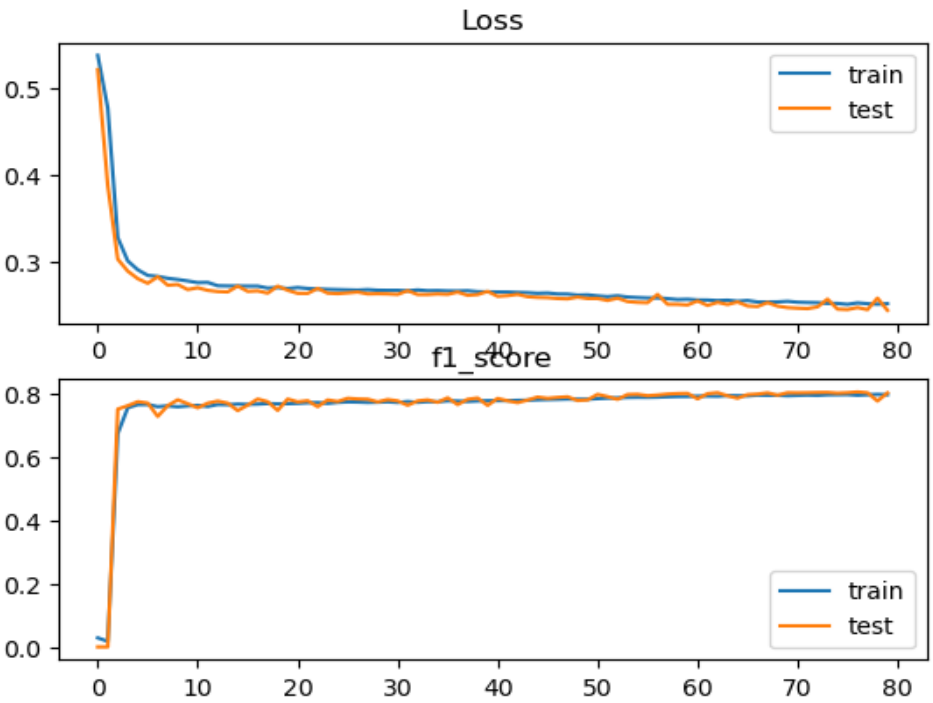

Figure 5: Binary cross-entropy loss for experiment 4

Results and Discussion

The experiments conducted in this study focused on the classification of student enrollment data, to predict future enrollment using machine learning and MLP neural network algorithms. The experiments conducted in the previous sections show that traditional machine learning models especially tree-based and Bagging algorithms such as Random Forest, perform better than other linear-based classifiers and MLP neural network algorithms in classifying highly imbalanced datasets as well as for moderately imbalanced datasets concerning accuracy, recall, and F1 score. while MLP neural networks perform well on moderately imbalanced datasets.

The under-sampling technique significantly improves the performance of classification models without affecting the data quality. Additionally, in terms of feature selection, it was found that a small set of five input features can achieve the required accuracy and F1 score metrics for predicting enrolled students in a specified course using an individual forecasting approach.

The use of standard scalar techniques also slightly improves the performance of models compared to MinMax scalar techniques. Overall, the study provides valuable insights into the

use of different Machine learning algorithms and techniques for classification and forecasting in education-related applications.

Conclusion

The paper presents a study on predicting course enrollment at AAUP using machine learning and MLP neural network techniques. The study focuses on developing individual-level classification models using only historical academic data with a limited set of input features. The study also explores the use of under-sampling techniques to address highly imbalanced datasets and evaluates the models' performance using accuracy, F1 score, Precision, and Recall metrics. The results show the effectiveness of these techniques in predicting course enrollment, with high accuracy and F1 scores achieved.

The study provides valuable contributions to the field of enrollment management in higher education and can inform enrollment management decisions to improve administrative performance. Future research can expand on these techniques and investigate the development of a generalized model for predicting student enrollment for any course in the institute.

Overall, the study highlights the potential of machine learning and neural network techniques in predicting course enrollment and improving enrollment management practices.

Recommendations

1. For researchers and practitioners in enrollment management or data analysis in higher education, this article provides valuable insights into how machine learning and neural network techniques can be used to predict individual-level enrollment in a particular course. The article compares different algorithms and provides a performance evaluation of each, which can help readers understand the advantages and limitations of each algorithm.
2. For those interested in machine learning and neural networks, this article provides a real-world example of how these techniques can be applied in the context of enrollment management in higher education. The article also highlights the importance of addressing imbalanced datasets, which is a common issue in many real-world applications.
3. Consider using traditional machine learning algorithms such as Random Forest and Bagging algorithms for highly imbalanced datasets and moderately imbalanced datasets.

These algorithms have shown better performance in terms of accuracy, recall, and F1 score than linear-based classifiers and MLP neural network algorithms.

4. Utilize under-sampling techniques to improve the performance of classification models without affecting the data quality. The study found that under-sampling techniques significantly improve the performance of classification models, especially for highly imbalanced datasets.

5. Use a small set of input features for predicting enrolled students in a specified course using an individual forecasting approach. The study found that only five input features can achieve the required accuracy and F1 score metrics.

6. Finally, for those interested in improving resource allocation and student support in higher education institutions, this article highlights the potential of machine learning and neural network techniques for optimizing operations and better meeting the needs of students. The article calls for further research to develop a generalized model for predicting enrollment in any course at AAUP, which can have broader implications for other similar institutions.

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Chapter 9 - Increasing the Plant Awareness of Prospective Biology Teachers: A Mixed Methods Study

Sena Seçil Akpınarlı, Galip Akaydın, Pınar Köseoğlu

Chapter Highlights

- Explores the pervasive issue of plant blindness within botanical education, highlighting its adverse effects on students' knowledge, interest, and appreciation for the importance of plants. Recognizes the impact of plant blindness on hindering a comprehensive understanding of plants' role in natural systems.
- Discusses the study's objective of assessing the recognition levels of prospective biology teachers regarding herbaceous plants in their environment. Emphasizes the significance of gaining insights from future educators to formulate effective strategies for combating plant blindness.
- Details the use of a synchronous/parallel mixed method research design, incorporating the Test for Recognizing Herbaceous Plants Around (RHPA) for quantitative data collection and a semi-structured interview form for qualitative data. Illustrates the methodological approach chosen to gather comprehensive insights.
- Summarizes the study's findings, noting the alignment of results in terms of visual perception of plants, classification of plants as living organisms, and general information about plants within the context of plant awareness. Highlights the consistency across different aspects of plant recognition.
- Proposes the potential development of a valid and reliable assessment scale based on the obtained results. Envisions this scale as a tool for evaluating future educators' plant awareness in four key areas, contributing to the ongoing efforts to address plant blindness in botanical education.

Introduction

The environmental factor having a great impact on organizations, is gradually becoming more variable and uncertain. For organizations to keep up with a dynamic environment, organizational structures must also be dynamic. If a business wants to be able to compete, gain superiority, and thus continue its life, it must be a learning organization that has an important place in adapting to the environment. Thus, the learning organization can have organizational agility. Thanks to organizational agility, it will be able to respond to changes in the environment both effectively and efficiently.

Environment is the settings where living organisms maintain their mutual relations with other creatures and be in an interaction (Ministry of Environment and Urban Planning, 2013). Developing knowledge, attitudes and environmentally friendly behaviours regarding environment is environmental awareness (Erten, 2004). The basis of making individuals attain environmental awareness is the time when he spends in the nature. In this sense, the necessity that individuals recognize the close setting in touch with nature and have certain knowledge is of importance in terms of being able to turn into a behaviour regarding the importance natural settings individuals with regard to the environmental health. As a matter of fact, since communal interaction decreases in the urban environment which are away from green fields, individuals grow up isolated in cities from their early ages onwards. In the case of having no open areas in touch with the nature in urban areas (parks, botanic gardens, city forests etc.), young people spend most of their time indoor and have limited interaction with nature (Nemutlu, 2017).

While all the plants, animals and human beings form a product of a balance (Faydaoğlu and Sürücüoğlu, 2011), there is an ecosystem variety in Türkiye because of its geographical structure as a location and of climatic features. Plants provide the necessary productions in meeting such basic needs as nutrition and accommodation in agricultural activities which are of importance for people and they are also used in health with their healing characteristics in diseases (Acıbuca and Budak, 2018). In this way, they make a great contribution to the economies of countries with their use in such many fields as food, pharmacy, medicine, paint, and cosmetics (Göktaş and Gıdık, 2019). In this sense, teaching plants which take place in life so intensively is a remarkable case. The task of recognising the close environment in the nature and turning this basic information into a behaviour using it in his own life is on the

prospective teachers of the future. The handicap for *plant blindness* in botany education which we mostly encounter recently is one of the problems existing for some time. This case poses a challenge for in understanding the importance of plants and natural systems and reaching significant global aims. For that reason, it is essential for the educators working in the field of botany education to apply effective learning approaches and methods in order to increase the awareness of students with plants.

What Could be Done in Botany Education to Eliminate Plant Blindness?

Numerous efforts have been undertaken to combat plant blindness, with particular emphasis on plants within both formal and non-formal biology education. Botanical gardens, as one of the out-of-school learning environments, have been actively involved in this endeavor (e.g. Lindemann-Matthies 2006). Studies have demonstrated that educational interventions at botanical gardens lead to a notable improvement in students' plant awareness, encouraging sensory exploration beyond mere visual observation (Krishnan et al. 2019). Additionally, outdoor education not only enhances knowledge of plant species but also fosters positive attitudes towards plants (Fančovičová and Prokop 2011).

From Plant Blindness to Plant Awareness

The definition of the term plant blindness was first put forward by Wandersee and Schussler (2011). From that time on, many studies regarding the issues have been made **(**e.g. Amprazis and Papadopoulou 2020; Krosnick, Baker, and Moore 2018; Frisch, Unwin, and Saunders 2010; Zani and Low 2022). Recently, Parsley (2020) enriched the discussion about plant blindness by proposing to change the term *'plant blindness'* to *'plant awareness disparity'*.

Plant awarenss is a concept made up of four fields (Figure 1), which are;

- Visual perception of plants (Balas and Momsen 2014; Schussler and Olzak 2008; Zani and Low 2022),
- Categorising plants as living organisms (Yorek, Şahin and Aydın 2009; Ahi, Atasoy and Balcı 2018; Lindemann-Matthies 2005; Amprazis, Papadopoulou and Malandrakis 2021),
- Knowledge about plants (identification and plant biology) (Kaasinen 2019; Palmberg et al., 2015; Sanders et al., 2022; Anderson, Ellis and Jones 2014; Barman et al., 2006),
- Attitudes towards plants (Colon et al., 2020; Kubiatko, Fančovičová and Prokop 2021; Fančovičová and Prokop 2010; Lohr and Pearson-Mims 2005).

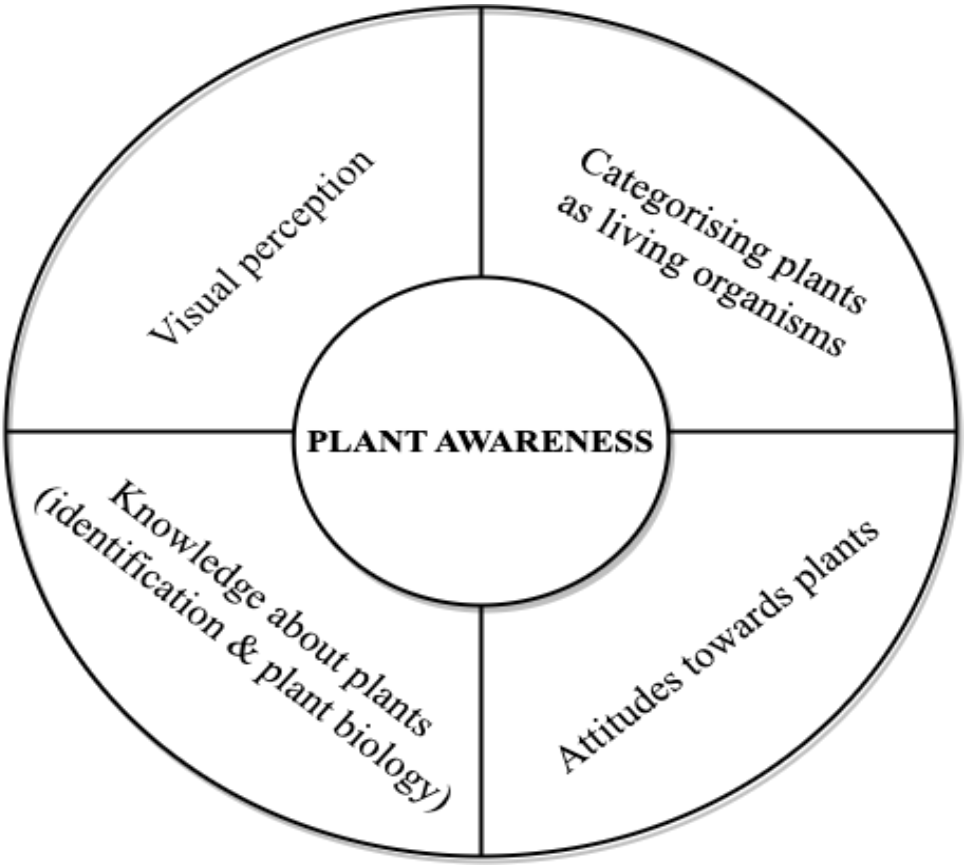

Figure 1. Four fields of plant awareness connected to each other

Learning Outdoors in Green Areas

In a study conducted by Soysal (2018), it was pointed out that participation of future biology teachers into field trips during their undergraduate education before they start their occupation would constitute a step to eliminate likely challenges to be experienced in biology course in the future. For that reason, it is indicated that it is important for biology teacher training curricula to make various field trip activities a part of their education.

All educational activities conducted outside learning settings (classroom, school or faculty) support in-class learning (Bozdoğan and Kavcı, 2016). Therefore, learning outside school depends on the sense that it could be realized in every field in touch with life. Biology, one of the courses that could be realized outside classroom settings, comprises a great many phenomena and events that are likely to be encountered in daily life (Karslı, Karamustafaoğlu and Kurt, 2019) while it makes an emphasis on the relationship between human being and environment in order that individual could be trained as a science literate and use any information attained at school and out of school in his life (Ministry of Education, 2018).

The Purpose of the Study

The fact that young generations should be trained as individuals sensible to environment in order that they could live in a healthier and more reliable environment (Demir and Yalçın, 2014) and the first stage of this process is teacher trainer is becoming more important. In this sense, biology course curriculum and teacher training programs to be applied in training future teachers should be dealt neatly. Since the perspectives of the prospective teachers towards environment, their level of knowledge and the behaviours they exhibit regarding it would set an example, it is necessary to make an observation in these issues. For that reason, it is aimed to determine the recognition levels of prospective biology teachers for the herbaceous plants around them in context with plant awareness. In this way, it would be possible to remark the importance of the content regarding botany issues in biology teacher training curricula and botany teaching in touch with nature.

The Problem of the Research

What is the recognition level of prospective biology teachers for the herbaceous plants around them and what is their recognition level of plant types around them depending on various variables (classroom level, the region they live, parents' occupation, whether they take the course of botany laboratory) and what are their views over living creatures?

Sub-problems

1. What are the recognition levels of prospective biology teachers for herbaceous plants around them?
2. What are the recognition levels of prospective biology teachers for herbaceous plants around them according to classroom levels?
3. What are the recognition levels of prospective biology teachers for herbaceous plants around them according to the region they live in?
4. What are the recognition levels of prospective biology teachers for herbaceous plants around them according to parents' occupation?
5. What are the recognition levels of prospective biology teachers for herbaceous plants around them according to whether they take the course of botany laboratory?
6. The views of prospective biology teachers over the order of importance among living creatures and the importance of their existence?

Method

In the current study, mixed methods research was used. The main basis of the mixed methods is the combination of the results obtained out of quantitative and qualitative data (Creswell, 2014). By means of this research method, researchers support the research problem, and their comparison and interpretation (Yıldırım and Şimşek, 2018). Basic designs in mixed methods are named depending on the purpose of the study, collection of qualitative and quantitative data and the order of analysis (Toraman, 2021). In this sense, the design of synchronous mixed methods research or parallel mixed methods research (Tashakkori et al., 2021), one of the basic designs in mixed methods (Creswell & Plano Clark, 2018), was used in the current study as given in Figure 2. In the study, it was aimed to determine the recognition levels of prospective biology teachers for the herbaceous plants around them over plant awareness by means of quantitative and qualitative data analyses.

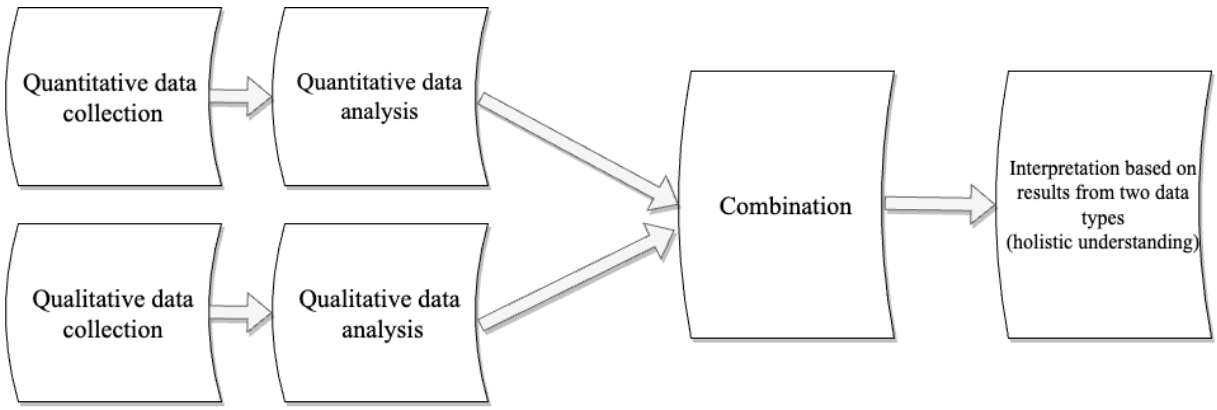

Figure 2. Synchronous/parallel mixed methods research

Participants

In the sampling selection of the study, purposed sampling method was used to recognize the features determining the phenomena and cases in the research problem and determined depending on the variables (Yıldırım and Şimşek, 2018). Working group was made up of 80 participants volunteering in the study chosen out of the prospective teachers in the biology teaching program where 93 students were studying in a state university in Ankara. The features of the participants are given in Table 1.

Table 1. Personal information about the participants and distribution of demographic features

	f	**%**

Gender		Woman	60	75.0
		Man	20	25.0
Academic Year Level		1st Year	22	27.5
		2nd Year	21	26.2
		3rd Year	19	23.7
		4th Year	18	22.5
Region They Live		Town	22	27.5
		City	58	72.5
Mother's Occupation	Other Group	Housewife	35	43.8
		Retired	6	7.5
	Professional Group Giving Personal Service	Self-employed	2	2.5
	Professional Group of Occupation	Teacher	11	13.8
		Nurse	8	10.0
		Engineer	4	5.0
		Lecturer	3	3.8
		Doctor	1	1.3
		Pharmacist	1	1.3
	Agriculture and Forestry Occupation Group	Farmer	2	2.5
	Professional Group Service	Bank Employee	1	1.3
		Civil Servant	6	7.5
Father's Occupation	Other Group	Retired	16	20.0
	Agriculture and Forestry Occupation Group	Farmer	4	5.0

	Professional Group Giving Personal Service	Self-employed	19	23.7
	Professional Group of Occupation	Engineer	5	6.3
		Doctor	3	3.8
		Pharmacist	3	3.8
		Teacher	6	7.5
		Lecturer	1	1.3
	Professional Group Serving	Supervisor	2	2.5
		Police Officer	1	1.3
		Bank Employee	2	2.5
		Civil Servant	11	13.8
		Accountant	5	6.3
	Supporter Professional Group of Occupation	Technician	2	2.5
The status of whether they take the course of "Botany Laboratory" during their undergraduate period		Yes	37	46.2
		No	43	53.7
General Total			**80**	**100**

As given in Table 1, the participant were mostly made up of women (60 students, 75%). As for the place they grew up, 72.5% (58 students) said that they grew up at a city while 27.5% (22 students) pointed out that they grew up at a town. Depending on the table, it is likely to see that most of the mothers were housewives (35 students, 43.8%) and fathers were self-employed (19 students, 23.7%). As for the academic year level of the participants, 27.5% (22 students) were first year students, 26.2% (21 students) were second year students, 23.7% (19 students) were third year students and 22.5% (18 students) were fourth year students. While

53.7% (43 students) participants did not take the course of Botany Laboratory during their undergraduate education, 46.5% (37 students) took this course.

Data Collection Tools

Test of *Recognizing Herbaceous Plants Around* (RHPA) was used as a data collection tool to collect quantitative data and a semi-structured interview form prepared with 1 open-ended question was used to collect qualitative data. Even though the test developed for the purpose of the current study was made up of two parts, in the first part was personal information for the participants, in the second part were the photographs of 14 herbaceous plants which prospective biology teachers encountered mostly around them, and the interview form regarding the plants was given in the third part. A total sum of 5 items regarding the genders of prospective biology teachers, their parents' occupations, the region they live, their academic year levels and whether they took the course of botany laboratory during their undergraduate education were given. In the test given in the second part, the photographs of the herbaceous plant types which prospective biology teachers might frequently encountered around them were determined depending on the field expert views. In this test, 1 photograph for each herbaceous plant type was given. The photographs of the plant types given in the test are the photographs taken by the author of Beytepe Bitkileri (Beytepe Plants), Prof. Galip Akaydın, in his field trips. As for the question of view given in the third part of the data collection tool, it was "Thinking of living creatures, what is the most important one for you? Explain why?". Firstly, prospective biology teachers were asked to answer the questions in the part of personal information and then to write the names of the herbaceous plants they recognize in the list. Following that, semi-structured interview was made and they were asked the question regarding the plants. Data collection process lasted 50 minutes for each prospective teacher in total. Prospective biology teachers completed all the parts fully in the data collection tool.

Data Analysis

The data obtained was analysed through quantitative and qualitative methods. In the analysis of the personal information answered by the participants in the data collection tool and their demographic features (answers regarding their genders, parents' occupations, region they live, their academic year level, whether they took the course of botany laboratory) with their

recognition levels regarding the scores they obtained in RHPA, such descriptive analyses as frequency, arithmetic mean, standard deviation were used. The analyses were done in the program of SPSS. After that, depending on the personal information of the participants, normality of the data sets regarding whether the scores they obtained in RHPA differed and whether their variances provided the homogeneity conditions were investigated. As a result, the RHPA scores obtained showed normal distribution, whether there was a difference in their recognition levels in terms of the region they lived, their parents' occupations, their academic year levels and whether they took the course of botany laboratory was examined through independent t-test and one way variance analysis (ANOVA).

The item given for each type of 14 herbaceous plants in the test was evaluated as 1 point. For that reason, the prospective teacher recognizing the whole herbaceous plants would have 14 points in total. In this sense, depending on the findings to be obtained, those recognising 0-4 herbaceous plants were classified as the ones who recognised at low level herbaceous plants, those recognising 5-9 herbaceous plants were classified as the ones who recognised at medium level and those recognising 10-14 herbaceous plants were classified as the ones who recognised at high level. The qualitative data found in the study through descriptive analysis was analysed with a summary around the theme formed upon the research problem. In this regard, the qualitative data obtained was analysed with the program NVivo in line with the purpose of the study.

Findings

The scores of the prospective biology teachers which they obtained in RHPA were given in Table 2.

Table 2. The Distribution of the Scores Obtained by the Prospective Biology Teachers in RHPA.

RHPA	N	Minimum Score	Maximum Score	Mean	Standard Deviation
	80	0	14	6.68	3.54

As given in Table 2, the mean score of prospective biology teachers (80 students) obtained in RHPA was 6.68.

The findings of prospective biology teachers recognising/not recognising herbaceous plants in RHPA were given in Table 3.

Table 3. Distribution of the recognising/not recognising herbaceous plants for prospective biology teachers around them

No	**Type of Herbaceous Plants**	**Prospective teachers recognizing them (f)**	**%**	**Prospective teachers not recognizing them (f)**	**%**
1	*Adonis flammea*	44	55	36	45
2	*Anthemis austriaca*	76	95	4	5
3	*Cichorium intybus*	18	22.5	62	77.5
4	*Fritallaria fleischeriana*	29	36.2	51	63.7
5	*Papaver macrostemum*	68	85	12	15
6	*Lamium amplexicaule*	23	28.7	57	71.2
7	*Salvia hypargeia*	30	37.5	50	62.5
8	*Taraxacum serotinum*	61	76.2	19	23.7
9	*Alcea pallida*	34	42.5	46	57.5
10	*Muscari neglectum*	25	31.2	55	68.7
11	*Ranunculus damascenus*	28	35	52	65
12	*Onosma aucherianum*	34	42.5	46	57.5
13	*Veronica pectinata*	42	52.5	38	47.5
14	*Gagea taurica*	24	30	56	70

As seen in Table 3, herbaceous plant types mostly recognised by prospective biology teachers were *Anthemis austriaca* (76 students, 95%), *Papaver macrostemum* (68 students, 85%) and *Taraxacum serotinum* (61 students, 76.2%) respectively. The types of herbaceous plants not recognised by the prospective teachers were *Cichorium intybus* (62 student, 77.5%), *Lamium amplexicaule* (57 students, 71.2%) and *Muscari neglectum* (55 students, 68.7%) respectively.

Table 4. Distributions regarding the levels of recognising herbaceous plants for prospective biology teachers around them were given in Table 4.

RHPA	**f**	**%**
Those recognising herbaceous plant at low level	27	33.7
Those recognising herbaceous plant at medium level	31	38.7
Those recognising herbaceous plant at high level	22	27.5

As given in Table 4, most of the prospective biology teachers (31 students, 38.7%) recognised herbaceous plants at medium level and this level was followed by those recognising them at low level (27 students, 33.7%). Those recognising herbaceous plants at high level were 22 students and its frequency was 27.5%.

The findings of whether recognising levels of prospective biology teachers for herbaceous plants differed in terms of academic year levels were given in Table 5.

Table 5. ANOVA results regarding academic year levels of RHPA.

Academic Year Level	**N**	**X**	**sd**		**Sum of Squares**	**df**	**Mean Square**	**F**	**P**	**Fark**
1	23	4.34	2.05	Between Groups	608.008	3	202.669	38.849	.001	1-3,4; 2-3,4;3-1,2;4-1,2
2	20	4.10	1.65	Within Groups	396.479	76	5.217			
3	19	10.26	1.96	Total	1004.488	79				
4	18	9.11	3.26							

As given in Table 5, there was a significant difference at the recognition levels of prospective biology teachers for herbaceous plants in terms of their academic year levels the study (*(F=38.849; p<.05*). According to Tukey HSD result that was carried out to determine in which academic year levels the recognition levels of the prospective teachers for herbaceous

plants around them differed, it was found that the prospective teachers studying at 3rd year level had higher recognition level for herbaceous plants (X=10.46) compared to that of the prospective teachers studying at 1st year level (X=4.10) and the prospective teachers studying at 4th year level (X=9.11) had higher recognition level than that of the ones studying at 2nd year level (X=4.10).

The scores prospective biology teachers obtained in RHPA and the findings obtained regarding whether prospective biology teachers took the course of botany laboratory were given in Table 6.

Table 6. Independent t-test results of the scores that prospective biology teachers in RHPA regarding whether they took the course of botany laboratory

	The status of whether they took the course of botany laboratory	**N**	**X**	**sd**	**t test**		
					t	**df**	**p**
Scores obtained in RHPA	Yes	37	9.70	2.70	10.648	78	.001
	No	43	4.23	1.86			

As seen in Table 6, the recognition levels of prospective biology teachers for herbaceous plants around them had a significant difference in terms of whether they took the course of botany laboratory during their undergraduate education *(t[78]= 10.648; p<.05)*. For that reason, the recognition levels of prospective biology teachers taking the course of botany laboratory for herbaceous plants around them (X=9.70) were more positive compared to those who did not take that course in their undergraduate education (X=4.23).

The findings of the scores of prospective biology teachers they obtained in RHPA regarding the region they lived were given in Table 7. As given in Table 7, there was no significant difference at the recognition levels of the prospective teachers for herbaceous plants around them in terms of the region they lived (p>.05).

Table 7. The scores of prospective biology teachers they obtained in RHPA regarding the region they lived

	The region they lived	N	X	sd	t test		
					t	df	p
Scores obtained in RHPA	Town	22	7.36	3.53	.928	78	.356
	City	58	6.53	3.57			

The scores of prospective biology teachers they obtained in RHPA regarding their mothers' occupations were given in Table 8.

Table 8. The ANOVA scores of prospective biology teachers they obtained in RHPA regarding their mothers' occupation

Mother's Group of Occupation	**N**	**X**	**sd**		**Sum of Squares**	**df**	**Mean Square**	**F**	**P**
Professional Group of Occupation	28	7.50	3.43	Between Groups	67.534	4	16.884	1.368	.253
Other Group	41	6.19	3.55	Within Groups	925.653	75	12.342		
Professional Group of Service	7	7.42	4.07	Total	993.187	79			
Agriculture and Forestry	2	7.00	.01						
Professional Group Giving Personal Service	2	2.50	.70						

As given in Table 8, there was no significant difference at the recognition levels of the prospective teachers for herbaceous plants around them in terms of the professional groups of mothers (p>.05).

The scores of prospective biology teachers they obtained in RHPA regarding their fathers occupations were given in Table 9.

Table 9. The ANOVA scores of prospective biology teachers they obtained in RHPA regarding their fathers' occupation

Father's Group of Occupation	**N**	**X**	**sd**		**Sum of Squares**	**df**	**Mean Square**	**F**	**P**
Professional Group of Occupation	18	7.11	3.54	Between Groups	74.283	5	14.857	1.196	.319
Other Group	16	6.93	3.80	Within Groups	918.905	74	12.418		
Professional Group of Service	21	7.04	3.68	Total	993.188	79			
Agriculture and Forestry	4	9.00	2.30						
Professional Group Giving Personal Service	19	5.52	3.30						
Supporter Professional Group of Occupation	2	3.50	3.50						

As given in Table 8, there was no significant difference in the recognition levels of the prospective teachers for herbaceous plants around them in terms of the professional groups of

fathers (p>.05).

The views of Prospective Biology Teachers over the Order of Priority among Living Creatures were given in Table 10.

Table 10. The Order of Priority among Living Creatures by the Prospective Biology Teachers

Theme	**Code**	**f**	**%**
Order of Living Creatures	Bacteria	7	8.7
	Algae	7	8.7
	Plants	20	25
	Animals	39	48.7
	Decomposers/Saprophytes	7	8.7

As given in Table 10, the prospective teachers pointed out that the priority order of the most important living creatures were animals (39 students, 48.7%) and plants (20 students, 25%) respectively. These were followed by bacteria (7 students, 8.7%), algae (7 students, 8.7%) and decomposers/saprophytes (7 students, 8.7%).

Sample expressions emphasising the views of prospective biology teachers on the order of priority among living things are presented below:

PBT3: *"All living things need respiration to maintain their vital activities. Of course, I think it would not be wrong to say the plants that provide the oxygen necessary for respiration as the most important living things."*

PBT15*: "Decomposers. Ecosystems and cycles wouldn't work without them."*

PBT47: *"Bacteria. For example, there are bacteria that fix nitrogen. They meet the plant requirements, in humans, there are bacteria that synthesize vitamins B and K. The bacteria that cause the disease are contagious. In my opinion, the most important and most important living things are microorganisms."*

PBT59: *"To me, bacteria and algae are the most important living things. When we look at all the cycles in life, I think that microorganisms affect our lives very seriously, from the food we eat to the water we drink. All around us in our bodies. They can also affect it in a bad way, to a very large extent. The pandemic is the biggest example."*

PTB71: *"Plants are the main food source on earth. Without plants, neither animals nor*

humans could exist."

The views of prospective biology teachers over the importance of the presence of living creatures they pointed out were given in Table 11.

Table 11. Distribution of the views of prospective biology teachers over the importance of the presence of living creation they pointed out

Theme	**Code**	**f**	**%**
The importance of microorganisms in the life of living things	Take place in ecosystem and cycles	8	10.0
	Play a supportive role in vitamin synthesis	1	1.2
	Effective on human life	5	6.2
	Its place in the evolution process	4	5.0
The importance of animals in the life of living things	A source of food	6	7.5
	Support pollination	35	43.7
The importance of plants in the life of living things	Contribute to healthy nutrition	2	2.5
	Play a role in organic/inorganic substance cycle	15	18.7
	Effective on climate change	15	18.7
	A basic need for a healthy environment	27	33.7
	Play a role in treatments/productions in the field of health	10	12.5
	Take place in food chain	9	11.2
	Produce oxygen	17	21.2

As was given in Table 11, the prospective teachers mostly thought regarding the importance of animals in the life of living things that they support pollination (35 students, 43.7%). It was followed by the view regarding the importance of plants in the life of living things that they are a basic need for a healthy environment (27 students, 33.7%), they produce oxygen (17 students, 21.2%) their effect on the climate change (15 students, 18.7%).

Statements emphasizing the views of pre-service biology teachers on the importance of the existence of living things are presented below:

PBT27: *"Plants perform photosynthesis and provide oxygen. We eat the fruits of plants, and we use them in the manufacture of medicines and fragrances. Without plants, erosion can occur because there is nothing holding the soil. Oxygen does not run out completely, because most of the oxygen in the world is provided by phytoplankton in the oceans and seas."*

PBT31: *"Plants have an important place in the food pyramid: variables such as the nutrition of living things and climate take shape according to the distribution of plants in nature."*

PBT68*: "I think that our vital activities could not continue without plants. The biggest reason comes to my mind first is the carbon cycle. Oxygen formation would have been negligible in the world, and insects, birds, sea creatures would all have lost their lives, of course, all other living things like mammals."*

PBT74: *"No plants mean most of our oxygen supply is gone. In addition, it causes the food sources of living things to decrease and disappear. As a result, life gradually begins to be interrupted."*

PBT80*: "If there were no plants, life would cease as we do not have a source of oxygen, and soil fertility would decrease. Since there was no pollination, fruit would not be produced, so food shortages arise."*

Results and Discussion

Depending on the findings obtained in the study, it was found that prospective biology teachers mostly had a medium-level and low-level recognition for herbaceous plants they frequently met around them (Table 4). At the same time, the mean score that prospective teacher got in PHPA test is a descriptive form of this result in another table (Table 2). In terms of plant awareness, these findings are of similarity with other studies (Ulucanlı, 2009; Civelek, 2012).

On the other hand, it was found that the herbaceous plants that prospective biology teachers mostly recognised were *Anthemis austriaca, Papayer macrostemum* and *Taraxacum serotinum* respectively (Table 3). The reason for this could be the fact that these three herbaceous plant types have the most common distribution. The herbaceous plants that prospective biology teachers were not able to recognise were *Cichorium intybus, Lamium amplexicaule* and *Muscari neglectum* respectively (Table 3). The fact that almost half of the prospective teachers participating the study did not take the course of "Botany Laboratory" (Table 1) is an important factor upon this result. It is because the findings showed that the recognition level of the prospective teachers for herbaceous plants around them differed depending on whether they took the course of botany laboratory during their undergraduate education (Table 6). Similarly, it was found in relation to this case that the recognition levels of the prospective teachers for the herbaceous plants around them was of a significant difference in terms of the academic year levels of them (Table 5). In all teaching hours of the course of "Botany Laboratory" at university, students have an opportunity to get to know the plants closely in the green field and territories practically and learn about them. For that reason, the fact that prospective teacher haven't taken this course and joined the field territorial applications affects their knowledge levels which is one of the four different fields in terms of plant awareness (Figure 1). As a matter of fact, similar studies were carried out in this field (Lindemann-Matthies, 2006; Fančovičová and Prokop, 2011; Krishnan et al. 2019).
In another finding obtained in the study, a significant different was found between the RHPA scores of the prospective teachers and the place they were born and grown up (Table 7). On the contrary, Lückmann and Menzel (2003) found in their study that recognition levels for herbaceous plants in close vicinity by those living in the villages were higher compared to the ones living in city centres.

The findings obtained showed that there was no significant difference in terms of the RHPA scores of the prospective teachers and both their mothers' and fathers' occupations (Table 8 and Table 9). Therefore, it is likely to say that the education level of the mothers and fathers of the prospective teachers has nothing to do with recognising herbaceous plants around.
Depending on the qualitative data obtained from prospective teachers, it was found that many of them regarded animals in the first place in the order of importance (Table 10). According to the findings, besides the order of importance among living creatures pointed out by the prospective teachers, they also indicated their views regarding the importance of the groups in the life of living things (Table 11). Accordingly, it is of importance that they frequently

highlighted “they help to pollination of plants” regarding the importance of animals since they attributed to the importance of plants through this code (Table 11). Findings showed that it was followed by the views regarding the importance of plants. Putting an emphasis on the importance of plants, the prospective teachers mostly pointed out “they are a basic need for a healthy environment” (Table 11). All the results obtained in the study correspond to visual perception of plants, their classification as a living organism in terms of information and frameworks taking place in the context of plant awareness.

Recommendations

The recommendations regarding the results obtained in the study are as follows:

- For an effective botany education, the issues and topics related to botany should be added to all academic year levels of undergraduate education in biology teaching,
- Prospective teacher should be made to join various trips (botany gardens and/or other green areas) informally regarding botany subjects out of school besides their formal education.
- In order to increase the plant awareness of prospective teachers, more studies should be carried out in “attitudes towards plants”, one of four fields.
- A valid and reliable assessment tool could be developed with which future educators could evaluate the plant awareness of prospective teachers in these four fields.

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Chapter 10 - The Indian Knowledge, Western Education Program: An Indigenous Community-Led College Faculty Training Program

Sean M. Daley, Allison Smith

Chapter Highlights

- Explores the Indian Knowledge, Western Education (IKWE) program, a faculty training initiative funded by the National Endowment for the Humanities. Highlights its unique approach of training non-Native American faculty members from a Midwestern community college to teach about contemporary Native peoples in culturally-appropriate manners.
- Details the composition of the faculty cohort, consisting of members from various academic disciplines. Describes the year-long training program where cohort members attended monthly seminars led by Native community members, providing insights into contemporary Native peoples, their communities, and relevant issues.
- Discusses the immersive learning experiences of the faculty cohort, including visits to American Indian communities and attendance at Native events. Emphasizes the significance of learning from Native community members outside of a traditional academic environment to enhance cultural understanding.
- Explores how the knowledge and perspectives gained by faculty cohort members were utilized to enhance existing courses or develop entirely new ones focused on contemporary Native peoples, communities, and their challenges. Discusses the transformation of curriculum to incorporate Native voices and perspectives.
- Highlights the outcomes of the program in terms of fostering cultural sensitivity in teaching about Native American topics. Illustrates the impact on faculty members and the broader educational community, emphasizing the importance of collaborative approaches for cross-cultural understanding.

Introduction

The *Indian Knowledge, Western Education* program, or *IKWE*, was a two-year National Endowment for the Humanities (NEH)-funded program designed to provide professional training and curriculum development focused on contemporary American Indian peoples to a cohort of non-Native American college faculty members and program directors from multiple academic disciplines. The purpose of *IKWE* was for non-Native American faculty members and program directors to develop components for existing courses/programs or develop entirely new courses/programs that focus on contemporary American Indian peoples, contemporary Native cultural traditions, and the issues that Native peoples and their communities face today. Faculty cohort members attended a series of seminars led by American Indian community members, during which time various cultural traditions and issues concerning contemporary American Indian peoples were discussed. Faculty members and program directors were also given the opportunity to meet with Native presenters one-on-one to further discuss the topics and issues. Faculty cohort members also traveled to American Indian communities and cultural events to meet with Native peoples and learn more about contemporary traditions and issues first-hand. The *IKWE* program officially began in August of 2018 and concluded in July of 2021. Currently, *IKWE* is being revised for a new college/university and a new faculty cohort.

IKWE Cohort Participants

In order to participate in *IKWE*, prospective faculty participants had to submit a written application to the directors of the program – Drs. Sean M. Daley and Allison Smith, the authors of this paper. At the time *IKWE* began, Daley was a professor of anthropology and the director of a center for American Indian Studies and Smith was a professor of art history and a department chair at Johnson County Community College in Overland Park, Kansas. Prospective faculty participants needed to submit an application that included a statement about why he/she wanted to participate in the program, a plan for how he/she was going to incorporate the materials learned into his or her teaching, such as new course components, new courses, a community engagement project, and so forth, and any prior experience working with Native peoples and communities, not that the latter was a requirement. Faculty cohort participants were selected based on their responses with special attention being paid to how the cohort participants were going to incorporate the new materials into their respective

curriculum and programs. Initially, Daley and Smith intended to accept ten faculty and program directors into the program, however, due to interest and the quality of the applications, twelve faculty members and program directors were offered slots. All twelve accepted; however, one cohort member (#12; see below) withdrew eight months into the project because of a personal matter. The remaining eleven faculty and program directors successfully completed the program.

Table 1. *IKWE* Faculty Cohort Information

ID#	Title	Degree	Discipline	Gender
1	Professor and Chair	PhD	Philosophy	Male
2	Professor and Co-Chair	MA	Sociology	Female
3	Professor	PhD	English	Male
4	Professor	MA	Philosophy	Female
5	Curator	MA	Art Education	Female
6	Professor	PhD	English	Female
7	Director	MA	Community-Based Learning	Female
8	Professor and Chair	PhD	Anthropology	Male
9	Professor and Director	MA	Sociology and Sustainable Agriculture	Male
10	Professor	JD	Environmental Sciences	Female
11	Professor	PhD	Political Science	Male
12	Professor	MA	English for Academic Purposes	Female

As *IKWE* was funded by the NEH, faculty cohort members were compensated for their participation. Compensation included a $2000 stipend; $1000 at the end of the first semester in December of 2018, and another $1000 payment in December of 2019 after the newly designed courses or course components were offered and/or incorporated into existing courses. Faculty cohort participants were asked to sign a contract committing to the project. Failure to complete the program would result in a forfeiture of the participant's stipend, either partially or fully depending at what point in the project he/she withdrew. Additionally, participants had all program travel-related costs to American Indian communities and cultural events covered; this included transportation, lodging, food, and any associated admission fees. Each participant also received a modest library of 18 scholarly books written by Native and non-Native scholars focused on current American Indian issues, as well as a few classics

in American Indian Studies. These books included Vine Deloria, Jr.'s, *Custer Died for Your Sins*, Roxanne Dunbar-Ortiz's, *An Indigenous People's History of the United States*, Tommy Orange's *There, There*, and Andrés Reséndez's *The Other Slavery*, among others.

The books were meant as a starting point for faculty cohort members to further develop their scholarly book collection on contemporary American Indian issues as well as resources to supplement the course components and courses being developed.

IKWE Native Community Member Participants

In all, *IKWE* participants had the opportunity to attend a series of seminars led by Native community members during the duration of the project. The first ten Native community members met with *IKWE* participants in-person; the last three met via Zoom due to the COVID-19 pandemic. The last presenter, #13, while non-Native, is a tribal historic preservation officer for one of the federally recognized Delaware/Lenape nations in the United States and has a great deal of knowledge on Delaware/Lenape peoples and their ways. Native community members who participated represented a wide-range of life experiences. They ranged in age from their late 20s through their late 70s. Some were born and raised in reservation communities, while others were born and raised in urban Indian communities. Several Native community participants were involved in the Red Power Movement and organizations such as the American Indian Movement and Woman of All Red Nations, and some were involved in present-day Indigenous community activism. A few participants were involved in Native cultural life as singers and dancers in the pow wow circuit and Indian artists, while a few others were involved in education, particularly higher education. A couple of participants worked for their tribal governments and non-Native local and state governmental agencies. Native community members were compensated for their time. Each Native community member received a $250 honorarium and all travel-related costs associated with his/her presentation were covered.

Table 2. *IKWE* Native Community Members Information

ID#	Tribal Affiliation	Topic Covered	Gender
Year 1			
1	Acoma and Diné	Navajo language preservation	Male
2	Dakota, Assiniboine, and	Sovereignty and self-determination	Female

	Oddawa		
3	Cheyenne River Sioux	Native maternal-child health and Native women's issues	Female
4	Prairie Band Potawatomi	Contemporary Native life in Kansas	Male
5	Oneida and Anishnaabe	American Indian dance	Male
6	Meskwaki	American Indian dance	Female
7	Paiute and Diné	American Indian music	Male
8	Choctaw	Contemporary American Indian literature	Male
9	Lakota and Mohawk	Contemporary American Indian art	Male
10	Tohono 'Oodham and Ponca	Contemporary American Indian politics	Female
Year 2			
11	Cheyenne River Sioux	Contemporary American Indian rights	Female
12	Cheyenne River Sioux	Contemporary American Indian rights	Female
13	Non-Native	Delaware/Lenape history in Pennsylvania	Female

Seminars and Events

In all, eleven seminars were held; nine the first year and two the second year. Two of the seminars – American Indian Music and Contemporary American Indian Rights each had two presenters. During each seminar issues surrounding contemporary American Indian life were discussed. Issues Native community members discussed with the faculty cohort members included contemporary American Indian life in the Midwest, US Federal Indian laws and policies, contemporary sovereignty, Native language preservation, contemporary American Indian music and dance, contemporary American Indian literature, contemporary American Indian visual art, and other topics.

Seminars were usually two-hours in length. The general format was the first hour was a presentation by a Native community member, and that presentation was open to all faculty, staff, and students at the community college. The second hour was a question and answer period reserved solely for *IKWE* faculty cohort participants. This gave them the time and ability to discuss the topics in further detail and to ask questions more tailored to their individual projects for the program.

There were also two trips associated with the program. The purpose of the trips was to allow faculty cohort participants a chance to visit Native communities in-person and to visit with Native peoples in their communities and at events that were for Native peoples. The first trip was a five-day trip in May of 2019 during which time faculty cohort members went to New Mexico and visited several American Indian communities, primarily Rio Grande Pueblo communities. At one Pueblo community, a feast was held in honor of the *IKWE* faculty cohort and they were given a tour of the original pueblo by tribal council members. They were also given the opportunity to visit with tribal elders and community members to learn more about life at this pueblo, both historically and presently. Faculty cohort participants also visited several tribal museums and Pueblo cultural centers allowing for visits with numerous Native scholars and artisans.

For the second trip, faculty cohort members attended the annual American Indian Art Show at Cahokia Mounds State Historic Site in Collinsville, Illinois in November of 2019. During this time, they met and visited with numerous contemporary American Indian artists who were participating in the art show. Additionally, faculty cohort participants were able to meet with archaeologists and historians who worked at Cahokia and who were knowledgeable about Cahokia and the Native people who once lived there.

The COVID-19 Pandemic's Disruptions

Regrettably, the COVID-19 pandemic caused serious issues the final several months of the project. Most notably, the faculty cohort were unable travel and visit any Indian communities or attend any events in the spring of 2020. Two trips had been planned. The first was a trip to a reservation-based Indian community in Kansas, and the second was a trip to the Gilcrease Museum in Tulsa, Oklahoma. The Gilcrease Museum has an extensive collection of contemporary Native art, as well a vast archive of Native American material culture. Additionally, the community college involved in the project hosted an annual competition pow wow the first weekend of every May for the previous 13 years. The 2020 pow wow was cancelled. Had it occurred, this would have given the faculty cohort an additional opportunity to meet and visit with Native community members. Fortunately, Daley was able to schedule three additional speakers via virtual presentations in the spring of 2021 to continue the discussions on contemporary Native peoples and issues. Due to the issues

caused by the pandemic, funds that were set aside for travel were reallocated to cover the stipends for the three speakers in the spring of 2021.

Results

Outcomes: Course Components and Courses Developed

In the end, all the faculty cohort participants developed and implemented new course materials, new courses, and/or new programs focused on contemporary Native peoples and cultures. Until this point, the majority of course components and courses at Johnson County Community College focused on Native peoples in a historical perspective. The components, courses, and programs developed in the *IKWE* program greatly changed the conversation concerning Indian peoples at this college and now there is an even split between components and courses focusing on Indian peoples in a historical perspective and a contemporary perspective. Table 3 provides a synopsis of the projects.

Table 3. Developed Native-Focused Course Components, Courses, and Programs

ID#	Title	Discipline	New Course Components, Courses, and Programs
1	Professor and Chair	Philosophy	Developed a new course component for an introductory ethics course in which American Indian ethics are examined and compared to the ethical belief systems of other cultural groups. A short writing assignment and a paper assignment are parts of the examination and comparison process.
2	Professor and Co-Chair	Sociology	Developed a new component on American Indian families for "Sociology of Families." This component included print and video resources for students.
3	Professor	English	Three new components were added to "English Composition II." These components were

			Native languages and linguistics, missing and exploited Native women and girls, and Native peoples and suicide. Readings, discussions, and class projects are a part of these new components.
4	Professor	Philosophy	Several lectures, readings, and discussions on American Indian philosophies were added to "Honors in Introduction to Philosophy" focusing on epistemology and metaphysics, identity and freedom, and ethics and values.
5	Curator	Art Education	A museum docent training manual was developed to help dispel myths and stereotypes about Native peoples found in classic mainstream American visual arts from the 1800s and 1900s. Also, a series of training sessions were organized for art educators to shift the dialogue about Native art from non-Native perspectives to emphasizing the voices of Native artists themselves.
6	Professor	English	Three Native focused books were adopted for an English composition course: Tommy Orange's *There, There*, Sherman Alexie's *The Lone Ranger and Tonto Fist Fight in Heaven*, and Bob Blaisdell's *Great Short Stories by Contemporary Native American Writers* for *Introduction to Fiction*. There were numerous graded writing assignments and discussions centered on these books as well.
7	Director	Community-Based	The Community-Based Learning Program

		Learning	partnered with a local American Indian urban center on several evening events open to the public focusing on contemporary local Native cultural traditions, including American Indian art and Indigenous agriculture and plant use. Presenters and volunteers included faculty, staff, and students from the community college involved with this project.
8	Professor and Chair	Anthropology	A YouTube channel was created with six videos focused on archaeology and Native peoples. The six short videos focus on a range of topics including "Archaeology and Representation" and "Cultural Resource Management and the Native American Graves Protection and Repatriation Act." The videos can be used in several courses currently offered by the anthropology department.
9	Professor and Director	Sociology and Sustainable Agriculture	A component for "Sustainable Agriculture" focused on Indigenous agroecology (the application of ecological concepts and principals in farming) and sustainability was developed. Also developed was a component for "Sociology of Food" focused Native food knowledge. Finally, a component was created for "Introduction to Sociology" focusing on racism and colonialism in the Native experience.
10	Professor	Environmental Sciences	A new environmental sciences course, "Native and Western Views of Nature," was developed and a case study in an honor's environmental studies course on Indigenous perspectives on

			managing salmon in the Pacific Northwest US and Canada was created.
11	Professor	Political Science	Lectures for two political science and international relations courses on Native cultural identity and its connection to politics were developed. The lectures focused mainly on two topics: cultural change in Native communities and US and international laws concerning Indigenous peoples.

Discussion or Conclusion

The purpose of the *IKWE* program was to bring the focus on Native peoples and their communities from the past into the present in a college curriculum and to have non-Native faculty work with Native peoples to incorporate Native voices and perspectives into that curriculum. The faculty in the cohort engaged with Native peoples regularly during the program and had opportunities to visit Native communities and attend Native events. These were things that many of the faculty cohort participants had not had the chance to do previously and this gave many of them a new understanding of Native peoples. Additionally, faculty cohort participants integrated what they learned and experienced into their respective curriculums and projects. As such, it is fair to say that the *IKWE* program was successful.

What made the *IKWE* program successful was its approach which was principally informed by community-based participatory research (CBPR). CBPR is an approach used by researchers in which community members are involved in all steps of the research project - design, implementation, evaluation, and dissemination; research that involves and affects them and their community. CBPR recognizes and utilizes the strengths that community members bring to a project. These are frequently strengths that the researcher lacks as often the researcher is not a part of the community. CBPR also seeks to form an equal partnership between the researcher and the community where both parties benefit from the research (NIMHD 2018). While the *IKWE* program was not true CBPR because it was not a research project, the idea of keeping the community involved as much as possible was central. One of the authors of this piece, Sean Daley, has been working with American Indian peoples and

communities for over 25 years. Much of his work has been in the areas of Native health and education. The CBPR approach has been crucial in his work and that of the research team with which he is involved. Native community members gave input formally and informally throughout the whole *IKWE* project. Without this approach, we do not think this project would have been nearly as successful because Native community members who participated had a stake in the project success since they were integral to it. Additionally, as with many funded-projects, there was a project manager. In the case of *IKWE*, there were two project managers because the first project manager left the project and the college shortly before the end of year one and another project manager was hired for the remainder. Both *IKWE* project managers were Native and active participants of the Native community.

Furthermore, because of the CBPR approach, the *IKWE* program was a step, albeit a small one, in the decolonization of Western education. Decolonization is about cultural, psychological, and economic freedom for Indigenous people with the goal of achieving Indigenous sovereignty - the right and ability of Indigenous people to practice self-determination over their land, cultures, and political and economic systems (Belfi and Sanderford 2021). It is a response to 500-plus years of colonialism. In the United States, the type of colonialism that has taken root is settler colonialism:

"…an ongoing system of power that perpetuates the genocide and repression of indigenous peoples and cultures. Essentially hegemonic in scope, settler colonialism normalizes the continuous settler occupation, exploiting lands and resources to which indigenous peoples have genealogical relationships. Settler colonialism includes interlocking forms of oppression, including racism, white supremacy, heteropatriarchy, and capitalism. This is because settler colonizers are Eurocentric and assume that European values with respect to ethnic, and therefore moral, superiority are inevitable and natural. However, these intersecting dimensions of settler colonialism coalesce around the dispossession of indigenous peoples' lands, resources, and cultures" (Cox 2017).

One of the many issues with settler colonialism, especially in regard to the current Western education system, is that Native peoples have become a static remnant of the past; they are often portrayed and seen by non-Natives as noble savages fighting to save an uncivilized and doomed way of life. Mainstream American school curricula, especially at the elementary, middle school, and high school levels, have not done well at bringing Indigenous peoples into

a modern context. Much of the curriculum used in history, social studies, literature, and the other classes in which elementary, middle school, and high school students are taught about Indigenous peoples still portrays them as frozen in time, living during the periods of European and American colonial settlement and Western expansion. The incorrect information and uninformed perspectives learned in school usually follow students into their college and university courses. It at this time that the college or university instructor usually has to begin correcting 18 plus years of miseducation, that is if he/she is aware of the mistakes and inaccuracies himself/herself. Additionally, there is often an assumption and bias in Western education that Native people today are somehow less authentic than their ancestors. As noted by Tuck and Yang, "…Native American is a racialization that portrays contemporary Indigenous generations to be less authentic, less Indigenous than every prior generation…" (2012, 12). Non-Native peoples and communities are allowed to change with time; for example, no one considers a White American as less authentic because he does not wear 1880s style clothing, yet the same does not apply to Native people. A Native person wearing sneakers and jeans, or who has short hair, is often seen as less authentic by non-Natives who are not familiar with contemporary Native peoples and cultures.

While the *IKWE* project was not a decolonization project, it was focused on bringing Native peoples into a modern and contemporary context in an academic setting, and it also allowed Native peoples voices in Western higher education. American Indians have the lowest representation of any ethnic, racial, or political group in the United States. We say political group here because according to the US federal government, American Indians are technically a political group because of treaties and the unique relationship between the federal government and tribal nations (Balu 1995; Daley and Daley 2023). According to the Postsecondary National Policy Institute, Native peoples comprise less than 1% of the US undergraduate and graduate student population, have the lowest degree attainment rates and have had a decrease overall in undergraduate and graduate enrollment between 2016 – 2020 (Postsecondary National Policy Institute 2021). As with any minoritized or marginalized group, having people from your group or your community in colleges and universities is a positive and empowering experience for most, while not encountering them is often problematic. Seeing and interacting with students, staff, and faculty that look like you and are a part of your community helps in the success of both undergraduate and graduate students, as well as junior faculty.

Lastly, and to some degree most importantly, we believe this program is easily replicable. For others to take the approach employed in the *IKWE* program and use it to create and revise American Indian-focused curriculum and programs at other colleges and universities, and to work with the Indigenous people and communities in their respective regions, is very doable. Of course, it will take time to develop the relationships and trust if they are not already there, but it can be done with time, patience, dialogue, and collaboration with Indigenous peoples.

One final comment, Sean Daley left Johnson County Community College and went to Lehigh University in Pennsylvania in August of 2020 during the height of the pandemic. Except for the project manager, who also moved to Lehigh University, everyone else involved with the *IKWE* program remained at Johnson County Community College. Due to the fact that this was during the pandemic and COVID protocols were in place at Johnson County Community College and Lehigh University, as well as in many other places through the US, in-person seminars, meetings with faculty cohort, and travel were not allowed. Because of all of this, we feel as though the project did not get a chance to conclude properly.

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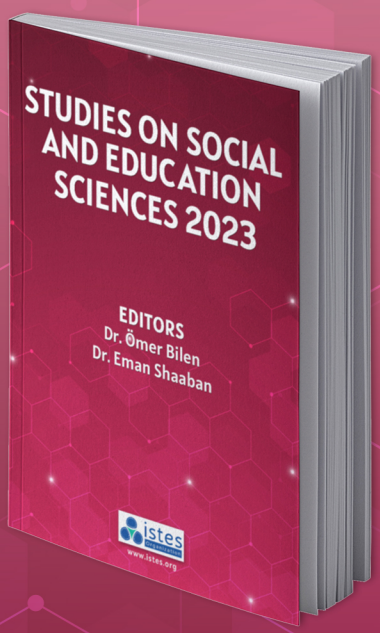

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