AMERICAN UNIVERSITY OF BEIRUT

THE EFFECT OF CLASS SIZE ON THE FINAL COURSE GRADES OF SECOND LANGUAGE SPEAKERS IN HIGHER EDUCATION PUBLIC HEALTH ACCREDITED PROGRAM

by
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ABSTRACT
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This study investigated the effect of class size on academic achievement within an accredited program at a private higher education institution in Lebanon. It addressed two research questions: (1) Is there a relationship between public health course classroom size and student final course grades? (2) Does this relationship differ between undergraduate and graduate students? A quantitative, non-experimental study design was employed to examine predictors of course grade by analyzing secondary panel data of 3,712 course entries from 349 students (2019–2024) using a linear mixed-effects model, while controlling for semester GPA, cumulative GPA, and course credit hours. Results showed that class size was a statistically significant negative predictor of student final course grades for graduate students. A key moderating effect was found: class size had a significant negative impact on graduate student grades ($p < .001$), but no statistically significant effect was observed for undergraduates. The findings suggest that graduate-level public health education, which relies heavily on interactive, competency-based pedagogy, is more susceptible to the constraints of larger classes. This study contributes to the limited research on class size in higher education within the Arab region and offers evidence to inform institutional policy and instructional design in specialized accredited programs.

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ABBREVIATIONS

Abbreviation	Definition
LOs	Learning Outcomes
PHP	Public Health Program
STEM	Science, Technology, Engineering, and Mathematics
SES	Socioeconomic Status
WHO	World Health Organization
UAE	United Arab Emirates
SPSS	Statistical Package for the Social Sciences
IRB	Institutional Review Board
CV	Coefficient of Variation
GPA	Grade Point Average
UG	Undergraduate
GR	Graduate
M	Mean
SD	Standard Deviation
N	Number of Observations
df	Degrees of Freedom
CI	Confidence Interval
MEPI	U.S. – Middle East Partnership Initiative
MCF	Master Card Foundation
PhD	Doctor of Philosophy
MPH	Master of Public Health

IB	International Baccalaureate
NGO	Non-Governmental Organization
QS	Quacquarelli Symonds (World University Rankings)

CHAPTER 1

INTRODUCTION

Background and Context

This research study addresses the effect of class size on student attainment of LOs in a higher education setting in Lebanon. In this study, student achievement will be based on student final course grades with their GPAs as covariates, while class size will be referred to as the number of students in each classroom. Lebanon has been struggling financially, politically, and economically since 2019 (Akar, 2022; Akar, 2023). This situation has consequently negatively affected the country's public and private Higher Education sectors in such ways that institutions had to strategize sustainable, cost-effective plans for their continuity (Akar, 2022; Akar, 2023). These plans included, among others, increasing the student-to-instructor ratio, leading to a bigger class size.

Many public schools in Lebanon follow a French system (Daou & Mikhael, 2018), and there are 27 private schools that follow IB curricula alongside others that follow the American system, where the Lebanese student is considered as a second language speaker, except for the Arabic language. When it comes to higher education institutions, the most prestigious high-quality universities, such as the private university, provide their students with remedial English courses, if needed. This, however, doesn't negate the fact that these students could still be at a linguistic disadvantage, which might therefore affect their achievement.

This private university is an NGO that strives for high-quality education and ensures academic excellence. One of the factors in terms of academic excellence is students' academic achievement at the institution, by which it earns its accreditation and its prestigious QS World University Ranking. To continue providing high-quality

educational services, constant investigations into the quality of education and the variables affecting it must be conducted.

In accredited programs, like the private university's accredited public health program, achievement can be measured through learners' attainment of specific learning outcomes and competencies, in addition to grades and student satisfaction data (Karas, 2021; Monks & Schmidt, 2011; Toth & Montagna, 2002). Accredited programs are required to establish clear learning objectives and ensure that students develop the knowledge, skills, and abilities necessary to succeed in their chosen field. This, in turn, makes the grades resulting from these course assessments representative of the achievement of LOs. In public health programs, these competencies may include scientific literacy, community health analysis, policy engagement, and communication skills, among others. To assess student achievement in accredited programs, institutions may employ a variety of assessment methods, such as course-embedded assignments, capstone projects, portfolios, and performance-based evaluations (the accrediting body, 2024). These assessments are designed to measure students' mastery of the program's specific learning outcomes and competencies, providing a more comprehensive view of their achievement beyond traditional grading practices.

Within the Arab region, there is a particular dearth of research examining the impact of class size on student achievement in accredited public health programs. As this private university continues to maintain its reputation as a prestigious institution and a top-ranked university in the Arab world, it is crucial to investigate factors that may influence the quality of education and student outcomes within its programs. Given the unique challenges faced by second language speakers, who constitute a significant portion of this private university's student population, exploring the relationship

between class size and achievement in the the accrediting body-accredited public health program can provide valuable insights for informing institutional policies and pedagogical practices.

One of the variables that has had a significant effect on achievement, specifically with second language speakers, is class size. Given that the private university's general population is mostly (81%) foreign/second language speakers, it is important to explore how or if the class size affects learner achievement.

In the context of the faculty, specifically the Public Health Program (PHP), there is a discrepancy in the number of students enrolled between one PHP and the other. There are graduate and undergraduate programs in the faculty. Therefore, these discrepancies, specifically between graduate and undergraduate levels, affect the class size and its plausible effects on achievement. Exploring the effect of class size in different programs could help in addressing underlying issues such as discrepant achievement levels.

Well-trained public health graduates can apply their expertise across various roles in government agencies, healthcare organizations, nonprofits, and global institutions dedicated to health promotion and disease prevention goals. There is thus a strong and growing demand for competent public health professionals graduating from high-quality institutions and maintaining program quality and positive student outcomes in Lebanon, as it remains an ongoing challenge requiring evidence-based insights.

With public health education, there are also specialized practice-based competency development needs rooted in community health analysis, health communication, public policy management, strategic planning, and translating scientific evidence for community benefit. Achieving student mastery across this multifaceted

skillset may require adaptable delivery models, sustained mentoring relationships, robust quality assurance procedures, and optimal student-faculty ratios. Investigating links between class size and core public health competency attainment can help identify benchmarks and recommendations tailored to this field's unique needs. These competencies are identified by the accrediting body and are indicators of student achievement in the private university's faculty.

Problem Statement

The effect of class size on student achievement has been under investigation in different grade levels and contexts since the 1950s (Jamison et al., 1974). Most studies have explored the effect of class size on achievement in school settings, specifically, lower grades such as elementary and early childhood levels, and very few studies have explored these effects in higher education institutions (Jones et al., 2020).

Among the studies that explored class size effects on students' achievement in higher education institutions, only one study explored this effect in a context relevant to a public health program. In the study by Lee et al. (2011), the effect of class size on the achievement and satisfaction of nursing students was explored, but the context wasn't specified; they only mentioned that it was in a university. This means that research on the effect of class size on achievement in the field of public health and domains related to it is limited to universities in an unspecified context. Therefore, there's minimal research done on class size effects in the context of public health programs, specifically in private institutions such as this private university, which can make the context more specific and possibly generalizable across similar institutions.

While the public health program is considered a STEM major under "Science," according to Claybourn (2023), virtually no studies have examined the effect of class

size in a Public Health accredited program specifically. There is only one relevant study in terms of the context and the program, which is the one performed by Kara et al. (2020). This study indicates that class size effects are more significant in higher education institutions for students enrolled under STEM majors. The authors further reiterate that STEM majors usually need more individualized instruction and a calmer and more spacious environment to work in, given the nature of inquiry-and project-based instruction that takes place in most STEM majors. Therefore, this current study will serve as further exploration into this claim in the literature.

The effect of class size on achievement is significant mostly when it comes to early years in school, compared to higher grade levels, let alone higher education institutions, according to Jones et al. (2020). The authors further reiterate that disadvantaged students or learners who need extra support benefit significantly more from smaller class sizes. It is important to acknowledge that second language speakers constitute most of the student population in the current study and that being in good command of the language is essential for developing reading comprehension skills. This is because courses and assessments are given in English, not in the native language of learners, which could thereby affect student achievement (Jones et al., 2020).

When considering class size effects on student achievement, it is essential to recognize that the definitions of "small" and "large" are highly relative and contextual (Ramchander & Naude, 2018; Jones et al., 2020). This means that what is considered a small or large class size differs significantly across countries, institution types, academic departments, and programs based on standard practices and norms in each setting. Furthermore, the instructor-to-student ratio can determine whether a class feels sizable or not - a class of 40 could allow for individualized instruction in one context or

completely, or impersonalize learning in another - depending on available teaching staff, for example. Ideal class size benchmarks also depend on the specific age group, subject matter, use of technology, teaching methods, and more. Ultimately, claims about the positive or negative impacts of class size changes must carefully weigh the baseline standards and realities in that educational context under study. A shift from 25 to 40 students per class could be unprecedented at a small liberal arts college but routine at a large public university. Thus, any discussion of class size effects must define "small" and "large" in relation to local expectations rather than fixed numerical thresholds.

Studies performed in public higher education institutions, such as the one by Ake-Little et al. (2020) and De Paola & Scoppa (2011), exploring the effect of class-size on student achievement from a state or governmental perspective, to approach curriculum studies for plausible enhancements in the system. Most populations rely mostly on the public sector in their countries to access affordable, quality education, which is considered as a human right in most countries. In Lebanon, however, the public sector is mostly for students who come from low socioeconomic backgrounds and have no other choice. Public institutions go through lots of turbulence, especially with the instability going on in the country. On the other hand, Lebanon has private institutions like the private university discussed in this study, which is well known for its consistent high-quality education despite the obstacles the country has been through. Therefore, it was chosen as a context for this study, especially since it houses students from different SES via scholarships while maintaining high quality education for all.

Achievement, on the other hand, has also been broadly defined across studies, where, in a literature review conducted by Toth & Montagna (2002), 4 out of 8 studies defined achievement as the class grades only. Other studies, such as Karas (2021) and

Monks & Schmidt (2011), added student satisfaction data collected from student surveys, which serve as another indicator of class size effects. This current study will take the definition provided by Toth & Montagna into account alongside the specific context of the private university, where, as per the accrediting body, achievement can also be measured through learners' attainment of Learning outcomes and competencies. This is because all assessments under the accredited unit at the faculty, whether graded or not, are mapped to LOs, which are in turn mapped to competencies, and hence the grade or feedback would be reflective of the attainment of learning outcomes and therefore of this achievement.

According to the review of the body of research, no studies have yet been performed on the effects of class size on student achievement in accredited higher education programs. The public health program to be explored in this study is accredited by the the accrediting body (the accrediting body). This is important because one of the criteria upon which institutions receive accreditation includes class size effects on achievement, which are addressed through student final course grades. The faculty's Public Health Program (PHP) at the private university is an accredited program, and exploring class size effects in it would contribute to the limited body of research on class size effects in accredited programs in the Arab region.

Exploring the effect of class size on student achievement has been a cornerstone in the body of research aiming to enhance the quality of learning in educational institutions. This study aims to explore these effects in higher education institutions where second language speakers, being Lebanese students, would need more scaffolding and hence would benefit more from smaller class sizes, according to the body of research.

Research Questions

The study aims to address the following research questions:

1. Is there a relationship between public health course classroom size and student achievement as defined by the accrediting body and the body of research in different PHP programs?

2. Does class size have a different effect on achievement for undergraduate and graduate students?

Rationale

The rationale behind this study stems from the recognition of the nature of class size and its potential implications for student achievement in higher education. Existing literature has highlighted the significance of class size in shaping various aspects of the learning experience, including student engagement, teacher effectiveness, and classroom dynamics (Hattie, 2008). However, much of this research has focused on general education contexts, overlooking the unique challenges and considerations faced by students in specialized fields such as Public Health. Moreover, the increasing diversity within educational institutions, marked by growing numbers of second language speakers (World Health Organization [WHO], 2018), underscores the need to examine how class size influences the academic experiences and achievement of these students, specifically in specialized higher education contexts.

Higher education programs in Lebanon have witnessed considerable expansion in annual student intakes during the year 2021, whilst recovering from a deteriorated medical, economic, and safety situations (Kadi, 2022). An increase in student intake generally results in larger class sizes and reduced individual attention per student (Kara et al., 2020). Based on broader education research, smaller classes correlate with

increased student engagement, interaction with instructors, participation levels, skill development, and knowledge retention (Finn & Achilles, 1999).

While the relationship between class size and student achievement has been extensively studied in various educational contexts globally, the body of research specific to the Lebanese and broader Arab region remains relatively limited (Shuayb, 2019). The scarcity of research in this context may be attributed to various factors, including limited funding for educational research, challenges in data collection and access, and the complexities of navigating diverse educational systems and policies within the region.

This study aims to contribute to the limited body of research by examining whether class size predicts student achievement in a private university's accredited public health program. By investigating factors that may influence the quality of education and student outcomes, particularly for second language speakers, this study can inform decision-making processes related to class size policies and pedagogical strategies. The findings derived from this study underscore the importance of considering the unique challenges faced by second language speakers and the potential benefits that smaller class sizes may offer in terms of individualized support, increased opportunities for interaction, and the development of essential competencies in public health education. By contributing to the limited body of research in this area, this study has the potential to influence educational practices and policymaking, ultimately supporting the success of second language speakers and enhancing the quality of public health education in the region.

Overall, this study holds a strong rationale for generating targeted evidence to guide efficient and equitable quality assurance and policymaking surrounding class

sizes, student access, and positive student outcomes across a private university's public health programs, witnessing rapid 21st-century expansion amidst high regional workforce training needs.

By exploring the effects of class size on achievement for this student demographic and examining potential disparities between undergraduate and graduate students, the study aims to generate insights that can inform pedagogical practices, program development, and educational policy within accredited Public Health programs in private universities in Lebanon and the Arab region.

Significance

This study hopes to add valuable information as it focuses on the undergraduate and graduate Public Health program within the faculty at the private university in Lebanon. This private university has played an influential role in health education and workforce training, equipping graduates well through rigorous English-language-based degree programs.

As Karami Akkary (2014) highlights, adapting higher education pedagogy for second language speakers involves addressing unique needs. Within a private university's Public Health major, rising class sizes coupled with English instruction for primarily Arabic-background students raise key questions regarding impacts on learning outcomes and achievement that this study can provide insights into.

Furthermore, the private university's health programs draw students from across the Middle East/North Africa region in addition to its local population of 81% Lebanese students. By investigating class size effects at a private university, findings would have strong relevance for student achievement considerations across various second-language public health education contexts beyond Lebanon, to the Arab region.

Evaluating the class size-achievement linkage at a private university also aligns timely with the University's strategic vision, elevating benchmarks for educational quality and student success alongside continued growth and global competitiveness goals. As one of the top-ranked university in the Arab region, quality assurance efforts initiated in a private university's Public Health program to uphold positive student outcomes can catalyse similar self-improvement in peer institutions across Lebanon and regionally.

In the realm of public higher education institutions, decisions regarding class size are often guided by governmental policies and resource allocation considerations. Many governments recognize access to quality education as a fundamental human right and aim to provide affordable and accessible educational opportunities to their populations (Ake-Little et al., 2020; De Paola & Scoppa, 2011). In this context, class size policies may be influenced by factors such as budget constraints, enrolment projections, and the need to balance educational quality with resource availability. Public institutions may face pressure to increase class sizes to accommodate growing student populations while operating within limited funding structures. However, it is crucial for policymakers and educational administrators to carefully consider the potential trade-offs between larger class sizes and student achievement, particularly for specific student populations or academic disciplines that may benefit from smaller learning environments (Jones et al., 2020; Kara et al., 2020; Ramchander & Naude, 2018). In this study, these effects are limited as the university under study is a private, prestigious institution. Resources and budget allocation of the department, however, could play a role in class size in terms of frequency of classes and number of sections per class offered each semester.

Conceptual Framework

This study is conceptually grounded in Maslow's hierarchy of needs, which posits that individuals must have their basic psychological and social needs met before they can effectively engage in higher-order cognitive processes such as critical thinking, problem-solving, and knowledge construction (Maloke & Mamokhere, 2021; Wang & Calvano, 2022). In educational settings, these foundational needs include psychological safety, a sense of belonging, and opportunities for meaningful interaction with peers and instructors (Maloke & Mamokhere, 2021).

Within this framework, class size is conceptualized as a structural condition that can either facilitate or constrain the fulfillment of these needs. Smaller class sizes may promote greater student visibility, increased interaction, and more individualized feedback, thereby supporting engagement and learning, while larger class sizes may reduce opportunities for participation and instructor-student interaction (Monks & Schmidt, 2011; Kara et al., 2020).

This framework is particularly relevant in the context of accredited public health programs, where learning outcomes emphasize competency development, applied skills, and professional communication (the accrediting body, 2024; Karas, 2021). For second language speakers, the cognitive demands of processing disciplinary content in a non-native language may further heighten the importance of supportive learning environments (Jones et al., 2020; Kara et al., 2020). Maslow's hierarchy therefore provides a theoretical basis for examining how class size may indirectly influence student achievement, as reflected in final course grades, through its impact on students' psychological and social learning conditions.

Taken together, the rationale and significance of this study highlight the need for empirical, context-specific evidence on class size effects within accredited public health programs. The following chapter synthesizes the existing body of literature to situate this study theoretically and methodologically, while identifying gaps that the current research seeks to address.

CHAPTER 2

LITERATURE REVIEW

The relationship between class size and student achievement has been extensively researched, primarily focusing on school settings and lower grade levels (Jamison et al., 1974; Ramchander & Naude, 2018; De Paola & Scoppa, 2011; De Paola et al., 2013; Kara et al., 2020; Finn & Achilles, 1999; Jones et al., 2020; Jepsen, 2015; Monks & Schmidt, 2011). However, fewer studies have explored this relationship in higher education institutions, particularly in the context of public health programs (Jones et al., 2020; Rockoff, 2009; Ramchander & Naude, 2018; Kara et al., 2020; Monks & Schmidt, 2011). The limited research available suggests that class size effects may be more significant for STEM majors, including public health, as these fields often require individualized instruction and project-based learning environments (Kara et al., 2020; Ake-Little et al., 2020).

In a study by Maloke & Mamokhere (2021), where they explored the effect of class size on student achievement in higher education institutions, they proposed Abraham Maslow's hierarchy of needs as the theoretical framework for the study. They argued that for students to build on their knowledge, they would need to socialize and interact, and that a smaller class size would allow students to interact better and henceforth perform better (Maloke & Mamokhere, 2021; Wang & Calvano, 2022). In addition, Maloke & Mamokhere (2021) used secondary data with purposive sampling to perform their quantitative study, which addressed the following research question: "Does the classroom size impact the students' psychological, safety, loving, and belonging needs in the process of learning?" These aspects are similar to the

methodology implemented in this study, where secondary data with purposive sampling was utilized to answer the research questions on class size effects on student achievement. Secondary data is one retrieved from a database, as it doesn't involve the act of data collection or obtaining participant consent, since they are anonymized, and the primary investigator doesn't have contact with them. Purposive sampling, on the other hand, is performed to collect data from a specific sample of a population for the study.

Moreover, the research model used in this study, the fixed effects model performed via SPSS, was used before in a study by Monks & Schmidt (2011). In the study by Monks & Schmidt (2011), the researchers investigated the impact of class size on student perceptions in higher education by analyzing a natural experiment where a university temporarily allowed professors to combine smaller classes into larger ones. The researchers used pre-existing administrative records and student course evaluations collected over a 12-year period, a form of secondary data collection. To ensure a precise measurement, their fixed effects analysis statistically controlled for fixed characteristics of individual instructors, specific courses, and time periods. The findings clearly showed that larger class sizes led to significantly lower student ratings on how much they learned, the instructor's effectiveness, and the overall course quality. In this study, however, the model was used to analyze student-perceived class-size effects rather than effects on achievement. Moreover, the fixed effects in the study mentioned before were applied to instructors who may teach more than one section, and to time periods that have significant effects on the survey implemented. In both studies, panel secondary data was used. Panel data describes the structure of the data, where it is two-dimensional, cross-sectional, and longitudinal (Levendis, 2023), while secondary data

describes the source of the data – pre-existing anonymized data from an official institution or database (Maloke & Mamokhere, 2021). Examples of panel data, as discussed in Levendis (2023), include estimating the effect of education on income using data that tracks the same individuals over several years, which is very similar to the data in this study, as individuals are tracked across different courses throughout their academic journey to check for class size effects on their achievement.

While general studies on class size effects in higher education provide valuable insights, it is essential to consider the unique challenges and considerations that may arise in specific academic disciplines. In fields such as Science, Technology, Engineering, and Mathematics (STEM), which include public health programs, the learning environment and pedagogical approaches often differ from those in other areas of study. Research has suggested that class size effects may be more pronounced in STEM fields due to the emphasis on hands-on learning, practical applications, and project-based instruction (Kara et al., 2020; Ake-Little et al., 2020). Smaller classes in these disciplines can facilitate more individualized attention, better access to laboratory equipment and resources, and more opportunities for collaborative work and feedback (Jones et al., 2020; Monks & Schmidt, 2011). Furthermore, public health education requires the development of a diverse set of competencies that span scientific knowledge, community health analysis, policy engagement, and communication skills. Achieving mastery in these areas may necessitate a more personalized and interactive learning environment, which could be better facilitated by smaller class sizes (Jones et al., 2020).

Second language speakers, who constitute 81% of students at the private university, may benefit significantly from smaller class sizes due to their need for

additional support (Jones et al., 2020; Kara et al., 2020; Jepsen, 2015; Chingos, 2012). One of the primary obstacles faced by second language speakers is the potential for language proficiency to impact their ability to comprehend course content, participate in class discussions, and effectively communicate their understanding (Kara et al., 2020; Monks & Schmidt, 2011). Additionally, second language speakers may encounter difficulties in adapting to different learning styles, communication norms, and academic conventions that may vary from their cultural backgrounds (Hambelton, 2004). Considering these challenges, smaller classes can provide a more supportive and conducive learning environment, allowing for increased opportunities for individualized attention, clarification of concepts, and tailored instructional support (Jones et al., 2020; Jepsen, 2015; Kara et al., 2020; Monks & Schmidt, 2011). Furthermore, smaller classes can facilitate more frequent interactions between students and instructors, enabling second language speakers to receive feedback, ask questions, and engage in discussions that promote language development and a deeper understanding of course material (Kara et al., 2020; De Paola & Scoppa, 2011; Monks & Schmidt, 2011). This, in turn, affects student achievement as defined in this study.

Defining "small" and "large" class sizes is relative and contextual, as these terms differ across countries, institutions, and academic programs (Ramchander & Naude, 2018; Jones et al., 2020; Opatrny et al., 2023; Johnson, 2010). Several factors can influence the effect of class size on the learning experience. The instructor-to-student ratio can significantly affect the dynamics of a classroom, with a higher ratio potentially making even a larger class feel more manageable and conducive to individualized attention (Jones et al., 2020; De Paola et al., 2013). The nature of the subject being taught can also shape the effects of class size. Courses involving hands-on activities,

laboratory work, or extensive discussions may require smaller classes to facilitate effective learning (Kara et al., 2020; Monks & Schmidt, 2011). It is noteworthy that definitions of "small" and "large" class sizes vary across institutional and disciplinary contexts, influencing the interpretation of findings. Additionally, the effects of class size may be mediated by other factors such as instructional methods and available resources. As emphasized by Cuseo (2007) and Monks & Schmidt (2011), understanding the different class size effects necessitates consideration of these contextual factors.

Moreover, cultural factors can play a role in shaping expectations and perceptions of class size, with some educational contexts highly valuing smaller classes, while in others, larger class sizes may be more accepted or even preferred (Jepsen, 2015; Monks & Schmidt, 2011).

Research has consistently demonstrated that smaller class sizes are associated with improved academic outcomes in the early grade levels, facilitating individualized attention, fostering student-teacher interactions, and creating a more conducive learning environment (De Paola & Scoppa, 2011; De Paola et al., 2013; Finn & Achilles, 1999). A study by Jamison et al. (1974) found that students in smaller classes performed significantly better on standardized tests compared to their counterparts in larger classes. This finding has been corroborated by subsequent research, which has highlighted the benefits of smaller class sizes in these early stages of education.

As students' progress through the educational system, the effects of class size on achievement become more nuanced, with some studies reporting a positive relationship between smaller class sizes and academic performance in higher grade levels (Kara et al., 2020; Jepsen, 2015), while others have suggested that the impact may be less pronounced or even negligible (Ramchander & Naude, 2018; Jones et al., 2020). These

mixed findings may be attributed to various factors, such as the complexity of the subject matter, the teaching methodologies employed, and the ability of students to engage in self-directed learning.

In higher education settings, the body of research on class size effects is relatively limited compared to studies focused on primary and secondary education. However, the existing literature provides insights into the potential implications of class size on various aspects of the collegiate learning experience. Several studies have explored the relationship between class size and student engagement, a critical factor in academic success. Smaller classes have been associated with increased participation, more frequent interactions with instructors, and a greater sense of community among students (De Paola et al., 2013; Finn & Achilles, 1999; Monks & Schmidt, 2011). These factors, in turn, can contribute to improved learning outcomes and overall achievement.

In a study by Abrahamsen et al. (2024), researchers also used secondary data spanning over several years to explore the effect of class size on student examination results in a higher education institution, the University of Stavanger in Norway. The authors highlighted the importance of identifying learning outcomes that are assessed by these examinations, and, like the current study, the authors differentiated between course levels (freshman, undergraduate, graduate, and postgraduate). In this study, courses were chosen from the accrediting body-accredited programs to ensure proper alignment and evaluation of learning outcomes in the assessments, which compile to form student final course grades and then semester and cumulative GPAs. Quite similar to this study, the results in Abrahamsen et al. (2024) demonstrated a statistically significant negative correlation, where larger class sizes were associated with lower average grades and a lower percentage of high grades (A and B). This negative effect

was found to be strongest in introductory-level courses and diminished as the course level increased.

Class size effects in higher education, encompassing both undergraduate and graduate programs, have received limited attention in academic discourse, as the bulk of research has historically concentrated on K-12 settings. In undergraduate education, studies have highlighted the potential advantages of smaller class sizes, including enhanced academic performance and student satisfaction. Kokkelenberg et al. (2008) observed that smaller class sizes in introductory economics courses correlated with higher grades at a large public university. Similarly, Bettinger et al. (2017) identified positive associations between smaller class sizes and higher grades, course completion rates, and degree attainment, particularly among underrepresented minority students.

At the graduate level, research on class size effects is relatively sparse but nonetheless suggests potential benefits of smaller classes. Dundar & Lewis (1998) found that smaller class sizes were associated with higher grades, particularly in advanced courses within economics PhD programs. Similarly, Banerjee et al. (2019) highlighted the positive impact of smaller classes on grades and comprehensive exam pass rates in graduate economics programs, particularly benefiting underprepared students.

While the existing literature provides insights into the potential benefits of smaller class sizes in higher education, further research is warranted, particularly concerning specific disciplines and degree levels. The inconsistent magnitude of effects across studies highlights the need for a more rigorous understanding of class size dynamics and their implications for academic achievement in both undergraduate and graduate settings.

One of the most commonly used measures of student achievement in educational research is academic performance as reflected in course grades (Toth & Montagna, 2002; Ramchander & Naude, 2018; De Paola & Scoppa, 2011, De Paola et al., 2013; Jamison et al., 1974; Kara et al., 2020; Ake-Little et al., 2020; Karas, 2021; Johnson, 2010; Wang & Calvano, 2021; Jones et al., 2020; Lee et al., 2011; Parks-Stamm et al., 2016; Monks & Schmidt, 2011). The use of grades as an achievement indicator is rooted in the assumption that they represent a quantifiable measure of a student's mastery of course content and their ability to demonstrate that understanding through various assessments, such as exams, assignments, and projects. However, it is important to acknowledge that grades alone may not provide a comprehensive picture of student achievement, as they can be influenced by various factors beyond academic performance, such as grading policies, instructor biases, and variations in assessment methods (Jones et al., 2020; Kara et al., 2020).

This literature review synthesizes existing research on the relationship between class size and student achievement, noting that the focus has been extensively on school settings and lower grade levels, with comparatively fewer studies in higher education, particularly within public health programs. The limited research suggests the effects of class size may be more pronounced in STEM fields, including public health, since these fields require more individualized instruction and adopt project-based learning.

Theoretical and methodological precedents are established, citing Maloke & Mamokhere (2021), who employed Maslow’s hierarchy of needs as a framework and utilized secondary data with purposive sampling - a methodology mirrored in the current study. The analytical approach is also grounded in prior work, referencing

Monks & Schmidt (2011), who used a fixed effects model with panel secondary data to analyze student perceptions.

The review highlights contextual factors that mediate class size effects. In STEM disciplines like public health, smaller classes are argued to better support the development of necessary competencies through personalized, interactive environments. Furthermore, the significant population of second language speakers, particularly in institutions like the private university, may derive greater benefit from smaller classes due to enhanced support for language proficiency.

Definitions of "small" and "large" classes are established as relative and contingent on institutional, disciplinary, and cultural contexts. While research consistently associates smaller classes with improved academic outcomes in early grades, findings in higher education are more nuanced, with studies reporting mixed results on the strength of the relationship.

Key studies in higher education, such as Abrahamsen et al. (2024) and Kokkelenberg et al. (2008), are cited, demonstrating a statistically significant negative correlation between larger class sizes and grades, particularly in introductory-level courses. This pattern decreases at advanced course levels. Research at the graduate level, though sparse, similarly suggests benefits to smaller classes in terms of their effects on student achievement.

Finally, student achievement is primarily operationalized through academic performance as reflected in course grades, a common metric acknowledged to be influenced by factors beyond content mastery. The review concludes by identifying a gap in rigorous, discipline-specific research on class size effects across undergraduate and graduate higher education settings.

CHAPTER 3

METHODOLOGY

Research Design

This study aimed to investigate the effect of class size on student final course grades with GPA as a covariate in an accredited public health program at a private university in Lebanon. Research on the effect of class size on achievement is more prevalent in early years and Western contexts. Very few studies have explored this effect or predictive relationship in higher education institutions, under a program of public health, and no studies have been done regarding this aspect in Lebanon – only one was done in the Middle East, in the UAE. Given this research gap, there's a need to explore the effect of class size on student achievement in a higher education institution in Lebanon.

To answer research questions, this study followed a non-experimental research design using quantitative methods where student final course grades were treated as the dependent variable, with semester and cumulative GPA included as covariates. The study explored these variables from the year 2019 to the year 2024 on a different population each time the course was given as part of the accredited public health program. Student final course grade entries were filtered by course and semester while keeping student IDs anonymized.

The study relied on secondary panel data spanning the academic years 2019 to 2024. Panel data allow for repeated observations of the same individuals across time and contexts, enabling more accurate estimation of relationships while accounting for within-student variability (Levendis, 2023). This design was particularly appropriate

given that students in accredited public health programs enroll in multiple courses across different semesters, often experiencing varying class sizes throughout their academic trajectory.

Participants

Population

The population of this study consisted of second language speakers enrolled in a public health program in a reputable private higher education institution in Lebanon.

Sample

Participants in this research study included students enrolled in the years 2019-2024 in a program of Public Health housed in the faculty at a private university that follows an American system and is in Beirut, Lebanon. This university is mostly populated with students from middle and high socio-economic classes. The students come from diverse backgrounds, where some are native speakers of the English language, while the greater population are non-native speakers. This private university's faculty has a maximum number of enrolments allowed per course, and it caters to each course and its needs. For example, some lecture courses can hold up to 40 students, while other lab courses are capped at 25 students. This was reflected in the dataset.

The sample included students enrolled in courses under the accredited public health program. Students in the sample were enrolled in the above-mentioned accredited programs between the years 2019 and 2024. For the participants to be considered in the study, they must have completed the course and not withdrawn from it or failed it. This was done to control for any plausible bias in the student survey and to have as much of a representative sample as possible. The unit of analysis in this study was the student–course enrollment, meaning that each observation represented an individual student's

final grade in a specific course during a specific semester. As a result, a single student could contribute multiple observations to the dataset if they were enrolled in more than one public health course over the study period. This approach yielded a total of 3,712 course-level grade entries from 349 unique students.

Importantly, although class size is a course-level characteristic, academic achievement was measured at the student level. Analyzing achievement at the student level preserves meaningful variation in performance among students enrolled in the same course and exposed to the same instructional conditions. In contrast, aggregating grades into course averages would have masked individual differences in academic performance, particularly among second language speakers, whose outcomes may vary widely even within identical classroom contexts (Jones et al., 2020; Kara et al., 2020).

Because observations were nested within students, the dataset exhibited within-student dependency. To address this, a linear mixed-effects model with a random intercept for student ID was employed. This modeling strategy accounts for repeated measures and allows each student to have an individual baseline level of achievement, thereby producing more accurate estimates of the relationship between class size and final course grades (Monks & Schmidt, 2011; Levendis, 2023).

This random intercept was essential to link course final grades and student GPAs across repeated observations and account for within-student covariance. The sample was chosen from the Public Health Program at this institution because it is accredited by the the accrediting body, which, as previously mentioned, added to the alignment of learning outcomes with given assessments.

Sampling Procedure

Purposive sampling was followed in this study. The population constituted of students taking courses in the faculty, and it was filtered to include students who are enrolled in a course that is under an accredited graduate or undergraduate program. Students enrolled in accredited programs were the basis of the sample because the courses under these programs must have LOs and assessments aligned as per the accrediting body, which makes grades more reflective of student achievement. The data was further filtered to include only those who passed the course and didn't withdraw from it or fail it. This filter was added because the real reason behind failure cannot be accurately identified since the data is anonymized. Students might have simply forgotten the withdrawal deadline, dropped out of the university without withdrawing, etc., which means that the cause could be attributed to administrative processes rather than actual student achievement. Moreover, the number of entries eliminated due to this filter was 63 – insignificant compared to the sample size (3712). Another filter was added to make sure that the sample chosen spans from the year 2019 to the year 2024 because that was when the undergraduate programs joined the accreditation unit after they underwent a curricular revamp. Another layer of filtering included courses that were given during "online" semesters, either due to COVID, protests, or the most recent war in Lebanon.

Since this data is considered secondary data and was already documented in the university's databases, and it was anonymized for the purpose of this study, there was no need to attain consent from participants. No identifying information about any of the participants was available to the researcher, only anonymous course grades, GPAs, and actual class size per course.

It's important to note that the dataset included academic records from students who were enrolled in public health courses between 2019 and 2024, regardless of their current enrollment status at the time of analysis. Although some students had graduated by the time the data were analyzed, their academic records remained accessible through the university's official administrative databases via the Registrar.

The inclusion of graduated students does not pose a methodological or ethical concern, as the data were archival, anonymized, and collected retrospectively. The use of historical academic records is consistent with best practices in secondary data research and has been widely employed in studies examining class size effects in higher education (Monks & Schmidt, 2011; Maloke & Mamokhere, 2021). Importantly, including graduates enhanced the longitudinal scope of the dataset and allowed for a more comprehensive examination of class size effects across multiple cohorts.

Figure 1. Sample Selection and Data Filtering Procedure.

Tools

It is important to note that the researcher is a staff member of the mentioned university at the faculty and is familiar with its regulations and procedures, which made data collection easier.

Student Final Course Grades

In this study, the term "final course grade" refers exclusively to the individual student's final grade earned in a specific course at the end of the semester, expressed on a 4-point scale using the official grade conversion system adopted by the university (Appendix). The term does not refer to an average grade for the course itself.

Final course grades represent student-level academic outcomes derived from assessments that are explicitly aligned with course learning outcomes and, by extension, the accrediting body-mandated program competencies. As such, these grades serve as a valid and commonly used indicator of student achievement in higher education research (Toth & Montagna, 2002; Karas, 2021).

Student final course grades were obtained from the Registrar's office and were anonymized using tokens before sharing them with the researcher.

Demographics

Data on demographics from the year 2019 to the year 2024 was available from the registrar's office, and it includes nationality, year of study, and program of study.

GPA

Semester GPA and cumulative GPA were included as covariates to control for differences in students' general academic ability and preparedness. Semester GPA reflects students' academic performance during the same academic period as the course grade and captures short-term fluctuations in academic functioning. Cumulative GPA, on the other hand, reflects longer-term academic performance across semesters and serves as an indicator of sustained academic ability.

Including both measures allowed the analysis to isolate the unique contribution of class size to student achievement beyond the influence of prior and concurrent

academic performance. Prior research consistently demonstrates that GPA is a strong predictor of course-level achievement in higher education, particularly in rigorous and competency-based programs (Monks & Schmidt, 2011; Karas, 2021). In the present study, controlling for GPA was especially important given the high proportion of second language speakers, for whom GPA may also indirectly reflect academic language proficiency and adaptation to English-medium instruction.

Class Size

Class size was obtained from the registrar's office for each course given each semester or year. The data was segmented into the number of students per course.

Data Collection Procedures

Exempt IRB approval was required for this research since the data were readily available on the databases, anonymized, and required no contact with any of the participants. The researcher received the anonymized data via tokens from the university's registrar. Student final grades and GPAs were obtained from course instructors via the university's platform. Class size was obtained from the university's system, where every enrolment, drop, add, and withdrawal is recorded.

Data Analysis Procedures

The data analysis procedures were done to answer the following research questions:

• Is there a relationship between public health course classroom size and student achievement as defined by the accrediting body and the body of research in different accredited PHP programs?

• Does class size have a different effect on achievement for undergraduate and graduate students?

For the Quantitative Data Analysis, the focus was on examining whether class size predicted students' final course grades, with student GPA as a covariate. This analysis was done for the whole sample, and since the output showed a statistically significant effect, additional analyses were conducted to compare class size effects between graduate and undergraduate programs.

Data Cleaning and Preparation

The dataset containing student final grades, GPAs, and corresponding class sizes was cleaned to handle missing values, outliers, and any inconsistencies. In addition, the cumulative GPA, semester GPA, and student final course grades were all converted to 4-point scale grades using the conversion table adopted by the university by the faculty's instructors (Appendix).

Descriptive Statistics

Descriptive statistics, such as means, standard deviations, and frequency distributions, were calculated for class sizes and final grades to provide an overview of the data and identify any potential patterns or trends among the sample as a whole and between undergraduate and graduate programs.

A linear mixed-effects model (Type III fixed effects) was conducted to examine whether class size predicted course grade, while accounting for student-level random effects (N = 3,714 entries; 349 students). The model included class size as a fixed effect and controlled for credit overall, semester GPA, cumulative GPA, and course credit hours. A random intercept for student ID was specified to account for within-student clustering. This model was used since, as previously discussed in the literature review, individuals are tracked throughout different courses with different class sizes and a model which maintains these multiple entries as one individual was

needed. After careful review of similar studies in the literature, there was a consensus that fixed effects model is the most appropriate for the data analysis of such studies.

It is important to mention that, in the PHP at the faculty, in terms of course credit hours, some courses in the PHP are 0, 1, 2, or 3 credit courses depending on the workload distribution and nature of the course, hence why course credit hours were controlled for.

SPSS was used to perform quantitative data analysis and fixed effects were manipulated to perform several tests to check for various effects. The results are presented using tables, graphs, and other visual representations, along with detailed interpretations and discussions of the findings.

CHAPTER 4

RESULTS

Descriptive Statistics

In Table 1, sample descriptive statistics were introduced. The analyses were performed on the sample consisted of 3712 entries. Undergraduate student entries constituted around 47% (*N=1752*) of the sample, while graduate student entries constituted around 53% (*N=1962*) of the sample. This indicated that the sample was somehow balanced in terms of student levels, as UG and GR constituted almost half the sample each.

Table 1. Descriptive Statistics

Variable	**Total *N* = 3712**			
	CV	*M*	*SD*	CV
Course grade	12.1	3.7494	0.45313	12.1
Class size	65.1	29.4038	18.97530	64.5
Credit hours	23.1	2.5919	0.60686	23.4
Semester GPA	9.9	3.7050	0.37467	10.1
Cumulative GPA	9.8	3.6111	0.36481	10.1

Note. N = number of observations; *M* = mean; *SD* = standard deviation; CV = percentage of coefficient of variation; GPA = grade point average.

Research Question 1: Relationship Between Class Size and Student Achievement

In Table 2, the results of the mixed effects model showed that class size significantly predicted course grade, F (1, 3705) = 30.29, $p < .001$, such that larger class

sizes were associated with lower course grades. Among the covariates, semester GPA and cumulative GPA were significant positive predictors of student achievement. The random intercept for student ID had significant variance, indicating substantial variability in course grades between students.

Table 2. Type III Tests of Fixed Effects Predicting Course Grade

Source	***N*df**	***D*df**	***F***	***p***
Intercept	1	3705	77.952	<.001
Class size	1	3705.000	30.290	<.001
Credit hours	1	3705.000	2.630	.105
Semester GPA	1	3705	522.178	<.001
Cumulative GPA	1	3705.000	21.358	<.001

*Note. N*df = numerator degrees of freedom; *D*df = denominator degrees of freedom. The dependent variable is course grade.

In Table 3, this model was also performed to test potential differences in class size effects by and credit hours. These tests were not statistically significant. However, the tests showed that both semester GPA and cumulative GPA were significant predictors of student final course grade F (1, 3705) = 540.9, $p < .001$, and final course grade and cumulative GPA F (1, 3705) = 17.27, $p < .001$. This indicates that there is a predictive association: students with higher cumulative GPAs and semester GPAs tend to achieve higher final course grades.

Table 3. Type III Tests of Fixed Effects for Course Grade with GPA Predictors

Source	***N*df**	***D*df**	***F***	***p***
Intercept	1	3705.000	62.814	<.001

Source	*N*df	*D*df	*F*	*p*
Overload seats	1	3705	2.950	.086
Credit hours	1	3705	6.548	.011
Semester GPA	1	3705	540.946	<.001
Cumulative GPA	1	3705	17.271	<.001

*Note. N*df = numerator degrees of freedom; *D*df = denominator degrees of freedom. The dependent variable is course grade.

In Table 4, the results indicate that semester GPA was a significant predictor of student final course grade, such that a one-point increase in semester GPA was associated with a .66 increase in course grade, and for every 1-point increase in cumulative GPA, the student final course grade increases by .14.

Table 4. Estimates of Fixed Effects Predicting Course Grades

Parameter	Estimate	Std. Error	*df*	*t*	*p*	95% CI Lower	95% CI Upper
Intercept	0.783501	0.088497	3705	8.853	<.001	0.609994	0.957008
Class size	−0.001741	0.000316	3705.000	−5.504	<.001	−0.002362	−0.001121
Credit hours	−0.015829	0.009760	3705.000	−1.622	.105	−0.034965	0.003308
Semester GPA	0.667392	0.029206	3705	22.851	<.001	0.610131	0.724653
Cumulative GPA	0.141805	0.030684	3705.000	4.622	<.001	0.081646	0.201964

Note. df = degrees of freedom; CI = confidence interval. The dependent variable is course grade.

Research Question 2: Class Size Effect Differences Between Undergraduate and Graduate Students

In Table 5, the fixed effects test was performed again to check for significant differences of class size effects between graduate and undergraduate students, results showed that class size was a statistically significant predictor of student final course grades for graduate students F (1, 1954) = 55.7, $p < .001$ in such a way that when the class size is larger, student course grades decrease by .001 for each additional student. For undergraduate students, on the other hand, class size didn't have a significant effect on their final course grades F (1, 1744) = 2.63, $p > .05$. Table 5 presents stratified results by academic level to address research question 2.

Table 5. Type III Tests of Fixed Effects Predicting Course Grades by Academic Level

Level	**Source**	***N*df**	***D*df**	***F***	***p***
UG	Intercept	1	1744.000	63.188	<.001
	Class size	1	1744.000	2.630	.105
	Credit hours	1	1744.000	12.905	<.001
	Semester GPA	1	1744	307.024	<.001
	Cumulative GPA	1	1744	10.364	.001
GR	Intercept	1	1954	8.063	.005
	Class size	1	1954.000	55.711	<.001
	Credit hours	1	1954.000	2.921	.088
	Semester GPA	1	1954.000	129.481	<.001
	Cumulative GPA	1	1954.000	11.606	.001

*Note. N*df = numerator degrees of freedom; *D*df = denominator degrees of freedom. UG = undergraduate; GR = graduate. The dependent variable is course grade.

Results Overview

It is important to note that sustainable variability was maintained in this model, which means that entries with identical randomized IDs were attributed to one profile under the same cumulative GPA and the respective semester GPAs. Future work could replicate these analyses in R to explore alternative random-effects structures where in SPSS, 3712 entries were accounted for rather than 349 participants, and these entries were coded with the same code across different semesters for the same individual. For the purposes of this study, SPSS provided a statistically robust platform for implementing the specified linear mixed-effects model, including fixed effects for class size, academic performance indicators, and demographic covariates, alongside a random intercept for student identification.

The analysis of the results provides clear evidence in response to both research questions. For the first research question, a statistically significant negative relationship was found between class size and student achievement, as defined by the accrediting body and the literature. Specifically, the linear mixed-effects model indicated that larger class sizes significantly predict lower student final course grades. Regarding the second research question, which examined differential effects by academic level, the results revealed a significant moderating effect. Class size exerted a significant negative impact on the final grades of graduate students ($p < .001$), whereas no statistically significant effect was observed for undergraduate students. This establishes that the relationship between class size and achievement is not uniform and is more pronounced at the graduate level within the studied public health program.

CHAPTER 5

DISCUSSION

Key Findings

This chapter addresses the study's research questions by interpreting the findings in relation to existing theory and empirical research. The discussion first examines the overall relationship between class size and student achievement within the accredited public health program and then explores whether this relationship differs between undergraduate and graduate students. The findings are interpreted through relevant theoretical frameworks and compared with similar research in higher education.

The findings of this study reveal a nuanced relationship between class size and academic achievement within the the accrediting body-accredited public health program. The analysis demonstrates that larger class sizes have a significant adverse effect on student final course grades, corroborating the broader literature on the benefits of smaller learning environments. However, this relationship is not uniform across all student cohorts. A critical finding is the differential impact based on program level: class size exerted a significant negative effect on the grades of graduate students, while no statistically significant effect was observed for undergraduate students. This suggests that the pedagogical demands and learning processes at the graduate level, which often emphasize specialized discourse (Abrahamsen et al., 2024), critical analytical tasks, and close mentorship, are more susceptible to the constraints of larger classes.

Research Question 1: Relationship Between Class Size and Student Achievement

In response to the first research question, the findings demonstrate a statistically significant negative relationship between class size and student achievement

as measured by final course grades. Larger class sizes were associated with lower student performance, even after controlling for semester GPA, cumulative GPA, and course credit hours. This indicates that class size functions as an independent predictor of achievement within the accredited public health program.

The significant negative effect of class size on graduate students, as opposed to undergraduates, may be further explained by the advanced linguistic demands of graduate-level public health education. For second language speakers, who constitute most of our sample, engaging in these higher-order tasks in a larger class can be particularly challenging. Larger classes typically offer fewer opportunities for each student to participate in nuanced discussions, present arguments, or receive detailed feedback on language use within their writing. The 'silent' experience of a large lecture hall can thus disproportionately hinder second language speaking graduate students who require more interactive, language-rich environments to master both the content and the communicative competencies required by the field.

Furthermore, as anticipated, student GPA emerged as a robust and significant predictor of course performance, affirming its role as a key indicator of academic preparedness and achievement. These results collectively underscore that class size effects are not universal but are instead mediated by the academic level and the specific educational context. In addition, the robust predictive effects of both semester and cumulative GPA on student final course grades underscore the role of pre-existing academic skills. In the context of a student body predominantly composed of second language speakers, a strong GPA likely reflects not only content mastery but also a developed proficiency in academic English. Students with higher GPAs may have already crossed a threshold of language fluency that allows them to navigate course

materials and assessments more autonomously, making them somewhat more resilient to the impersonal nature of larger classes. Conversely, students who are still developing their academic language skills may rely more heavily on the individualized interaction and immediate feedback that smaller classes facilitate, making them more vulnerable in larger settings.

The strong predictive association observed between GPA measures and final course grades further underscores the role of prior academic performance in shaping student outcomes. In the context of a predominantly second language speaker population, GPA may also indirectly reflect students' academic language proficiency and their ability to navigate English-medium instruction. Students with higher cumulative and semester GPAs may therefore be better equipped to cope with the reduced interaction and feedback typically associated with larger class sizes, whereas students with lower GPAs may depend more heavily on the individualized support and engagement facilitated by smaller classes.

These results support the original hypothesis that class size effects are significant in higher education classes, which answers the first research question addressed in this study.

As mentioned in the literature review, several studies, such as Monks & Schmidt (2011), Abrahamsen *et al*. (2024), Maloke & Mamokhere (2021), and Wang & Calvano (2022) have incorporated similar data collection sources and structures, followed similar research models and designs, and proposed theoretical frameworks for this study. When it comes to results and findings, the only comparable results from the study above are those of Abrahamsen *et al*. (2024). This is due to the similarity in research questions, methodology, and consideration of different academic levels. Both

this study and Abrahamsen *et al*. (2024), found that there's a significant class size effect on students in a higher education institution over the period of several years.

Research Question 2: Class Size Effect Differences Between Undergraduate and Graduate Students

In response to the second research question, the findings reveal that the effect of class size on student achievement differs by academic level. Class size was a statistically significant negative predictor of final course grades for graduate students, whereas no statistically significant relationship was observed for undergraduate students. This suggests that the impact of class size is not uniform across levels of study and is more pronounced in graduate-level public health education.

The differential impact observed between undergraduate and graduate levels aligns with this view. The negative effect of larger classes on graduate grades suggests that when the stakes for language proficiency are highest, the supportive environment of a small class becomes critical for second language speakers' success.

In terms of difference between undergraduate and graduate levels, the hypothesis initially suggested that class size effects would be bigger in undergraduate classes due to "practice effects" in the sense that graduate students are more experienced in the academic domain as they have already graduated from a higher education institution, and in the sense that they have probably been or currently are integrated in the professional field which gives them the skills and abilities to work collaboratively with more people or to share common workspaces.

Abrahamsen *et al*. (2024) found that there is a more significant class size effect on undergraduate students than graduate students, which confirms the initial hypothesis of this current study, but contradicts its results. On the other hand, it is worth

mentioning that, in general, the class size for UG classes tends to be lower in the PHP under study, except in foundational courses in which students from more than one undergraduate major are enrolled. In graduate courses, however, the class size is usually bigger for most courses except concentration courses. This is due to the fact that, in this specific PHP, for instance, MPH students from all three concentrations take the same foundational courses. This results in a large class size in such cases.

The Mediating Role of Language Proficiency

One of the premises of this study was its focus on second language speakers, a population for whom the classroom language of instruction is not their native tongue. The findings must be interpreted through this lens as well. The cognitive load for a second language speaker is inherently higher; they are simultaneously decoding complex disciplinary content and the linguistic structures in which it is delivered (Kara et al., 2020). Smaller class sizes can mitigate this load by providing a safer environment for clarification, more opportunities for spoken participation to practice academic language, and more frequent, tailored feedback from instructors.

Maslow's Hierarchy of Needs

The results of this study can be meaningfully interpreted through Maslow's hierarchy of needs, which has been applied in prior higher education research examining class size and learning environments (Maloke & Mamokhere, 2021; Wang & Calvano, 2022). According to Maslow's framework, learners must first have their psychological, safety, and belonging needs met before they can effectively engage in higher-order cognitive processes such as critical thinking, problem-solving, and knowledge synthesis.

Smaller class sizes may facilitate the fulfillment of these foundational needs by

fostering a sense of belonging, increasing student visibility, and creating psychologically safe environments for participation. In contrast, larger classes may reduce opportunities for interaction and feedback, potentially undermining students' sense of inclusion and confidence. This theoretical lens helps explain why class size effects were more pronounced among graduate students, whose coursework demands higher levels of participation, academic discourse, and professional identity formation.

These findings reinforce prior applications of Maslow's hierarchy of needs in higher education research, particularly those examining how structural conditions such as class size shape students' sense of belonging, engagement, and academic achievement.

Class Size Effects in STEM Majors

Public health programs are widely classified within the STEM domain due to their reliance on scientific reasoning, data analysis, epidemiology, and applied research methodologies (Claybourn, 2023). Prior research suggests that class size effects tend to be more pronounced in STEM disciplines, where learning is often inquiry-based, project-driven, and dependent on sustained interaction between students and instructors (Kara et al., 2020; Ake-Little et al., 2020).

The findings of this study align with this body of literature, particularly at the graduate level. Graduate public health courses emphasize advanced competencies such as critical analysis, research synthesis, professional communication, and policy evaluation—skills that require iterative feedback, discussion, and mentorship. Larger class sizes may constrain these pedagogical processes by limiting opportunities for individualized feedback and meaningful engagement, thereby disproportionately affecting student achievement in advanced STEM-based coursework.

The findings must also be interpreted within the context of second language instruction. For second language speakers, learning in English-medium STEM programs involves an increased cognitive load, as students must simultaneously process complex disciplinary content and academic language (Jones et al., 2020; Kara et al., 2020). Smaller class sizes may alleviate this burden by providing increased opportunities for clarification, interaction, and feedback, all of which support both content mastery and language development.

The strong predictive role of semester and cumulative GPA observed in this study suggests that students with higher academic performance, likely reflecting stronger academic language proficiency and institutional adaptation, are better equipped to navigate larger class environments. Conversely, students with lower GPAs may depend more heavily on the supportive conditions afforded by smaller classes to meet both academic and psychological needs. This interaction between class size, GPA, and language proficiency further underscores the importance of contextualized class size policies in STEM-based, second-language learning environments.

Limitations

In the study by Monks & Schmidt (2011), the authors differentiated between time "dummies," which referred to specific periods where results or participation would have been inflated. They made sure to include them in the statistical model and control for them as fixed effects. In this current study, however, irregular time frames, such as COVID, were excluded from the study. In addition, unlike in Monks and Schmidt (2011), the change of class sizes from what's called "super-sized classrooms" (Monks & Schmidt, 2011) wasn't accounted for. Meaning that, if, for example, a course used to be divided into two sections in the Fall and then the sections were joined to form one

super-sized classroom, with a greater number of students in Spring, it wasn't accounted for in this study. This prevents deriving more significant conclusions from the data analysis, as comparison within the same course, with the same instructor, with only a difference in class size, could result in more significant and specific outputs from the analysis.

Moreover, to account for language effects, the study should have considered each student's current English proficiency level, given that 80% of the private university's student population are second language speakers. Performing a standardized English test for subjects, if the study didn't depend on secondary data collection, would have also helped control for language effects on subject-matter achievement.

Implications

In the context of higher education institutions, decisions regarding class size are often influenced by financial considerations and the pursuit of profitability. From an administrative perspective, larger class sizes can be a more cost-effective option, as they allow institutions to accommodate a greater number of students with fewer instructional resources (Monks & Schmidt, 2011; Jepsen, 2015). However, it is important to note that the relationship between class size and cost-effectiveness is not necessarily linear. While larger classes may initially seem more profitable, there may be a point at which further increases in class size begin to negatively impact student learning outcomes and institutional reputation, potentially offsetting any financial gains (Lee *et al*., 2011). It is important for academic institutions in higher education to be aware that class size effects are significant even in tertiary education and not to overload classes with extra capacity to enhance the students' academic experience.

This could also guide faculty members in tertiary education to equip their classes with group and collaborative work, depending on the nature of the course and its content. This grouping of students could be randomized, based on academic level, background, topic, etc., allowing a more individualized experience, interaction, and instructor feedback without compromising the component of diversity and exposure to different contexts in the classroom. This is especially true in the case of second language speakers, who need more opportunities to practice the language in a safe, conducive learning space.

Another implication for higher education institutions could be to extract courses in which students performed the best, and explore their structure, assessments, learning outcomes, class size, etc., to benchmark a best-practices course in which students' ability to perform is significantly enhanced, and controlling for class size would be one aspect of it. Another aspect would be to acknowledge faculty-student ratios and adhere to standardized recommendations specifically for STEM majors, as these require more catered instruction and feedback.

Future Research

This research serves as a foundation for future research that could explore 1) student perception of attainment of learning outcomes and 2) instructor perception of the effect of class size on the course. This data is available at the faculty, but, for the purpose of preliminary exploration into the topic, and setting the foundation for the effect of class size on student achievement in a public health accredited program in a higher education institution, this aspect was not explored in this current study. However, results, specifically those showing a significant effect of class size (graduate level), could be triangulated with the aforementioned perspectives to add a layer of qualitative

data analysis and depth into the actual effect of class size on achievement.

Moreover, this study is the first in the Middle East that explores the effects of class size on student achievement in a reputable private university, under an accredited public health program, and includes both undergraduate and graduate levels. It could open the door for other similar studies and shed light on maintaining a standardized faculty-student ratio to enhance the student experience if the results were consistent throughout several studies. This will significantly add to the negligible amount of research on this topic in the context specified.

Conclusion

This study explored the effect of class size on the final course grades of second language speakers in a the accrediting body-accredited public health program at a private higher education institution in Lebanon. The findings indicate a significant relationship between class size and student achievement, thereby answering the first research question. However, this relationship is not uniform, revealing a critical nuance: class size had a significant negative effect on the final grades of graduate students, while no statistically significant effect was found for undergraduate students. This differential impact answers the second research question and suggests that the academic level mediates class size effects.

The significant effect on graduate students, contrary to the initial hypothesis, can be attributed to the advanced pedagogical demands and heightened linguistic competencies required at the graduate level. Graduate courses in public health emphasize specialized discourse, critical analytical tasks, and close mentorship—elements that are more susceptible to the constraints of larger classes. For a student population predominantly composed of second language speakers, who face an inherent

cognitive load of decoding complex content in English, smaller classes provide the essential, interactive environment for mastering both the subject matter and the communicative skills vital to the field. It is important to mention that this PHP program hosts MEPI and MCF scholars who join mostly from African countries. To avoid the identification of participants in this study, it was not possible to obtain educational backgrounds to further explore other variables that could affect student achievement.

This study contributes to the limited body of research on class size effects in higher education within the Arab region, specifically in an accredited public health context. It underscores that class size is a significant variable for student achievement even in tertiary education, particularly for specialized, competency-based STEM programs like public health. The findings also highlight the importance of considering the unique needs of second language speakers in institutional planning.

The implications of this study are pertinent for higher education institutions aiming to balance cost-effectiveness with educational quality. To enhance academic experience and uphold positive student outcomes, it is recommended that administrators and faculty acknowledge the detrimental impact of larger classes, especially at the graduate level. Strategies such as maintaining optimal faculty-student ratios, integrating collaborative group work to foster interaction, and benchmarking successful course structures should be considered.

Future research should build upon this foundation by incorporating direct measures of English language proficiency and triangulating quantitative findings with qualitative data on student and instructor perceptions of learning outcome attainment and class size effects. This study, as a pioneering investigation in its specific context, opens the door for further research to establish standardized benchmarks and/or

generalizations for class sizes that support the success of second language speakers in accredited health programs across the region.

APPENDIX

CONVERSION CHARTS

Numeric Course Grade to Letter Course Grade

Starting with Numeric Course Grade /100	Corresponding Course Letter Grade
< 60	F
60	D
61–62	D+
63–65	C–
66–68	C
69–71	C+
72–74	B–
75–78	B
79–82	B+
83–86	A–
87–92	A
93–100	A+

Grade Conversion Chart

Course Letter Grade	Quality Points
A+	4.3
A	4.0
A–	3.7
B+	3.3
B	3.0
B–	2.7
C+	2.3
C	2.0
C–	1.7
D+	1.3
F	0.0

Note: The GPA at AUB is capped at 4.0

I	P	PR	W	NP
Incomplete	Pass	In Progress	Withdraw	No Pass

Figure 2. Grade Conversion Charts

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