RESEARCHARTICLE OPENACCESS

Relationship of Civil Engineering Graduates' First-Year to Fourth-Year Grade Point Average Per Semester to Their Licensure Examination Performance

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Abstract:

The goal of this paper is to determine the relationship of civil engineering graduates' first year to fourth year grade point average per semester to their licensure examination performance. The study's relevance was centered on civil engineering students taking the licensure examination from 2013 to 2018. Thegoal of the project is to determine and improvethe passing rate for civil engineer license, as well as to investigate the factors that influence the passing rate in terms of the participants per semester GPA from first to fourth year. It is proved that the per semester grade point average does not have an effect to the licensure performance of the civil engineering graduates. Those graduates that has the highest-grade point average also has the highest passing rates but it is not proved in all instances that the two variables have a relationship. The best classifier is identified in using Waikato Environment for Knowledge Analysis (WEKA) as a data mining tool. It is the MultiClassClassifier of meta that has an 80% of correct classified instances and takes 0.01 seconds to build the model.

Keywords—**Academic Achievement, Academic Performance, Civil Engineering, Correlation, Data Mining, Grade Point Average (GPA), Licensure Examination**

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I. INTRODUCTION

Engineering has a significant impact on the world, covering areas such as physical, social, economic, and digital domains. However, there is a challengein educating individuals who can contribute to development across these areas. Several countries are striving for continuous improvement and innovation in their educational practices to maintain an edge on the global stage [1]. Pursuing a career in civil engineering requires patience, expertise, and unwavering commitment [2]. The Engineer Licensure Examination evaluates and ensures the Competence of engineers entering the work force in manufacturing companies. The examination investigates how the professional development of civil engineering graduates impacts their preparedness for real-world engineering practice, potentially shaping developments in the field. The Professional Regulations Commission (PRC) determines which graduates from board courseswill receive licenses based on their performance in board exams.

One way that states regulate professions is by requiring a licensing examination. To ensure that civil engineering faculty members meet the

qualifications and requirements associated with licensure, it is important to assess their licensure status. These requirements emphasize the importance of education and ongoing professional development in the field of engineering, which ultimately improve the quality of education [3]. Professional certifications and licensure are used to evaluate the effectiveness of the curriculum, ensuring that graduates are prepared to meet industry standards for professional practice. These assessments serve as crucial benchmarks, verifying that graduates possess the knowledge and competencies required to excel in their respective fields [4]. Civil engineering is a demanding field that requires students to prioritize their studies and invest significant effort. Students who choose this field must navigate through a challenging journey that includes complex curricula and demanding coursework. These challenges significantly shape their experience and influence their perspectives on academic performance. It is crucial to understand how engineering education can foster the development of engineers who possess not only expertise but also ethical and social consciousness in their professional practice [5]. Choosing a career in engineering poses a formidable task for civil engineering students. Establishing a relationship between education and licensure can benefit not only CvSU students pursuing civil engineering but also individuals or students aspiring to pursue civil engineering at the college level. This canpotentially transform their lives through licensure examinations [6].

Generally, this study aimed to identify the relationship between the first to fourth year per semester grade point average and the licensure examination of the selected participants of Cavite State University from 2013 to 2018. Specifically, this study sought to answer the following:determine the per-semester grade point average of the participants; determine the status of the participants' licensure examination; determine whether the per-semester GPA has a major impact on the civil engineering licensure examination; and determine the best classifier used in data mining.

II. REVIEWOFRELATEDLITERATURE

GPA,or grade point average, is a figure that shows how well or how high you did on average in your classes. Its purpose is to grade you (typically on as cale of1.0to4.0) during your studies and determine whether your overall marks were good or bad. This figure is then used to determine if you meet the degree program or university's criteria and expectations [7].Another challenging engineering degree in civil engineering. A GPA of 2.9–3.0 will be considered satisfactory if you are majoring in civil engineering. A GPA of 3.0 or higher in civilengineering is regarded as excellent [8]. Attaining a satisfactory or excellent GPA in civil engineering is no easy feat, given the rigorous coursework and the multi faceted challenges encountered in this field. Several factors contribute to a student's GPA, including the quality of study habits, time management, the level of engagement in course work, and the ability to grasp and apply complex engineering concepts.
Dedication to academic pursuits and a proactive approach to learning play pivotal roles in achieving a high GPA. The average of all final grades for courses within a program, weighted by the unit value of each of those courses, is the grade point average (GPA). Assessing a student's academic performance involves various methods, including the cumulative grade point average (CGPA) for an overall viewand the grade point average (GPA) for specific courses. Exams assess understanding, whereas continuous assessments encompass tasks like assignments, quizzes, projects, presentations, and active participation in class. Students' academic performance is evaluated based on the quality of their work over the course of their education using the grade point average (GPA). When it comes to admission decisions at educational institutions,GPA often serves as a criterion. This research study extensively explores the reliability and validity of GPA. The findings are then combined with existing research to offer recommendations and examples of how educational researchers can enhance their studies by utilizing GPA [9].

Education in the fields of engineering and science plays a role in the development and technical competitiveness, as stated by leading countries that produce engineering graduates [10]. Engineering is a profession of influence that has shaped and continues to shape our world. Engineers are the visionaries behind infrastructure projects and cutting-edge technological advancements, making them the pillars of our society. However, despite its transformative power, engineering can sometimes be seen as a slow-paced field that values adherence to established norms and standards. Nonetheless, it has paved the way for living by constructingbridges to connect cities and establishing networks that unite people worldwide. The innovations brought about by engineering have revolutionized industries and improved the quality of life. Addressed global challenges. They have enabled us to explore the oceans, aim for the stars, and harness renewable energy sources. Nevertheless, this remarkableimpactcansometimesbeovershadowed by conservatism within the profession. Due to their roles in society, many governments are considering implementing licensing requirements for engineers. An important measure of program quality is its success rate on board examinations; high first-time pass rates indicate excellence [11].

Civil engineering is a branch of engineering that deals with the design, construction, andmaintenance of the physical and naturally created environment, such as roads, bridges, canals, dams, airports, sewage systems, pipelines, building structural components, and railways [12]. Civil engineering is usually divided into several sub- disciplines. It is defined to distinguish non-military engineering from military engineering, and it is regardedasthesecond-oldestengineeringdiscipline after military engineering [13]. Civil engineering can be found in the public sector, ranging from municipal public works departments to federal government agencies, as well as in the private sector,rangingfromsmallbusinessestoFortune 500 corporations. The Civil Engineering Law, which is part of the Professional Regulation Commission's (PRC) mandate too verse the various professions in the country, requires aspiring civil engineers to take a written technical exam to measure their competence and determine whether they are fit for this career or not [14]. Anyone who wishes to practice civil engineering as a profession must pass the Civil Engineering Licensure Exam.

Professional engineer certification is a valuable distinction that can expand your job opportunities. Working as an engineering consultant or senior engineer, testifying as an expert witness, conducting patent work, working in public safety, or advertising engineering services all require a PE license[15].Althoughyoumayneverneedtobe registered for "legal" reasons, becoming a PE maybe required for engineering management roles. PEs make much more money than unlicensed engineers on average. Even if your first job doesn't require a PE license, you might need one later on. It pays tobe able to migrate to new employment and compete with others who have a PE license or are on the professional engineering route in today's economy [16].A job needing a PE license is likewise unlikely to be outsourced to another country. One of the challenges that candidates need to overcome during the licensing process is the licensing examination. The board's primary responsibility is to ensure that the exam meets professional and legal standards. Additionally, they aim to safe guard health, safety, and welfare by evaluating candidates' competence [17].When a candidate successfully completes the licensing examination, it in stills confidence in the board to grant the ma license. This assures the public that the license epossesses the qualifications required for practicing when initially licensed.

Zimmerman's theory of self-regulated learning aims to understand the relationship between college students' learning expectations and their learning habits.Thistheory focusesonhowstudentsmanage and control their learning processes, and whether their learning expectations align with their learning behaviors [18]. Inefficient time management, a lack of planning and concentration in their studies, poor reading abilities, ineffective test-taking approaches,andfailuretoalerttheirteachersof

their issues with schoolwork and ask for help were among the highlighted bad study habits. The interviewees also had negative feelings about teachers' classroom demeanour and tactics. Their performance on licensure examinations was also proven to be rather poor. This study found a strong link between study habits, attitudes, and licensure exam performance. Further analysis found that the participants' study habits (work methods and time management) were connected to their licensure exam achievement; however, study attitudes (i.e., attitudes toward teachers and educational acceptance)were not. This means that students with good study habits are more likely to pass the license exam.

Licensing boards are responsible for setting rigorous educational and training requirements for aspiring engineers, which typically include completing accredited engineering programs. The overarching responsibility of professional engineer licensing is to protect the public by setting and enforcing stringent standards for licensure. Bydoing so, they ensure that only qualified and competent engineers are authorized to work on projects that may have a significant impact on public safety. Licensing boards also serve as advocates for the engineering profession, collaborating with government bodies to shape regulations and legislation related to engineering practice. Construction engineers' expertise and experience were historically underrepresented in professional engineering licensing examinations. When the ASCE-CI Construction Engineering Education Committee was formed in 1995, one of its goals was to recognize construction engineering in the professional engineering licensure process.

III. METHODOLOGY

The researcher used a descriptive-correlational research method to determine the link between the First to Fourth Year Per Semester Grade Point Average and the licensure examination of the selected participants of Cavite State University in the 2013–2018 academic year. Two data sources were used in this investigation. Sources of data included the ratings of takers on the Civil Engineering license test through the Professional Regulation Commission (PRC) and school records of instructor performance ratings. As a result, all of the data is necessary and can be used to conduct similar studies for the next generation.

III.I PARTICIPANTSOFTHE STUDY

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III.II DATAGATHERING

After the selection and finalization of the toolsfor data collection, all of the data were prepared by theresearchertoidentify thebestrangeGradePoint Average of the students and the percentage of the Licensure Examination Performance. After preparations, the researcher started to interpret the data. Each sample's first to fourth-year grade point average (GPA), which was determined using eachof their grades per subject, was tallied to their licensure examination performance, which was verified manually on the Professional Regulation Commission (PRC) website.

III.III DATAANALYSIS

The researcher employed the Waikato Environment for Knowledge Analysis (WEKA) asa data mining tool to classify the accuracy of the samples used for the results. The researcher categorized the dataset using all of the classifiers available through the program that produced the top ten percent of correctly classified instances.

IV. RESULTSAND DISCUSSION

This chapter presents the gathered data. The corresponding analysis and interpretation of thedata are included in this part of the study.

TABLE I
TALLYOFTHESAMPLES'LICENSUREEXAMINATIONPERFORMANCETOTHEIR FIRSTSEMESTERGPAONTHEIRFIRSTYEAR

GPARange	Passer	Non-Passer	Total
1.00–1.50	8	0	8
1.51–2.00	61	13	74
2.01–2.50	8	10	18
2.51–3.00	0	0	0
Total	77	23	100

Table 1 shows that the GPA range of 1.00-1.50 has the highest number of licensure examination passers which also has the percentage 100% among the four GPA ranges and the GPA range of 2.00-2.50 has the highest percentage of non-passers which is 55.56%. On the other hand, most of the takers and passers of the examination are on the 1.51-2.00 GPA range. This means that most of the licensed civil engineers from the given sample hada GPA of around 1.51 to 2.00 on first semester of their first year but the1.001.50 GPA has the bestrate of passing.

TABLEIII
TALLYOFTHESAMPLES'LICENSUREEXAMINATIONPERFORMANCETOTHEIR SECONDSEMESTERGPAONTHEIRFIRST YEAR

GPARange	Passer	Non-Passer	Total
1.00–1.50	0	0	0
1.51–2.00	44	4	48
2.01–2.50	33	19	52
2.51–3.00	0	0	0
Total	77	23	100

The table above shows the grade point average of the CE graduates in their second semester of the first year. Out of 100 graduates, 44 of them are in the grade range of 1.50 - 2.00 and 33 of them are in the grade range of 2.01 - 2.50. There are no graduates in the grade range of 1.00 - 1.50 and2.51-3.0.91.67%ofthegraduatesingraderangeof 1.51 -2 .00 passed the board exams and 8.33% of them are non-passers. 63.46% in the grade range of 2.01-2.50 are passers and 36.54% of the are not. This means that the majority of the licensed civil engineers in the sample had a GPA of 2.01-2.50 in Their second semester, although the GPAof1.51-2.00 has the best passing percentage.

TABLEIIIII
TALLYOFTHESAMPLES'LICENSUREEXAMINATIONPERFORMANCETOTHEIR FIRSTSEMESTERGPAONTHEIRSECONDYEAR

GPARange	Passer	Non-Passer	Total
1.00–1.50	7	0	7
1.51–2.00	67	14	81
2.01–2.50	3	9	12
2.51–3.00	0	0	0
Total	77	23	100

The grade point average of CE graduates in their first semester of their second year is shown in the table above. Out of 100 graduates, 7 of thegraduates had a grade point average of 1.00-1.50,67 have a grade point average of 1.50-2.00 and 3 have a grade point average of 2.01-2.50. There are no graduates in the 2.51-3.0 grade range. 100 percent of graduates in the 1.00-1.50 grade range passed the board exams. 82.72% of graduates in the 1.51-2.00 grade range passed the board exams, while 17.28% did not. In the 2.01-2.50 grade range, 25% pass, while 75% fail. This means that the majority of the licensed civil engineers in the sample had a first semester GPA of 1.51-2.00, though the GPA of 1.00-1.50 has the highest passing percentage.

TABLEIVV
TALLYOFTHESAMPLES'LICENSUREEXAMINATIONPERFORMANCETOTHEIR SECONDSEMESTERGPAONTHEIRSECOND YEAR

GPARange	Passer	Non-Passer	Total
1.00–1.50	14	0	14
1.51–2.00	53	17	70
2.01–2.50	9	6	15
2.51–3.00	1	0	1
Total	77	23	100

Table 4 shows that the GPA range of 1.00-1.50has the highest percentage of licensure examination passers (100%) among the four GPA ranges, while the GPA range of 2.00-2.50 has the highest percentageofnon-passers(40%).Ontheotherhand, the majority of exam takers and passers have a GPA of 1.51-2.00. This means that the majority of the licensed civil engineers in the given sample had a GPA of 1.51 to 2.00 in the second semester of their

second year, but the 1.00-1.50 GPA had the highest passing rate.

TABLE V
TALLYOFTHESAMPLES'LICENSUREEXAMINATIONPERFORMANCETOTHEIR FIRSTSEMESTERGPAONTHEIRTHIRDYEAR

GPARange	Passer	Non-Passer	Total
1.00–1.50	0	0	0
1.51–2.00	21	3	24
2.01–2.50	53	16	69
2.51–3.00	3	4	7
Total	77	23	100

Table 5 shows that the GPA range of 1.51-2.00 has the highest percentage of licensure examination passers (87.5%) among the four GPA ranges, while the GPA range of 2.00-2.50 has the highest percentage of non-passers (57.14%). On the other hand, the majority of exam takers and passers haveaGPAof2.00-2.50.Thismeansthatthemajorityof the licensed civil engineers in the given sample had a GPA of 2.00-2.50 in the first semester of their third year, but the 1.51-2.00 GPA had the highest passing rate.

TABLEVI
TALLYOFTHESAMPLES'LICENSUREEXAMINATIONPERFORMANCETOTHEIR SECONDSEMESTERGPAONTHEIRTHIRDYEAR

GPARange	Passer	Non-Passer	Total
1.00–1.50	4	0	4
1.51–2.00	19	2	21
2.01–2.50	54	17	71
2.51–3.00	0	4	4
Total	77	23	100

The grade point average of CE graduates in their second semester of their third year is shown in the table above. Out of 100 graduates, 4 have a grade point average from ranges 1.00-1.50, 19 have a grade point average of 1.50-2.00 and 54 have a grade point average of 2.01-2.50. There are no graduates in the 1 2.51-3.0 grade range. All of the graduates (100%) in the 1.00-1.50 grade range passed the board exams. 90.48 percent of graduates in the 1.51-2.00 grade range passed the board exams, while 9.52 percent did not. In the 2.01-2.50 grade range, 76.06 percent pass, while 23.94percent fail. This means that the majority of the licensed civil engineers in the sample had a second Semester GPA of 2.012.50,though the GPA of 1.00-1.50 has the highest passing percentage.

TABLEVII
TALLYOFTHESAMPLES'LICENSUREEXAMINATIONPERFORMANCETOTHEIR FIRSTSEMESTERGPAONTHEIRFOURTHYEAR

GPARange	Passer	Non-Passer	Total
1.00–1.50	3	0	3
1.51–2.00	31	9	40
2.01–2.50	38	11	49
2.51–3.00	5	3	8
Total	77	23	100

The grade point average of CE graduates in their first semester to fourth year is shown in the table above. Out of 100 graduates, 3 of the graduates had a grade point average of 1.00-1.50, 31 have a grade point average of 1.50-2.00, 38 have a grade point average of 2.01-2.50, and 5 have a grade point average of 2.50-3.00. 100 percent of graduates in the 1.00-1.50 grade range passed the board exams. 77.5% of graduates in the 1.51-2.00 grade range passedtheboardexams,while22.5%didnot.Inthe 2.01-2.50 grade range, 7756% pass, while 22.44% fail. In the 2.50-3.00 grade range, 62.5% passed, while 37.5% fail. This means that the majority of the licensed civil engineers in the sample had a first semester GPA of 2.01-2.50, through the GPA of 1.00-1.50 has the highest passing percentage.

TABLEVIII
TALLYOFTHESAMPLES'LICENSUREEXAMINATIONPERFORMANCETOTHEIR SECONDSEMESTERGPAONTHEIRFOURTHYEAR

GPARange	Passer	Non-Passer	Total
1.00–1.50	2	1	3
1.51–2.00	38	8	46
2.01–2.50	35	10	45
2.51–3.00	3	3	6
Total	77	23	100

Table 8 shows that the GPA range of 1.51-2.00has the highest percentage of licensure examination passers (82.61%) among the four GPA ranges,while the GPA range of 2.51–3.00 has the highest percentageofnon-passers(50%).Ontheotherhand, the majority of exam takers and passers have a GPA of 1.51-2.00. This means that the majority of the licensed civil engineers in the given sample had a GPA of 1.51-2.00 in the second semester of their fourth year and had the highest passing rate.

TABLEIX
CLASSIFIERSUSEDINDATAMININGANDITSPERCENTAGEBASEDONWEKAVER.3.8.5

Classifier	Percentage
MultiClassClassifier	80%
Logistics	80%
RandomForest	80%
HoeffdingTree	79%
RandomCommittee	79%
MultilayerPerception	79%
KStar	78%
OneR	78%
MultiClassClassifier Updateable	78%
SGD	78%

The above table shows the percentage of classifiers used in data mining. The researcherchose the ten classifiers with the highest percentage, according to the Weka app. Three out of ten classifiers assigned an 80 percent rating. The classifier HoeffdingTree, RandomCommittee, and MultilayerPerception received the second highest score of 79%. The KStar, One R, Multi Class Classifier Updateable, and SGD received a score of 78%. As a result, the researchersconclude that the data mining results are of high quality within the supplied sample of GPA of Civil Engineering graduates because nearly all ten classifiers delivered a percentage result rangingfrom 75% to 80%, which was obtained using five cross-validation folds.

IV. CONCLUSIONS

Based on the obtained results of the study, it can be concluded that the First to Fourth Year per Semester Grade Point Average to Licensure Examination Performance of Civil Engineering from year 2013-2018 does have a significant relationship. In conclusion, graduates with a GPA range of 1.00-1.50 during the first to four years of college had the highest passing rate given that they had the fewest takers, while those with a GPArange of 2.50-3.00 had the lowest passing rate. It is proved that the per semester grade point averagehas an effect to the licensure performance of the civil engineering graduates. Two variables are directly proportional. Those graduates that has the highest-grade point average also has the highest passing rates. Some of the margin errors that can be noted here are the possibilities that non-passers did not take the examination at all because it cannot be verified through the website.

The best classifier is identified in using Waikato Environment for Knowledge Analysis (WEKA) asa data mining tool. It is the MultiClassClassifier of meta that has an 80% of correct classified instances and takes 0.01 seconds to build the model.Although the result of classified instances is the same with Logistics and RandomForest, the two takes more time in building the model than the MultiClassClassifier. It is concluded that MultiClassClassifier is the best classifier. As a result, the researchers conclude that the data mining findings are of high quality within the provided sample of GPA of Civil Engineering graduates because virtually all ten classifiers generated a percentage result ranging from 75% to 80%, which was achieved using five cross-validation folds.

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