Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.6, No.30, 2015


# Institutional Case-based Study on the Effect of Research Methods on Project Work in the Curriculum of Mechanical Engineering Programmes in Ghanaian Polytechnics

Emmanuel Baffour-Awuah
Mechanical Engineering Department, Cape Coast Polytechnic, P. O. Box AD 50, Cape Coast, Ghana

**Abstract**
Preparing students for Project Work (PROJ 1 and PROJ 2) require them to go through Research Methods (RE) as part of the curriculum though it takes the centre stage of the entire preparation process. Knowledge of the relationships between the two could be a useful tool in improving the performance of students in the former. The purpose of the case study was therefore to assess the relationship between the two courses of Higher National Diploma (HND) Mechanical Engineering students in Cape Coast Polytechnic, Ghana, within a ten-year period from 2002 to 2011. Raw data of examination results of all 529 students comprising Plant Maintenance Engineering, 285; Automotive Engineering, 165; and Production Engineering 79, on case-by-case basis was analyzed. The study was entirely quantitative employing frequencies, percentages, ratios and tables as descriptive tools for the analysis. The strength, direction and significance (ρ) of Pearson's Product Moment Correlation Coefficient (r) between the courses were determined utilizing SPSS, version 21 software. The ratios, in terms of positive significant correlation coefficients were found to be 11:7:13 for RE/PROJ 1; RE/PROJ 2; and PROJ1/PROJ 2 respectively; and 16:11:4 for Plant Maintenance, Automotive and Production Engineering respectively. Strength ranged between 0.117 and 0.869. The paper suggests that in reviewing the subject-curricula for the two courses, experts with professional background in curriculum design and structuring should be involved. Stakeholders such as the Ministry of Education (MoE), National Accreditation Board (NAB); The National Board for Professional and Technical Examination, (NABPTEX); the Polytechnic(s); and subject teachers should be included in the process.
**Keywords:** annual; biennial; correlation coefficient; relationship: subject-curricula.

## 1.0 Introduction

The subject of research methods as a provider of fundamental and basic knowledge to successfully going through students' project work, dissertation, thesis or research has normally been drawn with modules of disintegrated nature (Leston-Bandeira, 2013). This brings about various forms of anxiety in research methods courses (Papanastasiou & Zembylas, 2008). Students' anxiety according to Papanastasiou & Zembylas, (2008) may however not reflect in the grades they obtain in the course; but that anxiety levels could increase.

In various institutions in which research methods is taught as a subject, the aim is to introduce students to various concepts of research and how these could be applied in practical research both in school and at workplace. The purpose of the practical school research work has the additional purpose of verifying how students could apply the theoretically taught research methods and if necessary be guided by a supervisor who would assist and polish the skills of the student. It is however expected in all cases that the bulk of the application work is to be accomplished through the students' personal effort.

Project work, thesis and dissertation are usually done at the last year or semester of the academic programme. All courses/subjects in the entire curriculum are therefore expected to be applied by the student in exhibiting what he has been taught. However the embodiment of the entirety of the subjects taught could be ascertained from the project work, thesis or dissertation presentation and report. The integration, assembly, and arrangement of the project work dissertation or thesis therefore becomes eventually and finally evaluated from the point of view of the presentation and report.

The preparation of the student therefore in the research methods subject prior to engaging in the project work, dissertation or their preparation, presentation and reporting is indisputably pertinent in terms of the success of the student in the context of the project work. A link between the grades obtained by students in research methods and project work, dissertation or thesis paper when ascertained could be a basis for critically looking at the subject design and structure of the two courses in particular and the entire curriculum in general.

The importance of research or project work is rooted in the fact that being successful in going through the assessment is one of the fundamental prerequisite for programme graduation. The acknowledgement of this fact is demonstrated in various tertiary institutions including universities and the polytechnics. In Ghanaian polytechnics and particularly in the engineering disciplines, project work of students is very crucial. In the Mechanical engineering disciplines it is so important that performing below expectation could enable students extend the period of completion. It is in this regard that students' performance in Project Work may be inextricably linked to the success of the students' performance in Research Methods as subject curricula.

 

The purpose of this study is to ascertain the relationship between students' performance in research methods as a course and project work also as a course in the programme curriculum of Mechanical Engineering Students in Cape Coast Polytechnic. In pursuing this aim the study attempted to answer the following questions: What is the degree of relationship between Research Methods grades of students and the grades of first semester Project Work (PROJ 1) grades? What is the degree of relationship between Research Methods (RE) grades of students and second semester Project Work (PROJ 2) grades? What is the relationship between first semester Project Work (PROJ 1) grades and second semester Project Work (PROJ 2) grades? Has the year by year relationship between the three relationships been improving within the ten-year period; from 2002 to 2011or otherwise? Do the biennial and five-year relationships also show growth or otherwise? The study further looked at the implications of the findings?

## 2.0 Literature review

This section deals with curriculum as a concept. It also dilates on the subject-curricula of both Research Methods and Project Work.

### *2.1 The concept of curriculum*

Generally, there is no single definition for curriculum that is agreed upon (*Hamilton, 2014;* Wiles, 2008). However, broadly speaking, curriculum may be defined as the total experiences that take place in educational settings (Kelly, 2009; Wiles, 2008). The educational institution for that matter should have set instructional goals that must be met. In achieving these goals therefore instructions should be planned and sequential. Goals need to be interconnected within and across instructional grades to make their achievability articulated in the long run (Reys, Reys, Lapan, Holiday & Wasman, 2003). Hence, in developing curriculum, there is the need to ensure that instructional content, resources, materials and evaluation processes for obtaining educational objectives are included in students' planned interactions (Adams & Adams, 2003).

According to various authors a curriculum encompasses all the planned and guided learning by the institution. It could be individually or collectively pursued within or outside the institution. A curriculum should define and identify what, why, when, where, how and with whom to learn. It must outline the expected values, skills, performances and attitudes, describe materials and planned resources to help achieve institutional goals. Curriculum also include individual courses to be taught; total courses to be taught as requirement for graduation; course content (syllabus), instructional methods employed (strategies); and norms and values in relation to institutional organization. A curriculum should therefore be arranged sequentially and be organized across various grades in the instructional process (*Hamilton, 2014;* Kelly, 2009; Braslavsky, 2003; Smith, 1996; 2000).

A curriculum could be partly or entirely determined by an external body (such as the National Accreditation Board) or internally. An individual may refer to his curriculum to mean all the subjects that he will teach during a school year. According to Kelly (2009), at the classroom level, what is actually delivered comprise the curriculum as against the intended/written curriculum. Prescriptively a curriculum merely specifies what topics must be understood and to what level to achieve a particular grade or standard (Kelly, 2009).

As a procedure, curriculum involves diagnosis of needs; formulation of objectives; selection of content and organization of content. Others are the selection of learning experiences, organization of learning experiences and determination of what to evaluate and how evaluation is done (Smith, 1996; 2000). The learned or achieved curriculum is usually documented or written as against the unwritten or hidden curriculum (Kelly, 2009). It is defined in the context of schooling and the attainment of broader educational goals (*Hamilton, 2014;* Smith, 1996; 2000). In this paper the word curriculum is used taking cognizance of these general definitions but with contextual reference to Research Methods and Project Work subject-curricula within the framework of Mechanical Engineering Programme curriculum in Cape Coast Polytechnic.

### *2.2 Research Methods and Project Work curricula*

It is true to admit that research holds the torch of knowledge (Warner, 1896). For this reason final year Project Work of students in Cape Coast Polytechnic in general and the Mechanical Engineering in particular is research based. The Project Work is intended to ascertain the ability of the student to carry out research on his/her own through the application of what has been taught in the curriculum with little or no contribution (if possible) by the project supervisor who is to guide the student (Gauch, 2003)

The Project Work of students aims at increasing and improving the knowledge stock of the student. This could be knowledge in terms of society, culture and man and the application of this knowledge in developing non-existing products, processes and activities to create new beginnings and applicable ends (OECD, 2002). The student is expected to be creative using systematic and orderly means to establish facts and figures, re affirm results of work previously done, solve existing or new challenges or issues, support existing theorems or develop inexistent theories. In going through the project work the student may deal with testing the validity of experiments, research procedures work or replication of research elements previously done or an entire project.

According to Shuttleworth (2008), students' research could be basic or applied, with the distinguishing difference created in terms of documentation, discovery and interpretation; generally students' research work is required to be scientific. That is, the process of data information and facts gathering should be systematic while expositing the curiosity of the student at the same time. The Project Work therefore aims at using this process to advance the knowledge of the student and the general community.

Creswell (2008) also defines research as the process of presenting an answer to a question by posing the question and collecting data to answer the question. In so doing steps are taking to collect and analyze the data or information obtained so that the challenging issue at stake could be understood.

An elaborate definition by Merriam-Webster Online Dictionary states research as "a studious inquiry or examination, especially, investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts; or practical application of such new or revised theories or laws" (Adams & Adams, 2003). In conducting research some major ever- changing iterative steps are taken to arrive at a final stage (Shields & Rangarjan, 2013; Cresswell, 2008; Gauch, 2003).

The steps include:

- Identification of research problem
- Literature review
- Specifying specific research questions
- Determining specific research questions
- Specification of a conceptual framework (set of hypothesis)
- Choice of methodology (for data collection)
- Analyzing and interpreting the data
- Reporting and evaluating research
- Communicating the research findings and, possibly, recommendations

Though scientific research is supposed to be systematic and orderly, there may be variations in step order depending on the type of research or subject. Whether student research is basic or applied the order of steps may be as follows:

- Observations and formulation of topic
- Hypothesis or research questions
- Conceptual definitions
- Operational definitions
- Gathering of data
- Analyzing of data
- Data Interpretation
- Test, revising of hypothesis
- Conclusion and recommendations

The curriculum of Research Methods in the Mechanical Engineering Department is intended to give the requisite knowledge in going through these steps or processes when carrying out the project work. The course is taught in the preceding semester to the semester that Project Work commences though it is formally supposed to be taught simultaneously in the first semester (final year) that Project Work is supposed to begin (by the curriculum designers).

The general objectives as enshrined in the Research Methods curriculum is for students to understand and explain the research process, understand and write a research proposal, understand and undertake a research design, understand and collect data, understand and use data analysis techniques and understand writing-up a research report.

The performance objectives however are manifold. In terms of the research process the student should be able to explain research and discuss the purpose of research. The others are to discuss the place of theory in research, explain the importance of research and finally discuss and explain the research process.

That of the research proposal was however brief. In this regard the student was only to identify and outline research proposal and its parts. The syllabus was silent on these parts as required in research proposals. The conceptualization of research proposals and its importance to project work is also missing in content.

As far as the performance objectives of research design are concerned mention is made of classification of research as either quantitative or qualitative. Students are required to explain the terms sample and population; distinguish between random and non-random sampling and explain the types of sampling. Students are also expected to distinguish between primary and secondary data and to identify the sources of secondary data. They are further required to understand the terms survey, sample survey and respondents. In addition, they are to understand the basic methods of communicating with respondents.

The content curriculum of Research Methods as part of the curriculum also demands students to distinguish between descriptive and inferential statistics, construct and explain tabular and graphic methods of

 

displaying data. They are also to compute and explain measures of location and variation, calculate and explain the concept of simple correlation coefficient and finally to compute and discuss the least squares methods of analysis.

The final portion of the performance objectives is for students to outline the research report format and its parts. Here again those parts of the report were not indicated.

There are no specific subject-curricula for Project Work in the department though an assessment guide is present. The assessment guide has undergone some revisions though, over the years since the first batch of students graduated in 1996-1997 academic year.

As a department policy, final year students are required to make two oral presentations, one in each semester. The first semester presentation is based on the introduction and literature review of the project report; and sometimes methodology. The second semester presentation on the other hand, involves the entire work. Oral presentations are graded by members of lectureship rank in the department and the average determined.

The student is assessed such that 40% of Project Work grade comes from the average marks of oral presentation. The remaining 60% is scored solely by the student Project Work supervisor. Within the 40% for the presentation 5% is for appearance; 10% for clarity of definition of Aims and objectives of the project; 25% for clarity of introduction of report; 20% for the relevance of literature review to the topic, 20% for general expression/presentation, and 10% for project diary as evidence of meeting supervisor and 10% for Activity Plan. The presentation exercise is usually referred to as the project work defense.

## 3.0 Research methodology

The study in basically looks at the trend of the relationship between Research Methods as a course and Project Work of final year students on the assumption that grades obtained by students for Project Work is solely influenced by the Research Methods course taught. It is cased-based on students of Mechanical Engineering Department of Cape Coast Polytechnic. The three cases considered were related to final year students who pursed Plant Maintenance Engineering, Automotive Engineering and Production Engineering from 2002 to 2011. The total number of students studied was 529, comprising Plant Maintenance Engineering, 285; Automotive Engineering, 165 and Production Engineering 79 (refer table 1). Raw data was obtained from the department of Mechanical Engineering of the institution.

Table 1: Number of students in each class (n) from 2002 to 2011.

| | PROGRAMME | | | |
|---|---|---|---|---|
| Year | Plant Maintenance Engineering | Automotive Engineering | Production Engineering | Total |
| 2002 | 21 | 14 | 5 | 40 |
| 2003 | 22 | 15 | 7 | 44 |
| 2004 | 19 | 13 | 3 | 35 |
| 2005 | 31 | 10 | 7 | 48 |
| 2006 | 34 | 15 | 7 | 56 |
| 2007 | 29 | 17 | 7 | 53 |
| 2008 | 25 | 19 | 8 | 52 |
| 2009 | 34 | 20 | 12 | 66 |
| 2010 | 44 | 17 | 12 | 73 |
| 2011 | 36 | 25 | 11 | 62 |
| Total | 285 | 165 | 79 | 529 |

(Source: Study data, 2015)

The study was purely quantitative. Descriptive tools such as frequencies, percentages and tables were used. Pearson's Product Moment Correlation Coefficient (r) was employed using Statistical Package for the Social Sciences (SPSS), version 21 software. Annual correlation coefficients for the ten-year period were analyzed on case-by-case basis. Biennial and five-year correlation coefficients were also analyzed. The purpose was to ascertain firstly the growth or otherwise of the correlation between the two courses. With the period one-year, two-year, and five-year analysis, the growth or otherwise can be used to predict future relationships. This could serve as a basis to restructure or improve the subject-curricula of the two courses. Secondly the general direction of the relationship between the two courses was also identified for the three situations not disregarding the three departmental cases under consideration. The analyses considered the relationships between Research Methods (RE) and (PROJ 1); and Research Methods (RE) and (PROJ 2). The partial correlations of RE and PROJ 2 with respect to PROJ 1 were also determined on one-year, two-year and five-year basis. Number of students for each class (n) is referred to in Table 1.

## 4.0 Results and discussion

This section presents the results of the study. It also discusses the results, both data and analysis on case-by-case basis for Plant Maintenance Engineering, Automotive Engineering and Production Engineering.

### *4.1 Plant Maintenance Engineering*

The annual correlation analysis between 2002 and 2011 for RE and PROJ 1 yielded seven significant values for the years 2002, 2004, 2005, 2006, 2007, 2008, 2009 (Table 2). Correlation coefficients ranged between 0.261 and 0.693 with significant values (ρ) 0.005 and 0.002 respectively. Thus the correlations between RE and PROJ 1 for the years indicated were between small and large. All coefficients were positive implying that as grades in RE increases, grades in PROJ 1 also increases, between 2002 and 2009. However correlation does not necessary improve with time as shown in Table 2.

This trend is reflected in the biennial correlation coefficients from 2002 to 2011(refer Table 3). For the five biennial results, correlation coefficients were between 0.235 and 0.381 with respective significant values 0.005 and 0.006 for the years 2006/2007 and 2004/2005. The relationship between RE and PROJ 1 were therefore between small and medium for the biennial cases.

The five-yearly analysis from 2002 to 2011 however showed improvement (refer Table 3). The coefficient increased from 0.273 to 0.306 for the periods 2002-2006 and 2007-2011, with ρ being 0.002 and 0.005 respectively. This implies that the correlation between RE and PROJ 1 increased from small to medium within the 10-year period in that regard on five-year basis.

Analyzing the correlation between RE and PROJ 2 the significant correlation coefficients were for 2002, 2008 and 2010. The minimum and maximum values were 0.186 for 2002 and 0.449 for 2008 with ρ values at 0.03 and 0.022 respectively (Table 2). This result reflected in the biennial cases (Table 3). The correlation coefficients were significant for 2002/2003, 2008/2009 and 20010/2011 with the minimum being -0.381 and the maximum 0.660 at respective ρ values of 0.012 and 0.005. This is gratifying showing improvement between the periods. The improvement is supported by the five-year analysis. The correlation coefficient between RE and PROJ 2 improved from insignificant to ρ value of 0.000, the correlation being medium at 0.306 (refer Table 3).

The relationship between PROJ 1 and PROJ 2 gave six significant values (Table 2) for 2002, 2003, 2005, 2007, 2009 and 2010. The correlation coefficients ranged between 0.357 (ρ = 0,038) and 0.748 (ρ = 0.0005) for the years 2009 and 2002 respectively. For the biennial cases, correlation coefficients were significant for 2004/2005, 2006/2007 and 2010/2011 with the minimum being 0.297 (ρ =0.018) for 2006/2007 and maximum 0.660 (ρ =0.005) for 2010/2011 showing improvement between 2006 and 2011 period (Table 3). However improvement from 2002 to 2011 was generally erratic. Nevertheless the five-year results showed general improvement between the periods. Correlation coefficient increased from 0.358 (ρ = 0.005) for 2002-2006 to 0.49 (ρ =0.005) for 2007-2011 (Table 3) though both relationship were medium in strength.

 

Table 2: Strength and direction (r) and significance (ρ) of relationship between Research Methods and Project Work on annual basis for Plant Maintenance Engineering students

| | PLANT MAINTENANCE ENGINEERING | | |
|---|---|---|---|
| | | Correlation coefficient (r) | Significance (ρ) |
| 2002 | RE/PROJ 1 | 0.693 | 0.002 |
| | RE/PROJ 2 | 0.186 | 0.030 |
| | PROJ/PROJ 2 | 0.748 | 0.000 |
| | RE/PROJ 2/ P | 0.337 | 0.029 |
| 2003 | RE/PROJ 1 | -0.178 | 0.429 |
| | RE/PROJ 2 | -0.195 | 0.384 |
| | PROJ/PROJ 2 | 0.563 | 0.006 |
| | RE/PROJ 2/ P | 0.117 | 0.013 |
| 2004 | RE/PROJ 1 | 0.487 | 0.034 |
| | RE/PROJ 2 | 0.262 | 0.279 |
| | PROJ/PROJ 2 | 0.399 | 0.091 |
| | RE/PROJ 2/ P | 0.084 | 0.740 |
| 2005 | RE/PROJ 1 | 0.409 | 0.022 |
| | RE/PROJ 2 | 0.195 | 0.293 |
| | PROJ/PROJ 2 | 0.345 | 0.047 |
| | RE/PROJ 2/ P | 0.063 | 0.743 |
| 2006 | RE/PROJ 1 | 0.304 | 0.040 |
| | RE/PROJ 2 | -0.069 | 0.698 |
| | PROJ/PROJ 2 | 0.272 | 0.120 |
| | RE/PROJ 2/ P | 0.166 | 0.357 |
| 2007 | RE/PROJ 1 | 0.348 | 0.000 |
| | RE/PROJ 2 | 0.067 | 0.731 |
| | PROJ/PROJ 2 | 0.414 | 0.025 |
| | RE/PROJ 2/ P | -0.091 | 0.646 |
| 2008 | RE/PROJ 1 | 0.542 | 0.005 |
| | RE/PROJ 2 | 0.449 | 0.025 |
| | PROJ/PROJ 2 | 0.370 | 0.069 |
| | RE/PROJ 2/ P | 0.318 | 0.130 |
| 2009 | RE/PROJ 1 | 0.106 | 0.557 |
| | RE/PROJ 2 | 0.184 | 0.297 |
| | PROJ/PROJ 2 | 0.357 | 0.038 |
| | RE/PROJ 2/ P | 0.106 | 0.557 |
| 2010 | RE/PROJ 1 | 0.261 | 0.000 |
| | RE/PROJ 2 | 0.255 | 0.045 |
| | PROJ/PROJ 2 | 0.732 | 0.000 |
| | RE/PROJ 2/ P | 0.097 | 0.538 |
| 2011 | RE/PROJ 1 | -0.035 | 0.865 |
| | RE/PROJ 2 | 0.294 | 0.145 |
| | PROJ/PROJ 2 | 0.222 | 0.276 |
| | RE/PROJ 2/ P | 0.310 | 0.132 |

Legend: RE = Research Methods; PROJ 1 = 1st semester Project Work; PROJ 2 = 2nd semester Project Work; P = Partial Correlation. (Source: Study data, 2015)

 

Table 3: Strength and direction (r) and significance (ρ) of relationship between Research Methods and Project Work on biennial and five-year basis for Plant Maintenance Engineering students

| PLANT MAINTENANCE ENGINEERING | | | |
|---|---|---|---|
| | | Correlation coefficient (r) | Significance (ρ) |
| 2002-2003 | RE/PROJ 1 | -0.045 | 0.776 |
| | RE/PROJ 2 | -0.381 | 0.012 |
| | PROJ/PROJ 2 | 0.263 | 0.089 |
| | RE/PROJ 2/ P | -0.383 | 0.012 |
| 2004-2005 | RE/PROJ 1 | 0.381 | 0.006 |
| | RE/PROJ 2 | 0.240 | 0.093 |
| | PROJ/PROJ 2 | 0.476 | 0.000 |
| | RE/PROJ 2/ P | 0.072 | 0.622 |
| 2006-2007 | RE/PROJ 1 | 0.235 | 0.000 |
| | RE/PROJ 2 | -0.033 | 0.797 |
| | PROJ/PROJ 2 | 0.297 | 0.018 |
| | RE/PROJ 2/ P | -0.111 | 0.391 |
| 2008-2009 | RE/PROJ 1 | 0.379 | 0.003 |
| | RE/PROJ 2 | 0.301 | 0.020 |
| | PROJ/PROJ 2 | 0.383 | 0.003 |
| | RE/PROJ 2/ P | 0.183 | 0.170 |
| 2010-2011 | RE/PROJ 1 | 0.209 | 0.083 |
| | RE/PROJ 2 | 0.660 | 0.000 |
| | PROJ/PROJ 2 | 0.660 | 0.000 |
| | RE/PROJ 2/ P | 0.180 | 0.139 |
| 2002-2006 | RE/PROJ 1 | 0.273 | 0.002 |
| | RE/PROJ 2 | 0.000 | 0.999 |
| | PROJ/PROJ 2 | 0.358 | 0.000 |
| | RE/PROJ 2/ P | -0.109 | 0.224 |
| 2007-2011 | RE/PROJ 1 | 0.306 | 0.000 |
| | RE/PROJ 2 | 0.256 | 0.001 |
| | PROJ/PROJ 2 | 0.490 | 0.000 |
| | RE/PROJ 2/ P | 0.128 | 0.110 |

Legend: RE = Research Methods; PROJ 1 = 1st semester Project Work; PROJ 2 = 2nd semester Project Work; P = Partial Correlation. (Source: Study data, 2015)

Tables 2 and 3 show that the partial correlations between RE and PROJ 2 were insignificant. Thus the effect of controlling PROJ 1 to see the impact it has on the relationship between RE and PROJ 2 could not be determined. However a significant relationship was obtained for the 2002/2003 though the relationship was negative (r = -0.383, ρ = 0.012); the effort being slight and deteriorating suggesting that the relationship between RE and PROJ 2 is not due singularly to the influence of PROJ 1.

*4.2 Automotive Engineering*

The relationship between RE and PROJ 1 were significant for 2002, 2007 and 2008 for the annual cases (refer Table 4). The minimum and maximum correlation coefficient were -0.704 and 0.561 at ρ =0.005 and ρ =0.011 for the years 2008 and 2002 respectively. Thus for the year 2002, PROJ 1 grades increased with increase of the grades of RE. However for 2008 PROJ 1 grades decreased with increase in RE grades.

 

Table 4: Strength and direction (r) and significance (ρ) of relationship between Research Methods and Project Work on annual basis for Automotive Engineering students

| | AUTOMOTIVE ENGINEERING | | |
|---|---|---|---|
| | | Correlation coefficient (r) | Significance (ρ) |
| 2002 | RE/PROJ 1 | -0.704 | 0.005 |
| | RE/PROJ 2 | -0.545 | 0.044 |
| | PROJ/PROJ 2 | 0.811 | 0.000 |
| | RE/PROJ 2/ P | -0.535 | 0.060 |
| 2003 | RE/PROJ 1 | 0.238 | 0.394 |
| | RE/PROJ 2 | 0.336 | 0.220 |
| | PROJ/PROJ 2 | 0.829 | 0.000 |
| | RE/PROJ 2/ P | 0.256 | 0.376 |
| 2004 | RE/PROJ 1 | 0.273 | 0.366 |
| | RE/PROJ 2 | 0.569 | 0.042 |
| | PROJ/PROJ 2 | 0.590 | 0.034 |
| | RE/PROJ 2/ P | 0.526 | 0.079 |
| 2005 | RE/PROJ 1 | 0.278 | 0.436 |
| | RE/PROJ 2 | 0.862 | 0.001 |
| | PROJ/PROJ 2 | 0.500 | 0.141 |
| | RE/PROJ 2/ P | 0.869 | 0.002 |
| 2006 | RE/PROJ 1 | 0.392 | 0.148 |
| | RE/PROJ 2 | -0.086 | 0. 771 |
| | PROJ/PROJ 2 | 0.325 | 0.238 |
| | RE/PROJ 2/ P | -0.086 | 0.771 |
| 2007 | RE/PROJ 1 | 0.459 | 0.044 |
| | RE/PROJ 2 | 0.413 | 0.099 |
| | PROJ/PROJ 2 | 0.044 | 0.872 |
| | RE/PROJ 2/ P | 0. | 0. |
| 2008 | RE/PROJ 1 | 0.581 | 0.011 |
| | RE/PROJ 2 | 0.399 | 0.091 |
| | PROJ/PROJ 2 | 0.616 | 0.007 |
| | RE/PROJ 2/ P | 0.064 | 0.806 |
| 2009 | RE/PROJ 1 | -0.103 | 0.666 |
| | RE/PROJ 2 | 0.528 | 0.017 |
| | PROJ/PROJ 2 | 0.429 | 0.049 |
| | RE/PROJ 2/ P | 0.637 | 0.003 |
| 2010 | RE/PROJ 1 | -0.297 | 0.248 |
| | RE/PROJ 2 | 0.142 | 0.586 |
| | PROJ/PROJ 2 | 0.369 | 0.145 |
| | RE/PROJ 2/ P | 0.283 | 0.288 |
| 2011 | RE/PROJ 1 | 0.264 | 0.203 |
| | RE/PROJ 2 | 0.014 | 0.947 |
| | PROJ/PROJ 2 | 0.409 | 0.042 |
| | RE/PROJ 2/ P | -0.106 | 0.621 |

Legend: RE = Research Methods; PROJ 1 = 1st semester Project Work; PROJ 2 = 2nd semester Project Work; P = Partial Correlation. (Source: Study data, 2015)

In the biennial situation the relationship between RE and PROJ 1 was significant only for 2004/2005 with the relationship being positive (r=0.403; ρ =0.046); the rest were insignificant. However the five-year results were both significant. Nevertheless there was decrease in the correlation coefficients, r reducing from 0.208 to 0.190 at ρ =0.041 and ρ =0.044 respectively. Thus generally the influence of RE on PROJ 1 decreased over the years under review (refer Table 5).

 

Table 5: Strength and direction (r) and significance (ρ) of relationship between Research Methods and Project Work on biennial and five-year basis for Automotive Engineering students

| AUTOMOTIVE ENGINEERING | | | |
|---|---|---|---|
| | | Correlation coefficient (r) | Significance (ρ) |
| 2002-2003 | RE/PROJ 1 | -0.145 | 0.452 |
| | RE/PROJ 2 | -0.095 | 0.623 |
| | PROJ/PROJ 2 | 0.791 | 0.000 |
| | RE/PROJ 2/ P | 0.032 | 0.870 |
| 2004-2005 | RE/PROJ 1 | 0.403 | 0.046 |
| | RE/PROJ 2 | 0.698 | 0.000 |
| | PROJ/PROJ 2 | 0.678 | 0.000 |
| | RE/PROJ 2/ P | 0.630 | 0.002 |
| 2006-2007 | RE/PROJ 1 | 0.259 | 0.160 |
| | RE/PROJ 2 | 0.173 | 0.343 |
| | PROJ/PROJ 2 | -0164 | 0379 |
| | RE/PROJ 2/ P | 0.228 | 0.229 |
| 2008-2009 | RE/PROJ 1 | 0.195 | 0.241 |
| | RE/PROJ 2 | 0.547 | 0.000 |
| | PROJ/PROJ 2 | 0.546 | 0.000 |
| | RE/PROJ 2/ P | 0.536 | 0.001 |
| 2010-2011 | RE/PROJ 1 | 0.173 | 0.274 |
| | RE/PROJ 2 | 0.132 | 0.404 |
| | PROJ/PROJ 2 | 0.485 | 0.001 |
| | RE/PROJ 2/ P | 0.056 | 0.728 |
| 2002-2006 | RE/PROJ 1 | 0.208 | 0.041 |
| | RE/PROJ 2 | 0281 | 0.021 |
| | PROJ/PROJ 2 | 0.616 | 0.000 |
| | RE/PROJ 2/ P | 0.199 | 0.109 |
| 2007-2011 | RE/PROJ 1 | 0.190 | 0.044 |
| | RE/PROJ 2 | 0.319 | 0.001 |
| | PROJ/PROJ 2 | 0.415 | 0.000 |
| | RE/PROJ 2/ P | 0.268 | 0.009 |

Legend: RE = Research Methods; PROJ 1 = 1st semester Project Work; PROJ 2 = 2nd semester Project Work; P = Partial Correlation. (Source: Study data, 2015)

Significant values of r were recorded for 2002 (r= -0.545; ρ =0.044); 2004 (r=0.509; ρ =0.042) and 2009 (0.528; ρ =0.017) when the relationship between RE and PROJ 2 was considered on annual basis (refer Table 4). The biennial results however showed significant results for 2004/2005 (r= 0.698; ρ = 0.005) and 2008/2009 (r = 0.546; ρ = 0.005) only. In spite of this the five – year results both showed significant values for 2002-2006(r = 0.28; ρ = 0.021) and 2007-2011 (r = 0.319; ρ = 0.001). The effect of RE on PROJ 2 therefore increases, generally, from 2002 to 2011 on five-year basis (refer Table 5).

Considering the annual results, it was observed that the correlation coefficient between PROJ 1and PROJ 2 were significant for 2002 (r = 0.81; ρ = 0.005); 2004 (r = 0.590; ρ = 0.034); 2008 (r = 0.616; ρ = 0.007); 2009 (r = 0.429; ρ = 0.048) and 2011 (r = 0.409; ρ = 0.042) (refer Table 4). This is reflected in the biennial results in table 5. Correlation coefficients were r = 0.791; ρ = 0.005 for 2002/2003; r= 0.678, ρ = 0.005 for 2004/2005; r =0.546, ρ = 0.005 for 2008/2009; and r = 0.485, ρ = 0.001 for 2010/2011. This culminated in the five-year cases where r= 0.616, ρ =0.005 for 2002/2006 and r =415, ρ =0.005 for 2007-2011. Thus the relationship between PROJ 1 and PROJ 2 decreased within the five-year periods (Table 5) though positive.

The mere influence of PROJ 1 on PROJ 2 was analyzed using partial correlation. The study revealed that for the years 2005 (r= 0.869; ρ =0.002); and 2009 (r = 0.637; ρ = 0.003) the effect were significant (Table 4). Thus the study suggests that the observed relationship between PROJ 1 and PROJ 2 is not due merely to the influence of PROJ 1 for the two years. Table 5 shows the biannual results that for the years 2004/2005 and 2008/2009, values obtained were r= 0.63; ρ =0.002; and 0.536; ρ =0.001: respectively; both being strong and positive and significant. However the five year results yielded significant value only for 2007/2011(r=0.268; ρ = 0.009); correlation being small but positive (Table 5) and significant.

*4.3 Production Engineering*

Except 2002 (r = 0.530; P = 0.016) none of the annual relationship was significant (Table 6) in the case of Production Engineering. Thus there is a strong positive relationship between RE and PROJ 2 for 2002. The

 

2002/2003 biennial relationship between RE and PROJ1 (r = 0.433, ρ = 0.014) was also significant (Table 7). The 2002-2006 relationship between RE and PROJ 1 was again significant at r = 0.344 and ρ = 0.017. It could be observed that the strength of the relationship decreased from 0.530 to 0.344. All other relationships were insignificant (Table 7). In addition to this the results for the relationship between RE and PROJ 2 all showed insignificant values for the annual, biennial and five year periods (Table 6 and Table 7)).

However the annual results revealed significant relationship between PROJ 1 and PROJ 2 for 2002 (r = -0.733; ρ = 0.000); and 2003 (r = 0.702; ρ = 0.016) (Table 6). This reflected in the 2002/2003 (r= 0.638; ρ = 0.00) (Table 7). In addition table 7 revealed significant values for 2006/2007 (r = 0.681; ρ = 0.007); 2008/2009 (r = 0.494; ρ = 0.027); 2010/2011(r = 0.517; ρ = 0.007) for the biennial relationships. This is reflected in the five-year relationships for 2002-2006(r = 0.5733; ρ = 0.000) and 2007-2011(r = 0.464; ρ = 0.001), though in decreasing strength but positive (Table 7).

The results of the study further showed that there is insignificant effect of PROJ 1 on PROJ 2. Thus the mere effect of PROJ 1 on PROJ 2 could not be predicted for the period under consideration.

Table 6: Strength and direction (r) and significance (ρ) of relationship between Research Methods and Project Work on annual basis for Production Engineering students

| PRODUCTION ENGINEERING | | | |
|---|---|---|---|
| | | Correlation coefficient (r) | Significance (ρ) |
| 2002 | RE/PROJ 1 | 0.530 | 0.016 |
| | RE/PROJ 2 | 0.271 | 0.249 |
| | PROJ/PROJ 2 | -0.733 | 0.000 |
| | RE/PROJ 2/ P | -0.204 | 0.403 |
| 2003 | RE/PROJ 1 | 0.106 | 0.757 |
| | RE/PROJ 2 | 0.249 | 0.460 |
| | PROJ/PROJ 2 | 0.702 | 0.016 |
| | RE/PROJ 2/ P | 0.247 | 0.492 |
| 2004 | RE/PROJ 1 | 0.721 | 0.488 |
| | RE/PROJ 2 | -0.866 | 0.333 |
| | PROJ/PROJ 2 | -0.277 | 0.821 |
| | RE/PROJ 2/ P | 0.000 | 0.000 |
| 2005 | RE/PROJ 1 | -0.380 | 0.400 |
| | RE/PROJ 2 | -0.510 | 0.243 |
| | PROJ/PROJ 2 | 0.471 | 0.286 |
| | RE/PROJ 2/ P | -0.426 | 0.426 |
| 2006 | RE/PROJ 1 | 0.083 | 0.860 |
| | RE/PROJ 2 | 0.033 | 0.945 |
| | PROJ/PROJ 2 | 0.649 | 0.115 |
| | RE/PROJ 2/ P | 0.028 | 0.958 |
| 2007 | RE/PROJ 1 | -0.056 | 0.906 |
| | RE/PROJ 2 | -0.429 | 0.337 |
| | PROJ/PROJ 2 | -0.055 | 0.906 |
| | RE/PROJ 2/ P | -0.428 | 0.397 |
| 2008 | RE/PROJ 1 | 0.522 | 0.185 |
| | RE/PROJ 2 | 0.485 | 0.224 |
| | PROJ/PROJ 2 | 0.248 | 0.553 |
| | RE/PROJ 2/ P | 0.429 | 0.336 |
| 2009 | RE/PROJ 1 | -0.160 | 0.62 |
| | RE/PROJ 2 | -0.051 | 0.881 |
| | PROJ/PROJ 2 | -0.687 | 0.014 |
| | RE/PROJ 2/ P | -0.051 | 0.881 |
| 2010 | RE/PROJ 1 | -0.126 | 0.697 |
| | RE/PROJ 2 | -0.115 | 0.722 |
| | PROJ/PROJ 2 | 0.459 | 0.133 |
| | RE/PROJ 2/ P | -0.065 | 0.849 |
| 2011 | RE/PROJ 1 | -0.166 | 0.647 |
| | RE/PROJ 2 | -0.293 | 0.411 |
| | PROJ/PROJ 2 | -0.553 | 0.007 |
| | RE/PROJ 2/ P | -0.293 | 0.411 |

Legend: RE = Research Methods; PROJ 1 = 1st semester Project Work; PROJ 2 = 2nd semester Project Work; P = Partial Correlation. (Source: Study data, 2015)

 

Table 7: Strength and direction (r) and significance (ρ) of relationship between Research Methods and Project Work on biennial and five-year basis for Production Engineering students

| | PRODUCTION ENGINEERING | | |
|---|---|---|---|
| | | Correlation coefficient (r) | Significance (ρ) |
| 2002-2003 | RE/PROJ 1 | 0.433 | 0.014 |
| | RE/PROJ 2 | 0.115 | 0.539 |
| | PROJ/PROJ 2 | 0.638 | 0.000 |
| | RE/PROJ 2/ P | -0.235 | 0.211 |
| 2004-2005 | RE/PROJ 1 | 0.436 | 0.208 |
| | RE/PROJ 2 | 0.028 | 0.939 |
| | PROJ/PROJ 2 | 0.528 | 0.117 |
| | RE/PROJ 2/ P | -0.265 | 0.491 |
| 2006-2007 | RE/PROJ 1 | -0.193 | 0.509 |
| | RE/PROJ 2 | -0.297 | 0.303 |
| | PROJ/PROJ 2 | 0.681 | 0.007 |
| | RE/PROJ 2/ P | 0.231 | 0.449 |
| 2008-2009 | RE/PROJ 1 | 0.081 | 0.733 |
| | RE/PROJ 2 | 0.070 | 0.769 |
| | PROJ/PROJ 2 | 0.494 | 0.027 |
| | RE/PROJ 2/ P | 0.034 | 0.889 |
| 2010-2011 | RE/PROJ 1 | -0.246 | 0.269 |
| | RE/PROJ 2 | -0.287 | 0.185 |
| | PROJ/PROJ 2 | 0.547 | 0.007 |
| | RE/PROJ 2/ P | -0.188 | 0.540 |
| 2002-2006 | RE/PROJ 1 | 0.344 | 0.017 |
| | RE/PROJ 2 | -0.012 | 0.936 |
| | PROJ/PROJ 2 | 0.573 | 0.000 |
| | RE/PROJ 2/ P | -0.272 | 0.065 |
| 2007-2011 | RE/PROJ 1 | -0.106 | 0.462 |
| | RE/PROJ 2 | -0.060 | 0.077 |
| | PROJ/PROJ 2 | 0.464 | 0.001 |
| | RE/PROJ 2/ P | -0.012 | 0.933 |

Legend: RE = Research Methods; PROJ 1 = 1st semester Project Work; PROJ 2 = 2nd semester Project Work; P = Partial Correlation (Source: Study data, 2015)

*4.4 General relationships*

As part of the curriculum, Research Methods and Project Work subject-curricula are more closely and inextricably linked than the other subjects. From identification of project topic, coining the project topic, reviewing literature, designing the study defining sampling, collecting data, discussing the results, referencing, are all taught in Research Methods. Writing the report of the research is also taught in Research Methods. Thus presenting the report of good research largely depends on knowledge in Research Methods. The result obtained in this study however showed that the relationship between Research Methods (RE) and 1st semester Project Work (PROJ 1) is meager. For example, the maximum relationship was obtained for Plant Maintenance Engineering where 70 percent of the results were significant. Automotive Engineering and Production Engineering were 30 percent and 10 percent respectively though positive. The proportion of significant relationships between Research Methods (RE) and 2st semester Project Work (PROJ 2) for Plant Maintenance, Automotive and Production Engineering were 30 percent; 30 percent and 10 percent respectively; and positive. In the case of the relationship between 1st semester Project Work (PROJ 1) and 2nd semester Project Work (PROJ 2) the significant values obtained were 60 percent, 50 percent and 30 percent respectively for

Plant Maintenance, Automotive and Production Engineering; and positive. The average ratio, in terms of significant correlation coefficients, is therefore given by 11:7:13 (for RE/PROJ 1: RE/PROJ 2: and PROJ1/PROJ 2) (refer Table 8). Thus the proportion of significant correlation coefficients between 1st semester Project Work (PROJ 1) and 2nd semester Project Work (PROJ 2) for the 10-year period was the highest (43.3 percent); the lowest being between Research Methods (RE) and 2nd semester Project Work (PROJ 2) (23.3 percent). The average ratio for Plant Maintenance (53.3 percent), Automotive (36.7 percent) and Production (13.3 percent) Engineering was 16:11:4.

Table 8: Proportions of significant positive correlation coefficients (r) for the ten-year period (2002-2011)

| | RE/PROJ 1(%) | RE/PROJ 2 (%) | PROJ 1/PROJ 2 %) | Total (%) |
|---|---|---|---|---|
| Plant Maintenance Engineering | 70 | 30 | 60 | 160 |
| Automotive Engineering | 30 | 30 | 50 | 110 |
| Production Engineering | 10 | 10 | 20 | 40 |
| Total | 110 | 70 | 130 | 310 |

(Source: Study data, 2015)

A critical look at the Research Methods syllabus should be made in order to increase the positive effect it has on project work. Though the syllabus outlines the total experience that should be imported to the students its relationship with institutional goals appears to be missing in the syllabus (Kelly, 2009; Wiles, 2008). This is important because the interconnection between the two could have influence on long term achievement in the results obtained for the Project Work (Reys, et al, 2003) With clearly outlined goals, defining and identifying resources and materials, and evaluating processes for obtaining educational objectives including objectives for Project Work, planning for student's interaction with both students and the teacher becomes easier (Adams & Adams, 2003). When individual subjects are considered as subject-curricula, why, when, how and whom to learn with must be included. For example though the planners and designers of the curriculum expect Research Methods to be taught simultaneously with during the 1st semester of year 3, the implementers do so in 2nd semester, year 2. In addition to this the "why" "who" and whom to learn" aspects of the syllabus appear to be missing (Kelly, 2009; Braslavsky, 2003; Dewey, 1902). There is the need therefore to review the Research Methods syllabus to reflect the modern requirements of a curriculum as discussed above. The mode of assessment of the Project Work must also be critically looked at.

From the study it appears there is some disintegration between the Research Methods and Project Work (PROJ 1) since only 36.6 percent of students' results had some positive and significant relationship. In the case of Research Methods and Project Work (PROJ 2) only 23.3 percent relationships were significant and positive. This corroborates with the findings of (Leston-Bandeira, 2013) that research methods as an enabler in the provision of fundamental knowledge to successful project work is non-integrative in nature. Findings of Papanastosiou & Zembylas (2008) indicate that this may bring about anxiety among majority of students in Research Methods classes. The consequence, luckily, may not reflect in the grades they obtain in the Project Work though levels of anxiety could increase.

The issue of subject integration of the two courses and the mode of assessment of Project Work therefore need to be critically looked at. The mode of assessment include who should assess, how to assess and when to assess. In reviewing the syllabi for the two courses, people with professional background in curriculum design and structuring should be involved. The Ministry of Education (MoE), National Accreditation Board (NAB); The National Board for Professional and Technical Examination, (NABPTEX); the Polytechnics; and subject teachers should come together as a matter of urgency to consider restructuring the syllabi as part of programme curriculum review in the Polytechnics in Ghana.

## 5.0 Conclusion

The aim of the study was to assess the relationship between Research Methods and Project Work carried by final year Higher National Diploma Mechanical Engineering students in Cape Coast Polytechnic. The study showed that 36.6 percent and 23.3 percent of students' results had some positive significant relationships between Research Methods and Project Work for 1st and 2nd semester respectively. The study further showed that 53.3 percent of the relationships between 1st and 2nd semester Project Work results were significant and positive. The study recommends that both Government authorities such as the Ministry of Education (Tertiary) and Polytechnic authorities should come together to review the two syllabi. Involving professional curriculum designers with both Education (as a subject) and Mechanical Engineering background could go a long way to achieve the desired result.

## References

Adams, K. L. and Adams, D. E. (2003). *Urban education: A reference handbook*. Pp 31-32. ISBN 9781576073629.

Braslavsky, C. (2003). *The curriculum*. Geneva, IBE-UNESCO. www.ibe.unesco.org/AIDS/doc/cecilia%20e.pdf. 30/09/15.

Cresswell, J. W. (2008). *Educational research: Planning, conducting and evaluating qualitative and qualitative research* (3rd ed.) Upper Saddle River: Pearson.

Gauch, Jr., H.G. (2003) *Scientific Methods in Practice*. Cambridge, U.K: Cambridge University Press. P 3.

*Hamilton, D. (2014). Towards a theory of schooling. Routeledge Revivals. Pp. 7, 47, 55. ISBN 9780415857086.*

Kelly, A. V. (2009). *The curriculum: Theory and practice.* Newsbury Park, CA: Sage. Pp 1-55.

Leston-Bandeira, C. (2013). *Ten tips to develop engaging undergraduate research methods teaching.*

 

http://www.sa.ac.uk/political-insight/blog/ten-tips-develop-engaging-andergraduate-research-methods-teaching. 14/04/15.

OECD (2002). *Frascati manual: Proposed standard practice for surveys on research and experimental development*, 6th Ed. www.oecd.org/sti/frascatimanual. 27/05/15.

Papanastasiou, E. C. and Zembylas, M. (2008). Anxiety in undergraduate research methods courses: Its nature and implication. *International Jomnal of Research and methods in Education.* Vol. 31, Issue 2. Pp 156-167. DOI: 10-1080/17437270802124616.

Reys, R., Reys, B., Lapan, R., Holiday, G. and Wasman, D. (2003). Assessing the impact of standards-based middle grades mathematics curriculum material on student achievement. *Journal for Research in Mathematics Education*: Pp 74-95.

Shields, P. and Rangarjan, N. (2013). *A playbook for research methods: Integrating conceptual frameworks and project management*. Stillwater, OK: New Forums Press.

Shuttleworth, M. (2008). *Definition of research*. Explorable. explorable.com. 14/04/15.

Smith, M. K. (1996; 2000). Curriculum theory and practice. *The Encyclopedia of Informal Education. www.infed.org/bible/b-curric.html.* 14/04/15.

Unattributed. "Research in Dictionary "tab" Merriam Webster" (m-w.com) *Encyclopedia Britannica*. 14/04/15.

Warner, O. L. (1896). *Research holding the torch of knowledge.* Library of Congress, Thomas Jefferson Building, Washington D.C. United States of America.

Wiles, J. W. (2008). *Leading curriculum development.* Thousand Oaks, California, Corwin Press. P 2. ISBN 9781412961417.