

Impact of Rubrics, Addie and Gagne Model on the Performance of Students in Programming Subject

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Abstract: Student's satisfaction is the core of teaching and it is continuous learning process. In order to achieve this author have experimented with rubrics, ADDIE and Gagne model to deliver the topic thread in java subject. Detail rubrics with four criteria and four levels have been designed and performance has been evaluated after delivery of specific topic by using one of the educational models. Paired student's t-test has been used to evaluate the before the after impact and statistical significance. Results have been retrieved at 99%, 95% and 90% confidence interval. Criteria 1 and Criteria 2 has not retrieved significant results at $\alpha=0.01$ and hence failed to reject the null hypothesis in Gagne and Rubrics model respectively. The entire set hypothesis has rejected the null hypothesis at $\alpha=0.05$ and $\alpha=0.10$. The survey has been conducted for ADDIE and Gagne group at the end of this experimentation. This study has proven that to deliver programming subject steps of ADDIE model is more appropriate.

Keywords: Addie, Gagne, Rubrics, Statistical test

I. INTRODUCTION

In education delivery of contents is an art. In this work we have experimented with popular 3 educational models and importance of known rubrics in advance. To check the impact of educational model on programming subject java, on specific topic thread as it assumes to be difficult to understand and implement for the students as per verbal enquire about the subject. Addie model has been used in the literature in various domains. Proposed elements in this study have been used in versatile domain in literature. This model has designed in such a way that in every academic as well as related field steps of this model can be introduced to check the performance impact, comparison impact and so on. In [1] Addie model has been used for the feature driven development agile method and has given the new dimension to though process of usage of model. Language learning assumed to be very difficult after the person cross the certain age or one can say learning process slower down as the age progresses but in [2] author has clearly made use of Addie model for the development of educational model. This model has versatile application and many found them useful as the performance enhancer, in [3] this model has been used to sensitize the postgraduate students about the competency based medical education program. The steps enlisted in this model gives a very clear understanding for the demonstration of complicated subject as well, Thus model has gain a wide range of publicity in short span if time. Ideate precision medicine design is the important area and this model has also proven useful for this criteria, in

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[4] Addie has been used as a base model to ideate precision in medicine domain. In [5-7] various approaches for the usage of Addie have been explained, it is used in the domain of moral education, early childhood education as well as open online course to develop the professionalism in a teacher profession. In short Impact of Addie model has already been proven in versatile domain. In this study author has experimented the delivery steps of Addie model for the performance enhancement of programming subject along with the coordination of well design rubrics. In [8-10] usage of gagne model in the various domain has been explained. In [11-15] importance of rubrics in the assessment and its designed parameters are explained. Rubrics have played a very important role in the area of design thinking and working practices. Rest of the paper is divided into sections methodology, result, discussion and results. Methodology section gives the insight of identification of students in the study and application of steps of rubrics, Addie and gagne. In result section hypothesis statistical test and individual subject level performance analysis result has been retrieved. And the results are discussed in detail in discussion section. Study has been concluded in conclusion section.

II. METHODOLOGY

In this section approach used in this study has been discussed along with the criteria for inclusion and exclusion of subject in study.

A. ADDIE Model

This educational model involves five major steps analysis, design, development, implementation and evaluation. First phase mainly focus on the appropriate sample inclusion to deliver the expected product. In order to deliver the topic by adopting the steps of ADDIE model author have moulded entire instruction sets of topics in the skeleton of Addie model. Analysis phase has been fulfilled by identifying the appropriate sets of students, outcome of the course has been decided by setting the hypothesis to gain the enhancement in the criteria level, as input criteria level to this study is the output generated by case 1 study, author has set the hypothesis to increase the performance of the students on the scale of level. Various assignments have been produced and videos/tutorial and practical's have been designed and provided to students. Evaluation has been done on the basis of detailed designed rubrics and statistical test has been executed to check the acceptance and rejection of stated null hypothesis.

B. Gagne Model

Gagne model is educational delivery model which is mainly focus on steps for planning and steps for execution emphasize given to planning and execution steps decide the success of execution of gagne model. Planning steps of gagne comprises of identification of the type and learning outcomes. It also analyzes the skills already available with the learner so that dynamic learning model can be designed.

Creating a well background to float the real concept is also a major part of this model. Identification of appropriate media to deliver the content. Plan to motivate the learner as without motivation of the learner delivery of anything results into zero output. Once planning for execution is done this model focus on execution of steps in real environment and check the consequences of the planning well in advance. In execution gain the attention of student's plays an important role as if students are not paying attention to the delivery then entire planning would be fail, thus efforts need to make to gain attention and provide them with clear and concise feedback of their learning.

C. Design of Rubrics

Two types of rubrics have been designed in this study generalized rubrics with 7 criteria and 4 levels of satisfaction. A generalized rubric have been analyzed for the suitability of this study and rather than considering all seven criteria only four criteria has been involved in this study. Generalized and restricted rubrics are as shown in table 1 and 2 respectively. In restricted rubrics which are used in this study have four criteria and four level of satisfaction.

D. Study Setup

In education it is very important to keep on experimenting with delivery models as per the requirement. As in today's era technology is increasing in rapid manner and intervention of technology gives the feel of real visualization of subject and concept. Especially in programming subject in order to understand the concept visualization is the key tool to make student familiar with concept in easy and friendly way. To understand the impact of educational models ADDIE, Gagne on the delivery mode of programming subject this study has been conducted. To conduct the study three cases has been designed; case 1 is associated with importance of rubrics in an assessment and performance of the students. Case 2 and case 3 is associated with impact of involvement of model ADDIE and Gagne respectively in delivery of topic thread in java programming.

Study has been progressed in seven steps:

1. Design of rubrics for the generalized programming subject
2. Identified the appropriate topic to experiment.
3. Identified the appropriate criteria to assess the identified topic.
4. Identification of subject criteria to include or exclude from the study
5. Assessment of performance without circulating the rubrics in advance to students.(Case 1)
6. Assessment of performance by circulating the rubrics in advance to student.(Case 1)
7. Delivery of topic with ADDIE model and assessment by designed rubrics as in case 1(Case 2)

8. Delivery of topic with Gagne model and assessment by designed rubrics as in case 1(Case 3)
9. Comparison of results at criteria level.

For the execution of the study and to check its impact hypothesis has been designed for all three cases:

Case 1:

Null Hypothesis: There is no significant impact on the performance of the student of communicating rubrics in engineering education in advance.

Alternate Hypothesis: There is significant impact on the performance of the students of communicating rubrics in engineering education in advance.

Case 2:

Null Hypothesis: There is no significant impact on the performance of the students of delivering a programming subject by adopting the ADDIE educational model

Alternate Hypothesis: There is significant impact on the performance of the students of delivering a programming subject by adopting the ADDIE educational model.

Case 3:

Null Hypothesis: There is no significant impact on the performance of the students of delivering a programming subject by adopting the Gagne educational model

Alternate Hypothesis: There is significant impact on the performance of the students of delivering a programming subject by adopting the Gagne educational model.

Identified three cases have been executed by including an appropriate sample in study. Steps to identify the appropriate population are as in inclusion and exclusion criteria of the subject in study.

E. Inclusion and Exclusion criteria of subjects in study

In the first step of study, branch Cloud computing and Virtualization 4th semester students of university of petroleum and energy studies, Dehradun with strength of class 134(79 Male and 55 Females) in the age group of 18-20 has been identified. All students were physically and mentally fit to pursue 4 years of engineering degree education. Students have been already taught topic thread in subject java by using the resources, PowerPoint presentation and white board for the duration of 180 mins for 3 days in a week time.

Execution of case 1:

For the execution of case 1 entire available student 134 has been involved in batch size of 44, 44, and 46 without considering the ratio of male and female .These batch size has asked to implement the program considered and asked to execute the problem statement. Each batch size has provided with time of 90 mins for execution followed by quick questionnaire regarding the flow of program in order to mark the criteria 2 level of assessment.

“Implement a program

Statement: Banking domain work segment which include deposit and withdrawal operation.

Constraints:

1. No withdrawal is possible if Balance Amount < 5000.
2. No deposit if deposit amount>50000 in single day.

Concept: Thread/Multithread

Remark: No assessment guidelines, rubrics were provided to students.

Purpose of conduct of case 1: Identify an appropriate population for further study.

Students have been assessed by following the designed rubrics as in table 2. After assessment student population has clearly divided into two groups proficient and deficient group as in table 3. Proficient group has been identified by who has scored level 3 and level 4 in any of the 2 criteria's and Deficient group has been identified as who has scored only level 1 and level 2 in all the criteria's. Same case has been repeated in the followed week with same number of students in the same batch size but during this time rubrics were already made available to all the students and purpose to conduct this study is to reduce the deficient percentage level and increase the proficient percentage level.

Execution of case 2:

For execution of case 2 inclusion of subjects in the study has been identified from the result analysis of case 1. Deficient group even after introduced the rubrics in advance still need more attention to improve the overall performance in their academics, thus deficient group with only who has scored level 1 satisfaction only in 3 criteria's has been included. Addie model has been used to deliver the topic thread to the group of students.

Execution of case 3:

For execution of case 3 inclusion of subjects in the study has been identified from the result analysis of case 1. Deficient group even after introduced the rubrics in advance still need more attention to improve the overall performance in their academic thus deficient group with only who has scored level 2 satisfaction only in 3 criteria's has been included. The Gagne model has been followed to deliver the topic thread to the set of students.

Table 1: Generalized Rubrics designed for the study

No.	Criteria	Details
1	Process followed	Project Plan – Milestone Timelines - Requirement Analysis – Technical Design – Internal Reviews (Within team , With Mentor) – Product Packaging – Presentation – Hand-outs including Future Roadmap
2	Project Features	Simple, Medium and Complex Scenarios which are covered. <i>Watch for unwanted scenarios as well which lead to slippage and increased not required complexity in project.</i> Advance features which are implemented which actually adds value to project use
3	Usability	Minimum number of clicks Tool Tips Field arrangements. (Ex: First Name, Last Name, TAB Press / focus handling) Readily available analytics within project
4	Code Optimization	Design Flexibility Best Practices Followed. (ex: Code Comments) Coding Standard and Optimization / Performance Followed in implementation
5	Quality Assurance(Testing)	Testing Matrix (Unit , End to End), Test Data
6	Delivery Timeline	Duration within which it is completed and team spirit and strength
7	Documentation	Artifacts Created for future reference.

	Ex: Traceability matrix. SRS User Guide etc.
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F. Statistical Significance test:

Paired student t-test has been used to compute the statistical significance of before and after effect of all proposed approach. Test has been computed at confidence interval of 90%, 95% and 99% in order to check the correctness of method.

Paired student's t-test found to be appropriate to use in this study as major concern of this study is to check if there any significant impact of the experimented approach on the academic performance of the student or not.

Table 2: Restricted rubrics designed for the study

Criteria	Level 1(0-3)	Level 2(4-6)	Level 3(7-8)	Level 4(9-10)
Process followed and Project Features	Tried to create a program with basic knowledge only. Easily breakdown	Create a complete program with middle level of understanding, somewhere it breaks down	Create a complete program with proficiency level but not robust and somewhere breakdown	Made use of all appropriate methods to create a simulation for banking operations withdraw and deposit. Robust program. Efficient. No breakdown in any situation.
Usability	Not aware about flow in program	Able to explain few things	Able to explain more than half part of program	Excellent explain the flow
Quality Assurance Testing	Not prepared at all	Test cases are not supporting to robustness	Few test cases has been designed	Created sufficient test cases to prove the robustness of the system
Code Optimization /efficiency	No optimization	Some Part	Most Part	Highly optimized

III. RESULT

Results retrieved in this section are categorized into three parts. Part 1 results are the execution of Case 1 which is associated with impact of rubrics. Part 2 results are associated with impact of Addie model on the performance of the students. Part 3 results are associated with the execution of case 3 which deals in to identify the impact of gagne model on the academic performance of the students in programming subject.



Impact of Rubrics, Addie and Gagne Model on the Performance of Students in Programming Subject

Table 3: Proficient and Deficient group identification before and after rubrics.

Before				After			
Deficient		Proficient		Deficient		Proficient	
Male	Female	Male	Female	Male	Female	Male	Female
52	24	24	31	30	20	49	35

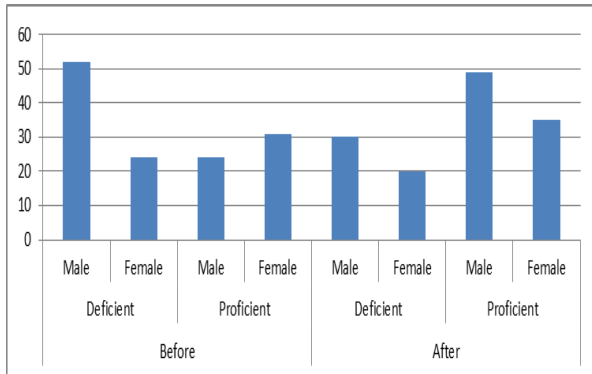


Figure 1: Before and after impact of rubrics involvement in the study

Table 4: Descriptive statistics result before and after implication of rubrics

Mode l	Mean							
	Before				After			
	1	2	3	4	1	2	3	4
Rubri cs	3.76	5.33	4.52	4.66	5.00	5.69	5.86	5.81

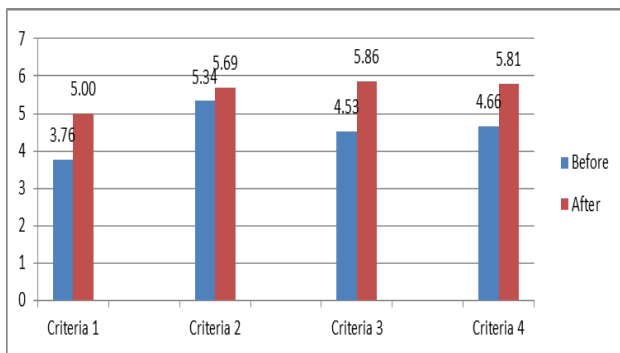


Figure 2: Impact at criteria level of rubrics

Paired student's t test has been computed to check the significant impact after introducing rubrics to the student in advance row wise as per criteria and columnwise. check the impact of known rubrics criteria level wise on the student population or not.

We have checked the impact of known and unknown rubrics on the performance of students 90, 95, 99% confidence interval

Table 5: Statistical performance of the rubrics

Rubrics	t	p	p=0.05	p=0.01	p=0.10
1	8.285994	0.00001	Sig	Sig	Sig
2	2.076517	0.03977	Sig	No-Sig	Sig
3	9.102436	0.00001	Sig	Sig	Sig
4	7.19909	0.00001	Sig	Sig	Sig

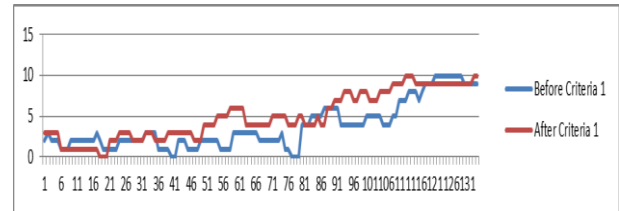


Figure 3: Rubrics impact before and after for criteria 1

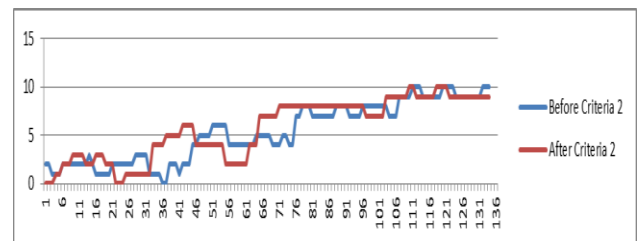


Figure 4: Rubrics impact before and after for criteria 2

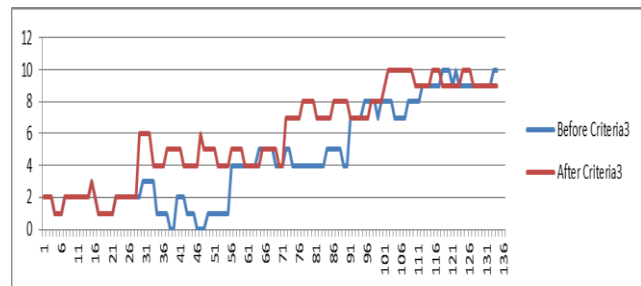


Figure 5: Rubrics impact before and after for criteria 3

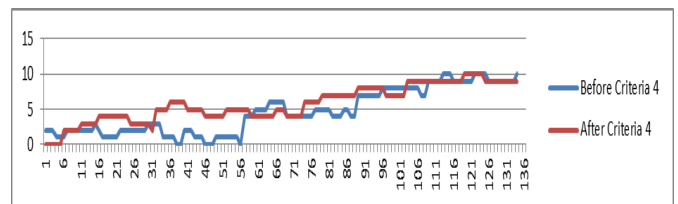


Figure 6: Rubrics impact before and after for criteria 4

Results of Execution of case 2:

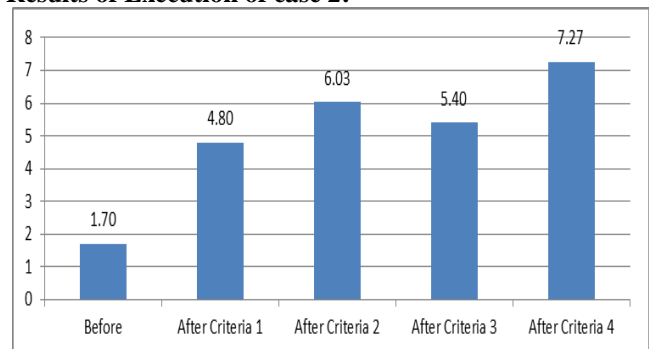


Figure 7: Performance assessment for Addie Model

Table 6: Statistical performance of the Addie Model

Criteria	ADDIE				
	t	p	p=0.05	p=0.01	p=0.10
1	7.468092	0.00001	Sig	Sig	Sig
2	6.585718	0.00001	Sig	Sig	Sig
3	6.76432	0.00001	Sig	Sig	Sig
4	9.788554	0.00001	Sig	Sig	Sig

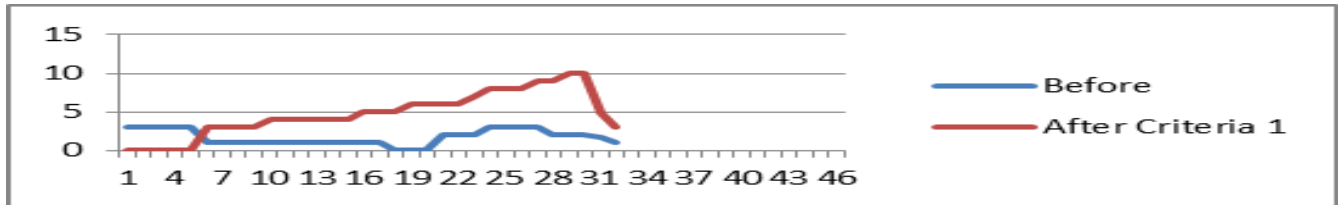


Figure 8: Addie impact before and after for criteria 1

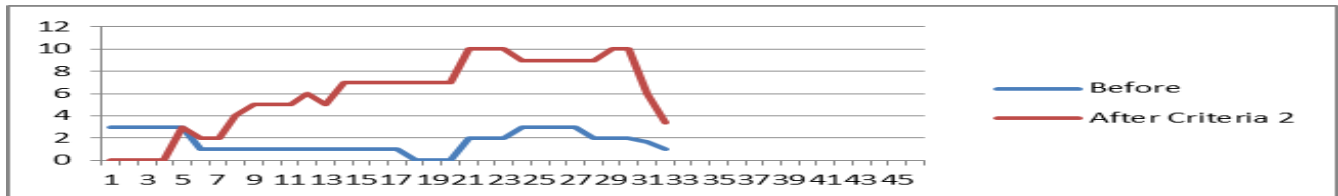


Figure 9: Addie impact before and after for criteria 2

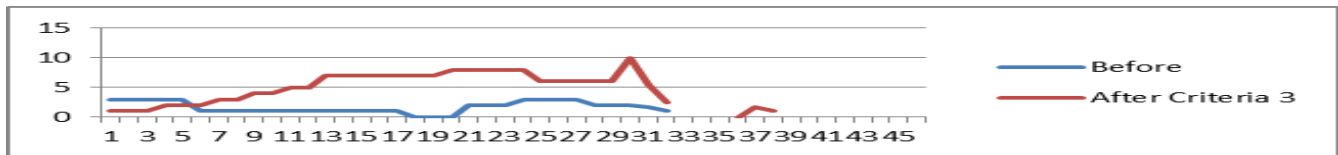


Figure 10: Addie impact before and after for criteria 3

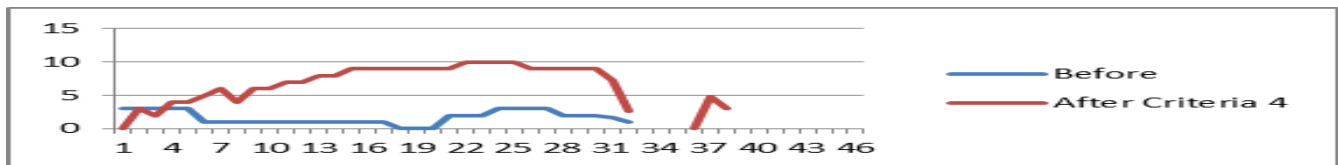


Figure 11: Addie impact before and after for criteria 4

Result of execution of case 3:

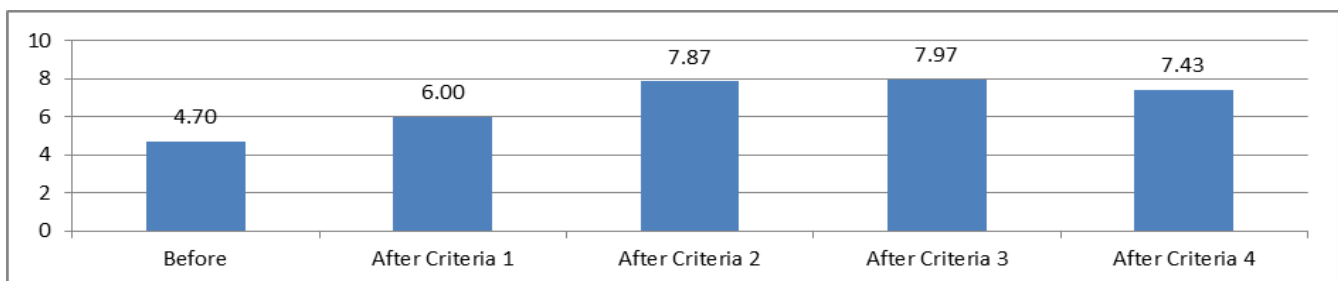


Figure 12: Performance assessment for Gagne Model

Table 7: Statistical performance of Gagne model

Gagne	Criteria	t	p	p=0.05	p=0.01	p=0.10
	1	2.376654	0.02429	Sig	No-Sig	Sig
	2	7.946215	0.00001	Sig	Sig	Sig
	3	9.641712	0.00001	Sig	Sig	Sig
	4	7.303142	0.00001	Sig	Sig	Sig

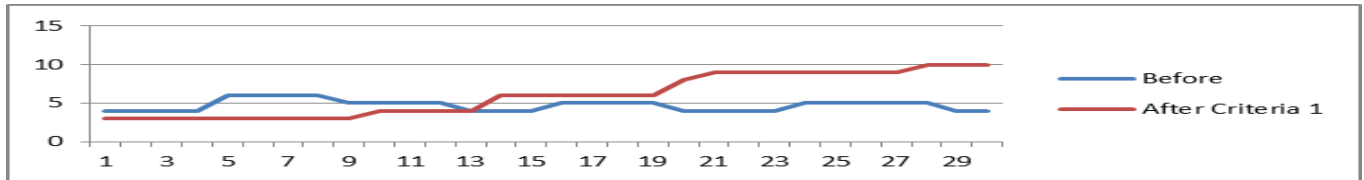


Figure 13: Gagne impact before and after for criteria 1

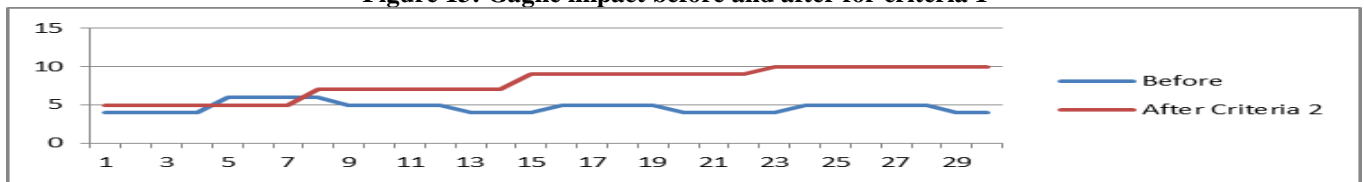


Figure 14: Gagne impact before and after for criteria 2

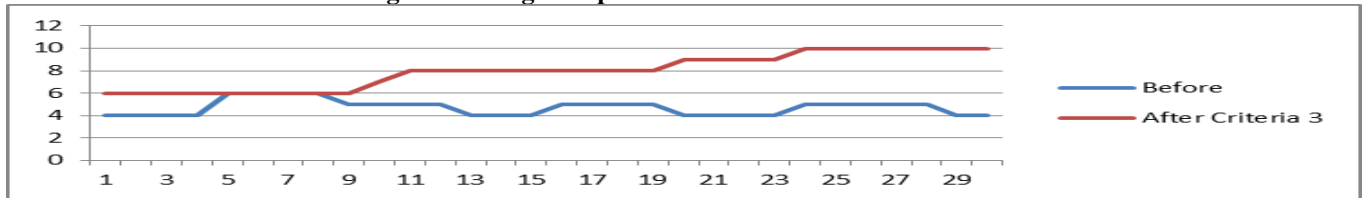


Figure 15: Gagne impact before and after for criteria 3

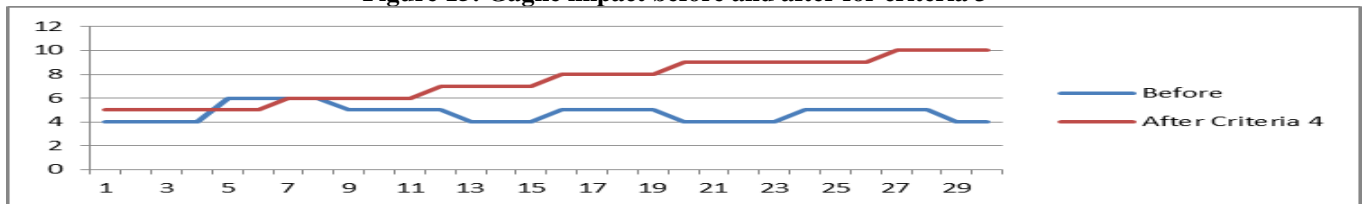


Figure 16: Gagne impact before and after for criteria 4

Comparative statement of result of execution of case 1, 2 and 3

Table 8: Statistical comparative results for rubrics, Addie and Gagne

Criteria	Rubrics			ADDIE			GAGNE		
	0.01	0.05	0.10	0.01	0.05	0.10	0.01	0.05	0.10
1	Sig	Sig	Sig	Sig	Sig	Sig	No-Sig	Sig	Sig
2	No-Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
3	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
4	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig

IV. DISCUSSION:

The purpose of conduct of this study is to identify the impact of rubrics and educational model Addie and gagne on the performance of students in programming subject. In order to analyze the impact author has designed 3 cases.

Case 1 has explicitly designed to check the impact of rubrics on the academic performance of the students. Rubrics with 4 criteria and 4 satisfaction level have been designed as shown in table 2. Students has asked to perform the programming problem statement without the knowledge of rubrics going to use for the evaluation.

Thus case 1 is a two-step process step 1 implement the thing without knowledge of rubrics for assessment. Step 2 with

knowledge of assessment criteria /rubrics. Descriptive statistics has been computed for both the steps and from figure it is clear that it has increased from step 1 to step 2. It is a clear evidence that if assessment criteria made available to students in advance it make a difference positively in the academic performance of the students. Statistical paired student t-test has computed at criteria level with confidence interval of 90, 95 and 99 and computed results are statistically significant for all confidence interval except 99% for criteria 2 as shown in table 5. Criteria 2 has been designed to check the understanding level of the students, but by making available rubrics in advance this criteria has failed to reject the null hypothesis at 0.01 value. But overall performance at other



criteria level has significant for all the level. Individual at subject level analysis has been performed as shown in figure 3 to 6 .It's clear evidence that there is a raise in the level after intervention of rubrics in the study. Case 2 has explicitly designed to check the impact of Addie model on the academic performance of the students. Rubrics with 4 criteria and 4 satisfaction level has been designed for the assessment .Deficient output group of case 1 as shown in table 3 and figure 1, who has only scored level 1 performance in 3 criteria's has been included in this case study. Student has been delivered a topic by following the steps of Addie as explained in the introduction section of this study. As all the students were at level 1, target to conduct this study is to improve the level of performance at all the criteria level. Statistical paired student t-test has computed at criteria level with confidence interval of 90,95 and 99 and computed results are statistically significant for all confidence interval for the target population as shown in table 6. Individual at subject level analysis has been performed as shown in figure 7 to 11 .It's clear evidence that there is a raise in the level after intervention of Addie step in the delivery of target topic. Criteria 4 have shown the exceptional growth. But performance of the students at criteria 1 and criteria 3 is less as compare to criteria 4 and 1. But as the overall significant impact is strong at all the confidence interval. Case 3 as explicitly designed to check the impact of Gagne model on the academic performance of the students. Rubrics with 4 criteria and 4 satisfaction level has been designed for the assessment .Deficient output group of case 1 who has only scored level 2 performance in 3 criteria's has been included in this case study. Student has been delivered a topic by following the steps of gagne. As all the students were at level 2, target to conduct this study is to improve the level of performance at all the criteria level. Statistical paired student t-test has computed at criteria level with confidence interval of 90,95 and 99 and computed results are statistically significant for all confidence interval for the target population except criteria 1 at 0.01 as shown in table 7. Individual at subject level analysis has been performed as shown in figure 12 to 16 .It's clear evidence that there is a raise in the level after intervention of gagne step in the delivery of target topic. Criteria 2 and criteria 3 have shown the exceptional growth. But performance of the students at criteria 1 and criteria 4 is less as compare to criteria 2 and 3. Copartive statement of conducted study is as shown in table 8. Criteria 1 has been designed to test the proficiency of students in formulating the problem statement and thus the steps include I Gagne model delivery has not cater the need of formulation of problem statement. Rubrics designed has not satisfied at 0.01 level for criteria 2 ,Criteria 2 has been set to understand the usefulness of the problem statement and understanding the usability criteria has not made clear to students by mere designing the rubrics and let the students know that rubrics in advance.

V. CONCLUSION

In these study Rubrics, ADDIE and Gagne Model has been experimented for concept thread in subject java and statistical results have been retrieved at the confidence interval of 90%, 95% and 99%. Addie model stands statistically significant to improve the performance of students from level 1 to level 4 at all the confidence level. Thus to deliver the programming subjects inclusion of ADDIE model steps for the delivery of

subjects can lead to better academic performance of the students.

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