

On the use of Serious Games in Operations Management: an investigation on connections between students' game performance and final evaluation

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Abstract: In last twenty years, interest in Serious Games has continuously raised, especially thanks to the technological improvement in computer science and virtual laboratories. A common objective of these games is to enhance practical skills of users by simulating realistic universes in which players could operate and learn. We present a study on the application of a Serious Game in an Operations Management course at the University of Parma. The game is designed as a web-based application replicating a realistic universe in which different e-bike producing companies compete, having a limited number of suppliers and customers. Each company is composed by different students, playing different roles within the company, and collaborating in order to take company strategical decisions. A KPI system has been implemented in order to best evaluate students' work during the game sessions. Also, a post-test has been submitted to students to better understand the perceptions they had towards the game. At the end of the courses, students received their final evaluation in Operations Management. The present paper has the objective to analyse (i) KPIs, (ii) game session duration, and (iii) post-test results, and look for a connection between the data analysed and the final evaluation gave to each student.

Keywords: Serious Game; Supply Chain Management; Operations Management; Game Based Learning

I. INTRODUCTION

In recent years, enterprises are looking for engineers with a solid background in theoretical knowledge as well as in practical skills. Up until the first years of XXI century, the training of practical skills has been done using paper exercises or with spreadsheets, nowadays is possible to use Serious Games (SGs) as new tool to convey this type of ability. Indeed, SGs represent an optimal solution to fill the gap in acquisition of practical, technological and soft skills (Burghardt *et al.*, 2021). Having these preconditions, in 2018 University of Parma staff started to design and develop an Operations Management Serious Game with the aim to enhance practical and soft skills in Operations Management learners. In the game, players will be divided in different companies competing in the market of e-bike production. The environment is designed as a collaborative/competitive game in which groups of two to three students will run a company, they will run singularly day-to-day actions and will take strategical decisions together. Each enterprise will compete with the other companies on suppliers and

customers to replenish their raw materials stocks and to acquire customer requests.

In the last years, different studies have tried to state if Serious Games are an effective tool to convey knowledge and if their usage improves learning outcomes. The studies which questioned the effectiveness of game-based learning have been published in the first years of 2000 (Kulik, 2002; Hays, 2005). However, in last 20 years the videogame field made an incredible amount of step forward and produced awesome development decreasing the relevance of the studies just presented. Nonetheless, contrasting opinion can be find in literature having studies testifying that learning games can both engage player as well as produce learning and, even if they are not more effective than other teaching methods, games and simulations are more appreciated by students (Prensky, 2006; Chin, Dukes and Gamson, 2009). Lastly, it is empirically proven that various learning outcomes can be identified by the usage of serious games which can influence different learners' aspects like perception,

cognition, behaviour, affects, and motivation (Connolly *et al.*, 2012).

Starting from the characteristics of Serious Games and considering the various outcomes that a Serious Game can produce accordingly with the literature analysed, the questions that authors wanted to investigate, and present in this paper, are:

- **RQ1:** is it possible to outline a difference in the final evaluation between the students who have played the SG and those who have not played it?
- **RQ2:** is it possible to highlight a connection between the performance students had during the game and the final evaluation they receive?

In order to answer these questions, the rest of the paper is structured as follow, section 2 presents an overview of the Serious Games in Operations Management and section 3 introduces the game and the methodology of work. In section 4 are reported the results of the analysis while in section 5 the results are discussed. Finally in section 6 the conclusions are drawn, and the future steps are introduced.

II. OPERATIONS MANAGEMENT SERIOUS GAMES OVERVIEW

The term “serious” denotes the willingness of the game to have, as objective, both the fun and the learning. Indeed, SGs present a valuable way to increase the engagement of learners and make them deal with complex problems and dilemmas (Hummel *et al.*, 2017). In last ten years, this tool saw an increase in its usage, in line with the rise of virtual laboratories and online services, in the education and training of engineering students and professional (Galli *et al.*, 2021). The decision to adopt this tool is also linked to the possibility to apply learning by doing teaching style, leaving learners free to try different solutions without causing damages to people or infrastructures (Reese, 2011). The usage of Serious Games in Operations Management and Supply Chain Management can be tracked back to 1998 with Beer Game (Kaminsky and Levi, 1998) which has been designed as a card based game. In recent years, a modern version of the Beer Game has been developed and integrated in a Supply Chain Management course by Lau (Lau, 2015). Here the author described the adoption of an action learning approach with the objective to motivate students towards SCM. Also, the study highlighted how the integration of SG with SCM course can enhance taught knowledge as well as build untaught knowledge as collaboration and partnership. Similarly, van den Berg *et al.* started to approach the field of SGs in SCM with low-tech game named “Tower of Infinity”, developed as a board game (van den Berg *et al.*, 2017). The year after, they have developed the high-tech version of the same game, reproducing the same environment and the same dynamics but in a virtual world. The difference between the two game have been reported in van den Berg *et al.*, 2018. Among the digital games, is possible to find Learn2Work which presents to the players three

possible scenarios to dive themselves in order to manage the company. Also, Practice Operations is a Serious Game distributed by McGraw-Hill Education in which players have the possibility to manage a whole company. Here, players have to manage inbound and outbound orders, select human resources to be assigned to different roles and complete the final products that will be finally sold.

III. METHODOLOGY OF WORK

The serious game has been developed as a brand-new tool in University of Parma. The scenario has been developed as a multiplayer cooperative and competitive environment in which students are divided in teams. Here, each company operates in a universe with a limited number of suppliers and customers, students are divided in three different functions, inbound manager, production manager, and outbound manager. Users work alone in day-by-day operations while they collaborate in taking strategic decisions, the final goal is to perform better than the other companies in an e-bike production market by buying the raw materials at the best possible conditions, optimize the production, and selling the products at the best prize possible, as described by Matteo Galli *et al.*, 2021.

The objectives of scenario designers were to create a tool to enhance soft skills like cooperation and team work, and to fill the gap between theoretical and practical skills, which represents an important issue for engineering students nowadays. To create the best possible scenario, the first release of the game underwent a two stages evaluation approach. In the first one, lecturers and experts played the game and gave their feedback on the game structure and variables to find the best combination of parameters. After that, the game has been played during the operations management course and evaluated by students. To better understand their point of view, a pre-test has been submitted to students during the first lesson of the semester and a post-test on the last day. In that way has been possible to investigate the different perception between students which have used the game and the one that have only saw tutorial videos. Also, the post-test had the objective to analyse different aspects of the game in order to fix raising problems and optimize game features and parameters. As a last step, authors conducted an analysis on the final results obtained by the students to highlight possible correlations between the game usage and the grade obtained.

A. Course and game organizational aspects

As already introduced, the serious game has been used for the first time during the summer semester of 2021 in the course of Operations Management as an elective tool. To do so, the lecturer gathered the students that wanted to use the game and created two different groups of players, for a total number of 53 students, and one of non-player which would have later worked as control group, composed by 155 students (Table I). Each player group used the game for six session of three hours each, for all the time users covered the same role in the same company

cooperating with the same colleagues. These two groups have been placed in two different universes in order to avoid conflicts between the two users' groups.

Also, a bonus system has been implemented with the game. The objective of this reward system is twofold, primarily it aims to maximize the involvement of students in the game and enhance the competitiveness, as each bonus grants extra 0.5 points in the final evaluation. To do so, a KPIs (Key Performance Indicators) system has been implemented, allowing the lecturer to evaluate the companies accordingly with their performance and create a rank. Bonuses have been assigned to companies from the first to the fourth position, based on this rank. Secondly it aimed to have the highest possible number of students participating in the game. Indeed, being a new tool, and being used for the first time in Operations Management course at University of Parma, its effectiveness and returns were not studied yet. Having these assumptions, the possibility to use the Serious Game as a mandatory tool for all students have been evaluated as a non-optimal solution.

TABLE I
GROUPS DISTRIBUTION

	Participants	Hours played
<i>Players' group 1</i>	29	18
<i>Players' group 2</i>	24	18
<i>Non-players group</i>	155	-

B. Rewarding system

One of the main goals of the game is to provide an environment in which students will learn how to collaborate and then enhance their teamwork skills. However, among the characteristics of the serious game it is possible to find the entertainment that they convey towards students. In order to make this aspect tangible and increase the involvement of students in the game, it has been decided to set up a rewarding system based on the performances achieved by students. To do so, it has been fundamental to create a KPI system based on the structure of the game. Indeed, the KPI system has been built on the different functions foreseen in the game, by classifying the performances measured in the sector of (i) company balance, (ii) sales, (iii) purchase, (iv) customer, and (v) production. All these KPIs are finally weighted, accordingly with the importance of the sector in which they are implied for the Operations Management, and a final grade is assigned to each company. Based on this ranking, additional bonuses are assigned to the company, namely: (i) four bonuses were awarded to the team that classified first, (ii) three bonuses were awarded to the second team, (iii) two bonuses to the third team and (iv) one bonus was awarded to the team classified fourth.

Also, with the objective to boost the participation to the game, an additional bonus has been given to all the

participants that kept a minimum percentage of presence to the whole game sessions (85%).

C. Final evaluation and analysis

Being the Operations Management course part of the bachelor's degree in management engineering, it has not been possible to create two different evaluations for the students that played the game and the one that attended lectures in the classical way. However, having a common way to evaluate students represented an optimal approach to compare possible results students obtained by playing the game. The exam for final evaluation has been structured as a combination of a theoretical and a practical part. In the former, students are requested to answer to theoretical questions, and the latter asks students to solve paper sheet exercises. Also, students cannot access the practical part of the exam if they have not achieved a positive evaluation in the theory. Once both phases are passed, the final grade is calculated and increased by potential bonuses achieved by students and, if accepted, it is registered.

The analysis of the results has been done twice, firstly by comparing the results achieved by playing students and by non-playing students, and secondly by comparing the grade achieved by students with the evaluation of the game they have expressed in the post-test. The post-test just mentioned has been designed accordingly with the framework validated by Iten and Petko (2016) investigating different game characteristics like (i) usefulness, (ii) simplicity, (iii) fun/enjoyment, (iv) personal ability, (v) fear of use, (vi) intention to use, (vii) clarity of the goal of the game, (viii) strategic approach, (ix) use of prior knowledge, (x) flow, (xi) feedback, (xii) help/assistance, (xiii) enjoyment of the game, and (xiv) competition with a Likert scale 1 to 5 (1 = strongly disagree, 5 = strongly agree).

This post-test has been administered to all the students on the same day which was the last class of the semester via Moodle questionnaire. This first analysis aimed to investigate possible differences in the acquisition of competences connected to the usage of the SG. To do so, the difference between the two groups have been analysed from various angles to have a full understanding of the impact that the game can have on the learning behaviour of students. Indeed, have been considered (i) the final grade, (ii) theoretical and practical grade, (iii) bonuses achieved, (iv) attempts, (v) withdrawals and (vi) failure to pass the exam. On the other hand, the second analysis had as objective the visualization of possible links between the evaluation students provided and the game usefulness they have perceived.

IV. RESULTS

In this chapter the results elaborated by analyzing the final results of the course in Operations Management and the results gave by students in post-test.

A. Attempts, withdrawals, and failures

During the six months that passed from the end of the course to the beginning of the analysis, 325 tries have been done by students to pass the exam. Among these tries, 25 times students booked the exam but did not take part at the exam, the authors decided to ignore these tries due to their non-evaluability. The remaining 300 are divided in 80 tries from Group A (player students, $n = 45$) and 220 tries from Group B (non-player students, $n = 155$). These data gave as results 1.78 tries per students for A and 1.42 for B. This data sees its corresponding in a 58.8% ($n=47$) of rejection on the total of tries for A while it decreases to 53.6% ($n=118$) for B. The same trend is represented by the students which have been rejected at least once which are 62.2% ($n=28$) for A and 55.5% ($n=86$) for B. However, it is in countertendency the data on the passed students which are the 68.9% ($n=31$) for A and 58.7% ($n=91$) for B. The similar is the behaviour of retired students which are 2.5% ($n=2$) for A and 5.0% ($n=11$) for B. Once all these data have been obtained, the focus shifted to another dimension, the time. Indeed, the initial data gave precious information of the data but did not gave the possibility to analyse a difference in the students' behaviour from a time perspective. Table II (Appendix A) reports the data on (i) the students who achieved a positive grade (i.e., passed students), (ii) the students who failed the exam or who retired (i.e. rejected & retired), and (iii) the students which tried the exam (i.e. tries) calculated as the sum of passed students, and rejected and retired one.

These data are reported for every time a student tried the exam and which does not correspond necessarily to the exam session. Actually, a student could try the exam for the 1st time at the third exam session, in that case its try has been counted in the 1st exam attempt. Similarly, it is classified its eventual positive or negative score. In a situation where the student is rejected and decide to skip the next exam session, once the student decide to try the exam again it will be classified as 2nd exam attempt and so on. The choice fell on this type of approach to have a better description and a higher possibility to compare Group A and Group B without being affected by the presence of students at each exam session. Table II reports the absolute numbers collected for all the groups reported as well as the percentage expressed on the sum of different exam attempts. No students made more than five attempts to pass the exam.

B. Exam evaluation

In this subchapter, we move the focus from the general evaluation of passed, rejected, and retired students, to the students evaluation expressed in their grades. We note here that the Italian grading system in university exams goes from 18/30 (minimum sufficient grade) to 30/30 (maximum grade), which could be increased by a *laude* for the best evaluation results. We note also that Group A was considered with the students grades both comprehending and non-comprehending the outcome of the rewarding system (i.e., bonus), as considerations on data could be misled by non-considering the contribution

of the rewarding system. Table III (Appendix A) shows the frequency distribution of the marks divided between Group A, with and without bonus, and Group B. The table reports the absolute, relative, and cumulated relative frequencies. Also, to compare the data, the average values have been calculated on the final evaluation with and without bonuses.

TABLE IV
2020 AND 2021 GRADES DISTRIBUTION

Grades	2020 Group		2021 Group	
	%	Cumulated	%	Cumulated
18	8.7%	8.7%	2.5%	2.5%
19	7.2%	15.9%	3.3%	5.8%
20	6.5%	22.5%	3.3%	9.1%
21	8.0%	30.4%	3.3%	12.4%
22	1.4%	31.9%	9.1%	21.5%
23	9.4%	41.3%	7.4%	28.9%
24	7.2%	48.6%	14.0%	43.0%
25	7.2%	55.8%	5.0%	47.9%
26	7.2%	63.0%	10.7%	58.7%
27	7.2%	70.3%	6.6%	65.3%
28	10.9%	81.2%	9.1%	74.4%
29	7.2%	88.4%	3.3%	77.7%
30	2.2%	90.6%	9.9%	87.6%
31 (<i>cum laude</i>)	9.4%	100.0%	12.4%	100.0%

It resulted that the average vote achieved on the theoretical part by Group A and Group B is the same and is equal to 0.79 (in a scale from 0 to 1). On the other hand, there has been a difference in the practical part which resulted in an average mark of 0.68 for Group A and 0.75 in Group B. When the final grades assigned to the students of Group A are considered with bonus, their average is equal to 25.71 (on a scale from 0 to 30), and it is close to the average obtained by Group B which is 25.97. However, this results strongly changes once the marks obtained by students of Group A are cleared of the bonuses. This operation lowers the average of the grade from 25.71 to 24.68 increasing the difference between Group A and Group B to 1.29.

However, the benefits of the serious game could not only be compared with the course held on the summer semester of 2021, but it has to be compared also with the previous course in order to underline the benefit that serious game can bring to the entire course. To do so, the result collected from Group A, cleared of bonuses, and from Group B have been merged in order to be representative of the year 2021. The results have been the creation of two groups, the 2020 and the 2021 Group, where the 2020 Group is representative of the exams after the Operations Management course held in summer semester of 2020 (from summer 2020 to spring 2021), and the 2021 Group is generated by merging Groups A and B, as they've been previously described. The possibility to compare these two groups is linked to the fact that the two academic years share the same lecturer, teaching method (i.e., remote classes in real time) program, and examination method. Indeed, the only difference between the groups 2020 and 2021 is the elective tool of the serious game for the latter group. In this data analysis the population of the 2020 Group was

equal to 138 positive results while the 2021 Group was represented by 122 results. The difference between the averages of groups is equal to 1.14 points being respectively 24.52 for the 2020 Group and 25.65 for the 2021 Group. The frequencies of grades for both groups are reported in Table IV.

C. Correlation between results and serious game

Lastly, an analysis on a possible correlation between the final grade achieved by students and their evaluation of the serious game provided has been conducted. The post-test that has been delivered to students at the end of the course is built as a combination of 43 different sentences related to 13 main characteristics of the game. Among these is possible to find (i) fun, (ii) simplicity, (iii) enjoyment, (iv) personal ability, (v) intention to use, (vi) use of prior knowledge, (vii) competition, etc. Students had the possibility to evaluate all the 43 sentences with a Likert scale from 1 to 5 (1 = strongly disagree, 5 = strongly agree). To provide significant a significant analysis, students have been sorted from lowest to highest grade achieved and the averages of the marks they gave to the post-test have been calculated. Despite the player of the game were 53, only 29 of them completed the post-test, being an its completion optional. In the end, 21 out of 29 achieved a positive result at the final exam representing so the group to be analysed. The results of these 21 students have been plotted on a graph (Fig. 1) having on its axis respectively the final grade (from 20 to 32) and the average evaluation to the post-test (from 2.5 to 5). As can be derived from Fig. 1, the two factors have a light negative correlation which has been calculated as -0.465 , showing a decrease in the evaluation of the serious game when the final evaluation of students is rising.

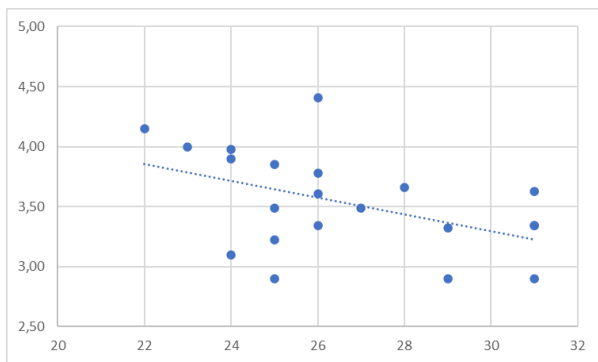


Fig. 1. Scatterplot of post-test evaluations and final grades

V. DISCUSSION OF RESULTS

The data reported in chapter IV, describe a situation in which the students from Group A have a higher percentage of rejections as well as a higher percentage of students which have been failed the exam at least once. However, the percentage of total students which passed the exam is higher in Group A than in B. These data, explains the higher incidence of number of tries for each student in Group A compared to B. Indeed, the results show that students playing the game are more inclined to

try harder to pass the exam despite being rejected more. This behaviour is also supported by the percentage of retired students which in Group B is twice Group A.

Fig. 2 (Appendix A) plots the data on attempts and passed students for Group A and Group B, as reported in Table II. In the graph, the blue bars represent the attempts per period, in grey can be saw the promoted students. The orange and yellow line are respectively the cumulated percentage of tries and promoted students. The trends of A and B are similar in tries and promoted students. Also, cumulated lines are close to a Pareto behaviour having more than the 80% of tries and positive results are collected in the first 2 exam sessions. Still, from data in Table II and from the graphs, can be seen that the majority of passed students (89%), and rejected students (95.35%) of Group B are collected in first and second session. On the other hand, the data of Group A are more shared between the first 3 sessions decreasing the inclination of the cumulated line.

The results obtained by students in theoretical part of the exam is equal for both A and B Group. The average practical grade achieved by Group B results little higher than Group A. Still, using the data cleared of the bonuses, the difference of 1.29 between the averages of final grade, linked with the distributions reported in Table III, seems to highlight a difference in competence between the two groups. Indeed, despite the addition of the bonuses help the average grade of Group A to fill the gap with the average grade of Group B, a difference can be noticed. This difference can be linked to the rewarding system which has been established accordingly with the serious game. Indeed, as already introduced beforehand, a rewarding system has been set to promote the usage of the serious game. Despite this was the initial objective of the bonus system, this procedure probably led to a non-homogeneous composition of Group A. Actually, from the data analysis can be hypothesised that the Group A have been composed by (i) learners having a really high willingness to use the serious game, and were not influenced by bonus system, and (ii) learners for which the game does not represented the main motivation, but their motivation was more linked to the rewarding system. This last part of the group probably lowered the average of the final grade by accepting lower marks and aiming to increase their final vote by using the bonus. However, this hypothesis will not be investigated in the present study.

Nonetheless, positive feedback has been received by the comparison between the course held in 2020 and the one held in 2021. Indeed, having only the game as difference between the course, the additional point in the average of the grade achieved in 2021, can be connected to the usage of serious game. More important of this, in 2021 low-medium grades (from 18 to 23) are more than 10% lower compared to the year before. This difference of 10% is partially absorbed by the medium grades (from 24 to 27) where the gap is reduced to 5%. The last important disparities are registered in the high marks (30 and 31) which sees the 20% of total marks in year 2021 in

opposition to the 11% scored the previous year. This clearly shows a shift in the low-medium to medium grades as well as a shift from medium-high to high grades. These results partially reply to the **RQ1** by highlighting higher results achieved by students compared to the previous year but with no significant differences with the students which have been part of the class the same year.

To reply to **RQ2**, a correlation analysis has been run between the final grade achieved, cleaned of the bonuses, and the bonuses assigned for the final ranking of the different companies. Nonetheless, the results show a very weak value (-0.11), suggesting no correlation between the final grades and the game results. Thus, a possible reply to the **RQ2** is that, as preliminary results show, the rank achieved in the Serious Game and the final evaluation of the exam assess different knowledge and competences. Still, more research is needed on this point. The comparison of the post-test results and the final evaluation ones underlined a small but negative correlation. This shows a difference in the interest and usefulness created by the serious game in the students. Indeed, students which usually find more difficulties in the acquisition of Operations Management notions consider the serious game as a valid tool for their learning and training.

VI. CONCLUSIONS & FUTURE STEPS

The data gathered showed a clear difference between the group which used the serious game and the group which held the course in the classic way. However, the rewarding system, structured to enhance the participation at the serious game, led to some odd results. The results show, in fact, that a large number of students participated at the game and achieved lower grades than the average. A possible explanation is that these students participated to the game to benefit of the rewarding system and raise their final grades. Nonetheless, the usage of serious game, and the rewarding system, brought also different advantages. Indeed, the statistics showed that the combination of the game and the rewarding system, stimulate the students' willingness to pass the exam also if it requires more attempts. The game works also as booster for the low-medium students who usually perform worst. This is confirmed by the comparison made between the course held in 2020 and 2021 which shows a higher score and a best trend for the year in which the serious game has been used. Moreover, the perception of the usefulness of the game has resulted higher among the students which usually perform below the average while for the other students the perceived usefulness is slightly lower, although still high.

The combination of the data gathered, and their analysis led to the conclusion that the game represents an optimal solution for students which do not achieve higher grades at the end of the course, who perceive it as useful, increase their willingness to sustain the exam, practice practical skills, and, if their game performance are sufficient, achieve rewards and additional points for their

final exam. Given these conclusions, one of the main future steps will be the extension of the game to the entire course as well as a progressive increase in the game difficulty, to raise the challenge for all students. Also, the rewarding program should be further investigated to assess its costs and benefits.

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Appendix A. FIGURES and TABLES

TABLE II
TRIES, WITHDRAWALS AND FAILURES PER STUDENT GROUP AND EXAM ATTEMPTS

Exam attempts	1	2	3	4	5		
Group A	<i>n</i>	44	22	10	3	1	<i>Tries</i>
	%	55.0%	27.5%	12.5%	3.8%	1.2%	
	<i>n</i>	15	9	5	2	0	<i>Passed students</i>
	%	48.4%	29.0%	16.1%	6.5%	0.0%	
	<i>n</i>	29	13	5	1	1	<i>Rejected & Retired</i>
	%	59.2%	26.5%	10.3%	2.0%	2.0%	
Group B	<i>n</i>	142	62	12	3	1	<i>Tries</i>
	%	64.5%	28.2%	5.4%	1.4%	0.5%	
	<i>n</i>	50	31	7	2	1	<i>Passed students</i>
	%	54.9%	34.1%	7.7%	2.2%	1.1%	
	<i>n</i>	92	31	5	1	0	<i>Rejected & Retired</i>
	%	71.3%	24.0%	3.9%	0.8%	0.00%	

TABLE III
GRADES DISTRIBUTION PER STUDENTS GROUP

Grade	Group A without Bonus			Group A with Bonus			Group B		
	<i>n</i>	%	Cumulated	<i>n</i>	%	Cumulated	<i>n</i>	%	Cumulated
18	0	0.0%	0.0%	1	3.2%	3.2%	2	2.2%	2.2%
19	2	6.7%	6.7%	0	0.0%	3.2%	4	4.4%	6.6%
20	2	6.7%	13.3%	1	3.2%	6.5%	3	3.3%	9.9%
21	4	13.3%	26.7%	0	0.0%	6.5%	4	4.4%	14.3%
22	3	10.0%	36.7%	1	3.2%	9.7%	5	5.5%	19.8%
23	4	13.3%	50.0%	5	16.1%	25.8%	6	6.6%	26.4%
24	3	10.0%	60.0%	4	12.9%	38.7%	11	12.1%	38.5%
25	3	10.0%	70.0%	4	12.9%	51.6%	3	3.3%	41.8%
26	1	3.3%	73.3%	5	16.1%	67.7%	12	13.2%	54.9%
27	4	13.3%	86.7%	1	3.2%	71.0%	6	6.6%	61.5%
28	0	0.0%	86.7%	1	3.2%	74.2%	8	8.8%	70.3%
29	2	6.7%	93.3%	3	9.7%	83.9%	2	2.2%	72.5%
30	1	3.3%	96.7%	1	3.2%	87.1%	11	12.1%	84.6%
31 (<i>cum laude</i>)	1	3.3%	100.0%	4	12.9%	100.0%	14	15.4%	100.0%

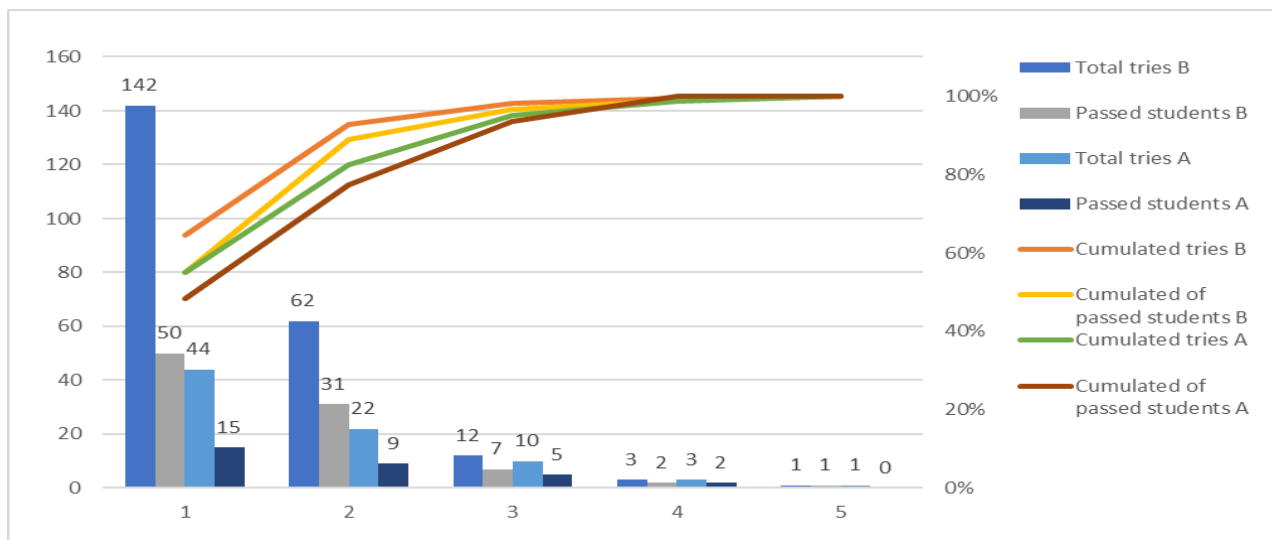


Fig. 2. Comparison of number of attempts and passed students between Groups A & B