ISSN 2614-5103 (Print)
2614-5111 (online)
IndoMath
Indonesia Mathematics Education
https://indomath.org /index.php/indomath
Vol 6, No. 2, August 2023, pp. 95-104

A Strategy To Improve Pass Rates Of Written Postgraduate Statistics Modules

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ABSTRACT

Many universities apply student support services to undergraduate (UG) students, but some postgraduate (PG) cases need it. South African universities have intensified PG admissions. PG students admitted with a minimum admission mark are not PG-ready. For the Bachelor of Science Honours (BSc Honours) in Statistics (Stats) that requires intense Math conceptual knowledge to apply to Stats concepts, where competition is high, only top students can be competitive. In South Africa, the job market prioritizes graduates from historically white higher education institutions (HEIs), and formerly black and newer university graduates' struggle. Non-stop students from the latter universities are not easily employed, so they need a stimulus. This study focuses on BSc Honours (Stats) students who perform low for intervention to improve their performance. Measures were proposed for student conduct and behavior to enable lecturers to constantly stimulate the teaching and monitor and evaluate progress while continuously assessing the students. The study followed an experimental design. Students were ordered to practice with module exercises using statistical software packages in the computer laboratory. Exceedingly high pass rates of 100% were realized. The methods were viewed as effective and beneficial.

Keywords: Innovation, Intervention, Reinforcement, Students-at-risk

ABSTRAK

Banyak universitas menerapkan layanan dukungan mahasiswa untuk mahasiswa sarjana (UG), tetapi beberapa kasus pascasarjana (PG) memerlukannya. Universitas Afrika Selatan telah mengintensifkan penerimaan PG. Siswa PG yang diterima dengan nilai penerimaan minimum belum siap PG. Untuk Bachelor of Science Honours (BSc Honours) dalam Statistik (Stats) yang membutuhkan pengetahuan konseptual Matematika yang intens untuk diterapkan pada konsep Stats, di mana persaingan tinggi, hanya siswa terbaik yang dapat bersaing. Di Afrika Selatan, pasar kerja memprioritaskan lulusan dari institusi pendidikan tinggi (HEI) kulit putih historis, dan perjuangan lulusan universitas kulit hitam dan yang lebih baru. Mahasiswa non-top dari universitas-universitas terakhir tidak mudah dipekerjakan, sehingga mereka membutuhkan stimulus. Studi ini berfokus pada siswa BSc Honors (Stats) yang berprestasi rendah, untuk intervensi guna meningkatkan kinerja mereka. Langkah-langkah diusulkan untuk perilaku dan perilaku siswa agar dosen dapat terus merangsang pengajaran, memantau dan mengevaluasi kemajuan sambil terus menilai siswa. Penelitian ini mengikuti desain eksperimental. Siswa diperintahkan untuk berlatih dengan modul latihan menggunakan paket perangkat lunak statistik di laboratorium komputer. Tingkat kelulusan yang sangat tinggi sebesar 100% terwujud. Metode tersebut dianggap efektif dan bermanfaat.

Kata kunci: Inovasi, Intervensi, Penguatan, Siswa berisiko

INTRODUCTION

Past admission criteria to postgraduate (PG) studies in higher education institutions (HEIs) of South Africa depended on how long it took an undergraduate (UG) student to complete the significant subject they wished to pursue at PG. Record time completion and merit in the many subjects at all UG levels were required. Due to lax admissions currently, pass rates of PG students have recently dropped, either in the pass mark percentage or the number of PG students who pass. This is not at all desirable, and some intervention could be solicited. The minimum mark, usually 60% or 65%, was the first criterion; another was completing the major within the minimum duration. Students who took over three years for a three-year degree would usually not be admitted to the Honours study programs. The Bachelor Honours program is viewed as the beginning of advanced knowledge for which students must be ready. For every subject discipline, the Honours basics are from the corresponding UG content (Morgan, 2016). This level has a definite edge over the UG level. It also leads to the Master's degree (M-). For Statistics or Mathematical Statistics, prerequisite knowledge is necessary. Advanced mathematical concepts have related basic concepts without which there can be an understanding or appreciation of the advanced ones. Hence, the Honours in these mathematical sciences depend exclusively on the UG basic concepts.

This paper is based on the initiatives that transpire at one of Gauteng's HEI in South Africa (the HEI or this HEI here onwards). UG students of the HEI benefit from student support services that resemble a household unit consisting of student custody where professional services involving guardians (who are lecturers), tutors (consisting primarily of PG students), psychologists, social workers, and representatives of the Student Representative Council (SRC), among other role players, form a domiciliary to assist students who struggle in their studies to cope. These services may be due to any problem hindering students' academic performance. These services attempt to deal with these numerous challenges. The problem can be of any nature, such as educational, financial, psychological, social, etc. Conscious effort is made to detect any student who may be facing any difficulties. Any UG student in the HEI, who can be found to be struggling with their studies, or who experience research problem(s) is aided through this household thread. This responsibility was initially established for first-year students. However, some second-and third-year students were identified as needing the services. Due to the demand at advanced UG levels, student support services were later extended to these higher UG levels as desired. PG students are occasionally requested to participate in this guardianship as tutors and through remedial tutorship.

There are PG students who also struggle with their studies. However, where PG students struggle to cope, some (but rarely) HEIs allow their campus student support services to extend guardianship to them as needed. Cases of PGs being guarded by guardianship are rare in the HEI. In the School of Science and Technology (SST), PG students do not have a second chance at the final examination if they fail a written test. The UGs, on the other hand, can participate in supplementary examinations (known as re-examinations) and have conditions that allow them to write unique reviews. These privileges are not extended to PGs of the HEI. As a result, PG students who struggle with their studies remain at risk, and many fail either by failing or dropping out. Hence,

it is necessary to introduce appropriate student support for PG, which is job readiness and advanced PG research.

Study context

The HEI's Bachelor of Science (BSc Honours) in Statistics (Stats) is a one-year complete study program consisting of eight (8) coursework or written modules and a research module that requires a project. Students admitted to this study program are high performers with 60% or more on aggregate in the 3rd-year Statistics modules from UG BSc and a pass in 3rd-year Math equivalent to the HEI Math's curriculum. The students admitted annually are between 15 and 30 in number. Each student is allocated a study supervisor for the project module. The department has limited staff (10 academics) suitable to supervise, and there are also M- and D- students to supervise. The BSc Honours (Stats) program is the first of the prerequisites for enrolling for the MSc (Stats) degree program. Other criteria include requirements of meritorious achievements, such as the minimum of 60% and preparedness to conduct research at the M- level in the subject (Peck et al., 2015). Hence, a pass that leads to the BSc Honours (Stats) degree award is insufficient to be admitted to the MSc (Stats) study program. In the past years, pass rates were usually outstanding due to the high admission requirements for the BSc Honours. However, for the 2016 group, distress was demonstrated, in which the failure rate was beyond expectation. A fear that this distress would continue in other years beyond 2016 was registered and is explained in the problem statement below.

Problem statement

At this HEI, in the years 2016 and 2019 in particular, some BSc Honours (Stats) lecturers realized limited commitment to work and some students' ensuing poor performance. Among the identified problems, punctuality was lacking in some students, and rampant absenteeism was also noticeable in the room used as a student workplace. Some students did not honor UG student support and tutorial sessions that they were obliged to facilitate weekly but still claimed and demanded payment for those sessions. Quite a number of these students did not always submit their academic assignments before the due dates. Even when they presented late, many of them still performed poorly. A few did not qualify for semester examinations (exams) in some of the modules they took. In the semester exams, a good number of them failed. These observations signaled the possibility of an unacceptable failure rate, which could have been avoided. In order to counterweight the predominant miserable failure rate, the Department of Statistical Sciences (DSS), which is the one offering this Honours program, devised means and measures to prevent increases in shameful poor performance. The researchers who authored this paper determinedly investigated corrective and intervention measures and developed a model for the BSc Honours (Stats) groups.

Department members realized that some student PG groups were underperforming on written modules/courses, even though (only) a few were doing well. In the first semester, a student had failed so dismally that she would not pass at the end of the year, even if she were to improve dramatically in the second semester. She had fallen more than one module. Several others in the same group were so at risk that, without interventions, they would not pass at the end of the year. These were in a much better position as they still had a chance to succeed when assisted to improve. The attitude

of many of these students was identified as negative. For a good proportion of them, hard work was non-existent. The DSS suggested and implemented an inclusive intervention.

Student-at-risk

Someone at-risk is under some serious threat. At-risk students struggle in their studies, which could be anything from working to understand the concepts, financial problems, social problems, psychological issues, and other miscellaneous random problems that hamper their academic performances (Write, 2013). These students need temporary or ongoing intervention to succeed academically, without which they cannot succeed. The long-term outcome regarding at-risk students generally is a low likelihood of thriving into successful adulthood and accomplishing economic self-sufficiency. Some more features of at-risk students include emotional or behavioral problems, truancy, a lack of interest in academics, and a disconnection from the school environment, all summed into poor academic performance (Luthar & Sexton, 2004).

Intervention

An intervention is a coordinated effort to get someone to seek professional help with a severe problem (Platinga et al., 2008). Interventions are either direct or indirect. The natural approach classically includes approaching the person involved. In contrast, the indirect approach supports the individuals who intervene directly to encourage them to be more effective in assisting the at-risk individual. According to several authors, the Johnson, Arise, and Systemic Family Models are the three major intervention models commonly in use (Grimes, 2002; Miller & Rollnick, 2002; Zurong, 2013).

1. Johnson model

The Johnson model (JM) is a direct intervention approach. It requires the helping party to approach the person with a bad routine habit to make them aware of the potential costs of their habit (Poster & Linda Beliz, 1992). The method quickens the support before a crisis point is reached. In education, it forces at-risk students to change to behaviors that prevent failure and enable them to change to behaviors that can help them to perform satisfactorily.

2. Arise, intervention model,

The Arise Intervention model (AIM) is an indirect approach with which at-risk parties and their household are brought to a collective intervention process. According to Smith and Meyers (2007), the AIM is an invitational, transparent, and gradually escalating intervention process.

3. Systemic family model

The Systemic Family Model (SFM) can be invitational or confrontational. It differs from JM as it nurtures the at-risk individual with firm coaching (Townsend, 2006). Efforts to intervene promote discussions with the entire household on how the ‘family’ assists their at-risk member to change the bad habit identified and how to approach the problem as a unit.

Evaluation of the Intervention

Intervention effectiveness depends on the process it takes. When intervening for corrective measures, such intervention should be evaluated to make it fully effective. Evaluating the intervention

is a linked process consisting of innovation, assessment, reinforcement, and continuous engagement (Carless, 2015; Chalkidou et al., 2009; Salge & Vera, 2012; Strumsky et al., 2010). It is essential to be selective and methodical regarding intervention methods. The intervention process components are described below.

1. Innovation

Innovation is an original idea, device, or method soliciting improved solutions satisfying new requirements, implicit needs, or existing needs of the market (Heyne et al., 2010). It is an original and more effective viewpoint and, therefore, new, which penetrates the market or society. Innovation can generally be viewed as the result of a process combining various novel ideas to improve some aspects of culture. It may be linked to improvement in efficiency, increase in productivity, upgrading of quality, intensification in competitiveness, and increase in market share (Salge & Vera, 2012). Strumsky et al. (2010) clarify that innovation aims to convert inventive activity into tangible performance improvements. They also state that organizations can use innovation to improve benefits and performance by providing work groups opportunities and resources on top of the employee's core responsibilities.

2. Assessment

Assessment in teaching and learning entails attesting the knowledge and skills level learned, usually in measurable terms (Nelson & Dawson, 2014). It assists in obtaining information from tests about the success and abilities of students. Largely, it encircles every activity to help students to learn and measure their learning progress. Its three forms are formative, summative, or diagnostic systems of assessment.

Formative assessment *i*s normally conducted throughout learning to support learning (McTighe & O'Connor, 2005). It can be standardized tests, quizzes, oral questions, or draft work. Its activities are performed concomitantly with lessons to prepare the students for a final or summative assessment.

Summative assessment consists of examinations or projects to appraise what the students have learned to determine the notch to which they understand the subject matter (Earl, 2003). It is usually given habitually at the end of a course to allocate students a grade.

Diagnostic assessment measures evaluate students' existing knowledge and skills to identify the understanding of concepts just taught and identify intervention methods to reinforce learning (Carless, 2015). They are used to identify at-risk students. Therefore, a test could be set to determine if revision is necessary and how it could be done.

For effectiveness, an assessment should be both reliable and valid. A reliable evaluation consistently reaches similar results with the same cohort of students (Vergis & Hardy, 2009). Factors affecting reliability include clarity of questions, the number of options in a question paper, precision level in marking instructions, and the proficiency of markers, as poorly trained titles are unreliable and may cause ineffectiveness. Temporal stability, form equivalence, and internal consistency lead to assessment reliability. Furthermore, a valid assessment measures what it is intended to measure (Jonsson & Svingby, 2007). The assessment content of a test should measure the stated objectives. Also, instructions should be clear.

3. Reinforcement

Reinforcement is when there is strengthening or fortifying of learned material. In education, it entails devising methods to intervene to improve results. It also requires motivating students. Motivation in teaching and learning encourages students' persistence in striving to succeed. Noble instruction and a skillful instructional fit contribute to the cause. Motivated students are usually successful, as they feel good about their participation and success. Fabricating reinforcement strategies entails addressing specific behaviors and motivating students effectively to strengthen learning (Newcomer, 2009; Simonsen et al., 2008). Reinforcement urges a previous behavior to occur again. Since every class is dissimilar, numerous reinforcement types may motivate different students. Before starting with reinforcement, it could be worthwhile to survey students to determine what motivates (s) them. In learning in particular, reinforcers should be direct and invite students to learn, such as blended learning methods where various facilitation methods, including technology incorporation in learning, are used (Smith & Meyers, 2007; Serrano et al., 2019). This may include interactive methods using many teaching tools and computing methods to enhance reinforcement.

4. Continuous engagement

In order to maintain momentum and persistent focus in learning and long-lasting grasping of study content, it is sensible to practice continually because the loss of stress is caused by pausing or taking time off the exercises. When students are given tasks and activities to practice continuously, they learn discipline and get used to working independently. Continuous engagement can be integrated into innovation, assessment, and reinforcement. Uninterrupted learning through ongoing engagement can ensure no pausing in education. Teaching and knowledge without interruption provide a greater chance of high academic performance and improved student results.

5. Intervention methods

If intervention methods are geared to identify at-risk students early, then there can be higher prospects that the identified students can be given effective preventative 'remediation' measures (Chalkidou et al., 2009). Common examples of intervention methods in learning include remediating programs, revising previously taught lessons, and tutoring.

METHOD

The study's design was experimental, and the study subjects were BSc Honours students of the HEI. The method used in this study was an intervention process that was introduced to guide BSc Honours students' conduct and to guard them against continuing to demonstrate poor academic performance. This group was compelled to work in the DSS computer laboratory from 7h45 to 15h45 daily from Monday to Friday, except at lunch hours and two mini-breaks, some midway before and after the lunch hour. Therefore, the experimental study design was followed to control and manipulate the scenery of the study subjects. DSS staff members insisted on producing competitive postgraduates because the UG seemed to be covered well. As a result, they decided that when they train the PG students, they want to instill self-sufficiency attributes that should be notified when their graduates face peers. Generally, the students had expected to be overindulged, that is, spoiled, as was the case at UG, which is a weakness of this HEI.

Experimental design Step 1: Message of discontent

On the recommencement of the second semester, the DSS academics addressed the students regarding the gross dissatisfaction with the relatively poor performance experienced in the first semester. Lecturers pointed out some of the unwelcome conduct identified by the students, which was attributed to being the primary cause of the poor performance. The lecturers provided evidence of student truancy and late submission of assignments. Sometimes students came unprepared when they were required to make presentations. It was also made clear to the students that the BSc Honours (Stats) is a strictly full-time study program and that lecture attendance is compulsory with no exceptions. Due to the urgency and severity of the problem, the JM was applied at this stage. In addition, these students were also made aware that their tutoring services were obligatory because they had signed the contracts and were being paid for them.

Experimental design Step 2: Show relatively poor performance vs. predecessors

Students were shown their average semester pass rates relative to their predecessor groups and the comparisons of average (mean), median, modal, maximum, and minimum marks. The condition and behaviors of the previous groups were also presented relative to their own.

Table 1. Results of different student groups

	1st	2nd	3rd	4th	At-risk group 1	At-risk group 2	5th
Pass rate	100	96	92	100	78	81	100
Mean	65	59	56	72	46	52	62
Median	64	55	52	69	47	49	60
Maximum	78	74	77	91	89	86	93
Minimum	53	44	39	58	34	42	62

Experimental design Step 3: Students ordered to comply

The department used the advantage that BSc Honours (Stats) is a full-time study program requiring lecture attendance and punctuality. The students were ordered to attend and be punctual. There was also a monitoring and control measure given through high-frequency and short tests/assessments proposed by Seeletse et al. (2017). These assessments were meant to ensure that there would be no taking of a breather in learning and continuation of learning would be non-stop. Attendance was also enforced because the students had to embark on assessments continuously. The approach was both invitational and confrontational. Thus, the SFM was used because the DSS personnel have become a family blend of adults and youth who intermingle to develop talents and potential in the fields it offers. To some extent, AIM was used through some anxious MSc students who discussed with the BSc Honours group members, steered them, and guided them on numerous techniques and attitudes they could embrace to improve.

Experimental design Step 4: Continuous supervision

These agreed conditions were supervised repeatedly. Each lecturer's task at any time of the day was to randomly visit the PG computer laboratory of the department and present a small classwork or quiz to the students for their module(s). Only available students received the examination and benefited from participating in it. The marks obtained on quizzes were recorded in

small chunks that were made accumulative assessment marks. During these times, even the register of student attendance was taken.

RESULT AND DISCUSSION

The approach was a transformation that required the BSc Honours students to work full-time in the department for the first time. This kind of engagement with students did not seem to go well with the students. Many of the students were not happy with the development of being forced to be constantly working and practicing in the computer laboratory. This was the AIM model of confronting a problem (Smith & Meyers, 2007). Therefore, attempts from students to resist were visible. In the beginning, therefore, grumbling from the students was noted. Then the JM was imposed in the Honours tuition system with no option for the students to resist (Zurong, 2013), and the lecturers remained resilient with the initiative. There were no apologetic postures from the lecturers as they continued to give assessments and randomly took registers. This was a new culture of hard work and commitment instilled and imposed on the Honours student groups in the department. Performances of students and records of students' progress were documented. Students were regularly updated on their performance and their new conduct. These students struggled to follow the instructions in the first few (two to three) weeks. Some truancy and failure to honor tutorial facilitation existed during this period, but only among a few students. As we moved on, the students were getting used to the system, and truancy and poor conduct, in general, were fading. These students' marks on the small tests were generally lower when compared with the subsequent ones.

From the third week onwards, the students demonstrated to settle into the new conditions and accept the new authoritarian conditions. They showed a high level of presence when they were needed, their conduct was showing to gratify, and their academic performances started to improve gradually. They also stopped grumbling because many consulted their lecturers on the literary work. They also showed to have improved their attendance to conduct tutorial sessions. Progressively, there was some clear improvement.

The next few weeks showed to have stabilized, and the students were getting used to working and practicing in their laboratory. The final assessment marks of the first semester were then compared with those of the second semester to compare the two performances to determine the statistical significance of the intervention. Table 2 is the resulting test of comparison: pre-intervention vs. post-intervention

Table 2. t-Test: Paired Two Sample for Means

	pre	***post***
Mean	58.8	75.4
Variance	549.7	377.8
Observations	5	5
Pearson Correlation	0.926784268	
Hypothesized Mean Difference	0	
df	4	

	pre	*post*
t Stat	-4.07922745	
P(T<=t) one-tail	0.007554001	
t Critical one-tail	2.131846786	
P(T<=t) two-tail	0.015108002	
t Critical two-tail	2.776445105	

The mean before the intervention was at a low of 59% and increased by 16% to a high of 75% after the intervention. This is an increase in performance. Furthermore, the null hypothesis of equality of performance was tested against the one-sided alternative hypothesis that 'post-intervention improved the performance'. This null hypothesis is rejected since the p-value = 0.0075 < 0.05 significance level. Therefore, there is a sign at the 5% significance level that the intervention improved the students' performance.

For intervention as was described, JM was suitable due to limited time to negotiate and because there was a guideline from the HEI that full-time contact lessons should be conducted and that students should attend lectures. The DSS guidelines on the assessment required each lecturer to customize assessments for their modules. Because of its merit under the circumstances, JM was the principal intervention technique applied throughout the process. It was essential since the students were underperforming dismally, and they would probably have resisted if given/allowed the option. Other two intervention models (AIM and SFM) were also used in the process, but mainly as secondary techniques to fortify the JM. This blend was used to optimize the intervention.

The intervention given showed to be effective. These students' academic performances and their pass rates, in general, showed an improvement. However, the results were not the epitome because the failures inherited in the first semester contaminated the final group performance's final marks. The intervention could not reverse the damage already caused in the first semester. Among its merits, though, the intervention assisted one student in having an additional opportunity to present an examination in one module, which she passed and could graduate with other group members.

The study indicated that late intervention is not a good idea. It also shows the reason to identify students at risk of failing early on and interventions be embarked on before primary assessments are conducted. Late intervention could not undo some of the damage already caused. Early intervention could have counterbalanced many negative occurrences and prepared the students to do well in their studies to prevent poor student performance.

IMPLICATION OF THE STUDY

The study shows that PG students can also require additional support even when they are excelling at UG. The PG content and modes of teaching can present new and complex settings for many students, especially those from other universities who do not understand the institutional culture of their new HEI. Hence, the study shows that the PG level could require its induction, and student support should be provided to the BSc Honours when necessary.

CONCLUSION

Student support, as an intervention such as tutoring, was initially reserved for UG students at the HEI. This study showed that when planned and applied suitably, it can also benefit PG students. BSc Honours, as a PG program, benefited from it in this study. This intervention could become the practice method for PG students in other departments. Since BSc Honours is a transition phase from UG to PG, strict rules could be applied so that the students may become disciplined researchers at the MSc level.

Since the DSS personnel believe that high BSc Honours student performance should occur as students admitted have great potential from UG levels, a method to enforce this occurrence should be used. Hence, the study recommends the following:

1. Early identification of at-risk students and immediate intervention;
2. The primary use of the JM model at every group enrolling in the BSc Honours (Statistics) right from the beginning of the academic year;
3. That subsequent years' plans should be based on working methods, such as empirical results of this study; and
4. The students should be given small assessments frequently to ensure that they get used to working hard in preparation for workplaces and for more advanced PG studies of the future.

ACKNOWLEDGEMENT

The authors would like to thank Sefako Makgatho Health Sciences University.

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