

Project Report

The Confluence of Supplemental Instruction (SI) Programme Factors on Selected Student Outcomes in a Historically Disadvantaged University

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Abstract: This paper sought to describe the combined influences (confluence) of the various aspects of the supplemental instruction (SI) programme on selected student outcomes. It points out that the SI programme's influence goes beyond the reports about the improvement of marks, throughputs, and retention. It shows that the SI programme bears on the development of academic literacies, graduate attributes, the building of a sense of community, and the inculcation of ethos and practices necessary for academic success. Framed in the positivist paradigm and a quantitative approach, aspects of the supplemental instruction programme such as instructional methods, lecturer's attitude towards SI, accessibility of the SI leaders, lecturer and departmental involvement, and student-facilitator relationship were correlated with the variables of students' outcomes. The students' outcome variables were measured by the acquisition of academic literacies and competencies, improved performance in assessment tasks, sense of community and belonging, and assimilation into a university's culture and ethos. Using purposive/convenient sampling, 122 students who made extensive use of the SI programme were selected to participate in a survey. Data were analysed statistically using ordinal regression. The study's findings highlight the need to consider different constructs in the planning and implementation of the SI programme. It provides evidence of students' successful engagement with supplemental instruction and the factors that contribute to such success. This study helps foster an understanding of the various planning, design, and delivery aspects of the supplemental instruction programme, so that ways of making the SI programme effective are devised. The identified significant factors form the basis for the construction of an SI implementation conceptual framework.

Keywords: supplemental instruction (SI); students' outcomes; regression; peer-assisted learning (PAL)



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1. Introduction

Studies across the world have shown that there are lots of reports on students' underperformance in universities [1–4]. De La Rosby [2] notes that about 75% of students leave universities without earning a degree after spending the first two full years of study. Similarly, Cornelius, V., et al. [5] posits that in Australia, almost one out of five Australian students drop out of their studies towards the end of their first year. These reports on students' underperformance have made many universities to think of interventions and many universities have implemented different supporting measures that have a high impact in terms of promoting positive student outcomes [4,6]. One of the programmes that seek to improve throughput rates and outcomes is the supplemental instruction (SI) programme. The SI programme was first introduced at the University of Missouri-Kansas City by Dr Dianne Martin in 1973. This voluntary programme has a non-remedial approach to learning that supports students on high-risk modules. Its purpose is to increase retention, improve student grades and student graduation rates [7].

The SI programme is one of the interventions that appreciates intrinsically directed learning, as well as the unique experiences, backgrounds, and learning styles of each

student. It incorporates academic literacies at higher education institutions to enable or build a student that succeeds both academically and whose psycho-social well-being is well taken care of [8,9]. The SI programme emphasises the development of study skills, the acquisition of academic literacies, and the fostering of social acculturation at universities [10]. It is premised on peer learning [11], in an informal setting and accentuates peer collaboration [12,13]. Studies on the SI programme show that students learn better when they interact with their peers. Peer learning enables students of any institution to interact with their peers to the same level that is less intimidating and authoritative [14,15]. Furthermore, peer facilitation aims at improving students' academic performance by engaging them in strategies of deciphering and exposing concepts [16]. The supplemental instruction (SI) programme implies that there should be an interaction between a less competent person and a more competent person as to encourage the less competent person to be independent and perform better in the future [17]. In this context, it is assumed that students would learn more than the content in class and develop study skills and independence. It is unlike traditional methods, where learning is a chore and offers little or no motivation for students to participate or interact.

Supplemental instruction is a programme developed by Dianne Martin in 1973 in the United States of America at the University of Missouri-Kansas City. It is student-centred, encourages students' interaction, collaboration, sharing, and exchange of ideas amongst students. However, this programme is attended voluntarily, which could pose a challenge for coordinators or SI leaders [18]. The programme affords the students an opportunity to discuss and process course information through scheduled out-of-class and peer-led sessions. In the case of the targeted university where this study was conducted, SI targets modules that had less than 50% pass rate in the last three years were found. At-risk courses such as Philosophy 1, Physics, Mathematics, Taxation, and Accounting 1 are some of the examples of these traditionally at-risk modules. In SI sessions, students are encouraged to be interactive and participative through the effective use of SI strategies such as group work, pair-share, and other study skills [19,20]. The benefit of attending these sessions is that students get to learn more than the course content, including study skills and other relevant skills that make a well-rounded student. This study sought to gain a deeper understanding from the vantage point of the beneficiaries, students' outcomes associated with first-year students' involvement with supplemental instruction, and the factors that explain and/or give rise to the realisation of student outcomes through the SI programme.

2. Literature Review

There have been several studies conducted on the effects and impact of SI sessions at universities. For example, Bowles, et al. [13] and Vorozhbit [16] reported that the effects of the use of SI have had a noteworthy influence on students' academic successes. Furthermore, the attendance to SI sessions has also increased students' confidence levels as they interacted with their peers [21]. With respect to attendance as a variable, it is found that students need to attend more than one SI session to see improvements in their academic performance and to improve on their study skills [14,22]). Dawson, et al. [23], added that the effectiveness of attending SI sessions increased average marks, a percentage increase of students' throughputs and pass rates, as well as an increase in retention in courses supported by SI.

Buchanan, et al. [12] explain that student retention is most paramount in higher education, and that is why institutions have initiated PASS. Furthermore, Manduna [22] supported the above statement by stipulating that the SI also contributed to the improvement in the performance of assessment tasks, which are improvements beyond the course content, implying that SI has an impact on enabling the development of academic skills, the student's general wellbeing, and enhancing social relationships.

The benefits of attending SI sessions are that students get to be independent learners [18] and get to be interactive and collaborative [24]. Latino and Unite [25] suggest that SI targets courses that have high rates of failure, high drop-out rates, and withdrawals

from already-admitted students. SI is also considered as a sensible investment for ensuring student retention and success [26]. These are some of the benefits of implementing the SI programme. Although there are several benefits of SI, Ribera, et al. [21] proposed that whilst there is “positive relationship between SI and student achievement and retention, little is known about how SI relates to other forms of effective educational practices”. This has presented a gap for this study to be conducted, especially in an HDU.

Besides, the impact of SI on students’ outcomes in higher education cannot be overemphasized. Several studies have been conducted to measure the impact and significance of the connection between SI and students’ outcomes [13,27,28], and [29]. Bowles, et al. [13] empirically proved through a statistical technique that the attendance of the supplemental instruction programme in first-year level courses increases the chances of timely completion of studies by 11%. This is visible in the improvement in students’ academic performance recorded in their course grade and retention. Similarly, Shannon, et al. [30] contend that the effects of SI on students’ outcomes centre on extended learning time which brings about learning opportunities, academic abilities, and stimulates a sense of belonging among students. Students can engage in diverse programmes which help boost their academic performance.

Arendale [31] argues that many key elements of SI distinguish it from other kinds of academic support for students. This is because of the way SI is structured and organized in universities. The SI programme is attached to specific modules known to be difficult for students. Trained SI leaders are attached to specific courses and those SI leaders facilitate the group discussion or tasks and monitor the group through appropriate learning strategies that the students can adopt on their own [32]. The SI leaders are supervised and monitored by a trained professional member of staff. This is to ensure that the purpose of learning support that is meant to be given to the students by SI leaders is achieved. Arendale [31] notes that although the SI programme is for students, they are voluntary to attend for any student who needs academic support. The essence of the programme is to render academic learning support for students who need assistance in any courses or cannot cope with some courses on their own. The willingness of the students to ask for help matters, since the SI programme is voluntary and not compulsory; hence, students are expected to embrace the academic support that is offered by the SI leaders through the SI programme.

Similarly, Johnson [33] notes that the SI programme is structured in universities in such a way that academic assistance is provided by SI leaders through collaborative learning approaches. This is because the programme is targeted to assist and render support to students who need support in difficult courses. Arendale [18] posits that the SI programme offers support to students who are having challenges in “historically difficult courses. The courses are referred to as historically difficult courses because more than 30% of students scored D, F, or W as their final grades in those courses. Hence, those courses are difficult for some students, and, as such, they need support to help them to improve their performance in those courses. Johnson [33] argues that the fundamental idea of the SI programme is that the programme focuses on difficult courses or high-risk courses instead of high-risk students. This is vital because many students find some courses challenging. This helps to create the consciousness of encouraging students to embrace the advantage of useful assistance provided for them in the SI programme.

3. Problem Statement

Several studies (e.g., [12–14,17,21,24]) have focused on experiences of students and how the SI model is designed. However, a survey of literature on the supplemental instruction programme suggests a paucity of scholarship on the effects of SI on students’ outcomes in a South African context, within an HDU context. Nyoni [34] defined the term HDU as the several universities, mostly in rural areas, in South Africa that were developed during the apartheid regime to admit Black people or non-White people. This was designed to prohibit racial integration at schools between Black people and White people [35] and thus still needs more development. A study by [36] focused on the effects of SI on nursing

students. However, this study's focus on a particular discipline is narrow and does not provide findings that could be generalised to all the other disciplines. [15] investigated how the SI programme is experienced by students and revealed the regression tendency to "emulate practices of lectures and tutors" by supplemental instruction leaders. Furthermore, most identified studies have been offering an international lens on understanding the implementation of SI ([18,21,26,37], and [14]. This presented itself as a gap for future research, which is why the focus of this study is to measure the influence of some aspects of the programme on selected students' outcomes within a South African context, especially within a rural university. The following research questions framed and focused the study.

1. On which student outcomes has the SI programme claimed to be successful by students in a historically disadvantaged university?
2. Which supplementary instruction (SI) programme aspects significantly influence students' outcomes in a historically disadvantaged university?
3. What is the confluence of supplementary instruction (SI) programme aspects on selected students' outcomes in a historically disadvantaged university?

4. Purpose of This Study

There have been several studies on the implementation of the SI programme. However, less work has been performed to determine the success of the SI model in terms of influencing students' outcomes in a historical disadvantaged university (HDU). Thus, the purpose of this study is to determine the aspects of the SI programme, an international programme, that have a bearing on the achievement of students' outcomes in a rural-based institution.

This study contributes to the body of knowledge about the variables that influence the success of an SI programme as well as the combined influence of these variables on selected students' outcomes. The findings of this study have a beneficial value for the SI coordinators, especially in the implementation process of the SI programme. This study, therefore, sought to shed light on the aspects that influence the SI programme in the realisation of students' outcomes. This study seeks to offer SI programme managers knowledge and insight on the factors that constitute to a successful SI programme, and the areas where these successes are claimed by most students. For methodological purposes, the instrument devised for the data collection offers insights on the variables that influence students' outcomes. In addition, it forms the basis upon which a more standardised tool could be devised and developed. It further suggests an SI implementation framework for a rural-based disadvantaged university.

5. Methodology

5.1. Research Design

This study employed survey research using a structured questionnaire. The choice of the survey was informed by its ability to allow many participants to express their views. In this research, it is used to show connections between existing conditions and their relationships with one another. Relevant dimensions of phenomena are flashed out whilst also allowing the use of different research purposes, namely description, exploration, analysis, confirmation, and explanation [38]. Thus, the survey design is deployed in this research to describe aspects of the SI programme that are deemed necessary for the programme's success, as well as students' outcomes that the SI programme has a bearing on. The survey data are also used to infer significant connections between the various aspects of the SI programme and students' outcomes. The limitation of the chosen design, namely, a survey is that it gathers self-reported data. The triangulation of methods (mixed methods design) would have ensured a more comprehensive understanding of the SI programme factors that influence students' outcome variables. In addition, an experimental design would have allowed for the control of extraneous variables. A larger sample size would have ensured better representativity and a balanced or more proportional

representation of the faculties and departments that make use of the SI programme and not just willing students.

5.2. Data Collection

The sample comprised 122 participants who participated in the SI programme in their first year of study and were drawn across disciplines in one rural-based campus of the university. These participants were selected purposively and conveniently based on their participation in the SI programme. SI session attendance records were used to invite the participants. The frequency of attendance to SI sessions was used as an inclusion criterion. The sample size of 122 was thought to be large enough to allow for the applicability of findings to the average 660 of SI programme takers in any given year in this university.

The questionnaire (survey) on the variable effects of supplemental instruction on students' outcomes in an HDU consisted of various sections, as follows: Section 1 sought to profile the participants in terms of faculty, number of modules for which SI sessions were attended, and the current year of study. Section 2 of the questionnaire consisted of predictor variables on the various aspects of supplemental instruction. The items for this section addressed the following issues: 1. SI leaders' facilitation methods; 2. lecturer's attitude towards SI; 3. scheduling of SI sessions; 4. monitoring of SI attendance by the lecturer; 5. SI leader–student relationship; 6. space for collaboration and transactional learning in the SI venues; 7. engagement, sharing, and exchange of ideas in the sessions; 8. follow-ups and tracking of progress by SI leaders; 9. focus on the mastery of contents of subjects in SI sessions; 10. encouragement to attend SI sessions by classmates; and 11. accommodation of individual learning needs in SI sessions. Section 3 consisted of students' outcomes which were represented by the following items: acquisition of academic literacies; improvement of marks in the assessment tasks; unlocking, exposing, and unpacking of difficult areas in the subject's contents; a sense of community and belonging; assimilation into the culture and ethos of the university; acquisition of study skills; and the development of graduate attributes.

5.3. Data Analysis

The analysis began with the presentation of the profile of the research participants, in terms of their faculties and the modules for which SI sessions were attended in their first year of study. This was followed by the presentation of the descriptives, namely frequencies and percentages on the aspects of the supplemental instruction programme and the selected students' outcomes (see Supplementary Materials).

This inferential study involved more than one predictor variables, namely 11 explanatory variables on the 7 learning outcome variables to infer variability in the effectiveness of a supplemental instruction programme. Thus, ordinal regressions were used since the questionnaire had all variables in the nominal and ordinal scales. The researchers sought to identify which single factor or a combination of factors best explained the variance on the influence of supplemental instruction on selected students' learning outcomes. The data for ordinal regression were captured, coded, and analysed using standard personal computer software called Statistical Package for Social Sciences (SPSS) version 24. Regression is a useful tool to analyse the relationship between multiple explanatory variables and outcome variables [39]. Considering the measurement scales used, [40] maintain that if researchers wish to study the effects of explanatory variables on all levels of the ordered categorical outcomes, an ordinal regression method is more appropriate for valid results. In this instance, both the predictor variables and the outcome variables were ordinal scales (Likert scale data) [41].

The pseudo-R square, that is, the Nagelkerke statistic, was used to gauge the percentage variance or degree of change on students' outcomes (dependent variables) and is explained by the SI programme's aspects or factors (predictor variables). Additionally, goodness-of-fit results were used to ascertain whether the ordinal regression models fitted the data very well. Lastly, the *p*-values for each of the predictor variables were used to check

their significant contribution or influence on the 7 students' outcome variables. Through this process, significant and/or insignificant explanatory variables on the questionnaire's data were discovered. The objective was to ascertain the explanatory variables that best explain variations on each of the 7 students' outcome variables.

6. Results

6.1. Descriptive Results

6.1.1. Profile of the Research Participants

The descriptive profile of the sampled SI participants consisted of students from different faculties, namely 47 Science and Agriculture (35.5%), 48 Social Sciences and Humanities (39.3%), 19 Management and Commerce (15.6%), 5 Education (4.1%), and 1 Health Sciences (0.8%) students. The number of modules for which SI sessions were attended by the participants were as follows: 1 module (39 students (32%)), 2 modules (49 students (40.2%)), 3 modules (12 students (9.8%)), and 4 modules (21 students (17.2%)).

6.1.2. Aspects of the Supplemental Instruction (SI) Programme

Table 1 below presents a descriptive summary of some aspects of the supplemental instruction (SI) programme which were thought to have an effect on the selected students' outcomes. The frequencies for the "strongly agree" and "agree" affirmation responses are reported. The cumulative percent reports on these collapsed and combined two response categories. The table presents only the affirming response categories in relation to some aspects of the SI programme. The "disagree" and strongly "disagree" response categories are not reported but can be found in the annexure (see the link below the reference list).

Table 1. Aspects of the Supplemental Instruction (SI) programme.

Items on the Aspects of the Supplemental Instruction (SI) Programme	Frequency		Cumulative Percent
	Strongly Agree	Agree	
1. SI leaders' facilitation methods enhanced The understanding of concepts.	47	69	95.9%
2. The scheduling of SI sessions ensured availability and accessibility of students.	37	74	92.5%
3. Individual learning needs were accommodated in SI sessions.	35	66	84.9%
4. Classmates encouraged attendance of SI sessions.	19	43	53%
5. SI sessions focused on the mastery of the subject outcomes.	37	71	92%
6. SI leader checked up on me and kept track of progress and performance.	37	41	67.2%
7. SI sessions were characterized by engagement, sharing, and exchange of ideas.	52	61	95%
8. SI session venues allowed space for peer collaboration and transactional learning.	44	61	87.5%
9. The student–SI leader relationship created an atmosphere conducive for learning.	41	68	90.1%
10. The lecturer's attitude towards SI fostered attendance of SI sessions.	28	57	72%

All the above SI programme aspects were affirmed as important in the design and development of a successful SI programme. Although the role of classmates in encouraging attendance of SI sessions and follow-ups by the SI leaders were the least scored, they are, however, acknowledged by more than 50% of the students as important in the success of the SI programme.

6.1.3. Selected Students' Outcomes

Below is Table 2 on the selected students' outcomes which were thought to be the potential benefits of the supplemental instruction (SI) programme. The table reports on the frequencies of the response categories that affirm ("great extent" and "fairly well") the SI programme's responsiveness to the achievement of these outcomes.

Table 2. Selected Students' Outcomes.

Items on Selected Students' Outcomes	Frequency		Cumulative Percent
	Great Extent	Fairly Well	
1. Acquisition of academic literacies such as scientific reading and writing.	30	72	85.7%
2. Marks for various assessments improved.	52	47	83.2%
3. SI sessions unlocked, exposed, and unpacked difficult areas in the content of subjects.	48	53	84.9%
4. SI attendance enabled assimilation into the culture and ethos of the university.	25	47	63.7%
5. Acquisition of study skills as a result of SI sessions.	40	55	79.8%
6. SI sessions offered a sense of community and belonging to the discipline and the university.	33	59	79.3%
7. SI sessions developed graduate attributes such as responsibility, independent learning, self-monitoring, etc.	49	54	86.6%

The above table shows that the above students' outcomes that were confirmed by the participants, although in varying degrees, which they were achieved with their involvement with the supplemental instruction (SI) programme. The SI programme's enablement of assimilation into the culture and ethos of the university, although at the bottom of the list, is acknowledged by more than 60% of the students as an outcome that is fostered by the attendance to SI sessions.

6.2. Inferential Statistics

As suggested by [21], ordinal regression analysis was performed to establish (1) the percentage variance that is explained by the model and the predictive ratio of the model; (2) the explanatory variable items that best explain the variable effects of supplemental instruction (SI), that is, the effects of the different explanatory variables by looking at the Wald test statistics on the selected students' outcomes; as well as (3) the data–model fit which indicates if the model is a good fit for the data (see Supplementary Materials). The presentation of the results with the 7 selected students' outcomes as organisers is outlined below.

6.2.1. Acquisition of Academic Literacies and Competencies Such as Scientific Reading and Writing Because of Attendance to SI Sessions

As shown in Table 3, the pseudo-R-square with Nagelkerke (0.581) suggested that 58.1 percent of the variations in the acquisition of academic literacies and competencies is significantly explained by supplemental instruction (SI) leaders' facilitation methods that enhanced understanding of concepts (0.00), and the scheduling of SI sessions that ensured availability and accessibility of the students (0.03). The monitoring of SI attendance by lecturers (0.05) and the SI leaders' follow-ups and keeping track of progress and performance (0.01) also significantly correlated with the acquisition of academic literacies and competencies. Pearson's chi-squared test ($X^2 = 320.071$ with d.f. of 284 and $p = 0.069$) showed consistency between the observed data and estimated values. Thus, the non-significant result indicates that the model fits the data very well.

Table 3. Acquisition of Academic Literacies and Competencies.

Goodness-of-Fit			
	Chi-Squared Test	df	Sig.
Pearson's Test	320.071	284	0.069
Deviance	135.731	284	1.000
Link function: Logit.			
Pseudo R-Square			
Cox and Snell		0.499	
Nagelkerke		0.581	
McFadden		0.353	
Link function: Logit.			

6.2.2. Improvement of Marks for the Various Assessment Tasks (Assignments, Tests, and Examinations) Because of Attendance to SI Sessions

The pseudo-R-square with Nagelkerke (0.824) shows that the model explains 82.4 percent of the variance in the improvement of marks for the various assessment tasks because of attendance to SI sessions. This is illustrated in Table 4 below. The significant predictors were lecturers' attitudes towards SI which fostered attendance to SI sessions (0.00), and peer collaboration and transactional learning in SI session venues (0.00). Pearson's chi-squared test ($X^2 = 237.718$ with d.f. of 284 and $p = 0.979$) showed consistency between the observed data and estimated values. This large and non-significant value suggests that the model fitted the data very well.

Table 4. Improvement of Marks for the various Assessment Tasks.

Goodness-of-Fit			
	Chi-Squared Test	df	Sig.
Pearson's Test	237.718	284	0.979
Deviance	166.392	284	1.000
Link function: Logit.			
Pseudo R-Square			
Cox and Snell		0.737	
Nagelkerke		0.824	
McFadden		0.593	
Link function: Logit.			

6.2.3. The Sessions Unlocked, Exposed, and Unpacked Difficult Areas in the Content of Subjects

Table 5 below shows the test result of 0.589, that is, 59.8 percent of the variations on the extent to which SI sessions unlocked, exposed, and unpacked difficult areas in the content of subjects are explained by a positive correlation with SI leaders' facilitation methods (0.03). This outcome also correlated significantly with lecturers' attitudes towards SI which fostered attendance to SI sessions (0.01), and the focus of SI on the understanding of contents of subjects (0.00). Pearson's chi-squared test ($X^2 = 178.323$ with d.f. of 284 and $p = 1.000$) showed consistency between the observed data and estimated values, and therefore, a good model–data fit.

6.2.4. SI Sessions Offered a Sense of Community and Belonging to the Discipline and the University

The Nagelkerke (0.516) results in Table 6 suggested that 51.6 percent of the variance in SI sessions offering feelings of community and belonging to the discipline and the university is explained by the following significant predictor variable: SIL's facilitation methods (0.00).

The monitoring of SI attendance by lecturers encouraged attendance of SI sessions (0.05) and significantly correlated with this outcome. Other significant contributors included the student–SI leader relationship that creates an atmosphere conducive for learning (0.01) and peer collaboration and transactional learning in SI session venues (0.00). The significance of Pearson’s chi-squared test ($X^2 = 205.466$ with d.f. of 275 and $p = 0.999$) showed consistency between the observed data and estimated values, suggesting an adequate data–model fit.

Table 5. Unlocking, Exposing, and Unpacking Difficult Subject Contents.

Goodness-of-Fit			
	Chi-Squared Test	df	Sig.
Pearson’s Test	178.323	284	1.000
Deviance	148.332	284	1.000
Link function: Logit.			
Pseudo R-Square			
Cox and Snell			0.528
Nagelkerke			0.598
McFadden			0.351
Link function: Logit.			

Table 6. Sense of Community and Belonging.

Goodness-of-Fit			
	Chi-Squared Test	df	Sig.
Pearson’s Test	205.466	275	0.999
Deviance	156.498	275	1.000
Link function: Logit.			
Pseudo R-Square			
Cox and Snell			0.453
Nagelkerke			0.516
McFadden			0.286
Link function: Logit.			

6.2.5. SI Attendance Enabled Assimilation into the Culture and Ethos of the University

Table 7 below shows a total of 47.4 percent (0.474) of the variance in the assimilation into the culture and ethos of the university was enabled by SI attendance. This effect is explained by the SI leader’s facilitation methods to a great extent (0.00). The follow-ups and tracking of progress and performance by SI leaders were significantly associated with the above-mentioned outcome (0.01). The significance of the test with Pearson’s chi-squared test ($X^2 = 251.684$ with d.f. of 266 and $p = 0.727$) showed the goodness of fit between the model and the data.

Table 7. Assimilation into the Culture and Ethos of the University.

Goodness-of-Fit			
	Chi-Squared Test	df	Sig.
Pearson's Test	251.684	266	0.727
Deviance	192.636	266	1.000
Link function: Logit.			
Pseudo R-Square			
Cox and Snell	0.435		
Nagelkerke	0.474		
McFadden	0.230		
Link function: Logit.			

6.2.6. Attendance in SI Sessions Enabled the Acquisition of Study Skills

The Nagelkerke (0.674) test results in Table 8 suggested that 67.4 percent of the variation in the acquisition of study skills is influenced by peer collaboration and transactional learning in SI session venues (0.00). There was a significant positive association with follow-ups and tracking of progress and performance (0.01). The significance of Pearson's chi-squared test ($X^2 = 236.608$ with d.f. of 284 and $p = 0.981$) showed a greater than 0.05 level of significance, which indicates a good model fit to the data.

Table 8. Acquisition of Study Skills.

Goodness-of-Fit			
	Chi-Squared Test	df	Sig.
Pearson's Test	236.608	284	0.981
Deviance	141.363	284	1.000
Link function: Logit.			
Pseudo R-Square			
Cox and Snell	0.602		
Nagelkerke	0.674		
McFadden	0.411		
Link function: Logit.			

6.2.7. SI Sessions Developed Graduate Attributes Such as Responsibility, Independent Learning, and Self-Monitoring

A total of 74.1 percent of the variations with Nagelkerke (0.741) concerning the development of graduate attributes is influenced positively by peer collaboration and transactional learning in the SI venues (0.02). Follow-ups and tracking of progress and performance by SI leaders (0.053) are also significantly associated with the development of graduate attributes in SI sessions. Pearson's chi-squared test ($X^2 = 158.980$ with d.f. of 284 and $p = 1.000$) showed consistency between the observed data and estimated values and suggests an adequate model–data fit. These results are shown in Table 9 below.

Table 9. Development of Graduate Attributes.

Goodness-of-Fit			
	Chi-Squared Test	df	Sig.
Pearson's Test	158.980	284	1.000
Deviance	113.309	284	1.000
Link function: Logit.			
Pseudo R-Square			
Cox and Snell			0.651
Nagelkerke			0.741
McFadden			0.499
Link function: Logit.			

7. Factors/Aspects of the Supplemental Instruction Programme Affecting Students' Outcomes

Arising out of the foregoing analysis, the SI factors that influence students' outcomes are identified. The presentation of the aspects of the supplemental instruction programme that had a significant contribution on the realisation of students' outcomes is outlined below.

- 7.1 The SI leader's following up and keeping track of progress and performance was found to have a significant influence on the (1) acquisition of academic literacies and competencies, (2) assimilation into the university culture and ethos, (3) acquisition of study skills, and (4) development of graduate attributes.
- 7.2 Supplemental instruction (SI) leader's facilitation methods significantly correlated with the (1) acquisition of academic literacies and competencies, (2) SI sessions unlocking, unpacking, and exposing difficult areas in the contents of subjects, (3) development of a sense of community and belonging, and (4) assimilation into the university culture and ethos.
- 7.3 Peer collaboration and transactional learning was linked to the (1) improvement of marks, (2) the development of a sense of community and belonging, (3) acquisition of study skills, and (4) the development of graduate attributes.
- 7.4 The lecturer's attitude towards supplemental instruction (SI) was found to be significantly related to the (1) improvement of marks and (2) with SI sessions unlocking, unpacking, and exposing difficult contents of subjects.
- 7.5 Monitoring the attendance of supplemental instruction (SI) sessions significantly contributed to the (1) acquisition of academic literacies and competencies, as well as the (2) development of a sense of community and belonging amongst students.
- 7.6 The scheduling of supplemental instruction (SI) sessions significantly influenced the acquisition of academic literacies and competencies of participants in the SI programme.
- 7.7 The focus of supplemental instruction (SI) sessions had a significant effect on the unlocking, unpacking, and exposition of difficult areas in the contents of subjects.
- 7.8 The student-supplemental instruction (SI) leader relations fostered the development of a sense of community and belonging on the part of the SI programme participants.
- 7.9 The following three factors, namely (1) engagement, sharing, and exchange of ideas in supplemental instruction (SI) sessions, (2) encouragement to attend SI sessions by classmates, and (3) accommodation of individual learning needs in SI sessions, were not significantly related to any of the students' outcomes.

8. Discussion

From the findings, it would seem that the facilitation methods of the SI leaders, peer collaboration and transactional learning, follow-ups on and tracking of students' progress, lecturers' attitude towards SI, and monitoring of SI, are significantly influencing most of the students' outcome variables. These successful aspects of the SI programme need to be consolidated. Aspects that showed little influence, such as the focus of SI programme,

scheduling of SI sessions, and the SI leader–student relationship, need further probing so that these aspects are improved and further developed to be able to have a more significant effect on the SI programme. Previous studies on the impact of SI confirm that the SI programme has played a significant role in student development over the years [13,22]. For example, reference [21] maintained that SI has a positive effect on students' academic and social relations. Williamson and Goldsmith [10] support the findings in suggesting that students must improve on more than academic work to succeed in higher education, thus building an all-rounded student. Many scholars such as [16,17,20,24,26] have also corroborated the findings that SI has several effects and impacts on students who attend SI sessions. However, very few studies have investigated other students' outcomes. It is also significant that this study has investigated other students' outcomes such as a sense of community and belonging, as well as assimilation into the culture and ethos of a university. This study showed significant benefits on these outcomes, although with less significance on the degree of change or improvement. Moreover, this study made use of SI impacts on how students take part in engagements at a university, whether it is to understand the culture of the university or being engaged as part of the university community [24]. The findings on the explanatory variables suggest that SI facilitation methods, peer collaboration, and transactional modes of learning in SI sessions explain most of the students' outcomes. The methods of the SI programme, coupled with follow-ups, monitoring, and keeping track of participants, as well as lecturers' attitude towards SI explain the success or otherwise failure of the SI programme. However, literature has paid limited attention in these regards. The three factors that were not linked to any of the students' outcomes were as follows: (1) engagement, sharing, and exchange of ideas in supplemental instruction (SI) sessions, (2) encouragement to attend SI sessions by classmates, and (3) accommodation of individual learning needs in SI sessions. These three factors need to be improved and further investigated as potential intervention areas for further development of the SI programme framework and model.

9. Implications

Beyond the replication of this study in other historically disadvantaged universities (HDU), this study could be conducted in all universities, irrespective of their location or situation. The results of this study also point out the need for investigations on SI programmes to be conducted in further studies. For example, there is need for an analysis of multiple factors that account for a successful SI programme. Statistical modelling needs to be performed to inform universities about an SI programme that could be developed, not only for rural-based universities but for all universities that offer the SI programme for at-risk modules or courses. Identified aspects of the SI programme that had less significance on students' outcomes need to be investigated further to see how these could be optimally enhanced and have a greater effect on students' outcomes.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/educsci13111145/s1>, Supplemental Instruction Descriptive and Inferential Analysis Results.

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