Exploring Undergraduate Research Projects Success Factors in Muni University, Uganda

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Abstract: *This paper presents the success factors for undergraduate research projects (URPs) at Muni University. The objectives of the study were to determine the relevant skills required for the success of URPs and investigate the roles of students, supervisors and faculty towards the success of URPs. The study used a cross-sectional design to collect data from 70 third-year (final year) students who belonged to the two (2) faculties of science and technoscience. The participants were selected using the purposive sampling technique since they belonged to the section of the students' population that had undergone the execution of the URPs. SPSS-v.21 program was used to determine the reliability of the research instrument and analyse the collected data using the frequencies, percentages and median of the parameters that formed the constructs of the study. The research instrument was reliable at Chronbach's alpha 0.9038. Results showed that research environment, research management, personal effectiveness, communication, networking and teamwork skills are paramount to the success of URPs. The study also found out that the key stakeholders (students, supervisors and faculty) perform their roles throughout the project period. However, there is a need to have a mechanism for project tracking, filing complaints, and having URPs externally examined, among others.*

Keywords: Undergraduate students, Research projects, Success factors, Muni University, Uganda

1. Introduction

In many universities worldwide, undergraduate students are expected to complete research projects that form part of key requirements leading to the fulfilment of programmes' completion prerequisites. Before gaining experience from the industry, the quality and level of innovativeness of fresh graduates from universities are significant in the research projects they are able to complete. According to the approved curriculums of Muni University by the National Council of Higher Education, final year students are taken through a research methodology course. They are expected to successfully design and execute a research project before their graduation.

In Muni University, undergraduate research projects are categorised in three (3) forms; (1) final year project, (2) senior capstone project and (3) course-based projects. The final year project is done by students of Bachelor of Science in Information Technology (BSc. IT), and Bachelor of Science with Education (BSc. Ed), whereas Capstone projects are done by students offering Bachelor of Information Systems (BIS) (Programme of Bachelor of Science in Information Technology, 2010; Programme for the Bachelor of Information Systems Degree, 2012; Programme of Bachelor of Science with Education, 2015). These research projects are described below, with a focus on the final year project and a senior capstone project.

*Final year research project at Muni University***:** The third-year (final) year students are expected to write a research project proposal largely of their own and direction in the field of study under the guidance of academic supervisors. At the end of the first semester, students submit their proposals and deliver an oral presentation of their research proposals to a panel of examiners describing their intended research. In the second semester of the final year, students implement a research project largely of their own and direction in the field of study while under the guidance of academic supervisors. Students submit research reports at the end of the final year summarising the findings of their research. Students also deliver oral presentations to a panel of examiners describing their research findings at the end of the second semester.

Capstone information system projects at Muni University: According to the Bachelor of Information Systems' curriculum, the capstone project covers "*project proposal writing, feasibility studies, intellectual property, teamwork, budgets, schedule management; professional communications (reports and presentations), design, implementation, testing. The course gives students the opportunity to show individual creativity and originality, to apply where appropriate the knowledge and skills learnt throughout Information System (IS) programme, and to demonstrate investigative, problem-solving and other transferable skills.*" (Programme for the Bachelor of Information Systems Degree, 2012, p.118),

Course-based projects at Muni University: Course-based projects are projects that are done during the progression of undergraduate students, from the time they report in the first year to the time they complete their programmes, as part of the fulfilment for the completion of different courses under different programmes. Usually, the management of such projects is at the discretion of the course's teacher under the guidance of the course curriculum.

According to Maltese et al., (2017), the key role players in the success of undergraduate research projects (URPs) are; student, supervisor/faculty mentor and faculty (SSF). Many advocates for URPs have investigated the role of URPs, especially in science, technology, engineering, and mathematics (STEM) related programmes. For example, a nationwide study by Olson & Riordan (2012) showed that universities in the United States had embraced early undergraduate research experience, and this has resulted in improved the learners' grades and confidence in pursuing further studies in STEM programmes and thus recommends discovery-based research courses to replace the ordinary laboratory-based courses with. Also, in a monograph, Walkington (2017, p.5) supports the recognition of undergraduate research as a pedagogical driver for 21st-century knowledge acquisition in which an inquiry-based model is advanced in a collaborative manner between the students and teachers/learning facilitators. The writer "*takes students as researchers in a higher education context to mean a pedagogic approach to supporting students in their engagement with undergraduate research within and/or beyond the formal curriculum with the aim of furthering their own knowledge and understanding, and in some cases contributing to, the broader knowledge base of their discipline*".

Despite the recent studies championing the involvement of undergraduate students in authentic research as a critical part in fulfilling the requirements for their undergraduate programs in preparation for future academic pursuance, workforce and counteracting the 21st-century global challenges (Maltese et al., 2017), little research has been conducted to explore the success of URPs.

As a prerequisite for graduation, students work with their faculty and faculty mentors to assist in ongoing undergraduate research projects in many universities across Uganda. Yet to date, few studies have investigated the extent to which students are involved in undergraduate research. This study aims at bridging the knowledge gap regarding the management of URPs in Uganda, thus improving the literature in the same area. Therefore, the study investigates the success factors for undergraduate research projects, inform of graduation and capstone projects at Muni University

1.1 Objectives of the Study

In responding to the purpose of the study, the following objectives were formulated to:
- Determine the relevant skills required for the success of undergraduate research projects.
- Ascertain the roles of students in the success of undergraduate research projects.
- Assess the roles of supervisors towards the success of undergraduate research projects.
- Examine the role of faculty in the success of undergraduate research projects.

2. Literature Review

Undergraduate research can be defined as original work conducted by undergraduate students working in collaboration with a faculty mentor. It is either an inquiry or investigation conducted by an undergraduate student that results in an innovative contribution to the discipline (Wilson, 2012). Similarly, in a study by Daihong (2017), it was pinpointed that situated theory and related research, authentic scientific inquiry in the context of undergraduate science classroom is defined as a form of original research project-based authentic learning done with the aim of adapting and integrating original research projects into undergraduate science curricula. This aims to provide

students with opportunities to experience authentic inquiry, through which they are increasingly involved in the scientific community's culture, develop the identification as scientists, and transfer from newcomers to full functional agents through peripheral participation. That is, undergraduate research is important because it provides a window on science-making that enables students to participate in scientific practices like research planning, modelling of scientific observations, or data analysis (Linn, et al., 2015).

According to Tress et al. (2005), successful projects are those that reach integration and project goals, produce tangible outcomes, contribute to progress in integrative research and provide positive experiences for their participants. The researchers further indicated that in order to reach success, it is recommended that projects are specifically organised to reach integration through the development of an Integration Implementation Plan where projects have a common research question and clear project goals.

It is seen in Beer and Thompson (2007) that many universities are currently recommending Research and Creative Activities (RCA) to students in all disciplines to expose them to challenging questions and induce a sense of inquisitiveness that comes from working on these questions. RCA is defined as a faculty-mentor and students' collaboration while participating in a project, internship, activity, and/or course-based study that enables students to pose or work from a defined research question, employ techniques and methodologies that are appropriate and recognised by the discipline, and disseminate the research output with others (Umbach & Wawrzynski, 2005; Beer & Thompson, 2017). This enables students to better understand published works, learn to balance between collaborative and individual work, establish an area(s) of research interest as they begin to explore their careers as researchers.

Over the past three (3) decades, many national stakeholders and disciplinary associations in the United States of America have been calling for improved accountability in higher education which has increased the educational outcomes at both the departmental and institutional levels (National Survey of Student Engagement, 2015). Many of such disciplinary associations have encouraged departments to promote undergraduate research as a means of accomplishing goals such as: pushing students to fully explore Bloom's Taxonomy, a foundational classification of learning objectives culminating in a student's ability to analyse and to evaluate information by creating new knowledge; and creating feedback that faculty and administrators can use for assessment purposes, which is seen in Young and Crews (2012) as cited in Crews (2013). It was advanced that this helps learners to benefit from the experience of conducting independent studies and from the direct feedback from faculty mentors, examiners and other reviewers, while departments/faculties and institutions can utilise the students' performances as feedback for internal purposes, using URPs' competency to review programs to prepare the next cohort of learners to advance their abilities to engage in independent work.

Students' participation in URPs has registered several benefits, which include: increased students' interest in the fields of research/study of their choice; improved inclusivity of underrepresented groups in research-based activities; gains in research and research-based skills; clarification, refinement, and confirmation of desired goals (either academic or career-wise); improves the understanding of the research process; and stimulates both self-confidence and self-esteem (Follmer, et al., 2015). In the same study, students participating in undergraduate research gave positive responses to their research experiences; where 91% indicated that they experienced gains like personal and professional gains, gains in communications skills, gains in various research skills (like laboratory/field skills, work organisation skills, etc.), confirmation of educational and career plans and goals, and improved career and/or preparation for further studies.

Research shows that original project-based learning design in nature facilitates the effective implementation of situated learning in school. Herrington and Oliver (2000) developed the instructional design framework as cited in Daihong (2017, p. 22) has excellent features for original project-based learning design. These features include: "*(1) original research project-based learning provides authentic context that reflects the way knowledge is used in real life; (2) students practice authentic scientific inquiry process and skills when they are engaged in original research projects; (3) the original research projects are currently under conduction by scientists who are also instructors to the courses, which allows easy access to expert performance and the modelling of processes; (4) original research aims to generate*

new scientific knowledge and application, which provides opportunities to experience multiple roles and perspectives in problem solving; (5) original research requires collaboration in nature; (6), it promotes reflection with providing students with the opportunities to compare their performances and results with experts and peers; (7) students interpret and negotiate their findings via academic writing or presentation, which promote articulation to enable tacit knowledge to be made explicit; (8) original research provides coaching and scaffolding at critical times; and (9) integrated assessments within the project tasks require pedagogical strategies and efforts from individual instructor."

In a study by Tress et al. (2005), the success of research projects rotates around: identification of common research questions and clear project goals; adopting time management practices; the allocation of realistic time budgets; strong leadership, which requires a high level of interpersonal skills as well as research credibility; frequent meetings among the participants; the support of the wider research environment; plan for tangible project deliverables, for example of scientific publications; an evaluation criterion for assessing the project outcomes.

Other critical skills like the ability to adapt to new conditions/situations; awareness of ethical values; independent knowledge acquisitions/learning; planning and time management; problem-solving; information management (search, selection and integration); critical thinking; team working; self-confidence; ability to apply knowledge to practice; oral and written communication; responsibility; decision-making; initiative and entrepreneurial spirit; use of information, communications and technology (ICT); and skills in the interpersonal relations; Innovation and creativity (Zúñiga, 2009; Fernández-Santander eta al., 2012). The influence of some of these factors is supported by Follmer et al. (2015). Other recent findings show that the success factors for URPs are: reading and understanding research literature; gathering research data; programming skills; analysis and interpretation of the researched data; communicating scientifically; understanding of the field and the research process; confidence in research related abilities (Maltese et al., 2017).

More factors like direct feedback from mentors, examiners and other reviewers, increasing faculty involvement in the process, and faculty staff working along with undergraduates on research projects play a great role in the success of URPs (Crews, 2013). Other researchers such as Daihong (2017), Beer and Thompson (2017) also highlighted the factors that influence the success of URPs, and these include: the duration of research experiences and the authenticity of research projects; relationship between undergraduate research characteristics including duration, autonomy, collaboration, and motivation, and research skills performance; student perceptions about research; time and other resources; research and creative activities; collaborative assignments and projects; and faculty involvement.

According to Kuo (2009), a mentor is like a pilot who can nurture students to complete their research activities like writing research papers. A mentor is expected to be empathetic with qualities of being patient, understanding, and encouraging students to keep pursuing the desired goal of research completion. In order to achieve that, the researcher highlights that in some cases, the mentor in a research process may help inexperienced researchers in the conceptualisation (from the selection of a topic to narrowing down to the desired topics), formulation of research questions, identification of kinds of literature related to the study; strengthening of writing skills, and completion of research projects. Additionally, Nolan et al. (2020), supports the role of a mentor(ing) in URPs, mentioning that quality mentoring is critical to the success of URPs. They added that mentoring helps students learn both technical and research skills from faculty mentors and be inculcated into their respective professions (like building professional connections that may be resourceful in academic support, source of future references, and preparation for academic progression.

Understanding the role of faculty in the success of URPs is very critical. The study by Beer and Thompson (2017) shows that there is a need for faculty involvement in research and collaborative activities worthy of examination because they play a vital role in developing transferrable skills and themes that can be utilised by students in contexts beyond the academic realm. The need for a strong relationship between the faculty and students in the process of executing undergraduate research is shown in the study by Cooley, Garcia, & Hughes (n.d).

In addition to the critical success factors, there are other factors like the mode of evaluation of URP that motivate students to engage in the implementation of URPs fully. There has been a challenge in the evaluation of research projects with many existing tools focusing on evaluating classroom learning. This usually results in students' not well-defined involvement in research, which makes measuring effort difficult. In order to successfully implement educational practices, there is a need for measurable goals, followed by rigorous evaluation that assesses both the effectiveness and impact on future decision making. Therefore, it is essential that reliable assessment tools are made available to faculty and program administrators who participate in the monitoring/supervision of students' development (Maltese et al., 2017). Existing assessment tools appropriate for the assessment of research-based learning, which is indicated in Lopatto (2004); Tariq, Stefani, Butcher, & Heylings (1998); and Rueckert (n.d), include written reports and critical thinking. Written Research Report, that the student's advisor grades on behalf of the faculty, assess the students' ability to write, analyse and synthesise, think critically, and understand research methodology. The paramount issue is the assurance that faculty evaluates research reports in a well-structured manner and with a high level of objectivity which can be best achieved through the use of a standard set of metrics, also known as rubrics (Moskal, 2000). Critical Thinking indicates the ability to analyse, synthesise, and evaluate claims/hypotheses (Fernández-Santander et al., 2012).

In a study by Follmer et al. (2015), some key metrics for grading students' outcomes of undergraduate research-based experiences are mentioned as broad experimental development with research and research activities; specific research-based skills and experiential development; production metrics like publications and conference presentations; openness to collaboration with fellow students and faculty in during execution of research activities and after completion of research; the impact of student pairings on research collaboration; and overall ratings of and satisfaction with research experiences. Based on the above, it has been seen that many studies have highlighted the factors that influence the success of undergraduate research projects generally categorised into four (4) key areas of research skills, students' participation, the relevant mentors/faculty advisors and faculty management (Beer & Thompson, 2007; Zúñiga, 2009; Fernández-Santander et al., 2012; Crews, 2013; Follmer et al., 2015; Beer and Thompson, 2017; Maltese et al., 2017).

3. Research Methodology

The study used a cross-sectional design to collect data from students who belonged to the two (2) faculties of science and technoscience at the time they completed their final year, which is equivalent to third-year according to the local context. The participants were selected using the purposive sampling technique due to the fact that the section of the students' population that had the characteristics of the researchers' interest was known, and these were third-year students. Survey questions used in the study were formulated based on theoretical frameworks and previous related studies (Daihong, 2017). Constructs used in the study include research skills, roles of students, roles of faculty advisors/mentors, and roles of the faculty. These constructs were represented by 68 survey questions using a Likert scale ranging from 1 to 5, with 5 being the highest.

Pilot testing data was collected from 24 students in the Bachelor of Information Systems Programme, and feedbacks were used to paraphrase unclear items. This process achieved the content validity of the study, demonstrating that the instrument addressed the outcomes that it was intended to measure, and the validity (through expert analysis) of the research, demonstrating that the items are articulated and understood well by the respondents. The study used the data that was collected in 2019 from third year (final year) students from two faculties of science and technoscience. The respondents pursued three (3) programs of Bachelor of Information Systems, Bachelor of Science in Information Technology and Bachelor of Science with Education. The URPs are being administered across the programmes that formed the respondents. The study used both open and closed-ended questionnaires—this study investigates the overall factors that affect the success of URPs at Muni University. The questionnaire had five sections. The first section captured the biodata of respondents, the second section studies the skills required for the success of URPs and the third, fourth and fifth sections studied the roles of students, faculty advisors/mentors and faculties, respectively, in the success of URPs. The study administered 70 questionnaires, and only

55 were received as filled. The return rate was thus 78.6%. The reliability of the research instrument was tested using Cronbach's alpha and was found to be 0.9038. Package for the Social Sciences (SPSS) program was used to analyse the collected data using the frequencies, percentages and median of the parameters that formed the constructs of the study.

4. Findings of the Study

The results obtained provided insights on the success factors for undergraduate students' research projects at Muni University. Seventy (70) questionnaires were distributed to different final year students, and fifty-five (55) returned the questionnaires contributing a 78.6% response rate.

Out of 55 student participants, 24(44%) belonged to Bachelor of Information Systems (ISM), 18(33%) belonged to Bachelor of Science information Technology, while 12(24%) belonged to Bachelor of Science Education, as shown in figure 1. Of the 55 participants, 40 (73%) were male, while 15 (27%) were female.
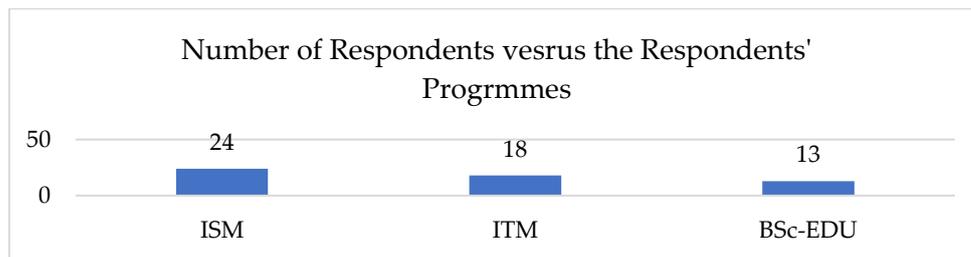
Figure 1: Programme of study

The analysis of objectives one to four was done through the use of a five (5) Likert scale which is shown in Table 1.

Table 1: Likert Scale

Response Rate	Response Mode	Description
1	SD	Strongly Disagree
2	D	Disagree
3	NS	Not Sure
4	A	Agree
5	SA	Strongly Agree

4.1 Determining the relevant skills required for the success of undergraduate projects

Table 2 below shows that Research methods (e.g., data collection and data analysis), and documenting and reporting were ranked the top two research skills by 46 respondents out of 54. Even though the respondents agreed that the attribute of critical reviewing was important to research skills, it was ranked last, with only 13 respondents strongly agreeing.

Table 2: Research Skills

No	Research Skills	SD		D		NS		A		SA		Total	Median	Interpretation
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
1	Research methods e.g., data collection, data analysis	0	0.00	2	3.70	6	11.11	17	31.48	29	53.70	54	5	Agree
2	Documenting and reporting	2	3.64	1	1.82	6	10.91	20	36.36	26	47.27	55	4	Agree
3	Knowledge of up-to-date literature about the research area	1	1.85	2	3.70	3	5.56	27	50.00	21	38.89	54	4	Agree
4	Research problem analysis	3	5.45	2	3.64	8	14.55	23	41.82	19	34.55	55	4	Agree
5	Critical thinking	2	3.64	3	5.45	6	10.91	26	47.27	18	32.73	55	4	Agree
6	Critical reviewing	3	5.56	3	5.56	12	22.22	23	42.59	13	24.07	54	4	Agree

In terms of research environment, students agreed that all the items listed in Table 3 were important for the success of graduation projects with skills of justifying research methods ranked number 1 and understanding research evaluation ranked number 6 as shown in Table 3.

Table 3. Research Environment Skills

No	Research Environment	SD		D		NS		A		SA		Total	Median	Interpretation
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
1	Justifying research methods	1	1.72	3	5.17	9	15.52	18	31.03	27	46.55	58	4	Agree
2	Following good research practice	2	3.70	1	1.85	7	12.96	27	50.00	17	31.48	54	4	Agree
3	Complying with ethical requirements	2	3.70	2	3.70	9	16.67	26	48.15	15	27.78	54	4	Agree
4	Understanding research funding	4	7.27	8	14.55	10	18.18	18	32.73	15	27.27	55	4	Agree
5	Understanding academic and commercial exploitation	3	5.56	3	5.56	13	24.07	20	37.04	15	27.78	54	4	Agree
6	Understanding research evaluation	2	3.64	1	1.82	8	14.55	32	58.18	12	21.82	55	4	Agree

According to the respondents (students), as shown in Table 4, research management skills are critical in the successful completion of undergraduate projects. They agreed that using information sources (like the internet and library), using information and related technologies (for data collection, design, development and implementation), planning and scheduling of research work, and information management (through research notebook, record versioning) are important in the success of graduation research/projects. The order of priority was ranked by the respondents, as shown in Table 4 below.

Table 4: Research Management Skills

No	Research Management	SD		D		NS		A		SA		Total	Median	Interpretation
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
1	Using information sources like the internet, library, etc.	2	3.64	4	7.27	1	1.82	22	40.00	26	47.27	55	4	Agree
2	Using information & related technologies for data collection, design, …	2	3.70	4	7.41	4	7.41	22	40.74	22	40.74	54	4	Agree
3	Planning and scheduling of research work	5	9.09	2	3.64	6	10.91	21	38.18	21	38.18	55	4	Agree
4	Information management through research notebook, record versioning, etc.	2	3.64	3	5.45	13	23.64	29	52.73	8	14.55	55	4	Agree

The respondents agreed that personal effectiveness was vital for the success of graduation projects with the majority (30/53 respondents) strongly agreeing that problem-solving and creativity & innovation (29/53 respondents) were ranked top while independent working and self-awareness students agreed that they are crucial though ranked among the last. This is highlighted in Table 5 below.

Table 5: Personal Effectiveness

No	Personal Effectiveness	SD		D		NS		A		SA		Total	Median	Interpretation
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
1	Problem-solving	1	1.89	4	7.55	1	1.89	17	32.08	30	56.60	53	5	Strongly Agree
2	Creativity and innovation	0	0.00	3	5.66	0	0.00	21	39.62	29	54.72	53	5	Strongly Agree
3	Flexibility and open-mindedness	1	1.89	2	3.77	5	9.43	20	37.74	25	47.17	53	4	Agree
4	Ability to learn	1	1.85	2	3.70	2	3.70	25	46.30	24	44.44	54	4	Agree
5	Ability to listen	2	3.70	2	3.70	4	7.41	23	42.59	23	42.59	54	4	Agree
6	Asking for guidance	2	3.70	1	1.85	4	7.41	26	48.15	21	38.89	54	4	Agree
7	Time management	3	5.56	2	3.70	6	11.11	23	42.59	20	37.04	54	4	Agree
8	Self-discipline	2	3.77	5	9.43	6	11.32	24	45.28	16	30.19	53	4	Agree
9	Self-awareness	2	3.70	1	1.85	9	16.67	29	53.70	13	24.07	54	4	Agree
10	Independent working	5	9.43	9	16.98	5	9.43	22	41.51	12	22.64	53	4	Agree

From Table 6, it is seen that communication skills were important to students for the success of the graduation project. Demonstrating effective verbal presentation skills, e.g., by presenting research confidently, appropriately and persuasively to differing audiences, adequate writing of research output (both progress and final deliverables) and promotion of research for wider public understanding were agreed to be among the top skills required by the students.

Table 6: Communication Skills

No	Communication Skills	SD		D		NS		A		SA		Total	Median	Interpretation
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
1	Demonstrating effective verbal presentation skills e.g., by presenting research confidently, appropriately and persuasively to differing audiences	1	1.85	3	5.56	3	5.56	25	46.30	22	40.74	54	4	Agree
2	Adequate writing of research output (both progress and final deliverables)	1	1.85	3	5.56	4	7.41	25	46.30	21	38.89	54	4	Agree
3	Promotion of research for wider public understanding	2	3.70	3	5.56	7	12.96	23	42.59	19	35.19	54	4	Agree

Table 7 shows how respondents responded to the questions regarding networking and team skills, networking and teamworking skills. Students strongly agreed and agreed that it is very vital for the success of graduation projects more especially Team management and leadership, where the majority agreed (27/54) that it was very vital, followed by building and maintaining a good relationship with others (24/54) and Coaching and mentoring skills student agreed that it's vital but among the last factors.

Table 7: Networking and Teamworking Skills

No	Networking and Teamworking Skills	SD		D		NS		A		SA		Total	Median	Interpretation
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
1	Team management and leadership	0	0.00	2	3.70	6	11.11	19	35.19	27	50.00	54	4.5	Strongly agree
2	Building and maintaining good relationship with others	3	5.56	0	0.00	1	1.85	26	48.15	24	44.44	54	4	Agree
3	Giving and receiving feedback	0	0.00	2	3.70	5	9.26	25	46.30	22	40.74	54	4	Agree
4	Technical skills	2	4.08	1	2.04	4	8.16	20	40.82	22	44.90	49	4	Agree
5	Coaching and mentoring skills	1	1.85	3	5.56	9	16.67	21	38.89	20	37.04	54	4	Agree

4.2 Ascertaining the roles of students in the success of URPs

From Table 8 below, the respondents agreed that students establish a good working relationship with their supervisors, students obtain feedback from their supervisors, students maintain collaborative teamwork among themselves, students initiate strategies for the success of URPs (e.g., project planning, risk management, resource mobilisation), and students adhere to the research ethics were ranked among the top five roles required by the student for the success of graduation projects and Students obtain project evaluation certificates was also required but among the last.

Table 8. Student Roles on the success of URPs

No	Roles of Students	SD		D		NS		A		SA		Total	Median	Interpretation
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
1	Students establish a good working relationship with their supervisors	2	5.66	2	3.77	6	3.77	17	43.40	26	43.40	53	4	Agree
2	Students obtain feedback from their supervisors	3	1.89	1	1.89	6	9.43	19	49.06	25	37.74	54	4	Agree
3	Students maintain a collaborative teamwork among themselves	3	5.77	2	0.00	2	7.69	23	50.00	23	36.54	53	4	Agree

No		SD		D		NS		A		SA		Total	Median	Interpretation
4	Students initiate strategies for the success of URPs e.g., Project planning…	1	3.70	1	1.85	8	9.26	21	59.26	23	25.93	54	4	Agree
5	Students adhere to the research ethics	1	1.85	1	1.85	5	14.81	26	38.89	20	42.59	53	4	Agree
6	Students write their thesis/project report in time	1	5.56	4	1.85	5	11.11	24	35.19	20	46.30	54	4	Agree
7	Students defend their projects	3	1.85	0	7.41	4	9.26	26	44.44	19	37.04	52	4	Agree
8	Students undertake URPs with dedication	2	3.77	2	3.77	7	11.32	24	32.08	19	49.06	54	4	Agree
9	Students keep an up-to-date register (Research Notebook) of project progress e.g,…	3	5.66	0	0.00	7	13.21	26	49.06	17	32.08	53	4	Agree
10	Students abide by the regulations governing the URPs	2	3.70	1	3.70	5	12.96	32	44.44	14	35.19	54	4	Agree
11	Students submit their thesis/project report in time	3	5.56	4	7.41	9	16.67	26	48.15	12	22.22	54	4	Agree
12	Students obtain project evaluation certificates	4	7.41	6	11.11	16	29.63	16	29.63	12	22.22	54	4	Agree

4.3 Assessing the roles of supervisors towards the success of undergraduate research projects

Table 9 shows that the respondents agreed that supervisors provide research guidance throughout the project period, supervisors provide timely feedback on the students' project submissions, supervisors maintain a good working relationship with their students, and supervisors inform their students about the available opportunities for the successful implementation of their URPs were among top four (4) roles performed by supervisors. The respondents also agreed that supervisors ensure that their students adhere to the research ethics, discuss issues regarding intellectual property and follow the regulations governing URPs were agreed that supervisors play those roles though they were ranked among the last.

Table 9: Supervisor Roles on the success of URPs

No	Roles of Supervisors	SD		D		NS		A		SA		Total	Median	Interpretation
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
1	Supervisors provide research guidance throughout the project period	3	0.00	2	3.64	6	5.45	19	58.18	25	32.73	55	4	Agree
2	Supervisors provide timely feedback on the students' project submissions	3	3.70	3	1.85	5	7.41	20	51.85	23	35.19	54	4	Agree
3	Supervisors maintain a good working relationship with their students	4	1.82	3	9.09	6	7.27	20	45.45	22	36.36	55	4	Agree
4	Supervisors inform their students about the available opportunities for the success of their URPs	1	5.45	5	3.64	4	10.91	25	34.55	20	45.45	55	4	Agree
5	Supervisors establish a stimulating research programme, e.g., Supervisors are free to counsel their students on the challenges facing their project progress	2	5.56	1	5.56	4	9.26	28	37.04	19	42.59	54	4	Agree
6	Supervisors ensure that their students adhere to the research ethics	0	3.70	2	5.56	3	11.11	32	53.70	18	25.93	55	4	Agree
7	Supervisors discuss issues regarding intellectual property	1	1.85	5	9.26	5	9.26	27	50.00	16	29.63	54	4	Agree
8	Supervisors follow the regulations governing URPs	2	7.27	3	5.45	6	10.91	29	36.36	14	40.00	54	4	Agree

4.4 Examining the role of the faculty in the success of Undergraduate research projects

In terms of the faculty role, in the success of the projects, the respondents (students) were not sure if the faculty has a project tracking/monitoring mechanism (Median=3), processes are in place by which students could file a complaint if their performance is underrated (Median=3), whether URPs ownership is well stipulated (by policy or any other forms) (Median=3), the projects are externally examined (Median=3) and not sure whether there is a formal mechanism for change of

supervisors (Median=3.5). However, students agreed that their faculty approves the project ideas (median=4), functional research ethics committee, has project grading system (reward) is known (as per the curriculum) and followed, and assigns project supervisors to students (median=4) as shown in Table 10.

Table 10: Faculty Roles on the success of URPs

No	Faculty Roles	SD		D		NS		A		SA		Total	Median	Interpretation
		Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
1	The faculty has a functional research ethics committee	1	3.70	5	7.41	20	3.70	15	42.59	13	42.59	54	4	Agree
2	The faculty has an approved project management policy	2	1.85	2	7.41	23	12.96	20	40.74	8	37.04	55	4	Agree
3	The project grading system (reward) is known (as per the curriculum)	2	3.70	0	1.85	22	25.93	17	37.04	13	31.48	54	4	Agree
4	The project grading system (reward) is followed	2	5.56	1	5.56	14	20.37	20	48.15	17	20.37	54	4	Agree
5	The faculty approves the project ideas	1	12.73	4	18.18	7	7.27	22	27.27	20	34.55	54	4	Agree
6	The faculty assigns project supervisors to students	2	3.70	4	0.00	2	40.74	23	31.48	23	24.07	54	4	Agree
7	There is a formal mechanism for change of supervisors	5	26.42	5	7.55	17	11.32	16	35.85	11	18.87	54	3.5	Not Sure
8	The faculty provides the necessary resources to enable successful implementations of URPs e.g., internet, library, laboratory, peers etc.	7	1.85	10	9.26	4	37.04	15	27.78	19	24.07	55	4	Agree
9	URPs duration is enough to enable students complete their project work	14	3.64	4	3.64	6	41.82	19	36.36	10	14.55	53	4	Agree
10	The mode of communicating project deliverables is known e.g., through mini-presentations, conferences, progress reports, thesis, etc.	3	9.26	3	9.26	11	31.48	26	29.63	11	20.37	54	4	Agree
11	The faculty has a project tracking/monitoring mechanism	10	18.18	8	14.55	11	20.00	13	23.64	13	23.64	55	3	Not Sure
12	Processes are in place by which students could file a complaint if their performance is underrated	10	12.73	7	14.55	14	25.45	12	30.91	12	16.36	55	3	Not Sure
13	The URPs ownership is well stipulated (by policy or any other forms)	5	9.26	6	11.11	19	35.19	15	27.78	9	16.67	54	3	Not Sure
14	The projects are externally examined	7	18.18	8	12.73	14	25.45	17	21.82	9	21.82	55	3	Not Sure

5   Discussion

The perception of learners is crucial in understanding the success factors for undergraduate research projects. The purpose of the study was to investigate the success factors for undergraduate research projects, in the form of graduation and capstone projects, in Muni University, one of the public universities in Uganda. This purpose was achieved through four specific objectives, i.e., to determine the relevant skills required for the success of undergraduate research projects; ascertain the roles of students in the success of undergraduate research projects; assess the roles of supervisors towards the success of undergraduate research projects; and examine the role of faculty towards the success of undergraduate research projects.

Tables 2-7 show the relevant skills required for the success of undergraduate research projects. These skills include; Research Skills (shown in Table 2), Research Environment (shown in Table 3), Research Management (shown in Table 4), Personal Effectiveness (shown in Table 5), Communication Skills (shown in Table 6), Networking and Teamworking Skills (shown in Table 7). These skills conform to the ones highlighted in the related studies by Tress et al. (2005), Follmer et al. (2015), Zúñiga (2009), and Fernández-Santander et al. (2012).

All the respondents agreed (with a median response of at least 4.0) that the following skills contribute to the success of undergraduate research projects:

Research Skills: Research skills basically entail the skills necessary for research data management, and they include Research methods, e.g., data collection, data analysis, documenting and reporting, knowledge of up-to-date literature about the research area, research problem analysis, critical thinking, and critical reviewing.

Research Environment Skills: These are environmental awareness skills required by the university in relationship with the national and international research-related standards and or practices. Justifying research methods; Following good research practice; Complying with ethical requirements; Understanding research funding; Understanding academic and commercial exploitation; and Understanding research evaluation.

Research Management Skills: Research management encompasses the step-by-step procedure (process) for executing research activities and information technologies to support the process. These skills include using information sources like the internet, library, etc.; Using information & related technologies for data collection, design, development and implementation; Planning and scheduling of research work; and Information management through research notebook, record versioning, etc.

Personal Effectiveness: Personal effectiveness is the individual's ability to understand his/her weakness and strengths and work towards exploiting the strengths while working to improve on the weakness to become better researchers. The related skills include problem-solving; Creativity and innovation; Flexibility and open-mindedness; Ability to learn; Ability to listen; Asking for guidance; Time management; Self-discipline; Self-awareness, and independent working.

Communication Skills: These are skills that help the researchers write and present the study's findings to an audience. These skills include Demonstrating effective verbal presentation skills e.g., by presenting research confidently, appropriately and persuasively to differing audiences; Adequate writing of research output (both progress and final deliverables); and Promotion of research for wider public understanding.

Networking and Teamworking Skills: These are skills needed among the researchers to coordinate well with peers and relate well with the supervisors. These skills include Team management and leadership; Building and maintaining a good relationship with others; Giving and receiving feedback; Technical skills; and, Coaching and mentoring skills.

On ascertaining the roles of students in the success of URPs, as shown in Table 8, all the respondents agreed (with a median response of at least 4.0) that students establish a good working relationship with their supervisors, students obtain feedback from their supervisors, students maintain collaborative teamwork among themselves, students initiate strategies for the success of URPs (e.g., project planning, risk management, resource mobilisation), students adhere to the research ethics, students write and submit their thesis/project report in time, students defend their projects, students undertake URPs with dedication, students keep an up-to-date register (Research Notebook) of projects progress e.g., literature review, requirements, design, development and implementation results), students abide by the regulations governing the URPs with the university, and students obtain research project evaluation certificates (where necessary). These findings are also in support of the previous studies of Herrington and Oliver (2000), Crews (2013), Maltese et al. (2017), Daihong (2017), and Beer and Thompson (2017).

The assessment of the roles of supervisors towards the success of undergraduate research projects, as shown in Table 9, shows that the students agreed in unison (with a median response of 4.) that Supervisors provide research guidance throughout the project period, supervisors provide timely feedback on the students' project submissions, supervisors maintain a good working relationship with their students, supervisors inform their students about the available opportunities for the success of their URPs, supervisors establish a stimulating research programme, e.g., supervisors are free to counsel their students on the challenges facing their project progress, Supervisors ensure that their students adhere to the research ethics, Supervisors discuss issues regarding intellectual property, and Supervisors follow the regulations governing URPs. These findings blend well with the studies by Moskal (2000), Crews (2013), and Follmer et al. (2015).

Lastly, on examining the role of the faculty in the success of undergraduate research projects (URPs), as shown in Table 10, the respondents (students) had partially agreed with a median response of 4.0) to some of the roles of the faculty towards URPs' success and also partially expressed their limited levels of awareness (with a median rating of either 3.0 or 3.5, Not Sure) about some of the roles of the faculty towards URPs success. The study revealed that students were in agreement with the roles like The Faculty has a functional research ethics committee, The Faculty has an approved project management policy, The project grading system (reward) is known (which is clearly indicated in the curriculum), The project grading system (reward) is followed, The Faculty approves the project ideas, The faculty assigns project supervisors to students, The faculty provides the necessary resources to enable successful implementations of URPs (e.g., internet, library, laboratory, peers etc.). This study is in support of the faculty roles highlighted in the previous studies by other researchers like Moskal (2000), Cooley et al. (n.d), Maltese et al. (2017), Daihong (2017), and Beer and Thompson (2017). On the other hand, the students expressed their unawareness about the following faculty roles being performed in the university, i.e., the faculty has a project tracking/monitoring mechanism, processes are in place by which students could file a complaint if their performance is underrated, whether URPs ownership is well stipulated (by policy or any other forms), the projects are externally examined, and not sure whether there is a formal mechanism for change of supervisors. Therefore, from this study, there is a need for the faculty to work towards improving on their roles in the management of URPs, and the existing relationship between students and their supervisors should be upheld.

6   Limitations and recommendations for further Study

The study was subjected to students only. Thus, there is a need to also carry out a detailed study on the comparison of students and faculty mentor responses. Pointing out a recommendation on related work by Maltese et al. (2017), future extensions of this work especially on the association between programmatic characteristics (like mentorship strategies, day-to-day activities) and student gains, need to be carried out.

This research being the first in Mun University, there is a need to conduct more similar studies in other subsequent academic years to confirm the outcomes of this study. As already mentioned in the limitations section, there are limited studies available at the national level. More studies need to be done in other universities in Uganda for better and generalised conclusions regarding the success of URPs to be reached. Similar experiences from other teachers and universities would generate a larger amount of data that would help to improve an action-research process Fernández-Santander et al. (2012).

There is a need to carry out a similar study covering all forms of projects done at the undergraduate level at Muni University. The course-based projects provide a foundation for undergraduate students to engage in the capstone and final year projects. The impact of these course-based projects needs to be explored as well.

7   Conclusion and Recommendations for Practice

Regardless of some limitations like limited sample sizes and non-responsive participants, valuable information regarding the success of URPs has been obtained and can be used to improve the management of URPs in Muni University and other universities around the globe.

On the relevant research skills, findings showed that many skills are very relevant to the success of URPs. These skills included: data collection, data analysis; documenting and reporting; justifying research methods; using information sources like internet, library, using information and related technologies for data collection, design, development and implementation, planning and scheduling of research work; information management through research notebook, record versioning; problem-solving and creativity and innovation; effective verbal presentation skills e.g. by presenting research confidently, appropriately and persuasively to differing audiences; Adequate writing of research output (both progress and final deliverables); promotion of research for wider public understanding; team management and leadership; and building and maintaining a good relationship with others. The study also showed that some skills are of less importance to the success of URPs. These skills were generally ranked low in the set of constructs where they fall. These include critical reviewing, understanding research evaluation, independent working and

self-awareness, and coaching and mentoring skills. These results show that research, research environment, research management, personal effectiveness, communication, networking and teamwork skills are paramount to the success of URPs in Muni University.

In ascertaining the roles of students, the research shows that students of Muni University indicated that students: establish a good working relationship with their supervisors; obtain feedback from their supervisors; maintain collaborative teamwork among themselves; initiate strategies for the success of URPs (e.g., Project planning, risk management, resource mobilisation); and adhere to the research ethics. The same study ranks last the role of students obtaining project evaluation certificates.

On assessing the roles of supervisors, the students indicated that supervisors: provide research guidance throughout the project period; provide timely feedback on the students' project submissions; maintain a good working relationship with their students, and inform their students about the available opportunities for the success of their URPs. These roles were ranked highly in this study. On the other side, the study assessed that some roles like supervisors ensure that their students adhere to the research ethics; supervisors discuss issues regarding intellectual property, and supervisors follow the regulations governing URPs were ranked low.

The role of faculty was examined, and the research indicated that students were not sure if: the faculty has a project tracking/monitoring mechanism; processes are in place by which students could file a complaint if their performance is underrated; the URPs ownership is well stipulated (by policy or any other forms); the projects are externally examined, and there is a formal mechanism for change of supervisors. However, the study noted that the faculty approves student's project ideas and assigns project supervisors to students.

Generally, this study has provided a foundation of research on the URPs in Muni University and Uganda. It has investigated the students' opinions on the success of URPs in Muni University, which is the 6th public university in Uganda. The output of this study has been informative to Muni University and many other universities around the world that value undergraduate research projects by understanding the underlying factors affecting the success of undergraduate research projects. These factors are categorised into four domain areas: research management skills, students' participation, relevant mentors/faculty advisors, and faculty management. At an organisational/faculty level, the results of this study can be used as an input to the policy formulations that guide undergraduate research, curriculum development, and a best practice guide for managing URPs. At the lecturer's level, it spells out the best practices for facilitating students undergoing research projects as well the prerequisite skills needed to be imparted to the 21st-century undergraduate research students. These skills can be nurtured into the learners from the time they enter university classes till they complete their programmes of study. These skills can be reflected in the course content covered, types/forms of assessments given to learners and class engagement. At a student's level, the study informs the learners about their expected input as they undergo the process of research planning, execution and management. When the results of this study are put into use by all the stakeholders involved in the management of URPs, students would successfully implement their research while realising the key objectives of undergoing the research studies. In summary, all the key players in the management of URPs should be nurtured to diligently execute their roles in order to realise the success of URPs.

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