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Research Article

Application of Connectivism Theory in the Development of Academic Resiliency Model for Science Education Students: A Participatory Action Research Approach

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About Article

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ABSTRACT

Academic resiliency is understood to be the capacity of students to perform well in school despite of disadvantaged background. Addressing this global concern requires various initiatives tailored to the needs of learners and their context. Thus, in this study, the researchers proposed an academic resiliency model designed for Science Education program anchored to the Connectivism Theory. To develop this model, the researchers employed three stages: stage 1: identifying issues; stage 2: developing solutions from the issues; and stage 3: building an academic resiliency model from issues and solutions. The use of participatory action research approach was utilized employing both In-Depth Interviews (IDI) and Focus Group Discussions (FGD). A total of five batches (batch 2018-2019 to 2022-2023) of the science education program of UM Digos College are the subject of the study and participated by 60 students (freshmen, seniors, alumni). Based on the IDI (stage 1), there were 13 issues that the students experienced that affected their studies in the program. Following stage 2 (FGD 1), solutions were developed from the identified issues focusing on the five essential skills - flexibility, determination, planning, interpersonal, and positive attitude. The stage 3 (FGD2) developed the academic resiliency following issues and solutions identified by the participants. The model developed focuses on transferring five essential skills from alumni to senior students to freshmen students to attain academic resiliency. Moreover, the developed model allows students in the program to be equipped with the essential skills to move forward and become successful in their chosen field by building connections from each batch. Thus, this study recommends using the developed academic resiliency model to foster resiliency among students in the Education Science program.

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1. INTRODUCTION

Resilience refers to successful adaptation to adverse situations. Academic resilience applied this concept to educational settings, indicating students' ability to perform well in school despite advantages (Cui *et al.*, 2023; Rudd *et al.*, 2021). In the Industrial Revolution 5.0 era, resilience was needed by individuals to face various challenges in the future (Rachmawati *et al.*, 2021). de Oliviera (2024) further noted that being resilient in this new era meant being able to change quickly to stay ahead of the curve and adapt to changing market dynamics. Academic resilience was not a predetermined outcome but, instead, a changeable ability that could be improved (Masten, 2001; Özcan & Bulus, 2022; Rudd *et al.*, 2021; Wang *et al.*, 2023). Thus, creating a guide to help learners to succeed in their chosen field is vital for every education institution. Therefore, this study presents a new paradigm towards academic resiliency in the context of science education to better help students in their academic journey.

The ability to withstand academic pressure is known as the academic resilience. Pajares (2005) stated that while academic resilience may not offer the necessary skills for success, it can provide the determination and persistence needed to acquire and utilize those skills effectively. For example, through this mindset students can cope with challenges they experienced in school such as exam pressures, poor performance, various schoolwork, etc (Martin & Marsh, 2008). In addition, self-efficacy of students are also directly linked to how they react to various academic adversity they experienced (Cassidy, 2015). Other contributors that may affect student's academic resiliency include support from family (Rojas, 2015), mental health (Hand *et al.*, 2022), financial support (Mullen, 2008) to name a few. By examining these factors, educators can better understand the situation of each student in the classroom and, therefore, can create a positive learning environment.

Several frameworks and models were developed based on the principle of academic resiliency. The educational resiliency model developed by Sandoval-Hernández and Cortes (2012) has pointed out four key factors and this include; personal, family, school, and community. Each of these factors has indicators that are directly linked to each factor identified. In addition, the digital feedback and academic resilience model developed by Guerra *et al.* (2018) included personal characteristics and acceptance of the use of technology that can affect academic resilience. Though there are models that involve academic resiliency, however, there is a limited model that tackles academic resiliency in the context of science education. Developing a new model that targets students in science education and is contextual in nature can greatly help these groups of students.

To facilitate in the development of the new academic resiliency model for science education students, the use of connectivism theory was used. Siemens (2005) pointed out that connectivism theory is based on the premise that decisions are built based on the acquisition of new information and the rapid pursuit of information. In addition, this theory also suggests that learning occurs when individuals participate in an informal network where they can share knowledge and expertise with others (Kropf, 2013; Sangra & Wheeler, 2013). Moreover, Downes (2012) and Siemens (2005) connectivism as a networked process of social learning. By utilizing the connectivism theory, the new academic resiliency model designed for science education will be responsive to the current challenges experienced by students.

The outcome of this study will serve as a guide to students, teachers, school administrators, stakeholders, and policymakers on how to approach academic resiliency in the context of science education. To achieve the development of the academic resiliency model, the following objectives are utilized;

(1) determine the issues that the science students identified in their schooling;

(2) determine the solutions to these identified issues based on the student's perspectives; and

(3) create a resiliency model based on the issues and solutions identified by science students.

2. LITERATURE REVIEW

2.1. Connectivism theory

Connectivism is a learning theory that emphasizes the importance of connections and networks in acquiring knowledge (Downes, 2005). In the study conducted by Hendricks (2019), he emphasized that connectivism theory highlights the occurrence of learning through various networks, and emphasizes the social aspect of constructing knowledge, making the learners key in the knowledge-creation process. A comprehensive literature review of connectivism revealed that this theory presents a new learning paradigm where knowledge is dispersed across networks of individuals, technologies, and organizations, accentuating the need to stay connected in this rapidly changing world (Alam, 2023). Furthermore, Bell (2011) explored how connectivism plays a key role in fostering the development of lifelong learning skills. By encouraging learners to navigate and adapt to various information networks, connectivism prepares them to acquire and apply knowledge throughout their lives. The theory asserts that in today's complex, interconnected world, the ability to identify, build, and maintain networks is just as important as the ability to understand and apply knowledge. Additionally, unlike other theories – behaviorism, cognitivism, and constructivism, which place learning at the center of the cognitive development of learners – connectivism stresses that learning is distributed across different networks, and thus learning involves the capacity to build and understand these networks (Hendricks, 2019; Siemens, 2005).

2.2.Academic resiliency

Resilience provides individuals with the mental fortitude to handle stress and difficulties (Radhamani & Kalaivani, 2021). In the realm of education, resilience pertains to a learner's capacity to meet their goals while dealing with negative or distressing conditions (Edwards *et al.*, 2016; Yang & Wang, 2022). Academic resilience reflects students' ability to achieve strong academic results despite facing challenges. It signifies academic success despite encountering adverse or trying circumstances within the educational experience (Mallick & Kaur, 2016). Cassidy (2016) highlights academic resilience as a measurable construct that encompasses perseverance, adaptive help-seeking, and the ability to manage negative emotional responses to academic challenges. Furthermore, Martin and

Marsh (2006) explain that academic resilience entails the proactive engagement of students in overcoming academic setbacks. They assert that resilient students exhibit high levels of self-regulation, emotional control, and motivation, which enable them to persist despite adversities. Research shows that resilience is influenced by support systems, including positive teacher relationships and encouraging school environments, which promote academic success despite external pressures (Masten, 2001; Southwick *et al.*, 2014). Additionally, the development of resilience is linked to fostering a growth mindset, where students view challenges as opportunities for development rather than obstacles (Tugade & Fredrickson, 2004). Such students show improved performance even after being confronted with stressful conditions as well as events due to which they fall under the probability of performing poorly at the school level or consequently leaving the school (Alva, 1991). As such, academically resilient students maintain high levels of academic achievement even in the face of stressful and complicated circumstances that lead to the risk of low grades in schools (Radhamani & Kalaivani, 2021).

3. METHODOLOGY

3.1. Research design

This study utilized a Participatory Action Research (PAR) design to attain the objectives of the study. Participatory action research (PAR) is a research approach that prioritizes the value of experience that tackles issues and problems and creates and implements possible solutions and alternatives (Cornish *et al.*, 2023). Kindon *et al.* (2009) pointed out that PAR involves the full participation of participants in identifying problems and finding solutions to the identified problems. Based on Cornish *et al.* (2023), PAR project design involves several crucial standards. This includes building relationships, establishing working practices, establishing a common understanding of the issue, observing, gathering and generating materials, collaborative analysis, and planning and taking action. Thus, this design was used to create an academic resiliency model grounded by the participant's experiences to further enhance the credibility of the developed model.

3.2. Research local and participants

This study was conducted at UM Digos College, a higher education institution located in Digos City, Philippines, and is one of the college branches of the University of Mindanao. Currently, this institution has a total population of 5,200 students enrolled as of the first semester of the academic year 2024-2025. Particularly, participants of this study are students and alumni of the Department of Teacher Education, particularly the secondary education program majoring in science education. Based on the profile of this program, this program produced a 100% passing rate in the national licensure examination administered by the Professional Regulation Commission (PRC) in the Philippines for five consecutive national licensure examinations and is able to produce a total of nine top notchers of the said national licensure examination. Five batches of the science education program participated in the study. This batches were 2nd Year (2022-2023), 3rd Year (2021-2022), 4th Year (2020-2021), Alumni 2 (2019-2020), Alumni 1 (2018-2019). Moreover, to accomplish the objectives of the study the researchers employed In-depth Interview (IDI) and Focus Group Discussion (FGD). The purpose of IDI, is to extract the issues and challenges faced the students during their schooling. For IDI, three participants from each identified batches were recruited, resulting to a total of 15 participants in the IDI. This selection is based on Creswell's (1998) suggestion that 15 participants are enough in a study that involves interviews.

Table 1. Number of participants of the study

Phase	No. of Participants
Focus Group Discussion (FGD)-1	35 (7 per batch) *cycle 1 - Batch 2022-2023 *cycle 2 - Batch 2021-2022 *cycle 3 - Batch 2020-2021 *cycle 4 - Batch 2019-2020 *cycle 5 - Batch 2018-2019
Focus Group Discussion (FGD)-2	10 (2 per batch)
Total	**60 Participants**

Moreover, this study employed two phases of FGD. The purpose of the first phase is to create solutions based on the identified problems by the participants, while the second phase involves the development of a model based on the issues and solutions identified. The first phase included five cycles of FGD involving seven participants for each batch (a total of 35 participants). This selection of a number of participants per cycle is based on the suggestion of Ritchie and Lewis (2000) that four to ten participants in FGD are recommended to avoid distractions and to extract relevant information. The second phase includes two participants from each batch, resulting in a total of ten participants for this phase.

Overall, this study has a total of 60 participants from five batches and therefore represented more than 300 students (alumni and currently enrolled in the program) of the program. Furthermore, a proper ethical consideration was followed by the researchers in conducting the study. These ethical considerations include anonymity, voluntary participation, informed consent, confidentiality, the potential for harm, and results communication were strictly followed by the researchers. Participants of the study are properly oriented before the conduct of the study. Part of the orientation include their role as participants and the ethical guidelines. Participants signed an informed consent form indicating their willingness to participate in the study.

3.3. Research instrument

This study utilized the following research instruments in the conduct of the study: an interview guide and a recorder. In the interview and FGD, the researchers used the validated semi-structured interview guide to gather responses from the participants to focus on identifying their academic resilience issues and solutions as science major students (DiCicco-Bloom & Crabtree, 2006). The questions in the semi-structured interview guide encompassed the core and related questions associated with the study's central question (Creswell, 2007).

To capture the participants' responses more effectively, the researcher utilized a recorder to avoid writing notes during the interview. The purpose of this is for researchers to focus on interview content and verbal prompts, and enable a verbatim transcription of the participants' responses (Jamshed, 2014).

3.4. Procedure

This research study conducted a four process of data gathering – Approval, Interviews, and two Focus Group Discussions and a final phase for presentation of findings (see Figure 1 for the process). The following steps were taken:

Phase I - Approval from the Gatekeeper and Participants. A permission letter signed by the researchers was sent to the office of the director of UM Digos College asking for permission to conduct the study on January 2024. A separate letter was sent to the Department of Teacher Education for the approval to conduct the study under in their department. Once all of these are approved, the researchers contacted students and alumni of the science education program, indicating the nature of the study and asking for their willingness to participate in the study. Several students and alumni responded to the call. However, the researchers only chose 60 participants (12 per batch).

The researchers employed a simple random sampling, specifically the lottery method to determine who will be selected as participants of the study. This method is used to avoid biases in selecting the participants of the study (Acharya *et al.*, 2013). After the selection, the researchers conducted an orientation to the target participants regarding the study and emphasized their role as participants and the ethical considerations to be followed in the study. After the orientation, the participants signed the informed consent form indicating their willingness and voluntary participation. The participants then given the schedule for both IDI and FGD (with their approval). Data collection the commence after this phase is conducted.

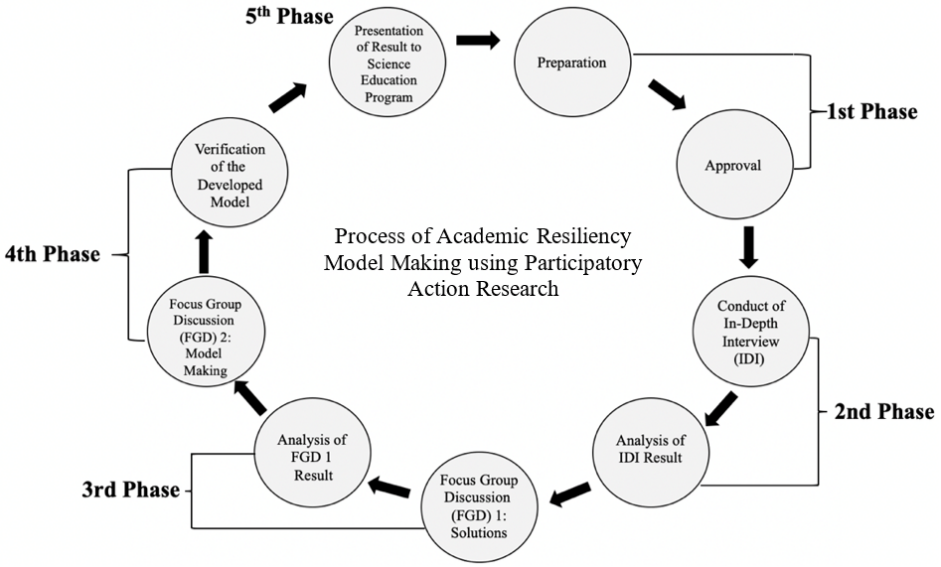

Figure 1. Participatory Action Research Process in the Context of this Study

Phase II - Conduct of In-Depth Interview (IDI). Phase 2 which is the issue identification through IDI was conducted from January to February 2024. The IDI mostly lasted in 20 minutes maximum and 15 minutes minimum. The IDI begins with the participants from batch 2022-2023 and then commences in batch 2018-2019. After the IDI, transcription was conducted and then returned to the participants for the validation of the transcripts. This process is done to ensure that all of the information in the transcripts is true based on the conducted IDI. After the approval, the researchers then conducted a content analysis to determine the issues raised by the participants during the IDI. This method of analysis was used to extract the most relevant information that be used in the study (Harwood & Garry, 2003). After the analysis, the researchers then give the result of the analysis to the participants of IDI for their final approval. Once approved, the research then proceeded to Phase III.

Phase III: Focus Group Discussion (Solution). The third phase includes FGD to different groups of batches to identify solutions to the issues identified at each year level (conducted on February 2024). The FGD primarily consists of a maximum of 30 minutes and a minimum of 20 minutes. The FGD begins with the issues identified in the 1st year level up to 4th year level. Following this format, all batches gives solutions to the identified issues encountered in the 1st year level, while the issues identified in 2nd year level are only given solutions by batch 2018-2019 to 2021-2022, issues identified in 3rd year level are given solutions only by batch 2018-2019 to 2020-2021, and finally only batch 2018-2019 and 2019-2020 are allowed to give solutions to the issues in the 4th year level.

After the FGD, the researchers then transcribed the discussion then were given to the participants for their approval. Once approved, the researchers then summarized the proposed solutions then were given again to the participants for their final approval. These findings are then used for the next phase of the study, which is model-making through FGD 2.

Phase IV - Focus Group Discussion (Model Development). After the data were analyzed from the FGDs, the development of the academic resilience model followed (happens on March 2024). The researchers presented the data (both issues and solutions) to the participants for their

analysis and basis for model-making. The discussion lasted a total of 180 minutes (3 hours) (with breaks) before coming up with a proposed model. After the discussion, the researchers transcribed the discussion and were given to the participants for their verification. After the approval, the researchers then enhanced the model that the participants created and then presented again to the participants for their final approval. Once approved the model is now ready to be presented to the science education program.

Phase V - Presentation of Findings. This phase is the final phase of the current study. The researchers presented the findings to the science education program for information dissemination and suggestions on the next step or future direction of the study. Suggestions of the present study were taken positively by the researchers and will be incorporated into the next cycle since the model that is being developed is dynamic and, therefore, responsive to the needs of the students.

4. RESULTS AND DISCUSSION

4.1. Issues identified by the participants

In a semi-structured interview, the participants expressed the individual issues they encountered at each academic tier. Following one-on-one meetings with participants from various batches, thirteen (13) issues were identified from all their responses. Second-year students have identified six issues: adjustment, low self-confidence, pressure, procrastination, time management, and unpreparedness during their first year in the university. Excluding adjustment and unpreparedness, students currently enrolled in the third-year level have experienced the same challenges with the addition of subject complexity, disappointment, online learning setup, and procrastination. In addition to adjustment, subject complexity, low self-confidence, online learning setup, procrastination, and time management, currently enrolled fourth-year students have also experienced difficulty learning concepts during their first three years in the university.

All these issues were also experienced by both Alumni 1 and Alumni 2, except for unpreparedness for Alumni 1 and pressure for Alumni 2. Additionally, anxiety, difficulty in learning concepts, and low motivation are also experienced by both alumni batches, with the issue of relationship with others added to alumni 2. Moreover, all of these issues are presented in Figure 2.

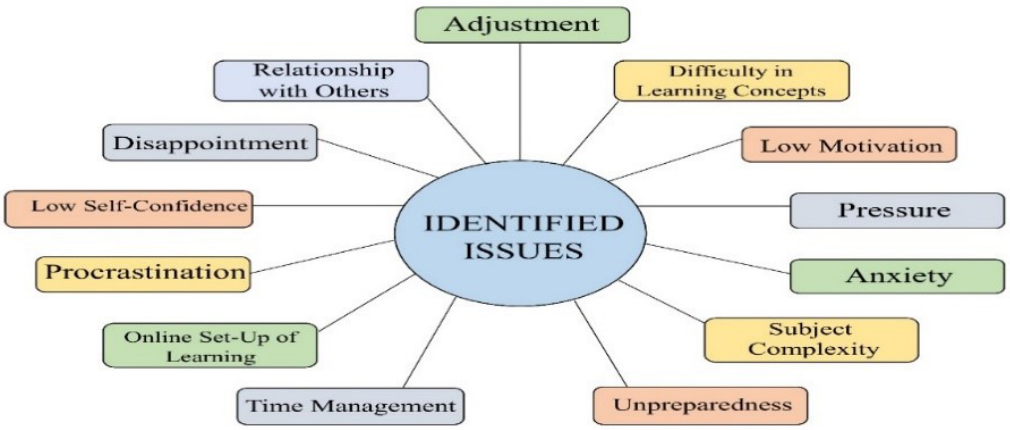

Figure 2. Identified Issues by the Participants in IDI

Adjustment. During the first year in the university, science education students from the currently enrolled second and fourth years, soon to take licensure examination, and licensed teachers expressed their problems in adjusting to college life, including the environment, schedule, subjects, and social interaction. The transition from high school to university affected their academic performance. Qualitative data from one study revealed that first-year students were confronted with adjustment issues across four main aspects with academic adjustment as the primary predictor of students' academic performance, followed by personal-emotional adjustment (Ayele, 2018).

Difficulty in Learning Concepts. Problems were frequently an inevitable but crucial aspect of learning. It was especially true for learning difficult concepts (Lodge *et al.*, 2018). For students enrolled in the science education program, the difficulty of learning concepts came from every two-week examination policy of the University, instructors' teaching styles (Chetty *et al.*, 2019), and complex topics.

Low Motivation. Motivation is crucial to students' learning and achievement (Chen & Jang, 2010). Research on the significance of students' motivation has indicated that it is among the primary factors that lead to active engagement of students in class (Al-Hashmi, 2021). In the study of Acuña *et al.* (2021), the engagement of students from UM Digos College during online classes was perceived to be moderate, attaining the lowest mean score among other dimensions. It explains students' exhaustion and passing of bare minimum output as expressed by the participants from the two alumni batches during their second, third, and fourth years in the university.

Pressure. Pressure has been a significant factor influencing the academic experiences of science students from various year levels, including alumni. This can be traced to numerous reasons, including pressure to excel academically, manage frequent examinations, and keep up with the expectations set by peers and mentors, which often creates a challenging

environment for them. This academic pressure can has a significant impact to students' mental health, thus a need to create a support mechanism during this transition is crucial for students' mental health (Talley & Thompson, 2024).

Anxiety. In the higher academic years, Competency Appraisal (CA) and Licensure Examination for Teachers (LET) were two major exams that education students must pass to earn their degree and license. The overwhelming emotion that comes with these exams allowed anxiety to creep in. These are both expressed by the LPTs and 2024 LET takers as they recollected their experiences during their LET and CA journeys, respectively. Test anxiety was present among university students in general, making it a prominent problem globally (Trifoni & Shahini, 2011), and even pre-service teachers were found to have high levels of anxiety in taking the LET exam.

Subject Complexity. Higher education catalyzed the advancement of society in all different spheres – cultural, economic, social, political, and technological, through the production of skilled individuals, going beyond the boundaries of knowledge and technology, and preserving culture (Bahreini, 2022). The different learning challenges faced by students in post-secondary education (Fook & Sidhu, 2015), reflected this responsibility of higher education. In the science education program, students from third and fourth years, and even alumni, shared their sentiments on the subject difficulty that they have faced as they advance to higher academic tier.

Unpreparedness. Participants from 2nd year and LPT stressed unpreparedness as one of the main challenges during the first two years in the university. This factor was revealed as one of the reasons for students' absence during examinations due to a lack of confidence, not enough study time, and a lack of understanding of the materials (Tladi, 2013).

Time Management. Time management is a skill that plays an important role in the academic life, both the performance and achievement, of students (Khanam *et al.*, 2017; Nasrullah & Khan, 2015). In the case of science education at UM Digos, students from 2nd year to 4thyear, including alumni, expressed their problems managing their time effectively due to factors such as a lack of time management skills (Ventura, 2021), juggling both work and studies (Pedroso *et al.*, 2023), overwhelming tasks (Nasrullah & Khan, 2015) including organizational responsibilities, and online learning modality (Batbaatar & Amin, 2021).

Online setup of learning. The transition to online learning during the pandemic brought about significant challenges for students, affecting their academic performance and overall learning experience (Bao, 2020). One of the primary issues encountered was unreliable internet connectivity (Reyes-Chua *et al.*, 2020), which led to frequent disconnections during live sessions (Diez *et al.*, 2021). This resonated with science students and alumni of UM Digos during their academic learning at the onset of the pandemic.

Procrastination. Behaviorally, procrastination is the delay in an intended course of action that becomes problematic (Steel, 2010). In the case of science students including second year to fourth year, even the two batches of alumni, procrastination has been present throughout their academic endeavors. Participants expressed procrastination that often leads to cramming which usually happens when students put off studying until the last possible second (Cho & Lee, 2022).

Low Self-Confidence. Students from the science education program have considered low self-confidence an issue they have experienced across all academic tiers. Currently, crisis in the educational system is mostly associated with low self-confidence among students leading to insufficient class participation and unsatisfactory progress after spending so much time in class (Akbari & Sahibzada, 2020). Science students and alumni expressed concern about being called into the class for recitations or speaking in front of everyone for presentations, socialization, and internships (Diquito *et al.*, 2022). It was in line with the findings of Rubio (2007), stating that psychological situations such as anxiety, self-insecurity, fear, and feeling apart from society were possible situations that might result from low self-confidence in students.

Disappointment. Third-year students and the two alumni batches of the science program expressed their disappointment during their first year at the university. The problem was rooted in the participants' low exam scores and grades, resulting in discouragement. According to D'Entremont (2018), low scores result in academic disappointment influencing students' self-esteem.

Relationship with Others. On-the-job training (OJT) for fourth-year science education students and education students, in general, plays a crucial role in the professional growth and development of student-teachers (Caceres, 2015), thus, it is critical to maintain a positive relationship between pre-service teachers and the cooperating teachers (CT) (Lu, 2013). Student teachers consider their cooperating teachers a crucial factor for the success of their journey preparing them for their teaching program (Clarke *et al.*, 2014).

4.2. Solutions identified by the participants (FGD 1)

In the introductory focus group discussion, the facilitators prompted the participants to brainstorm possible solutions to academic resilience issues faced by science students. Five main solutions have emerged from the data collected during the focus group: Flexibility, Determination, Planning Interpersonal Skills, and Positive Attitude. Each solution is reinforced by several sub-solutions, offering a thorough comprehension of the elements that contribute to the academic resilience of science education students. Moreover, the participants offered the following sub-solutions to attain each major solution; To attain flexibility students must have adaptability and camaraderie. To attain determination - the students must have self-learning, self-discipline, self-motivation, resourcefulness, perseverance, and self-reflection, moreover. To develop a planning skill they must consider setting priorities have time-management skills and can organize tasks efficiently. To acquire interpersonal skills, they must have support, communication, and inquisitive skills. To develop a positive attitude they should be able to accept failure and must develop optimism and trust. This set of solutions is crucial to developing academic resiliency based on the participant's point of view.

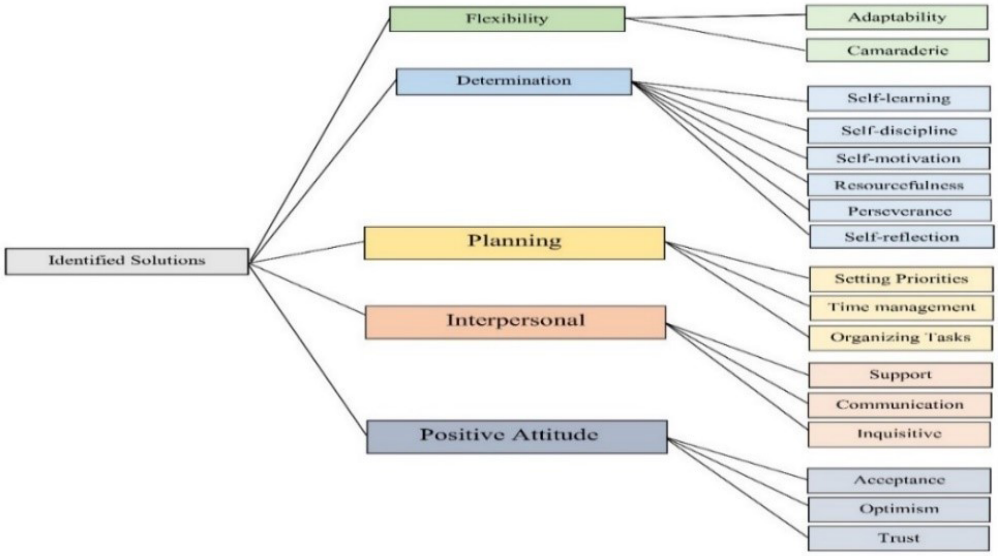

Figure 3. Identified Solutions Based on the Participants of FGD 1

4.3. Academic resiliency model (FGD 2)

In the second phase of the FGD, participants utilized the problems and issues gathered during the IDI and FGD 1. This phase marks a pivotal moment as they aim to construct a model that facilitates the transfer of academic resilience across different academic years. Moreover, the discussion of FGD 2 yielded a strong model that transfers academic resiliency from the alumni of a science education program to the freshmen of the said program. Below is the description of how to transfer the academic resiliency of students in the science education program based on the participants:

Alumni to Year 4: Team Building. Alumni can engage with Year 4 students through team-building activities. These activities allow alumni to share their experiences and insights on transitioning into the workforce and managing advanced academic responsibilities. Through collaborative exercises and discussions, alumni can help Year 4 students enhance their flexibility, adaptability, and interpersonal skills, preparing them for collaborative environments in their future careers. They can also discuss the importance of maintaining a positive attitude, focusing on acceptance, optimism, and trust. Additionally, alumni can facilitate sessions on advanced planning, setting priorities, time management, and organizing tasks, thus preparing Year 4 students for real-world challenges. As a result, Year 4 students focus on further enhancing their flexibility and adaptability while deepening their determination, self-learning, self-discipline, self-motivation, and perseverance. They also master resourcefulness and planning, including setting priorities, time management, and organizing tasks. Their interpersonal skills, such as communication and support networks, are strengthened, and they cultivate a positive attitude with acceptance, optimism, and trust.

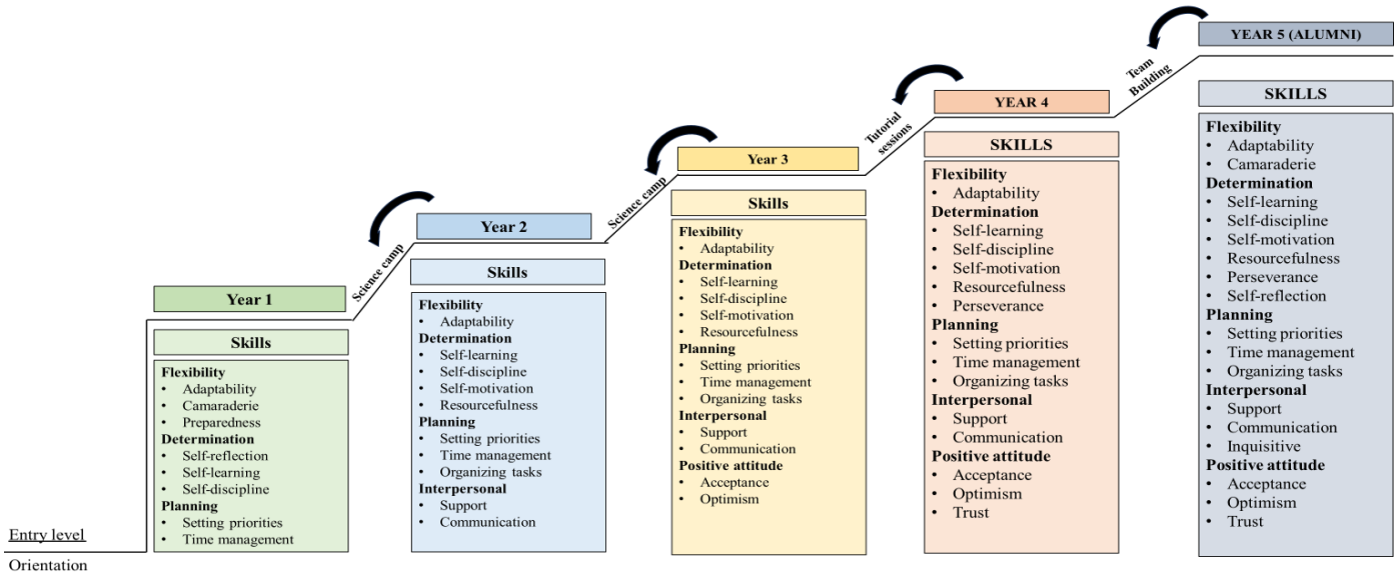

Figure 4. Academic Resiliency Model

Year 4 to Year 3: Tutorial Sessions. Year 4 students can support Year 3 students through tutorial sessions. These sessions enable Year 4 students to share their knowledge and strategies on self-discipline, determination, and advanced planning skills. Through peer teaching and interactive discussions, Year 4 students can help Year 3 students deepen their understanding of course material, improve their self-learning capabilities, and develop effective time management and organizational skills. This mentorship fosters a collaborative learning environment, encouraging Year 3 students to enhance their perseverance and problem-solving abilities. Consequently, Year 3 students solidify flexibility and adaptability as part of their everyday practice. They foster determination, self-learning, self-discipline, self-motivation, and resourcefulness. Planning and time management skills are refined, and interpersonal skills such as support and communication are enhanced. A focus on acceptance and optimism helps in maintaining a positive attitude.

Year 3 to Year 2: Advanced Science Camp. Year 3 students can assist Year 2 students by participating in science camps. These camps provide a practical and immersive learning experience where Year 3 students can demonstrate adaptability, flexibility, and resourcefulness by leading more complex activities and projects that challenge Year 2 students. By leading these activities, Year 3 students can help Year 2 students enhance their problem-solving abilities, self-motivation, and perseverance while fostering a sense of camaraderie and teamwork. This camp emphasizes developing advanced skills, pushing Year 2 students beyond foundational competencies into more refined areas like strategic planning and self-motivation. Through hands-on experiments and group challenges that are more sophisticated, Year 3 students can also mentor Year 2 students in developing essential skills like self-reflection and critical thinking. As a result, Year 2 students build on foundational adaptability and flexibility but now focus on advancing their determination, self-learning, self-discipline, self-motivation, and resourcefulness. Organizational and planning skills improve as they prepare for future leadership roles. In contrast, interpersonal skills such as communication and support networks are cultivated to help them thrive in more demanding scenarios.

Year 2 to Year 1: Introductory Science Camp. Year 2 students can also engage Year 1 students through science camps. These camps introduce the academic challenges and opportunities ahead, with activities designed to ease Year 1 students into the academic environment. Year 2 students can mentor Year 1 students in developing self-discipline, self-learning, and planning skills, focusing on basic skill-building that sets the stage for their academic journey. Year 1 students can build their flexibility, adaptability, and positive attitude through hands-on activities and collaborative projects, foundational for their challenges. The camp is less complex than the Year 3 to Year 2 camp, offering a more nurturing environment where Year 2 students guide Year 1 students in setting realistic goals, managing time effectively, and fostering a supportive peer network. Consequently, Year 1 students establish flexibility, adaptability, and camaraderie, which help them build a supportive network and prepare for academic challenges. They initiate practices of determination, self-reflection, self-learning, self-discipline, and preparedness, learning to set priorities and manage time effectively. This stage is crucial as it lays the groundwork for their future academic success. Meanwhile, although the mode of transfer is similar to that of the Year 3 to Year 2 camp, the difficulty and complexity of the activities done in each camp vary, with the Year 1 camp being more introductory and less challenging.

Year 1 to Entry Level: Orientation. Year 1 students can welcome new entry-level students through orientation programs. These programs include sessions on self-reflection, determination, and setting priorities. Orientation activities help entry-level students acclimate to the academic environment, establish supportive networks, and develop essential skills such as time management and preparedness. Year 1 students can demonstrate how to cultivate a positive attitude, build resilience, and engage effectively with their peers and faculty through interactive sessions, ice-breaking activities, and group discussions. As a result, entry-level students begin their academic journey focusing on determination and self-reflection, developing self-learning and self-discipline, setting priorities, and managing time effectively.

The academic resiliency model from the focus group discussion outlines a clear progression of skills students need to develop from Year 1 to become successful alumni. The detailed mode of transfer from alumni to Year 1 students involves team-building activities, tutorial sessions, science camps, and orientation programs, ensuring that each year level builds upon the previous one to foster a comprehensive set of resilient attributes.

This research utilized the connectivism theory, as defined by Downes (2012) and Siemens (2005) plays a significant role in the academic resiliency model developed through this research. This theory posits that learning is a networked social learning process where individuals participate in networks to share knowledge and expertise (Kropf, 2013; Sangrà & Wheeler, 2013). The academic resiliency model integrates connectivist principles to foster an environment where students can effectively navigate and utilize networks and connections to build resilience. Throughout the model, various modes of transfer and collaboration are implemented: Alumni engage with Year 4 students in team-building activities, where they share experiences and insights to enhance flexibility, adaptability, and interpersonal skills. Year 4 students, in turn, mentor Year 3 students through tutorial sessions, fostering a collaborative learning environment to nurture the principles of self-discipline and determination. Science camps involve Year 3 and Year 2 students leading activities, mentoring younger peers, and developing problem-solving and critical-thinking skills. Orientation programs led by Year 1 students, welcome freshmen, promoting camaraderie and a positive attitude among incoming students.

The model emphasizes creating and strengthening connections among students at different academic levels. Students learn to leverage networks for support, guidance, and resource sharing, which is essential for academic resilience. Collaborative activities enable students to navigate their networks effectively, enhancing their learning experience and preparing them for challenges.

Connectivist principles ensure that learning is continuous and adaptable to changing environments. Students are prepared for lifelong learning and adaptation, equipped with skills necessary for academic and professional success. By engaging in shared experiences and collective intelligence within their networks, students benefit from each other's insights and perspectives, enhancing their understanding and resilience.

In summary, connectivism theory informs the design of the academic resiliency model by emphasizing the importance of networks and connections in the learning process. The model leverages these principles to create a supportive and collaborative learning environment where students can thrive and develop the resilience needed for academic success and lifelong learning. Through connectivist practices, students are empowered to navigate their academic journey effectively, utilizing their networks to grow and adapt in a dynamic learning environment.

5. CONCLUSIONS

This participatory action research identified existing problems for each year level from the perspective of five different batches. The study outlined solutions that embody the resilience cultivated by science education students throughout the academic year. The experiences shared by the participants have shown that higher attainment of educational level equates to increased challenges the students have faced. Thus, higher resiliency is being acquired. A model for academic resiliency for science education students was created in line with the identified issues and solutions.

The researchers acknowledge that the implications of this study are confined by the limitations in how the results were interpreted, and it is essential that these limitations be addressed in future research. Based on the model created of this study and the suggestions from science education program during the presentation, several recommendations are proposed for considerations:

First, ensuring that the model aligns with the Program Educational Objectives (PEOs) of the Science program will help build resilience while supporting broader educational goals. This alignment will enhance the model's impact, contributing to the program's mission of producing competent and resilient graduates. Moreover, future researchers are encouraged to build on this work by exploring adaptations of the model to different educational levels or by incorporating new resilience strategies. Continuous evolution of the model is crucial for maintaining its relevance in an ever-changing educational landscape.

Second, developing a tool to measure the effectiveness of resilience transfer between batches. This tool could include surveys, interviews, or observational metrics to assess key resilience outcomes, enabling data-driven improvements to the model. Third, applying the academic resiliency model within the science education program offers a targeted opportunity to evaluate its impact on students' resilience in a specific context. Success in this pilot study could inform broader applications of the model across other programs.

Lastly, expanding the model to other programs acknowledges that resilience is valuable across all disciplines and could help cultivate a more adaptive student body while providing comprehensive data for further refinement.

These recommendations are suggested for implementation at UM-Digos College to enhance the effectiveness and applicability of the academic resiliency model within its educational framework. Moreover, other educational institutions that offer science education programs can also utilize the model being created or create a new model that is suitable to their own context. This way, higher education institutions that offer science education programs can produce a resilient learner.

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