

New Methods in Scientific Research

All Sciences Academy

Editor: Asst. Prof. Dr. Umut ÖZKAYA



***NEW METHODS IN
SCIENTIFIC
RESEARCH***

Editor

Asst. Prof. Dr. Umut ÖZKAYA





New Methods in Scientific Research
Editor: Asst. Prof. Dr. Umut ÖZKAYA

Publishing: December 2023
Certification Number: 72273
ISBN: 978-625-6530-76-8

© All Sciences Academy

CONTENT

1. Chapter	5
Interactive Instructional Material to Aid TVET Module <i>Nalienaa Muthu, Faieza Abdul Aziz, Lili Nurliyana Abdullah, Makhfudzah Mokhtar, Muhd Khaizer Omar</i>	
2. Chapter	18
Effectiveness of Technology-Rich Classrooms on Students' Biology Achievement in Ukwuani Lga of Delta State, Nigeria <i>Iroriteraye Adjekpovu, Janice Imizuokena, Nwabuaku Louis, Maria Onyedikachi Obinne, Raphael Imobhio, Obukohwo Etaneki</i>	
3. Chapter	30
Synergizing Design and Engineering: Holistic Approaches to Noise Reduction <i>Melik Sami, Khelil Sara</i>	
4. Chapter	64
Knowledge of Nursing Students Towards Tele-nursing Care: A Cross-Sectional Study <i>Iaila Matrok, Raneem Faleh, Alanod Sultan, Shafa Rahil, Ayat Masoud Omar Masoud, Amara Bekhatroh Rashed</i>	
5. Chapter	76
Extracurricular Activities –Factors for Interethnic Relations in Schools <i>Besa Havziu, Diellza Kelmendi, Ardita Ceka, Afërdita Saliu</i>	
6. Chapter	90
Climate-Responsive Design of Vernacular Architecture in Hot-Dry Climates: Lessons from the South of Algeria <i>Ahmed Kaihoul, Efsio Pitzalis</i>	
7. Chapter	105
Urban Metallurgy: Reviving Industrial Sites through Architectural Valorization of Minerals <i>Melik Sami, Khelil Sara</i>	
8. Chapter	129
Scattering of Plane Wave from Rectangular Plate in NID Space <i>Fawad A. K. Faraz, Fazal Muhammad, Salman Khan, Muhammad Ismail, Zeeshan Khan</i>	

9. Chapter	145
Body Composition and Health Status of Female Physical Education Students During the Summer Outdoor Activities Camp On-Site at Gazivode Lake	
<i>Jasna Popović, Miloš Popović, Tatjana Popović Ilić, Ružena Popović, Vladimir Miletić, Tijana Purenović-Ivanović</i>	
10. Chapter	157
The impact of human migration in the Durres Region after 1990	
<i>Lindita Kiri</i>	
11. Chapter	173
Geology of the Walsh and Naopurdan formations (groups) in the Soran area, Arbil Governorate, NE-Iraq	
<i>Kamal Haji Karim, Sherzad Tofiq Mohamad Al-Barzinjy, Bashar Jalil Hamza</i>	

1. Chapter

Interactive Instructional Material to Aid TVET Module

Nalienaa Muthu ^{1*}

Faieza Abdul Aziz ¹

Lili Nurliyana Abdullah ¹

Makhfudzah Mokhtar ¹

Muhd Khaizer Omar ¹

¹ Department of Mechanical and Manufacturing Engineering, Faculty of Engineering, Universiti Putra Malaysia 43400 UPM Serdang, Selangor Darul Ehsan, Malaysia

Email of the corresponding author: gs57132@student.upm.edu.my

ABSTRACT

The utilization of Augmented Reality (AR) technology is a significant aspect of the ongoing Digital Revolution 4.0. In the realm of contemporary education, the integration of innovative technologies has become pivotal in enhancing instructional methodologies. The aim of this study is to create Mobile Augmented Reality (AR) content and a storyboard for instructing the Basic Microcontroller module within the Telecommunication Program for Technical Vocational Education and Training (TVET). This involves referencing the Written Instructional Manual (WIM), survey and interview sessions to ensure the integration of AR into the instructional materials. An engaging and effective AR content that aligns with the course objectives and enhances the learning experience for trainees undertaking the Basic Microcontroller module in the Telecommunication Program that features two operational modes were developed. In the learn mode, trainees explore seven augmented Basic Microcontroller components through a user-friendly interface, guided by instructional materials. There is an evaluation mode, wherein trainees are assessed on their circuit assembly and programming skills, receiving star ratings and feedback for performance improvement. The research outlines the development of a user-friendly educational application, incorporating interactive guidance and trainer input in the selection of topics, microcontroller components, and circuit assembly training modes, emphasizing a preference for Android platform development. The application is designed to enhance the learning process by providing an engaging and interactive educational experience.

Keywords – Augmented Reality, Mobile Augmented Reality, Technical Vocational Education and Training, Industrial Vocational Education, Technology-Enhanced Learning,

INTRODUCTION

The incorporation of Augmented Reality (AR) technologies is a vital element in the ongoing progression of the fourth industrial revolution, referred to as IR 4.0. According to [1], the recommended strategy to ensure a consistent workforce in the future is to provide digital literacy training to Technical and Vocational Education and Training (TVET) trainees. This training aims to equip them with the necessary abilities to thrive in the technology-driven workplace of Industry 4.0.

In order to achieve the objective of IR 4.0, [2] have suggested that it is necessary to undertake research on the subject of understanding professional teaching practices and enhancing educators' skills. The integration of technological advancements based on the Fourth Industrial Revolution (IR 4.0) into the workplace is enabling organizations to explore novel avenues for generating value-added prospects. According to [3], there is a growing trend towards facilitating extensive customer engagement and fostering the advancement of digital ecosystems. The integration of recently produced technology into educational methodologies has become a crucial element within the contemporary educational environment, aiming to enhance pedagogical approaches. [4] argue that there is a need to augment the TVET curriculum by incorporating multimedia and hypermedia elements since this can effectively boost students' academic performance.

Utilizing Mobile Augmented Reality (MAR) enables learners to comprehend and master intricate procedures without posing any risks [5]. The application of MAR appears promising in engineering education, as highlighted by authors discussing recent technological advancements that enhance the accessibility and attractiveness of Augmented Reality (AR) on mobile devices [6]. Presently, smartphones stand out as the predominant computing devices for experiencing mobile Augmented Reality, although it's noteworthy that the camera integration in mobile AR apps leads to a higher power consumption compared to their desktop counterparts [7].

The utilization of mobile augmented reality has been identified as a promising avenue for enhancing students' motivation to engage in academic pursuits. [8] observed the existence of a gap in existing educational practice that presents an opportunity for exploration through the implementation of AR within the realm of education. According to [9], the implementation of a system like Augmented Reality (AR) is specifically necessary for undergraduate trainees in order to improve their learning and training experience. The objective of this research is to develop Mobile Augmented

Reality (AR) content and a storyboard for the purpose of instructing the Basic Microcontroller module in the Telecommunication Programme for Technical Vocational Education and Training (TVET).

MATERIALS AND METHOD

The research concentrates on creating a fundamental microcontroller module within an Augmented Reality setting. The primary focus of this distinctive technique is to provide trainees with a tangible representation of the practical aspects of wiring and port configurations, together with programming concepts. In order to commence this procedure, a comprehensive analysis was undertaken on the diverse subjects and subtopics included within the Microcontroller module in Technical Vocational Education and Training (TVET) provided by the Telecommunication department. Following this, the process of choosing an appropriate subtopic to be transformed into a mobile augmented reality format, which includes interactive elements and a web framework, was conducted. This selection was led by the guidelines put forward by [10].

Components Overview:

The mobile Augmented Reality for Technical and Vocational Education and Training (mART) application encompasses two distinct operational modes. The first setup, which is accessible by selecting the "learn" user interface (UI) button [11], will provide learners with an introduction to the fundamental components of a Microcontroller. The instructional material consist of seven enhanced components and one video clip elucidating the Integrated Development Environment (IDE), a software tool employed for coding and programming microcontrollers. The components required for this project include an Arduino Uno board, a breadboard, wires, a 220-ohm resistor, Light Emitting Diodes (LEDs), a USB cable, and a push button [12].

In first mode, also known as the "learn" mode, trainees are provided with directions and guidance through an augmented overlay when they select the components picture icon. The participants were afforded the option to engage in experimentation with augmented electronic components. These components were rendered realistically and can be manipulated by the

participants. Furthermore, an augmented overlay was offered to allow an explanatory framework for the functioning of these components.

Circuit Assembly Instruction:

Mode one involves both the component overview and the training on circuit assembly, specifically focusing on the Microcontroller Worksheet in TVET. Four distinct types of circuits have been identified by subject matter experts. There are four distinct categories of circuits, including the LED flashing circuit, the running light circuit, the push to activate running light circuit, and the traffic light circuit. The programme was designed by utilising the pin number and LED colour as integer variables, while also establishing the delay time, pin, and other relevant parameters as fixed integers. The schematic representation of the traffic light circuit is identical to that of the running light circuit, with the sole distinction lying in the modification of the programming segment. The programming encompasses various sets of commands designed to comprehensively address the syllabus requirements for TVET trainees.

The inception of the Integrated Development Environment (IDE) programming laid the groundwork for the subsequent development of pop-up programming. The assembly of the circuit should be carried out in accordance with the instructions provided by the overlay augmented reality system. Upon completion of the assembly process, the programming segment will be displayed. The integration between the enhanced circuit diagram environment and the drag and drop programming command was achieved by implementing C# scripting.

A consensus has been reached to provide three distinct choices for delay durations, specifically 500 seconds, 1000 seconds, and 5000 seconds, respectively. The trainees were provided with these alternatives to enable them to differentiate between the timing and blinking rate of the LED. Trainees have the opportunity to engage in experimentation with delay time selection through the utilisation of the recycle bin. Nevertheless, there are certain limitations to this practise, as trainees are only permitted to dispose of objects in the recycle bin on a maximum of three occasions. Subsequently, it will be necessary to initiate the reinitialization process of the programming.

Assessment Using Star Rating and Commentary:

The evaluation was classified as Mode two inside the storyboard and designated as a test in an augmented reality (AR) setting. The test mode entails the administration of a question to the trainees for each circuit they have undergone in mode one. The trainees are required to independently do the circuit assembly task, which involves placing wires and components without any form of direction or assistance. In addition, it is important for them to successfully fulfil the programming component without any further directives or enhanced guidance.

The test mode commences by prompting the trainee to input their name. The inclusion of a trainee's name, whether it is their actual name or a fictional name, has frequently observed to have a significant impact on the incorporation of motivating elements in digital games, including augmented reality (AR) games [13]. Upon the successful completion of the initial circuit diagram question, trainees may advance to the subsequent circuit diagram question and continue in this manner until all four circuit diagrams have been completed. The use of iteration is prohibited in the testing segment in order to establish an atmosphere that closely resembles an examination setting.

Following the completion of each individual test, a star rating will be assigned. The purpose of this study is to ascertain the allocation of points. In the event that the response provided by the trainee is inaccurate, a reduced quantity of stars will be granted, and comments will be presented with the intention of enhancing performance. The selection of the development platform for the application was determined through a survey conducted among trainees in Technical and Vocational Education and Training (TVET), as documented by [14].

RESULTS

Based on the validation results, the components included in the introduction of the mART application are the breadboard, USB cable, LED, Arduino Uno board, push button, resistor, and connecting wires. The acceptance of the video recording of Arduino IDE utilising Screencast O Matic was also acknowledged. The exclusion of the sensor, motor, capacitor,

transistor, and relay components from the augmented reality (AR) conversion was attributed to their restricted availability as determined by the trainers. The trainers' selection of components was determined by multiple factors. The utilisation of microcontrollers is facilitated by their ease of accessibility and frequent usage in microcontroller modules. They serve as a fundamental tool for acquiring knowledge in the field of microcontrollers, providing trainees with a strong foundation before progressing to more intricate components.

Four distinct circuit types were chosen for this study, including the LED flashing circuit, running light circuit, push to activate running light circuit, and traffic light circuit. The circuits for temperature sensing, digital clock, keypad interfacing, and ultrasonic distance measurement were deemed ineligible for selection based on the trainers' restricted voting capacity. The circuit schematics were chosen based on particular criteria, with a primary focus on the command usage associated with the circuits. The practicality of real-world applications. The development of circuits that are both functional and user-friendly has been a significant focus in the field of electrical engineering. Basic microcontroller concepts must be comprehended through these circuits prior to entering into more complex subjects.

The central focus of this study revolved around the dissemination of information and knowledge, which was manifested through the design of learning content. Table 1 displays the star rating derived from the average marks.

Table 1. Stars Awarded According to Mean Grades

No.	Average marks	Stars
1	81-100	
2	61-80	
3	41-60	
4	21-40	
5	1-20	
6	0	

The learning sequence incorporated many components such as coaching, cooperation, reflection, and reward. Star rating mechanism was implemented to evaluate and acknowledge the trainee's performance.

The assessment of marks is based on the average of the total marks obtained by trainees for each question. If a trainee provides an incorrect response, the system will assign a lower star rating as a measure of performance evaluation. Concurrently, it will provide constructive feedback, as depicted in Table 2, with the intention of aiding the trainee in rectifying their errors and augmenting their comprehension.

Table 2. Commentary and star ratings at the end of each test

Marks	Comments
0	Circuit does not function & did not follow instructions
50	The circuit is running and complete but the delays are not right
50	The circuit is running but did not follow the right sequence
50	The circuit is running but missing some components
50	Circuit functions but did not follow the instructions
100	Manage to run the circuit & follow instructions
100	Perfect

TVET learners tend to exhibit a preference for Android over Apple's iOS due to its cost-effectiveness, extensive array of functionalities, adaptability, and user-friendly interface, which notably includes the conveniently accessible Quick Settings panel for personalised customization. The outcome is depicted in Figure 1. The Android platform is utilised by a majority of trainees, specifically 83%, while the remaining 17% opt for alternative platforms.

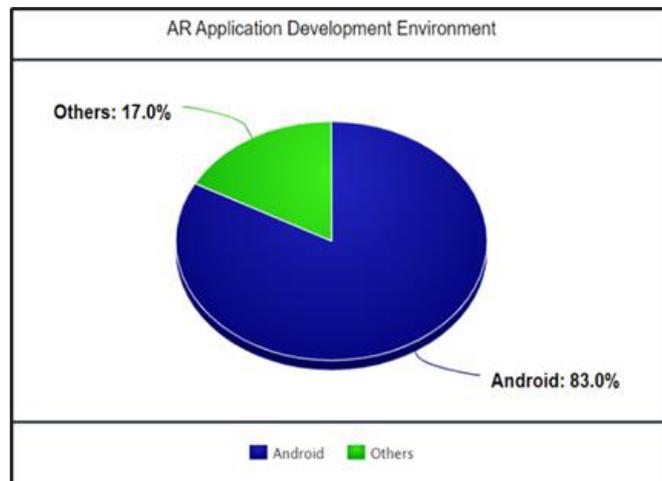


Figure 1. Trainees favour Android for AR apps.

The Mobile Augmented Reality for Technical and Vocational Education and Training (mART) was specifically designed to accommodate users of the Android operating system.

DISCUSSION

The Mobile Augmented Reality (AR) content has been developed specifically for the purpose of instructing the Basic Microcontroller module within the Telecommunication Programme. This instructional material has been created in accordance with the guidelines outlined in the Written Instructional Manual (WIM) and accompanying worksheet. The information was created using clear and comprehensible principles and interactive instructions. The development process is informed by inputs provided by subject matter experts, specifically TVET trainers who have confirmed the selection of topics and subtopics to be incorporated into the application. The design encompasses a meticulous assortment of Microcontroller components, consisting of seven distinct components and one movie. Four circuit assembly training modules were selected, encompassing the construction of LED flashing, running light, push-to-activate running light, and traffic light circuits. The application incorporates a star rating mechanism alongside remark functionality to facilitate learner input. Additionally, it provides two distinct modes, namely learning and testing. A significant proportion of trainees exhibit a preference for the Android platform, hence prompting the creation of mART specifically tailored for Android users.

CONCLUSION

The development of content for mobile augmented reality (AR) devices has been undertaken to enhance the educational materials of the Telecommunications Program's Basic Microcontroller module, specifically focusing on the Wireless Information Module (WIM) and its associated worksheets. The content was developed with clear guidelines and instructions that are user-friendly and engaging. Subsequently, it underwent evaluation by specialists in the respective field. A total of eight

microcontroller components and four distinct types of circuit assembly, each including unique programming modes, were ultimately determined.

ACKNOWLEDGMENT

The authors deeply acknowledge UPM for its financial support (Vote Number: 9735100), and the Research and Management Centre of UPM for funds. The authors also acknowledge the Public Service Department (PSD) of Malaysia as one of the sponsors.

REFERENCES

- [1] H. B. Kenayathulla, "Are Malaysian TVET graduates ready for the future?," *High. Educ. Q.*, vol. 75, no. 3, pp. 453–467, 2021, doi: 10.1111/hequ.12310.
- [2] A. Balyer and Ö. Öz, "Academicians' views on digital transformation in education," *Int. Online J. Educ. Teach.*, vol. 5, no. 4, pp. 809–830, 2018, [Online]. Available: <http://iojet.org/index.php/IOJET/article/view/441/295>
- [3] D. Ø. Madsen, "The emergence and rise of industry 4.0 viewed through the lens of management fashion theory," *Adm. Sci.*, vol. 9, no. 3, 2019, doi: 10.3390/admsci9030071.
- [4] J. . Nwokolo-Ojo and S. N. Longkoom, "Application Of Multimedia And Hypermedia In Teaching And Learning Of Technical Vocational Education And Training (TVET): The Global Challenges," *Int. J. Progress. Altern. Educ.*, vol. 4, no. 1, pp. 1–13, 2017.
- [5] C. D. Fehling, A. Müller, and M. Aehnelt, "Enhancing Vocational Training with Augmented Reality," *Proc. 16th Int. Conf. Knowl. Technol. Data-driven Bus.*, no. October, 2016, [Online]. Available: <https://www.researchgate.net/publication/309373052>
- [6] J. M. Patricio, M. C. Costa, and A. Manso, "A gamified mobile augmented reality system for the teaching of astronomical concepts," in *14th Iberian Conference on Information Systems and Technologies (CISTI)*, 2019, vol. 1, no. June, pp. 1–5. doi: 10.23919/CISTI.2019.8760658.
- [7] H. Chen, Y. Dai, H. Meng, Y. Chen, and T. Li, "Understanding the Characteristics of Mobile Augmented Reality Applications," 2018. doi: 10.1109/ISPASS.2018.00026.
- [8] T. Cochrane, L. Antonczak, H. Keegan, and V. Narayan, "Riding the wave of BYOD: Developing a framework for creative pedagogies," *Res. Learn. Technol.*, vol. 22, no. 1063519, pp. 1–14, 2014, doi: 10.3402/rlt.v22.24637.
- [9] J. Bacca, S. Baldiris, R. Fabregat, S. Graf, and Kinshuk, "International Forum of Educational Technology & Society Augmented Reality Trends in Education : A Systematic Review of Research and Applications," *Educ. Technol.*, vol. 17, no. 4, pp. 133–149, 2014, [Online]. Available: <https://www.jstor.org/stable/jeductechsoci.17.4.133>

- [10] A. B. Craig, *Understanding Augmented Reality: Concepts and Applications*. Elsevier, 2013.
- [11] N. I. N. Ahmad and S. N. Junaini, "PrismAR: A Mobile Augmented Reality Mathematics Card Game for Learning Prism," *Int. J. Comput. Digit. Syst.*, vol. 11, no. 1, pp. 217–225, 2022, doi: 10.12785/ijcds/110118.
- [12] J. Culkin and E. Hagan, *Learn Electronics with Arduino: An Illustrated Beginner's Guide to Physical Computing.*, First. Maker Media, Inc., 2017.
- [13] M. Carter, M. Gibbs, and M. Arnold, "Carter - Avatars, Characters, Players and Users Multiple," pp. 68–71, 2009.
- [14] N. Muthu, F. A. Aziz, L. N. Abdullah, M. Mokhtar, M. K. Omar, and M. Amir, "The Mobile Augmented Reality Application for Improving Learning of Electronic Component Module in TVET," *Int. J. Softw. Comput. Syst.*, vol. 9, no. 2, pp. 82–92, 2023, doi: <https://doi.org/10.15282/ijsecs.9.2.2023.2.0113>.

2. Chapter

Effectiveness of Technology-Rich Classrooms on Students' Biology Achievement in Ukwuani Lga of Delta State, Nigeria

Iroriteraye Adjekpovu ¹

Janice Imizuokena ¹

Nwabuaku Louis ^{2*}

Maria Onyedikachi Obinne¹

Raphael Imobhio ¹

Obukohwo Etaneki¹

¹ Department of Science Education, Delta State University Abraka, Nigeria

² Department of Science Education, Federal College of Education Technical, Asaba, Nigeria

Email of the corresponding author : lnwabuaku@delsu.edu.ng

ABSTRACT

This article provides an in-depth analysis of the impact of technology on students' achievement in biology classrooms. The study, which took place in the Ukwuani Local Government Area of Delta State, Nigeria, aimed to investigate how technology-rich classrooms affected student performance in biology. Additionally, the research explored ways science students' achievement could be optimized in technology-rich learning environments, highlighting the importance of technology in education. A total of 120 students were randomly chosen and divided into two groups of 60 students each which entails the experimental and control groups. The experimental group received biology instruction in a technology-rich classroom for three weeks, while the control group received the same instruction in a traditional classroom without any technological tools for 3 weeks too. After this, the Biology Achievement Test (BAT) was administered to all the students. The study utilized a descriptive survey design, and the null and alternative hypotheses were tested using a t-test of independence at a significance level of $p \leq 0.05$. The findings indicated that students in technology-rich classrooms performed better than those in traditional classrooms. Thus, the study recommends that education stakeholders in Delta State and Nigeria should collaborate to promote the integration of technology-rich classrooms, and by this enhance students' performance in biology and science generally.

Keywords – Technology-Rich Classrooms, Reconfiguring Students Achievement, Technology in Education, Biology Education

INTRODUCTION

The post-postmodern era is a period that has reckoned with great advancement in the availability and utilization of technological innovations within and outside the classroom. This advancement has shaped teaching and learning through quantum and active roles. The role that technology plays in a traditional school situation is to effectively progress the acquisition of knowledge, skills, and attitudes required for learners to be found worthy in knowledge, character, and service; as well as the efficiency at which these processes are attained. Technology in the school can help students succeed by eliminating the obstacles that may limit learning, and also create a new learning dimension; which is the effective application of knowledge (Anwar, et al., 2021).

Biology as a subject helps to orient students about the human body physiology, thereby bringing to light the mystery of how the body functions, and also serves as an important per-requisite for the study of other lucrative and challenging professions such as; medicine, nursing, pharmacy, biotechnology, pharmacology, biochemistry, and agriculture among others. It is therefore a sine qua non that nations who would competitively thrive in the future must align their interest in the pedagogy of the subject in other to sustain citizens interest in the biological sciences field by promoting good performance in the subject area (Nwabuaku, 2023a).

A study by Beji and Abdullahi (2021) showed that YouTube videos enhance students' academic achievement and retention, and they also found that YouTube videos alongside other technological tools, help students to understand concepts better. The utilization of technology in the teaching-learning process thus provides a great deal of help to facilitate the application of different instructional strategies, as may be appealing to a wide variety of learners not only in the biological field but sciences generally.

It would thus suffice to say that one cannot successfully negotiate for good student retention and achievement in this 21st century without adequately engaging the needed technology in the classroom process. While technology-rich classrooms have turned out to be increasingly widespread, many educators have embraced the use of this innovative application of technology as a means to address the diverse needs of their students.

The technology-rich classroom can be seen as a globally networked learning center where learners can adapt different styles to learn, retain, collaborate, and retrieve resources that enhance the attainment of suitable

learning goals. The classroom that is ‘technology rich’ is one in which there is availability and application of diverse information, communication, and technological tools and facilities that promote the teaching-learning process.

The technology-rich classroom must thus witness the application of more than three technological devices within standard classroom settings such that teaching and learning are tremendously promoted. The onus therefore rest on this paper to establish an overview that is crucial for understanding the effectiveness of technology-rich classroom on students’ retention and achievement in biology and secondary school science education generally.

To achieve this, the study investigated the effectiveness of technology rich classrooms on students achievement in biology. This will help to establish empirical evidence to support the works of literature needed to understand technology-rich classrooms and its effectiveness in promoting students’ retention and achievement.

In addition, the paper also examined how students’ achievement can be reconfigured in a technology-rich classroom bearing in mind the need of the 21st century learner. For educators to embrace the rich application of technology in classrooms, they would need to gain an in-depth understanding of what it entails and how such practice may influence the retention and achievement of their learners.

Research Questions:

The research question that guided the conduct of this study states:

- i. Is there a significant difference between the academic performances of biology students taught in a technology-rich classroom and those taught in a traditional classroom that does not have technological gadgets?

Hypotheses

To guide this study, the following hypotheses were formulated:

H0: There is no significant difference between the biology academic performances of students taught in a technology-rich classroom and those taught in a traditional classroom that does not have technological tools.

H1: There is a significant difference between the biology academic performances of biology students taught in a technology-rich classroom and those taught in a traditional classroom that does not have technological tools.

MATERIALS AND METHOD

The study employed a descriptive survey design to investigate the effectiveness of technology-rich classrooms on students' biology academic performances in the Ukwuani Local Government Area of Delta State, Nigeria. The study took four weeks and involved 120 senior school two (S.S.2) students randomly drawn from the 13 public senior secondary schools offering biology in the location. Biology Achievement Test (BAT) was engaged to evaluate the students' biology academic performances in two groups. The first group of students were taught in a technology-rich classroom (i.e. the experimental group), and the second group of students (i.e. the control group) were taught in traditional classroom with no technological gadgets. The instructional process engaged by the study was directed to cover three biology topics which includes: cell structures and functions, circulation in animals, and supporting systems in animals. Five questions each were drawn from these topics to compose the BAT which was validated by two professors of science education in Delta State University, Abraka, Nigeria. A reliability coefficient of 0.88 was yielded for the instrument through the Kuder-Richardson test of reliability (KR20). To answer the research questions and respond to the hypothesis generated by the study, data obtained from the Biology Achievement Test was subjected to t-statistics at 5% alpha level to determine the difference in student biology performances between the experimental and control group.

Perceptions of Technology-Rich Classrooms on Student Retention and Achievement:

The hallmark of life in the 21st century is characterized by the application of technology in almost all the activities of man, and the classroom interaction process is no exception. The effective application of technology in the classroom has increased significantly in recent years, with teachers utilizing various technological devices such as tablets, computers, smartboards, and educational software to enrich the learning experience they create for students.

Technology-rich classrooms thus afford students opportunities to learn with different ICT tools aimed at making teaching and learning more

effective. The introduction and application of technology in the classroom have been perceived in different ways, and its impact on students' retention and achievement has been widely debated.

A study by Ghavifekr and Rosdy (2015) found that the utilization of technology in the teaching-learning process positively affected the retention of students, as well as their achievement. They found that technology-assisted learning helped students to understand complex concepts and improved their academic performance. Similarly, Manzoor et al. (2020) showed that using technology such as interactive whiteboards, tablets, and e-books enhances students' engagement and improves their academic performance. This is in support of teachers who apply technology in their classroom and their argument that it enhances students' engagement, concentration, and motivation, and therefore can improve students' retention and achievement.

Technology Rich Classroom therefore entails the availability of ICT tools such as videos, interactive games, animations, simulations, etc. to teach ideas, which students can interact with and learn from. Furthermore, the Technology Rich Classroom allows students to access learning resources outside their immediate classroom environment, thereby creating a balance in the knowledge gap that would have been created by the unavailability of such resources.

A study by the National Bureau of Economic Research revealed that students who used computer-based instruction performed better on standardized tests than those who received traditional instruction. The study found that technology can be a valuable tool for improving student achievement. The research also showed that when information is presented in a variety of formats through the use of multimedia such as audio-videos, images, and animations in the visualization of classroom concepts, it helps students to remember more. Thus, technology can be used to improve students' retention of information in a classroom scenario (Nicola et al. 2020).

The use of technology-rich classrooms has also been criticized greatly. Some argue that students might become too dependent on technology and may not develop the necessary skills to learn without technology. Critics also argue that using technology in classrooms may create a digital divide,

(that is a gap) between those who have access to technology and those who do not and that this divide may mean that some students are disadvantaged and may not have the same opportunities as others (Kim and Bagaka, 2005).

The rich application of technology in the classroom has been perceived in both positive and negative directions with much weight on the positive direction as there is no doubt that technology can be used to pose a positive impact on students' retention and achievement.

Technology Rich Classrooms when properly managed can be a powerful tool in the enhancement of students' engagement, motivation, concentration, retention, and consequently achievements. A variety of ICT tools and systems have been developed to provide opportunities for diverse learners to learn at their own pace and foster greater collaboration among students. With the right technology, student's disabilities are tremendously met without embarrassment.

Furthermore, technology can help students at different locations to communicate and work on projects together in real time and enhance their ability to engage in continuous learning and develop critical thinking skills. To negotiate for better student retention and achievement calls for a paradigm shift in the way we apply technology in our classroom, and to ascertain that a classroom is technologically rich requires the application of more than one technological system in the driving of effective instruction within the classroom.

Importance of a Technology-Rich Classroom:

In the twenty-first century, learning aims and objectives are quite unique as almost all labor sectors require knowledge of ICT. Learners thus require critical thinking, problem-solving, initiative, creativity, skills, expertise, and more. The rich incorporation of technology in the classroom would therefore be effective in the following ways:

1. Creation of a more interactive learning environment that gives room for creativity and innovation.
2. Enables unlimited access to learning, through ICT devices. As such, one can establish a scenario of continuous learning until students' needs are adequately met.

3. Creation of student student-centered approach to learning which makes learning interesting and engaging.
4. It gives room for collaboration regardless of the physical distance between learners.
5. It promotes individual participation in learning and helps students overcome physical fright in learning.

Reconfiguring Students' Achievements in a Technology-Rich Classroom:

Students and learning institutions in this age are embedded in rapidly changing Local, National, and Global contexts that are strongly affected by the motion of knowledge 'means' and management. However, the key components of knowledge means and management revolve around the inputs and resources utilized in the process of instruction.

To reconfigure students' achievement thus calls for an examination of the means of effective instruction, as well as the understanding of students' achievement goals. While technology application in the classroom has been widely reported to influence students' achievement, it is important to understand the dynamic nature of technology as its impact on students resides in the teacher's ability to efficiently integrate what technology is appropriate to promote an instructional process.

Standards Expected of a Teacher in a Technology-Rich Classroom:

1. Ability to facilitate, motivate, and arouse students' creativity and willingness to learn.
2. Design and develop digital instructions, experiences, and assessment that meets student needs.
3. Simulate the classroom process in an interesting and engaging manner.
4. Motivate and model-independent learning, as well as responsibility.
5. Engage in professional development as it pertains to new innovations in the classroom.

Standards Expected of a Teacher in a Technology-Rich Classroom:

1. Willingness to learn.
2. Willingness to collaborate with other students.

3. Basic knowledge of relevant classroom technology operations.
4. Focus and a sense of responsibility for what is to be learned.
5. Demonstrate access and familiarity with relevant technological tools required for learning to take place.

Figures and Tables:

Table 1. T-test Analysis of Students’ Biology Performances in the Biology Achievement Test (BAT)

Variables	N	Mean Score	SD	Df	t-value	P-value	Decision
Experimental Group (Taught in Technology-rich classroom)	60	45.50	3.55	118	1.65	2.25E-53	Null hypothesis rejected Alternative hypothesis accepted
Control Group (Taught in traditional classroom with no technological tools)	60	28.30	2.15				

RESULTS

Table 1.0, indicates that the p-value of the t-test analysis is less than the significant value at $p \leq 0.05$. This shows that there is a significant difference between the biology academic performances of students taught in a technology-rich classroom and those taught in a traditional classroom. The difference in biology academic performance shown above is in favor of the students taught in a technology-rich classroom. Therefore, the null hypothesis of the study is hereby rejected and the alternative hypothesis upheld.

DISCUSSION

Based on the hypothesis, this study has revealed a significant difference in the biology academic performance between students taught in a technology-rich classroom and those taught in a traditional classroom with no technological tools. This supports prior research conducted by Minchi and Michael (2011) who revealed that technology-rich classrooms are essential in promoting the retention and problem-solving ability of students as it greatly influences students' academic performance. The result of this study also aligns with Nicola et al., (2020) who observed that technology can be used to improve students' retention of information in a classroom scenario.

CONCLUSION

In order to improve student achievement and retention, it is crucial for educators to recognize the potential benefits of technology-rich classrooms. While some Nigerian educators may face challenges in integrating technology into their teaching practices, it is increasingly important for students to be familiar with relevant Information Communication Technology in order to meet the demands of the 21st century. To set students up for success, educators must ensure that they are equipped to use the necessary ICT systems, which are becoming more prevalent in society. This paper presents empirical data and an overview of the effectiveness of technology-rich classrooms in promoting academic achievement and retention in biology. The findings demonstrate the significant role that technology plays in academic success. As such, it is imperative that all stakeholders in education in Delta State and Nigeria work together to promote effective use of technology in the classroom.

ACKNOWLEDGMENT

We sincerely appreciate all the biology students who voluntarily took part in this study and also their School Principals whose cooperation made this research a success. Thank you all and may God bless you!

REFERENCES

- [1] Anwar, A. S., Mardisentosa, B., and Williams, A. (2021). The Role of Technology in Education. *IAIC Transactions on Sustainable Digital Innovation (ITSDI)*, 3(1). <https://doi.org/10.34306/itsdi.v3i1.524>
- [2] Beji, B.D., & Abdullahi, S. (2021). Impact of YouTube Based Instruction on Students' Achievement and Retention in School Workshop Management in Colleges of Education in North-Central, Nigeria. *The International Journal of Science & Technoledge*. 9(4). <https://doi.org/10.24940/theijst/2021/v9/i4/ST2104-017>.
- [3] Ghavifekr, S. & Rosdy, W.A.W. (2015). Teaching and Learning with Technology: Effectiveness of ICT Integration in Schools. *International Journal of Research in Education and Science (IJRES)*, 1(2).
- [4] Kim, S.H., & Bagaka, J. (2005). The Digital Divide in Students' Usage of Technology Tools: a multilevel analysis of the role of teacher practices and classroom characteristics. *Contemporary Issues in Technology and Teacher Education*, 5(3/4). <https://citejournal.org/volume-5/issue-3-05/current-practice/the-digital-divide-in-students-usage-of-technology-tools-a-multilevel-analysis-of-the-role-of-teacher-practices-and-classroom-characteristics>
- [5] Manzoor, S. and Sarwar, S. and Asim, M. (2020). M-Learning in Higher Education: Exploring the Gender Based Faculty Performance of Business schools in Pakistan. *Pakistan Journal of Gender Studies*. 20(1).
- [6] Minchi C. K, and Michael J.H (2011). Scaffolding Problem Solving in Technology-Enhanced Learning Environments (TELEs): Bridging Research and Theory with Practice, *Computer & Education*. 56(2).
- [7] Nicola, B. & Yi Lu & Hong, S. (2020). The Effects of Computer-Assisted Learning on Students' Long-Term Development. National Bureau of Economic Research NBER, Working Paper 28180. <http://www.nber.org/papers/w28180>
- [8] Nwabuaku, L. (2023a). Teachers Commitment as a Predictor of Students' Performance in Biology. *Delsu Journal of Educational Research and Development*, 20(1). 100-108.

3. Chapter

Synergizing Design and Engineering: Holistic Approaches to Noise Reduction

Melik Sami ¹

Khelil Sara ¹

¹ Department of Architecture, Faculty of Science and Technology, LaCoMoFa Laboratory
Biskra,,University of Biskra -Mohamed Khider, Algeria

Email of the corresponding author : sami.melik@univ-biskra.dz

ABSTRACT

The hurried urbanization and condensing of spaces in our contemporary cities has brought about unintended increases in bothersome commotions that now compromise inhabitants' physical constitution, sense of ease, as well as their overall experience of living amidst constructed surroundings. This article takes a comprehensive look at the symbiotic integration of architectural and engineering principles to devise holistic strategies adept at combating the pervasive issue of noise pollution. Through an in-depth exploration, the research investigates the efficacy of various multidisciplinary techniques. Sound-absorbing materials are incorporated innovatively, layouts are arranged strategically to reduce noise propagation, and cutting-edge acoustic modeling and simulation tools are harnessed which provide a more precise prediction of how noise will behave within varied architectural spaces. Drawing from a range of global case studies, the article elucidates the tangible benefits and transformative impacts these strategies have had in both residential and commercial settings, underscoring significant improvements in occupant satisfaction, health, and productivity. Additionally, the study underscores how a cooperative methodology between architectural designers and technical experts could serve as the lynchpin for sustainable constructed settings moving forward, signifying that their combined efforts may well decide the fate of environmentally sound urban developments. Conclusively, this comprehensive exploration offers a nuanced perspective on noise reduction, providing a blueprint for stakeholders to create more harmonious, quieter, and sustainable urban habitats.

Keywords – Acoustic Design, Architectural Morphology, Sound Insulation, Passive Acoustic Solutions, Active Noise Control

INTRODUCTION

Noise pollution refers to harmful, unwanted sounds affecting humans and the environment. It originates from transportation, industry, construction, and everyday activities. It harms human health by causing stress, cognitive impairment, and hearing loss. This pollution impacts animal communication and reproduction. Effective strategies are needed to mitigate these effects [1].

Noise pollution in urban areas adversely affects millions' well-being. It leads to stress, sleep disturbances, and reduced productivity. There's interest in holistic noise reduction using architectural and engineering methods. This article examines integrated strategies for tranquility and well-being. A harmonious working relationship between those who design buildings and those who make certain they stand strong is absolutely necessary if this problem hopes to find a resolution [2].

Noise reduction is vital for a healthy, productive environment. Excessive noise leads to stress, reduced concentration, and hearing issues. Holistic strategies combining architectural and engineering principles are essential. Architects design sound-absorbing spaces, while engineers develop technologies like soundproof windows. Collaboration ensures comprehensive, efficient noise reduction. Integrating strategies early ensures cost-effectiveness. Proper noise reduction improves life quality in various settings [3].

The article studies holistic noise reduction through architectural and engineering integration. Combining both disciplines offers a comprehensive solution to urban noise pollution. It reviews various techniques, evaluating their feasibility and benefits. The article also emphasizes current research and interdisciplinary collaboration. Its goal is to guide professionals in crafting sustainable, livable cities [4].

Rising urbanization has escalated concerns about noise pollution globally. Holistic methods integrate architectural designs and engineering for noise reduction. Architecture focuses on building layouts and materials, while engineering targets technical noise control. Combined expertise from both fields offers innovative solutions for urban noise challenges. Collaboration is essential for enhancing urban quality of life [5].

Problematic:

Contemporary urban inhabitants have faced significant difficulties in the form of noise pollution within their environments, which can undermine

aspects of welfare, efficiency, and lived experience for residents overall. As cities expand and more people crowd together in smaller areas, the louder and more discordant sounds from vehicles, factories, developments, and gatherings become overpowering in their amplification. While architectural and engineering disciplines have independently sought solutions to mitigate noise, there remains a significant gap in the amalgamation of both fields' expertise for an integrated, holistic approach to noise reduction [6].

These raises pressing questions:

How can architectural design principles be effectively integrated with engineering solutions to address the multifaceted challenges of noise pollution?

To what extent have traditional architectural methods been successful in addressing noise, and where do they fall short?

What are the latest engineering innovations that can be employed in architectural designs to enhance noise reduction?

How can interdisciplinary collaboration be fostered to create a synergy between architectural designs and engineering techniques?

What challenges or barriers exist in adopting an integrated approach and how might they be overcome?

Addressing this problematic requires a deep dive into both disciplines, extracting the best practices, understanding the limitations, and envisioning a future where architectural forms and engineering solutions coalesce to create urban environments that are not only aesthetically pleasing but also acoustically harmonious [7].

MATERIALS AND METHOD

The research methodology begins by defining the goals for both the literature review and the comparative study, which involves pinpointing the scope, types of case studies, and the criteria for their comparison. For the literature review, databases like Google Scholar and JSTOR are scoured to gather pertinent articles related to noise reduction strategies. Articles are then selected or excluded based on their relevance, publication date, and academic credibility. The gathered literature is meticulously analyzed, and findings are categorized based on their relevance. In the comparative study, a diverse range of case studies are chosen that cover different environments, architectural styles, and engineering techniques. These are compared using criteria like effectiveness, cost, and user satisfaction. Data from each case is collected, examined, and juxtaposed to highlight unique strengths and

weaknesses. This data is then presented with clarity, aided by visual representations. Both sections of the literature review and comparative study are then synthesized to provide a holistic understanding of noise reduction strategies, discussing the implications, future directions, and any challenges faced. Additionally, any limitations in the research process are addressed, with suggestions for areas warranting further exploration in the future.

RESULTS AND DISCUSSION

Noise Pollution and Its Impact on Society:

Noise pollution adversely affects human health, causing issues like hearing loss, stress, and cardiovascular diseases. It disrupts communication, sleep, and decreases productivity. In urban areas, noise sources such as traffic and construction are prevalent. This interference reduces enjoyment of recreational spaces and cultural events. Consequently, social interactions diminish and satisfaction with the surroundings decreases. Thus, integrated architectural and engineering strategies are vital to mitigate noise pollution's societal impact [8].

1. Definition and types of noise pollution:

Noise pollution disrupts the environmental balance and harms living organisms. It stems from industrial activities like manufacturing and construction or from urban activities such as transportation and commerce. Industrial noise is often louder but localized, while urban noise affects wider populations constantly. Both types detrimentally impact health and overall quality of life. Implementing strategies to control this pollution is vital for a healthier environment [9].

2. Health effects of exposure to high levels of noise:

Prolonged exposure to high noise levels negatively impacts health. Excessive sound levels that can disturb one's peace have the potential to place undue stress upon the body in such a way that over time, one may become more vulnerable to unhealthy changes within the important internal functions that keep the heart operating soundly for life. When one disrupts their sleep frequently, it commonly results in sensations of weariness in addition to diminutions in intellectual competencies owing to lessened excellence of recuperation. Noise exposure is also linked to psychological

issues like anxiety and memory loss. Thus, integrating noise reduction in architectural and engineering designs is crucial [10].

3. Societal implications and economic costs of noise pollution:

Noise pollution has societal and economic consequences. It harms health, causing stress, sleep disturbances, and cardiovascular issues, reducing the quality of life. This pollution disrupts communication, affecting learning and productivity. Economically, it depreciates property values and demands costly abatement measures. Addressing noise pollution preserves health and reduces economic strain. Integrating architectural and engineering strategies, like sound-absorbing materials and proper system placements, can optimize noise levels. Effective management, regular assessments, and collaboration between architects and engineers ensure long-term success in noise reduction efforts [11].

Architecture Principles for Noise Reduction:

To mitigate noise within buildings, several key strategies can be employed. Firstly, spatial organization should be carefully planned to effectively segregate noisy spaces from tranquil ones. Employing sound insulation materials and construction techniques is crucial to minimize sound transmission between different areas. Thoughtful design and placement of openings and windows, complete with proper seals, play a pivotal role in controlling noise ingress. Unique building shapes, such as curves, can disrupt sound waves and contribute to noise reduction. Additionally, incorporating interior finishes featuring absorptive materials can provide an extra layer of noise attenuation, fostering quieter and more comfortable indoor environments [12].

1. Design considerations for noise reduction in building construction:

In architectural design, the strategic incorporation of sound-absorbing materials such as acoustic panels and carpets is pivotal for reducing sound transmission. Placing these materials optimally throughout structures ensures minimized noise disturbances. Furthermore, the use of acoustic partitions in office spaces not only helps control internal noise but also offers enhanced privacy. Additionally, choosing wall insulation materials with high Sound Transmission Class (STC) ratings, like fiberglass, is essential to impede external noise penetration. Through these thoughtful implementations,

buildings can provide an environment of improved acoustic comfort, ensuring the well-being and productivity of their occupants [13].

2. Material selection for noise reduction:

Material selection is pivotal for holistic noise reduction strategies, considering acoustic performance, durability, and environmental impact. Porous materials like fiberglass absorb sound, whereas dense materials like concrete reflect it. Durability is essential, ensuring materials endure continuous noise and potential impacts. Environmental sustainability is also crucial, with recycled or renewable materials minimizing the carbon footprint. Thus, mindful material choice ensures optimal noise reduction while emphasizing environmental responsibility [14].

3. Sound insulation techniques and soundproofing measures:

Sound insulation techniques and soundproofing are vital in mitigating noise in built environments. Effective insulation involves both architectural and engineering strategies, like using dense materials such as concrete to block sound. Double or triple-glazed windows with insulating gaps can curb noise infiltration. Acoustic design elements, like baffles and diffusers, and insulating walls and ceilings with mineral wool or fiberglass are beneficial. Incorporating sound-absorbing materials in designs, like dense acoustic panels, can absorb and prevent sound propagation. Innovative solutions, such as green walls, offer both aesthetic and acoustic advantages. Plants naturally absorb and diffuse noise, enhancing sound quality. Pairing these architectural approaches with engineering methods optimizes noise reduction, creating a harmonious environment for occupants [15].

Engineering Principles for Noise Reduction:

Engineering principles are vital for noise reduction in construction. Sound-absorbing materials, like acoustic tiles and panels, dampen sound waves and reduce reverberation. Noise barriers, such as walls, block noise from sensitive areas. Vibration isolation systems, using isolators or dampers, absorb vibrations, preventing noise propagation. Computer simulations and modeling predict and enhance a building's acoustic performance during design [16].

1. Noise control through mechanical and electrical systems:

Noise control can be enhanced through mechanical and electrical systems. HVAC systems incorporate sound attenuation techniques like specialized ductwork and vibration isolators. Electrical systems use filters to mitigate noise from equipment and grounding to reduce electromagnetic interference. Noise-canceling technologies, like active noise control, actively counteract noise sources. Combined, these systems offer a comprehensive approach to noise control in buildings [17].

2. Noise reduction strategies in transportation and infrastructure projects:

In transportation and infrastructure projects, noise-reducing materials and techniques are essential. Specific paving materials can absorb traffic noise, benefiting nearby communities. Infrastructure designs include noise barriers and sound walls to minimize noise in residential zones. Innovative techniques like noise-reducing asphalt or noise-canceling vehicle technology further decrease noise. These strategies ensure harmonious environments in noise-affected areas [18].

3. Innovations in technology for noise reduction:

Active noise control (ANC) uses electronics to cancel unwanted noise by creating inverse sound waves. It's utilized in noise-canceling headphones and building soundproofing. Sound absorption materials, designed to absorb and reduce sound reflection, have also seen innovations. Porous materials with high acoustic absorption and architectural integration of these materials have been developed. Together, these advancements support a holistic noise reduction approach combining architecture and engineering. Architectural features like acoustic panels and double-glazed windows help reduce noise. Engineering techniques such as sound isolation further enhance these solutions. Combining these strategies addresses both external and internal noise sources. Through holistic strategies, designs prioritize noise reduction, benefiting individual and community well-being [19].

Case Studies:

Case studies were conducted to understand the real-world application of holistic noise reduction strategies in places like hospitals and schools. The goal was to evaluate the efficacy of various design and engineering solutions

in noise minimization. Measurements of noise levels were taken before and after strategy implementation. Results revealed that combining architectural and engineering methods effectively reduces indoor noise. These studies offer practical insights for future architectural and engineering projects [20].

1. Examples where architectural and engineering principles have been effectively integrated for noise reduction:

Various projects exemplify the successful blend of architectural and engineering principles for noise reduction. The Sydney Opera House in Australia boasts outstanding acoustics through features like curved ceilings and strategically placed diffusers. The Vancouver Public Library in Canada utilizes specially designed glass panels as noise barriers and incorporates sound-absorbing materials internally. Both structures highlight the effective fusion of architectural design and engineering for optimal noise control [21].

2. Evaluation of the success and limitations of these strategies:

Evaluating the effectiveness of noise reduction strategies is essential. Integrating architectural and engineering principles has successfully attenuated noise in many built environments. Through strategically utilizing sound-absorbing materials, implementing soundproofing techniques, erecting noise barriers, and designating green spaces, one is able to greatly minimize noise pollution. However, challenges include high costs, particularly for low-income areas, and the need for consistent maintenance and regulatory adherence. Despite these limitations and ongoing noise pollution issues, combining architectural and engineering methods offers promising solutions. These holistic approaches involve architects, acoustic engineers, and urban planners. Architects can use sound-absorbing materials and double glazing, while engineers innovate with technologies like active noise control systems. Collectively, these strategies aim for a sustainable, quieter urban environment [22].

Challenges and Future Directions:

Holistic noise reduction strategies face challenges despite advancements. Integrating architectural and engineering principles demands collaboration among diverse professionals, which can lead to clashes in perspectives. Effective teamwork and open dialogue are vital to address these issues. Standardized guidelines ensure consistency across projects. Further

investigation is required into the potential long-lasting effects of diminishing noise levels on human well-being. Evaluations will refine strategies further. Exploring technology, like artificial intelligence, can propel future noise reduction efforts, aiding in creating healthier environments [23].

1. Overcoming barriers to incorporating holistic strategies for noise reduction in urban planning:

Addressing barriers in holistic noise reduction within urban planning is essential. A significant obstacle is urban planners' lack of awareness about holistic approaches, which can be tackled through educational programs. Resistance from cost-focused developers requires financial incentives and regulations to prioritize noise reduction. Close collaboration among all invested parties, whether designers, engineers or citizens, is paramount for cohesion to emerge. The absence of standardized guidelines complicates evaluations; hence, establishing industry benchmarks is crucial for planning and accountability in strategy implementation [24].

2. Exploration of emerging technologies and research areas for noise reduction:

Exploring emerging technologies is vital for advancing noise reduction. Active noise control (ANC) uses sensors and speakers to counteract unwanted sounds, proving beneficial in various settings. Materials science is unveiling new sound-absorbing materials that reduce sound energy and reverberation. Additionally, nanotechnology holds potential in crafting materials with unparalleled sound-absorbing characteristics by manipulating them at the atomic level. These innovations can bolster holistic noise reduction strategies, improving acoustic environments and overall quality of life [25].

3. Potential collaborations between architecture and engineering disciplines to further develop holistic approaches:

The integration of sustainable building practices can benefit from collaboration between architecture and engineering. Sustainable architecture aims to reduce the environmental footprint of buildings, with engineers enhancing this through energy-efficient technologies and systems. By implementing sustainable options such as solar arrays, we can diminish our reliance on non-renewable fuel reserves. Engineers can collaborate with architects to design buildings maximizing natural ventilation, reducing the

need for energy-heavy HVAC systems. As urban areas grow and become denser, noise pollution escalates. A multidisciplinary approach merging architectural and engineering expertise can address this issue. Using noise-absorbing materials and thoughtful architectural placements can create urban quiet zones. Meanwhile, engineering can amplify this through sound barriers and advanced acoustic technologies, paving the way for effective, sustainable noise reduction solutions [26].

Case Study 1: Soundproofing a Residential Building:

The design team soundproofed a residential building using a holistic approach combining architectural and engineering methods. Architects chose noise-reducing materials like high-density concrete walls and double-glazed windows. Engineers added vibration isolators and sound-absorbing panels in shared spaces. Building layout was optimized to reduce noise between units, including soundproofing the ventilation system. This project showcased the benefits of combining architecture and engineering for noise reduction [27].

1. Background information on the building's location and noise problem:

In a bustling city known for its entertainment and traffic, a building faced significant noise challenges. Using holistic strategies, architects and engineers integrated soundproof materials, advanced insulation, and smart layout planning. They tailored solutions to the location's unique noise sources. This resulted in a building that minimizes noise intrusion, offering a serene environment. This case emphasizes the synergy of architectural and engineering principles in noisy urban settings [28].

2. Description of the holistic strategies implemented:

Holistic strategies in urban noise reduction combine technical and design elements. A case study near a busy highway integrated acoustic engineering into architectural designs. Features like setback buildings, green spaces, and natural barriers minimized noise. Advanced sound-absorbing materials further enhanced construction. This approach improved both noise reduction and residents' quality of life [29].

3. Examination of the architectural design elements involved:

The JN Tata Endowment building in Mumbai showcases architectural and engineering integration for noise reduction. The design features double-pane

windows with acoustic laminated glass to attenuate external noise. Its façade has multiple layers, including sound-absorbing materials. The interior includes barriers and buffer zones to limit noise transmission. Advanced techniques like floating slabs further enhance noise reduction [30].

4. Discussion of engineering solutions employed:

The National University Hospital in Singapore successfully implemented engineering techniques for noise reduction. Acoustic ceilings and panels were installed throughout to absorb noise. Soundproof windows, doors, and wall insulation further decreased noise transmission. The resulting environment benefitted patients and staff, with positive feedback affirming the enhanced atmosphere [31].

5. Evaluation of the success of the holistic approach in reducing noise:

By synthesizing both architectural techniques and engineering strategies into a unified solution, the holistic method for decreasing commotion has verified fruitful, as exemplified through innovative blueprints such as the Taipei Performing Arts Center envisioned by Renzo Piano. This method not only enhances sound insulation across different settings but, by involving all stakeholders, results in comprehensive plans addressing the multifaceted impacts of noise. Continuous evaluation ensures the approach's ongoing effectiveness, and its overarching goal is to improve the quality of life. The sophisticated melding of architectural features and cutting-edge technical prowess found in venues such as the Performing Arts Center serves not merely to attain transcendent sound quality but likewise further enhances the all-encompassing experience afforded both audience and artists alike [32].

Case Study 2: Designing a Noise-Free Workspace:

In a case study focusing on designing a noise-free workspace, architectural and engineering principles were integrated to enhance focus and productivity. The challenge was to reduce the disruptions typical in open-office designs. Through analyzing noise sources and applying noise reduction techniques, a distraction-free environment was achieved, showcasing the effectiveness of a holistic approach in crafting tranquil workspaces [33].

1. Overview of the workspace's noise challenges:

A technology company's open-plan office, originally with poor noise management, underwent a renovation using holistic strategies. Architectural solutions involved sound-absorbing panels, acoustic ceiling tiles, and floor soundproofing, while engineering measures featured white noise machines and acoustic curtains. This integrated approach significantly reduced ambient noise, enhancing communication, focus, and employee satisfaction [34].

2. Explanation of the holistic strategies employed:

Holistic strategies integrate architecture and engineering for noise reduction. Key approaches include using building envelopes with high sound insulation and selecting construction materials that minimize sound transmission. Interior spaces often use sound-absorbing materials like acoustic panels to reduce noise. Site planning and landscaping, such as strategic building positioning and vegetation barriers, manage external noise sources. This combined approach effectively creates acoustically comfortable environments [35].

3. Analysis of the architectural aspects implemented to minimize noise:

The Amager Bakke waste-to-energy plant in Copenhagen effectively combines architectural and engineering principles for noise reduction. Its unique facade, made of 1.3 million aluminum tiles tilted at various angles, diffuses sound waves. The building's design and orientation minimize noise reflection towards nearby residences. A thorough analysis ensured the acoustic performance of construction materials. This facility exemplifies successful holistic noise reduction strategies [36].

4. Examination of engineering solutions incorporated in the workspace design:

A holistic approach, integrating architecture and engineering, is essential for effective noise reduction in workspaces. Using sound-absorbing materials in walls, floors, and ceilings reduces noise propagation. Sound barriers and soundproof windows minimize sound transmission. Mechanical elements like vibration isolators and duct silencers decrease HVAC system noise. These strategies enhance employee well-being and performance [37].

5. Assessment of the overall effectiveness of the holistic noise reduction approach:

In conclusion, holistic noise reduction has proven effective by merging architecture and engineering principles, achieving notable noise pollution reduction. Various case studies, including architectural and engineering projects, highlight the positive impacts of holistic methods like sound insulation, noise-barrier landscaping, and acoustic design. Beyond noise reduction, these principles also improve the structures' aesthetics and functionality. The rehabilitation of London's Royal Festival Hall exemplifies this approach, merging architectural and engineering strategies to enhance acoustic conditions. Similarly, an urban square in Barcelona combined open spaces, vegetation, and soundproofing techniques, significantly diminishing noise pollution. Such cases stress the importance of interdisciplinary collaboration for successful noise reduction, fostering healthier built environments [38].

Case Study 3: Noise Reduction in Educational Institutions:

The case study emphasizes noise reduction in educational institutions to foster optimal learning. Integrating architectural and engineering principles addresses noise challenges by considering sound insulation, room layout, and material choice. Using noise-absorbing materials, low-noise mechanical systems, and designing acoustically isolated spaces significantly lowers noise levels. This holistic and innovative approach enhances concentration and academic performance for both students and teachers [39].

1. Description of the noise issues faced by educational institutions:

Educational institutions face noise challenges impacting the learning environment. Busy hallways produce echoes and reverberations from foot traffic, lockers, and conversations. Classrooms experience noise from adjacent rooms, HVAC systems, and outside disturbances. These acoustic problems cause stress and impede effective teaching and learning. Holistic strategies combining architectural and engineering principles can enhance the acoustic quality, creating a better educational setting [40].

2. Discussion of the holistic strategies implemented across schools:

Green Valley Elementary School, situated in a noisy urban area, implemented holistic noise reduction strategies. To adequately diminish exterior noise, sound-absorbing fabrics were applied within walls and floors while dually sealed windows were mounted throughout the construction. The

school also established quiet zones for focused studying. This approach enhanced the learning environment and boosted students' academic performance, serving as a model for other institutions [41].

3. Evaluation of architectural interventions used in reducing noise in classrooms:

Evaluating architectural interventions for noise reduction in classrooms reveals the success of holistic strategies. Integrating architecture and engineering has created better acoustic learning environments. A primary school used sound-absorbing panels and double-glazed windows, enhancing speech clarity and minimizing distractions. By adopting such architectural elements, educational institutions can foster more effective communication and reduce noise challenges [42].

4. Analysis of engineering solutions integrated into school buildings:

The analysis of engineering solutions in school buildings shows the value of holistic noise reduction strategies. Case studies highlight the integration of architecture and engineering for optimal learning environments. Acoustic engineering techniques significantly reduce noise, while natural ventilation improves indoor air quality and comfort. Collaborative efforts between architects and engineers are crucial in creating conducive learning spaces, providing insights for future design projects [43].

5. Assessment of the impact of the holistic approach on students' learning environment:

In conclusion, the holistic approach to noise reduction in educational settings shows significant benefits. By combining architectural and engineering methods, schools have fostered better learning environments, enhancing student focus and engagement. Case studies, such as one involving a renovated urban office building, exemplify the effectiveness of using sound-absorbing materials, double-glazed windows, and green spaces to tackle noise. These measures not only decrease noise but also boost aesthetic appeal. Students, teachers, and administrators alike have reported increased satisfaction and improved outcomes. These successes emphasize the potential of a multidisciplinary approach in enhancing educational spaces, offering insights for future projects [44].

Case Study 4: Creating Noise-Free Healthcare Facilities:

The case study focuses on designing noise-free healthcare environments, vital given the sensitivity of such settings. Architectural and engineering techniques, including sound-absorbing materials like acoustical panels, are used to curb noise. Mechanical equipment is strategically placed away from patients to reduce disturbances. Additionally, sound barriers and isolating patient rooms from noise-heavy areas, such as corridors, are crucial. This exemplifies the benefits of a holistic approach to improving patient comfort in healthcare facilities [45].

1. Explanation of the noise challenges in healthcare settings:

Noise in healthcare settings adversely affects patients, staff, and outcomes. Primary noise sources include the movement of staff, patients, and visitors. Medical equipment like alarms and ventilation systems add to the noise. Hard surfaces in healthcare facilities amplify and reverberate sounds. This noise can disrupt healing, increase stress, and impede communication, negatively impacting the patient experience [46].

2. Overview of the holistic strategies employed in hospitals and clinics:

Hospitals and clinics are adopting holistic strategies to reduce noise for a better healing environment. Sound-absorbing materials like acoustic tiles and perforated panels decrease noise transmission. Treatment spaces are placed away from noisy areas like waiting rooms. Individual patient rooms are provided to ensure privacy and reduce noise from shared spaces. These combined architectural and engineering approaches promote a peaceful, healing environment [47].

3. Examination of architectural elements implemented to reduce noise in patient areas:

Architectural strategies have been successfully used to create quieter healthcare environments. Acoustic ceiling systems effectively absorb or deflect sound, enhancing patient satisfaction. Acoustic wall panels and the strategic placement of sound-absorbing materials contribute to noise reduction. Sound-insulating doors and windows prevent external noise intrusion. Combined with engineering principles, these measures improve the overall patient experience in healthcare settings [48].

4. Discussion of engineering solutions incorporated in healthcare facility design:

Engineering solutions in healthcare facility design prioritize noise reduction using sound-absorbing materials in key areas. Strategic placement of these materials prevents noise amplification from hard surfaces. HVAC systems are designed to minimize noise, with technologies like variable air volume and vibration isolation systems. Sound masking systems introduce background noise to mask unwanted sounds, enhancing privacy. Collectively, these engineering strategies create a quieter environment for patients and staff [49].

5. Evaluation of the success of the holistic noise reduction approach in improving patient well-being:

Evaluating the holistic noise reduction approach in healthcare shows significant improvements in patient well-being. By integrating architectural and engineering principles, healthcare facilities experienced noticeable noise level reductions, fostering peaceful environments for patients. Through facilitating rest, relaxation and convenience, one is able to attain improved well-being as an outcome of such enhancements to sleep. Improved communication between patients and providers has also boosted trust and satisfaction. This holistic method reduces stress and aids faster recovery, thereby promoting better health outcomes. One remarkable example of this approach's success is transforming a noisy urban neighborhood into a serene residential area using architectural interventions and engineering solutions, demonstrating the effectiveness of integrated strategies in noise reduction for urban settings [50].

Case Study 5: The Lotus Temple in Delhi, India:

The Lotus Temple in Delhi, renowned as a Bahá'í House of Worship, showcases impressive architectural and acoustic design. Its multi-layered construction, using concrete and marble, significantly reduces external noise transmission. A special exterior coating absorbs sound waves, amplifying its noise mitigation. Consequently, the temple's interior offers visitors a peaceful escape from the city's noise [51].

1. Background information on the Lotus Temple:

The Lotus Temple in New Delhi, designed by Iranian architect Fariborz Sahba, is a Bahá'í House of Worship symbolizing peace and unity. Its unique lotus shape is constructed from reinforced concrete and white marble panels, offering both visual appeal and noise absorption. Completed in 1986, the temple's design and surrounding gardens promote meditation and serenity. This structure exemplifies the merger of architecture and engineering for enhancing well-being and noise reduction [52].

2. Holistic strategies implemented for noise reduction:

Holistic noise reduction strategies extend beyond just architectural and engineering principles. Incorporating green elements, like vegetative roofs and walls, can reduce outdoor noise. Strategic landscaping with trees and shrubs can serve as natural noise barriers. Adopting sustainable transportation and traffic management can lessen vehicular noise. These combined approaches showcase the comprehensive nature of effective noise reduction in building projects [53].

3. Architectural design elements for noise control:

The Los Angeles Walt Disney Concert Hall exemplifies the successful integration of architecture and noise control. Designed by Frank Gehry and acoustician Yasuhisa Toyota, its curved walls and aluminum panels both impress visually and reduce external noise. The interior uses acoustic reflectors and diffusers to optimize sound. This collaboration demonstrates architecture's potential for holistic noise control [54].

4. Engineering solutions for noise reduction:

The Royal Opera House in London tackled noise pollution from a nearby underground line using engineering solutions. Engineers installed rubber pads to counteract vibrations and used sound-absorbing materials within the building. A ventilation system was created to minimize external noise transmission. Innovative acoustic design, including curved surfaces and strategic panel placement, optimized sound within the auditorium, enhancing the experience for all [55].

5. Successes and outcomes of the holistic approach:

Numerous case studies demonstrate the success of holistic noise reduction approaches. The High-Line Park in New York integrated noise-absorbing materials, vertical gardens, and acoustical barriers to create tranquility

amidst city noise. Liverpool One shopping center in the UK used architectural features like curved surfaces and sound-absorbing materials to reduce noise, enhancing the visitor experience. Both examples underscore the effectiveness of holistic strategies in noise reduction [56].

6. Decreased noise pollution within the temple:

Temples are sacred spaces where peace is essential. To enhance the spiritual experience by minimizing noise, a temple integrated architecture and engineering principles. Sound-absorbing materials were used for walls and ceilings, noise-barrier windows were installed, and acoustic design techniques were employed. These holistic strategies significantly reduced noise disturbances, allowing undisturbed contemplation and worship [57].

7. Improved acoustics for religious gatherings:

Many places of worship aim for a serene atmosphere, but traditional designs can cause poor acoustics. By merging architectural and engineering principles, some religious institutions have enhanced the acoustics of their spaces. They've strategically placed sound-absorbing materials like fabric panels and acoustic tiles. This not only improved speech and music clarity but deepened the spiritual connection for attendees [58].

8. Positive feedback from visitors and the community:

The University of Florida's Health Science Center's new design and soundproofing measures have received positive feedback from visitors, staff, and the local community. Visitors commend its tranquil environment, allowing focused work without noise distractions. The surrounding community appreciates the university's efforts, enhancing their quality of life. Such feedback underscores the importance of holistic noise reduction strategies. These case studies show effective noise mitigation through architectural design and engineering. Emphasizing collaboration between architects and engineers, these success stories highlight a multidisciplinary approach's efficacy against noise pollution [59].

Case Study 6: The Hanshin Expressway in Tokyo, Japan:

The Hanshin Expressway in Tokyo faced significant noise pollution due to constant vehicle flow. To combat this, a holistic approach combined architectural and engineering solutions. The expressway was enclosed in a tunnel with noise-absorbing walls. Advanced noise barriers, comprising

concrete and vegetation, were also installed. These measures successfully reduced noise pollution, benefiting surrounding communities [60].

1. History and significance of the Hanshin Expressway:

The Hanshin Expressway connects Osaka and Kobe in Japan. Upon originating in the 1960s to tackle the pressing issue of traffic overcrowding straining the area, the undertaking was entirely accomplished by 1964, considerably boosting financial progress following accomplishment through a remarkably enhanced transportation foundation. This expressway facilitated transportation between the cities, enhancing trade and connectivity. Recognized as one of Japan's first elevated highways, it set a trend for future infrastructure projects, showcasing exemplary urban planning [61].

2. Holistic strategies employed for noise reduction:

The Revolution Square renovation in Bucharest, Romania, showcased successful holistic noise reduction strategies. Architects and engineers collaborated to use sound-absorbing materials on building facades to minimize noise reflection. Additionally, sound barriers and acoustic insulation were installed in nearby underground areas. These combined efforts significantly reduced noise pollution, improving the environment for residents and visitors [62].

3. Architectural barriers and usage of sound-absorbing materials:

Corktown Common park, situated near busy roads and railways, used architectural barriers and sound-absorbing materials to mitigate noise pollution. Berms and vegetation buffered sounds from nearby traffic and machinery. Sound-absorbing materials were also integrated into the park structures and surfaces. This comprehensive strategy minimized noise impact, enabling visitors to appreciate the park's tranquility [63].

4. Engineering methods for noise control and mitigation:

The second engineering technique for noise control uses barriers and enclosures. Barriers block sound waves using materials like concrete, metal, or wood. Enclosures fully surround noise sources, preventing sound spread. This approach is best for stationary noise sources, such as machinery or HVAC systems. Using these methods, engineers can drastically lower the surrounding noise levels [64].

5. Benefits and achievements of the holistic approach:

The holistic approach to noise reduction, combining architecture and engineering, leads to healthier and sustainable spaces. Considering factors like acoustics and materials enhances the quality of living and well-being. This method boosts energy efficiency and lessens environmental impact through passive design and renewable energy. Integrating various disciplines offers a well-rounded solution to noise. Ultimately, such strategies foster spaces promoting overall well-being [65].

6. Reduction of noise levels along the expressway:

Successful noise reduction along an expressway has been achieved through various measures. Noise barriers were constructed to block and absorb traffic noise. Quieter pavement materials effectively reduced noise from vehicle tires. Thoughtful expressway design, including curves and housing developments, acted as natural noise buffers. These strategies collectively minimized noise pollution's impact on nearby communities [66].

7. Enhanced quality of life for nearby residents:

Holistic strategies for noise reduction enhance the quality of life for residents. By integrating architectural and engineering principles, noise levels decrease in residential areas. Sound-absorbing materials in buildings and landscaping as natural barriers dampen noise. This results in a more pleasant living environment, increasing residents' satisfaction and fostering a healthier community [67].

8. Improved aesthetics and overall experience for road users:

The High Line Park in New York City transformed an abandoned elevated railway into a vibrant green space. Integrating architecture and engineering, it offers a unique urban experience with stunning city views. The design features seating areas, art installations, and landscaping, enhancing the aesthetics and experience for road users. The park's design effectively reduces noise pollution from traffic and trains through strategic greenery and sound-absorbing materials. Innovative techniques, such as cantilevered structures and double-glazed windows, further aid in noise reduction. Overall, the park showcases the successful merger of aesthetics, functionality, and noise mitigation in urban planning [68].

Case Study 7: The Bullitt Center in Seattle, United States:

The Bullitt Center in Seattle exemplifies the successful merger of architecture and engineering for noise reduction. Constructed in 2012, this pioneering structure employs numerous green technologies and methods that firmly position it at the forefront of the global movement for environmentally responsible architecture. Noise reduction features include an airtight envelope, triple-pane windows, and high-quality insulation. The building also employs extensive soundproofing and a dedicated mechanical noise mitigation system. This ensures a tranquil interior, offering an ideal workplace that aligns with its sustainability goals [69].

1. Overview of the Bullitt Center as a sustainable building:

The Bullitt Center in Seattle is a leading sustainable building completed in 2013. It boasts top green certifications, like the Living Building Challenge. Among the environmentally conscious amenities are a solar panel installation atop the roof harvesting sunlight for energy use, a rainwater collection system to store precipitation for non-potable purposes, and an on-site organic material composting facility closing the loop on food and plant wastes. The design prioritizes natural light and ventilation, reducing energy use. This building represents a gold standard in sustainable construction [70].

2. Holistic strategies integrated for noise reduction:

The article underscores the success of blending architecture and engineering for noise reduction. Case studies show the benefits of using sound-absorbing materials, thoughtful design, and advanced systems. These holistic methods not only reduce noise but enhance well-being and productivity. As quieter spaces become more sought after, interdisciplinary collaboration is vital for creating harmonious environments [71].

3. Passive design principles for noise control:

Effective noise reduction in buildings involves passive design principles, blending architectural and engineering features. Strategies include sound-absorbing materials like acoustic tiles and carpets to minimize noise. Space design can include sound barriers like walls or curtains. Double-glazed windows with air gaps shield against external noise. These principles enhance tranquility and comfort for occupants [72].

4. Engineering techniques for noise insulation:

While sound barriers manufactured from materials like concrete, steel, or wood are adept at dampening disturbances by absorbing acoustic oscillations, a few techniques for attenuating noise prove rather efficacious in utilizing such partitions capable of muting transmitted undulations. Soundproof windows and doors, designed with multiple layers and air gaps, also block sound transmission. Together, these methods create quieter, more comfortable spaces for building occupants [73].

5. Positive outcomes derived from the holistic approach:

The holistic approach to noise reduction enhances the quality of life by merging architecture and engineering principles. By integrating noise reduction into early design phases, spaces provide better concentration, improved sleep, and less stress for occupants. This approach also prioritizes the environment, leading to sustainable solutions beneficial to both human health and the ecosystem [74].

6. Minimized noise pollution in workspaces:

The Hearst Tower in New York was retrofitted to minimize noise pollution using both architectural and engineering principles. Strategies like sound-absorbing materials, acoustic panels, and double-glazed windows were utilized. Green roofs and atria were added for aesthetics and to act as noise barriers. This integration significantly improved workspace noise levels, enhancing employee productivity and well-being [75].

7. Enhanced productivity and well-being of occupants:

Holistic strategies combining architecture and engineering enhance productivity and well-being in buildings. Excessive noise affects cognitive performance, causing reduced productivity. Sound-absorbing materials, strategic workstation placement, and acoustic design effectively lower noise levels. A quieter environment reduces stress, boosts satisfaction, and promotes well-being, improving overall job performance and contentment [76].

8. Recognition and awards received for the sustainable and noise-reducing design:

The Vancouver Convention Centre in Canada exemplifies sustainable and noise-reducing design. It earned LEED Platinum certification for sustainable features like its green roof and recycled materials use. In 2011, this building earned the honor of capturing the World Architecture Festival's accolade for

its premier green design. Through using noise-blocking tactics like double-glazed windows, acoustic baffles, and sound-absorbing panels, one is able to install features within a room that can help dampen any bothersome sounds travelling in from the outside surroundings. Another high-rise case study in a busy urban area used architectural and engineering methods to dramatically cut noise pollution. Techniques involved sound-absorbing materials, double-glazed windows, vibration isolators, and noise barriers, enhancing both occupants' comfort and the community's quality of life [77].

Comparative Study:

Table 1. Comparative Study

Criteria / Case Study	The Lotus Temple (Delhi, India)	The Hanshin Expressway (Tokyo, Japan)	The Bullitt Center (Seattle, U.S.)
Primary Use	Place of worship	Transportation infrastructure	Commercial building
Main Material Used	White marble	Concrete, Steel	Wood, Metal
Noise Reduction Methods	- Double-layered petals for sound insulation - Water bodies surrounding temple dampen urban noise	- Elevated road structures to minimize ground-level noise - Sound barriers along certain stretches	- Airtight building envelope - Triple-pane windows - Acoustically treated interior spaces
Integration of Architecture and Engineering	Use of petal structure both for aesthetics and acoustic	Structural design to minimize vibration and noise	Sustainable design that incorporates

ring	benefits	transfer	advanced mechanical systems for noise mitigation
Additio nal Sustaina ble Feature s	Solar energy use for lighting	Efficient traffic flow reduces vehicular emissions	Rooftop solar panel array, rainwater harvesting, composting system
Impact on Surroun dings	Provides a peaceful environment amidst a bustling city	Efficient traffic management, potential reduction in noise in surrounding areas	Reduces noise infiltration, improving the workplace and surrounding environment
Awards/ Recogni tion (if any)	Numerous architectural awards for its unique design	Not specified in context provided	Recognized for sustainable and noise-reducing design

Diverse Case Studies: The comparative study presents three very different case studies, each representing a unique use case from a place of worship to transportation infrastructure and a commercial building. This diversity showcases how noise reduction strategies can be adapted to various environments and purposes.

Material Selection: The "Main Material Used" column underscores the importance of material choice in noise reduction. From white marble to concrete and steel, and wood and metal, the selection of materials plays a pivotal role in the acoustic performance of each project.

Innovative Noise Reduction Methods: The "Noise Reduction Methods" section outlines innovative approaches to mitigating noise. For instance, the Lotus Temple's use of double-layered petals and water bodies to dampen noise highlights how architectural design can integrate with acoustics. Meanwhile, the Hanshin Expressway employs elevated structures and sound barriers, emphasizing the importance of engineering solutions in transportation noise reduction.

Integration of Architecture and Engineering: The "Integration of Architecture and Engineering" section showcases how thoughtful design can combine aesthetics with acoustic functionality. The petal structure of the Lotus Temple and the structural design of the Hanshin Expressway are excellent examples of this integration.

Sustainable Features: In today's environmentally conscious world, sustainability is a key consideration. All three case studies incorporate sustainable elements, such as solar energy, rainwater harvesting, and efficient traffic management, demonstrating a commitment to eco-friendly practices alongside noise reduction efforts.

Positive Impact on Surroundings: The "Impact on Surroundings" column highlights the broader benefits of noise reduction efforts. These projects not only create quieter spaces but also contribute to more peaceful environments and, in the case of the Hanshin Expressway, potentially reduce emissions and enhance overall quality of life.

Awards and Recognition: Notably, the table acknowledges awards and recognition received by some of these projects. This recognition underscores the significance of their innovative approaches and serves as a testament to their success in achieving noise reduction and sustainability goals.

In summary, this table effectively captures the essence of each case study's approach to noise reduction, emphasizing the importance of material selection, innovative techniques, sustainable practices, and the broader positive impact on the environment and society. It provides valuable insights for architects, engineers, and environmental enthusiasts alike.

Comparison and analysis of the case studies:

A comprehensive review of various case studies underscores the effectiveness of a holistic approach in noise reduction, blending architecture and engineering. Key to success is a profound grasp of acoustics, strategic architectural decisions, and pioneering engineering solutions. The synergy between architects and engineers is vital, ensuring an aesthetically pleasing design while prioritizing noise reduction. Each project demands bespoke strategies, and there's a notable tilt towards sustainability in many cases, championing eco-friendly materials and passive designs. Collectively, these insights serve as guidelines for future endeavors in this realm [78].

1. Identification of commonalities and differences in the holistic strategies used:

The analysis of holistic strategies in various case studies reveals the efficacy of combining architectural and engineering techniques for noise reduction. Common elements include the consideration of various factors and stakeholders in design, ensuring comprehensive solutions. Each study prioritizes passive noise reduction methods, like sound insulation and optimal building orientation, which are both sustainable and energy-efficient. Conversely, active noise control systems, which might be expensive and energy-consuming, are minimized. The differing strategies across case studies show the adaptability of these holistic approaches to individual contexts and challenges [79].

2. Evaluation of the effectiveness of these strategies in achieving noise reduction goals:

The holistic combination of architectural and engineering principles is effective for noise reduction, as demonstrated by various case studies. Employing techniques like sound-absorbing materials, spatial planning, and mechanical system optimization leads to significant noise level reductions. Starting noise reduction planning from the early design stages ensures improved acoustic quality in buildings. Sustainable materials and energy-efficient systems enhance noise reduction while also providing environmental benefits. These case studies underscore the capability of such integrated approaches in achieving desired acoustic outcomes and promoting sustainable built environments [80].

3. Discussion of any limitations or challenges faced in the implementation of these strategies:

Implementing holistic strategies for noise reduction, which integrate architectural and engineering principles, can face challenges. Primarily, the associated costs can be prohibitive, especially when integrating sound-absorbing materials. Specialized materials and skilled labor can be financially burdensome. Extensive planning and collaboration among stakeholders like architects, engineers, and construction workers can be complex and potentially fraught with conflicting priorities. The effectiveness of strategies may also differ based on building characteristics and environmental factors, necessitating tailored approaches. Yet, successful applications of these strategies are evident in projects like New York City's Greenway, which combines landscape architecture and building design to combat urban noise. Similarly, Songpa Micro-Housing in Seoul used innovative design to reduce noise. These projects emphasize the benefits of interdisciplinary collaboration for effective noise mitigation [81].

CONCLUSION

In conclusion, the marriage of architecture and engineering is vital for holistic noise reduction strategies. Multi-disciplinary collaboration between architects and engineers effectively tackles noise pollution. Implementing sound-absorbing materials, optimizing layouts, and innovative design can significantly reduce noise. Advanced tools like acoustic modeling further help in assessing potential noise levels. By embracing this integrated approach, we can move towards quieter and sustainable built environments [82].

ACKNOWLEDGMENT

The authors express gratitude towards all contributors to this research on 'Synergizing Design and Engineering: Holistic Approaches to Noise Reduction.' Appreciation is extended to the Department of Architecture faculty, participating architects, industry professionals, and researchers whose works were instrumental for the literature review. They also thank their supportive families and friends. The study was self-funded, and the authors take responsibility for any errors or omissions.

REFERENCES

- [1] R. Habash, *Sustainability and Health in Intelligent Buildings*, Woodhead Publishing, Apr. 2022.
- [2] S. M. Veres, "Active Sound and Vibration Control: Theory and Applications," in M. O. Tokhi (Ed.), IET, Jan. 2002.
- [3] A. Pérez-Fargallo, "Removing Barriers to Environmental Comfort in the Global South," in L. Marín-Restrepo (Ed.), Springer Nature, May 2023.
- [4] L. L. Beranek, *Noise and Vibration Control Engineering: Principles and Applications*, I. L. Vér (Ed.), John Wiley & Sons, Nov. 2005.
- [5] M. Brooks, "Operator Cab Interior Noise Reduction Material Selection Test Method," Society of Automotive Engineers, Jan. 1989.
- [6] J. E. Ollswang, *Simplified Design for Building Sound Control*, J. Ambrose (Ed.), John Wiley & Sons, May 1995.
- [7] A. Alexandre, "The Impact of Noise Pollution: A Socio-Technological Introduction," in G. Bugliarello (Ed.), Elsevier, May 2014.
- [8] Department of Human Services, *Occupational Noise Exposure: Criteria for a Recommended Standard*, Centers for Disease Control and Prevention, CreateSpace Independent Publishing Platform, Feb. 2014.
- [9] S. P. Singal, *Noise Pollution and Control*, Alpha Science Int'l Ltd., Jan. 2000.
- [10] V. Mahandiyan, *Environmental Noise Pollution (Causes, Evils, Legislation and Controls)*, Deep & Deep Publications, Jan. 2006.
- [11] A. Fiebig, *Soundscapes: Humans and Their Acoustic Environment*, in B. Schulte-Fortkamp (Ed.), Springer Nature, Apr. 2023.
- [12] A. E. Gonzalez, *Noise and Environment*, in D. Siano (Ed.), BoD – Books on Demand, Feb. 2021.
- [13] M. Möser, *Handbook of Engineering Acoustics*, G. Müller (Ed.), Springer Science & Business Media, Nov. 2012.
- [14] M. A. Thomas, *The Greenest Building: How the Bullitt Center Changes the Urban Landscape*, Ecotone Publishing, Jan. 2016.
- [15] P. R. Donovan, *Evaluating Pavement Strategies and Barriers for Noise Mitigation*, Transportation Research Board, Jan. 2013.
- [16] S. Dittoh, *Community Innovations in Sustainable Land Management: Lessons from the field in Africa*, Maxwell Mudhara (Ed.), Routledge, Jun. 2016.
- [17] D. L. Klepper, *Worship Space Acoustics*, in M. Kleiner (Ed.), J. Ross Publishing, Aug. 2010.
- [18] D. Saunders, *Acoustic Design*, D. Templeton (Ed.), Elsevier, May 2014.
- [19] United States. Office of Noise Abatement and Control, "Toward a National Strategy for Noise Control," U.S. Environmental Protection Agency, Office of Noise Abatement and Control, Jan. 1977.
- [20] M. Dastbaz, *Sustainable Ecological Engineering Design: Selected Proceedings from the International Conference of Sustainable Ecological Engineering Design for Society (SEEDS) 2019*, L. Scott (Ed.), Springer Nature, Jun. 2020.
- [21] D. Shiers, *Sustainable Building Design: Principles and Practice*, M. Keeping (Ed.), John Wiley & Sons, Dec. 2017.
- [22] J. Bengtsson, *Environmental Methods for Transport Noise Reduction*, M. Nilsson (Ed.), CRC Press, Nov. 2014.

- [23] R. Nayak, *Acoustic Textiles*, R. Padhye (Ed.), Springer, Oct. 2016.
- [24] P. H. T. Zannin, *Noise Pollution in Urban and Industrial Environments: Measurements and Noise Mapping*, Nova Science Publishers, Incorporated, Jan. 2016.
- [25] R. Thomas, *Environmental Design: An Introduction for Architects and Engineers*, Taylor & Francis, Jan. 1999.
- [26] J. T. Lang, *Urban Design: A Typology of Procedures and Products Illustrated with Over 50 Case Studies*, Routledge, Jan. 2017.
- [27] Soundproof Cow, "An Architect's Guide to Soundproofing," Mar. 21, 2023.
- [28] Soundproof Cow, "How to Soundproof a Psychologist's Office," Jul. 15, 2022.
- [29] Acoustical Surfaces, "Noise Control in Multi-Family Buildings | Residential Soundproofing," Sep. 4, 2020.
- [30] M. Arif, M. Katafygiotou, A. Mazroei, A. Kaushik, and E. Elsarrag, "Impact of indoor environmental quality on occupant well-being and comfort: A review of the literature," *International Journal of Sustainable Built Environment*, vol. 5, no. 1, pp. 1-11, 2016.
- [31] Ikoustic Soundproofing, "Science of Soundproofing - Ikoustic Soundproofing," Jun. 29, 2022.
- [32] ROCKWOOL, "Blocking Exterior Sound To Reduce Noise Pollution," Oct. 30, 2019.
- [33] Cognitive Research, "Senses of place: architectural design for the multisensory mind," Sep. 18, 2020.
- [34] MDPI, "Design of A Sustainable Building: A Conceptual Framework for Implementing Sustainability in the Building Sector," May 4, 2012.
- [35] NCBI, "Senses of place: architectural design for the multisensory mind,"
- [36] C. Spence, "Senses of place: architectural design for the multisensory mind," *Cognitive Research: Principles and Implications*, vol. 5, no. 1, p. 46, 2020.
- [37] NCBI, "Evaluating Therapeutic Healthcare Environmental Criteria: Architectural Designers' Perspectives," Jan. 1, 2023.
- [38] A. H. Awang and Z. Denan, "Designer's office in Malaysia: Comparative analysis on space planning and design issues," *International Journal of Social Science and Humanity*, vol. 6, no. 6, pp. 427-432, 2016.
- [39] D. Van Damme, "Implications for educational practice of the science of learning and development," *Journal of Education for Teaching*, vol. 45, no. 3, pp. 347-349, 2018.
- [40] P. Woolner and E. Hall, "Noise in Schools: A Holistic Approach to the Issue," *International Journal of Environmental Research and Public Health*, vol. 7, no. 8, pp. 3255-3269, 2010.
- [41] K. Shaaban and A. Abouzaid, "Assessment of traffic noise near schools in a developing country," *Transportation Research Procedia*, vol. 55, pp. 1202-1207, 2021.
- [42] G. R. Ana, D. G. Shendell, G. E. Brown, and M. K. C. Sridhar, "Assessment of noise and associated health impacts at selected secondary schools in Ibadan, Nigeria," *Journal of Environmental and Public Health*, 2009.
- [43] N. Bulunuz, "Noise Pollution in Turkish Elementary Schools: Evaluation of Noise Pollution Awareness and Sensitivity Training," *International Journal of Environmental and Science Education*, vol. 9, no. 2, pp. 215-234, 2014.

- [44] G. R. Ana, D. G. Shendell, G. E. Brown, and M. K. C. Sridhar, "Assessment of noise and associated health impacts at selected secondary schools in Ibadan, Nigeria," *Journal of Environmental and Public Health*, 2009.
- [45] E. de Lima Andrade, D. C. da Cunha e Silva, E. A. de Lima, R. A. de Oliveira, P. H. T. Zannin, and A. C. G. Martins, "Environmental noise in hospitals: a systematic review," *Environmental Science and Pollution Research*, vol. 28, pp. 19629-19642, 2021.
- [46] A. Connor and E. Ortiz, "Staff solutions for noise reduction in the workplace," *The Permanente Journal*, vol. 13, no. 4, p. 23, 2009.
- [47] A. Stafford, A. Haverland, and E. Bridges, "Noise in the ICU," *AJN The American Journal of Nursing*, vol. 114, no. 5, pp. 57-63, 2014.
- [48] A. Joseph and R. Ulrich, "Sound control for improved outcomes in healthcare settings," *The Center for Health Design*, vol. 4, 2007.
- [49] V. Blomkvist, C. A. Eriksen, T. Theorell, R. Ulrich, and G. Rasmanis, "Acoustics and psychosocial environment in intensive coronary care," *Occupational and Environmental Medicine*, vol. 62, no. 3, pp. e1-e1, 2005.
- [50] J. M. Olivera, L. A. Rocha, V. I. Rotger, and M. C. Herrera, "Acoustic pollution in hospital environments," *Journal of Physics: Conference Series*, vol. 332, no. 1, p. 012003, December 2011.
- [51] M. Sahil and P. Kothari, "Case Study on Architecture of Lotus Temple," *International Journal of Engineering Research & Technology*, vol. 9, no. 5, pp. 907-912, May 2020.
- [52] "Case Study on Architecture of Lotus Temple," *ResearchGate*, Jun. 8, 2020.
- [53] "Conservation Perspectives: The GCI Newsletter," *Getty Conservation Institute*, Apr. 18, 2023.
- [54] "Improving Mental Health through Streetscape Design in Indian cities: a typology and proposed intervention in the Kalkaji neighborhood of Delhi," *Landscape Architecture & Regional Planning Masters Projects*, University of Massachusetts Amherst, 2023.
- [55] M. Sahil and P. Kothari, "Case study on architecture of Lotus Temple," *Int. J. Eng. Res. Technol.*, vol. 9.
- [56] S. Yadav, R. Bandyopadhyay, G. Rasul, and A. Rawal, "Exploring the relationship between socio-cultural factors and tourist satisfaction: a study of Lotus Temple, New Delhi, India," *Worldwide Hospitality and Tourism Themes*, vol. 2, no. 5, pp. 554-558, 2010.
- [57] W. W. Clark II, *Sustainable Cities and Communities Design Handbook: Green Engineering, Architecture, and Technology*, Butterworth-Heinemann, Nov. 2017.
- [58] S. El Khouli, *Holistic Housing: Concepts, Design Strategies and Processes*, H. Drexler (Ed.), Walter de Gruyter, Jul. 2013.
- [59] G. C. Tocci, *Architectural Acoustics: Principles and Practice*, W. J. Cavanaugh (Ed.), John Wiley & Sons, Nov. 2009.
- [60] "Innovation in the Japanese construction industry," *GovInfo*, 2016.
- [61] T. Yoshino, T. Sasaki, and T. Hasegawa, "The traffic-control system on the Hanshin Expressway," *Interfaces*, vol. 25, no. 1, pp. 94-108, 1995.
- [62] R. S. Chalumuri and A. Yasuo, "Modelling travel time distribution under various uncertainties on Hanshin Expressway of Japan," *European Transport Research Review*, vol. 6, no. 1, pp. 85-92, 2014.

- [63] S. Yabe, K. Imanishi, and K. Nishida, "Two-step seismic noise reduction caused by COVID-19 induced reduction in social activity in metropolitan Tokyo, Japan," *Earth, Planets and Space*, vol. 72, pp. 1-11, 2020.
- [64] K. Yamamoto, "Japanese experience to reduce road traffic noise by barriers with noise reducing devices," in *10th European Congress and Exposition on Noise Control Engineering, EuroNoise*, May 2015, vol. 31.
- [65] H. Kanda, H. Tsuda, K. Ichikawa, and S. Yoshida, "Environmental noise reduction of Tokaido Shinkansen and future prospect," in *Noise and Vibration Mitigation for Rail Transportation Systems: Proceedings of the 9th International Workshop on Railway Noise*, Munich, Germany, 4-8 September 2007, Berlin, Heidelberg: Springer Berlin Heidelberg, April 2008, pp. 1-8.
- [66] Q. Meng and J. Kang, "Effect of sound-related activities on human behaviors and acoustic comfort in urban open spaces," *Science of the Total Environment*, vol. 573, pp. 481-493, 2016.
- [67] X. Zhang, M. Ba, J. Kang, and Q. Meng, "Effect of soundscape dimensions on acoustic comfort in urban open public spaces," *Applied Acoustics*, vol. 133, pp. 73-81, 2018.
- [68] J. Bengtsson, *Environmental Methods for Transport Noise Reduction*, M. Nilsson (Ed.), CRC Press, Nov. 2014.
- [69] WBDG - Whole Building Design Guide, "Bullitt Center," 2016.
- [70] Brikbase, "The Bullitt Center: A Whole Building Design Guide Case Study," 2014.
- [71] J. Homchick Crowe, "Architectural advocacy: The Bullitt Center and environmental design," *Environmental Communication*, vol. 14, no. 2, pp. 236-254, 2020.
- [72] LinkedIn, "High-Performance Building Envelopes," 2023
- [73] R. Peña, C. Meek, and D. Davis, "The Bullitt center: A comparative analysis between simulated and operational performance," *Technology|Architecture+Design*, vol. 1, no. 2, pp. 163-173, 2017.
- [74] S. T. Cowan, B. R. E. N. T. Davies, D. Diaz, N. O. A. H. Enelow, K. E. V. I. N. Halsey, and K. Langstaff, "Optimizing urban ecosystem services: The Bullitt center case study," *Ecotrust: Portland, OR, USA*, 2014.
- [75] D. Mirel, "The greenest of the green: the Bullitt Center in Seattle prides itself on being the world's greenest office building," *Journal of Property Management*, vol. 79, no. 1, pp. 30-32, 2014.
- [76] R. K. Miller, *Fundamentals of Noise Control Engineering*, A. Thumann (Ed.), Fairmont Press, Jan. 1990.
- [77] S. Doub, J. Hanford, M. Sprug, C. Hellstern, and K. Misel, "Living Buildings: The Bullitt Center," in *Architecture and Health*, pp. 260-279, Routledge, 2019.
- [78] V. Bates, *Making Noise in the Modern Hospital*, Cambridge University Press, Dec. 2021.
- [79] N. Ahmed, *Advances in Noise Analysis, Mitigation and Control*, BoD – Books on Demand, Oct. 2016.
- [80] T. Adams, "Sound Materials." *A Compendium of Sound Absorbing Materials for Architecture and Design*, Frame Publishers, Nov. 1, 2016.
- [81] P. R. Donovan, "Evaluating Pavement Strategies and Barriers for Noise Mitigation." *Transportation Research Board*, Jan. 1, 2013.

- [82] T. Holmes, "Sound Art." Concepts and Practices, Routledge, Apr. 27, 2022.

4. Chapter

Knowledge of Nursing Students Towards Tele-nursing Care: A Cross-Sectional Study

laila Matrok ^{1*}

Raneem Faleh ¹

Alanod Sultan ¹

Shafa Rahil ¹

Ayat Masoud Omar Masoud ²

Amera Bekhatroh Rashed ²

¹ Undergraduate students at Department of Nursing, College of Applied Medical Sciences, Jouf University, Al-Qurayyat, KSA.

² Department of Nursing, College of Applied Medical Sciences, Jouf University, Al-Qurayyat, KSA

Email of the corresponding author: amasoud@ju.edu.sa

ABSTRACT

Background: Telenursing, a component of telehealth, uses technology for remote nursing care, promoting healthcare access, and improving patient outcomes effectively. Aim: This study aimed to assess the knowledge of nursing students towards telenursing care. Method: A cross-sectional design was employed, and data were collected from 80 nursing students at Jouf University. The participants' knowledge of telenursing was evaluated through a questionnaire consisting of multiple-choice items. Results: The findings revealed that the participants had a moderate level of knowledge regarding telenursing, with a higher understanding of the concept compared to specific advantages, disadvantages, and resources used in telenursing. Overall, the nursing students exhibited positive attitudes towards telenursing, perceiving it as an effective and safe form of patient care.

Keywords – Telenursing, Knowledge, Cross-Sectional Study.

INTRODUCTION

Telehealth, the use of telecommunication technologies to deliver health care services, is increasingly being adopted as an effective solution to meet the challenges of health care delivery [1]. Telenursing, a subset of telehealth, is the provision of nursing care through remote communication technologies such as telephone, videoconferencing, or mobile applications [2]. With the growing demand for telehealth services and the global shortage of nurses, telenursing has become an essential component of nursing practice [3]. Therefore, it is important to assess nursing students' knowledge and attitudes towards telenursing care to ensure its successful integration into nursing education.

The integration of telenursing in nursing education is critical because it enables nursing students to learn and develop the necessary skills to provide remote care [4]. A study by [5] showed that nursing students who received telehealth training had a better understanding of the potential benefits and challenges of telehealth. The study also found that nursing students who received telehealth training were more likely to consider telehealth as part of their future practice.[6]

However, despite the potential benefits of telenursing, there are concerns about its impact on patient safety, privacy, and confidentiality [7, 8]. It is, therefore, important to assess nursing students' knowledge and attitudes towards telenursing care to ensure that they are adequately prepared to provide safe and effective care through remote communication technologies. The problem addressed in this study is the need to assess nursing students' knowledge towards telenursing care in the College of Applied Medical Sciences at Jouf University. This problem is crucial because it affects the quality of nursing education and ultimately, the quality of healthcare delivery. Nursing students who are not adequately prepared to provide telenursing care may pose a risk to patient safety and may not be able to provide optimal care to patients who require remote care services.

The aim of this cross-sectional study is to assess the knowledge of nursing students towards telenursing care in the College of Applied Medical Sciences at Jouf University.

MATERIALS AND METHOD

In the proposed study, we employed a cross-sectional descriptive design using a quantitative approach. This design was chosen due to its effectiveness in gathering and analyzing data at a single point in time, providing a snapshot view of the knowledge and attitudes of nursing students towards telenursing care. This design is particularly appropriate for this study as it allows for large amounts of data collection, suitable for statistical analysis to make conclusions about the population under study.

Tool of data collection:

This study utilized an online questionnaire to gather data from the participants. The questionnaire is organized into four distinct sections, designed to capture various aspects of the knowledge of nursing students towards telenursing care. The questionnaire was developed based on the literature reviewed, specifically the study of [1] , [9]., and section collects demographic information of the participants. This includes age, gender, current year of study, and previous exposure to telenursing either through formal study or workshops. If the participant has had exposure to telenursing, they are also asked to specify the source of this information, with options including books, formal study, friends, the internet, or academic journals.

The second section of the survey evaluates the participant's knowledge of telenursing. Participants are asked if they understand the concept of telenursing, if they know the difference between telenursing and telemedicine, and if they are aware of the advantages, disadvantages, benefits, resources, and guidelines of telenursing. Each question provides four options: Yes, No, Somewhat, and Not sure.

Validity and Reliability:

The instrument was submitted to a jury of faculty staff who reviewed and evaluated it for validity and reliability then changes were made as needed.

The target population for this study consists of nursing students currently enrolled in the College of Applied Medical Sciences in Al-Qurayyat. This university-based setting provides an appropriate environment for the study as it comprises diverse cohorts of students across different levels of study, thus offering a comprehensive insight into the knowledge and attitudes of future nursing professionals towards telenursing.

The student population within this setting, encompassing individuals at various stages of their nursing education, is of particular interest given their imminent entry into the nursing profession where telenursing is likely to be a crucial component of healthcare delivery. Given that the study is cross-sectional, all data will be collected at one specific point in time, providing a snapshot of the knowledge and attitudes towards telenursing among nursing students within this particular educational setting at Jouf University.

The sampling method employed in this study was convenience sampling, as all nursing students currently enrolled at the College of Applied Medical Sciences in Al-Qurayyat were invited to participate. For sample size determination, we used the formula for estimating population proportions with desired precision: $n = (Z^2 * P(1-P))/d^2$, where Z is the Z-score (1.96 for 95% confidence), P is expected prevalence (we'll estimate 50% or 0.5 for maximum variability), and d is the desired precision (e.g., 5% or 0.05). Using these values, we calculated a minimum required sample size of around 188 students. However, due to limited time constraints, we gathered data from 80 participants.

The choice of this sample size is primarily based on the principle of achieving sufficient statistical power to detect significant differences, while ensuring the feasibility of data collection. Given the relatively large size of the sample, it is expected to be a representative sample of the nursing student population at the university, enabling valid and generalizable inferences about this group's knowledge and attitudes towards telenursing.

Inclusion Criteria:

- Students must be enrolled in the Nursing program at the College of Applied Medical Sciences in Al-Qurayyat at the time of the study.
- All levels of study (from 1st to 4th year) are eligible to participate. Students must be willing to provide informed consent to participate in the study.

Exclusion Criteria:

- Students not currently enrolled in the Nursing program at the College of Applied Medical Sciences in Al-Qurayyat were excluded.
- Students who are on academic leave or are not currently active in their course (for example, due to illness or personal circumstances) during the period of the study will be excluded.

- Students who are unwilling or unable to provide informed consent will be excluded from the study.
- Students who have graduated or have not yet commenced their program at the time of the study will be excluded.

Non-nursing students at Jouf University will be excluded.

This research adheres to the highest ethical standards. Prior to conducting the study, ethical approval will be sought from the Institutional Review Board at Jouf University. Participants were provided with detailed information about the study's purpose, what participation entails, potential risks, and benefits before they give informed consent. All data were anonymized to maintain participant confidentiality. The main benefit of this study is to improve understanding of students' knowledge and attitudes towards telenursing. Any potential harm is minimal as the study only involves the completion of a survey. We also secured permissions as necessary for use of specific tools or access to specific locations for the conduct of the study.

Data Analysis plan:

Data collected from the study were coded and inputted into the Statistical Package for Social Sciences (SPSS) software for analysis. Prior to in-depth analysis, data was cleaned and inspected for any entry errors. Descriptive statistics were calculated to summarize and organize the data collected. For nominal and ordinal data, such as demographic information, frequencies and percentages were calculated.

RESULTS

Table 1. Demographic information (n=80)

Variable	Frequency	Percentage
Age range		
1. 18 – 20 years	30	37.5%
2. 21 – 23 years	35	43.75%
3. More than 23 years	15	18.8%
Gender		
1. Male	30	37.55
2. Female	50	62.5%
Level of study		
1. 1 st year	15	18.8%
2. 2 nd year	25	31.2%
3. 3 rd year	20	25%
4. 4 th year	20	25%
Previous information with telenursing		
1. Yes	35	43.8%
2. No	45	56.2%

In the study of 80 nursing students at Jouf University, the participants were divided into three age ranges: 18-20 years (n=30, 37.5%), 21-23 years (n=35, 34.7%), and more than 23 years (n=15, 18.8%). Gender-wise, a greater portion of participants were females (n=50, 62.5%) compared to males (n=30, 37.5%). The distribution of participants according to their level of study was evenly distributed between the 2nd, 3rd, and 4th year (n=25, 31.2%; n=20, 25%; n=20, 25% respectively), while fewer students were in their 1st year of study (n=15, 18.8%). When asked about their previous exposure to telenursing, 43.8% (n=35) of the participants indicated that they had prior information, while a slightly higher percentage of 56.2% (n=45) had not.

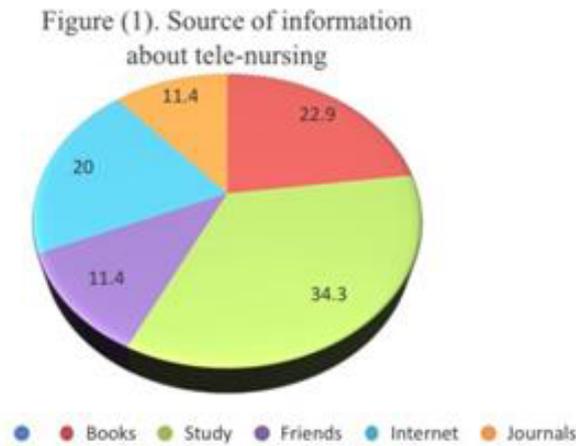


Figure 1. Source of information about telenursing

For those who had prior information, sources varied: study materials (n=12, 34.3%) and books (n=8, 22.9%) were the most common, followed by the internet (n=7, 20%). A few students mentioned learning from friends (n=4, 11.4%) or from journals (n=4, 11.4%) as their source of information on telenursing (Fig 1).

Table 2. Commentary and star ratings at the end of each test

Question	Yes	Somewhat	Not sure	No	Mean
Understand the concept of telenursing	40 (50%)	25 (31.25)	10 (12.5)	5 (6.25)	2.18
Difference between telenursing and telemedicine	30 (37.5)	25 (31.25)	15 (18.75)	10 (12.5)	2.00
Know the advantages of	35 (43.75)	25 (31.25)	15 (18.75)	5 (6.25)	2.12
Know the disadvantages of telenursing	20 (25)	30 (37.5)	20 (25)	10 (12.5)	1.75
Know the benefits of telenursing	35 (43.75)	25 (31.25)	15 (18.75)	5 (6.25)	2.12
Know the resources used in telenursing	20 (25)	30 (37.5)	20 (25)	10 (12.5)	1.75
Know the guidelines of tele-nurse utilization	25 (31.25)	25 (31.25)	20 (25)	10 (12.5)	1.88
Total score	Moderate Level of Knowledge				13.8

In terms of knowledge of telenursing among the sample of 80 nursing students, results revealed a moderate level of understanding with a mean total knowledge score of 13.8 out of a possible 21. The concept of

telenursing was understood by half of the participants (50%, n=40), with a mean score of 2.18. Just over a third (37.5%, n=30) of the students recognized the difference between telenursing and telemedicine, reflected in a mean score of 2.00. When it came to awareness of the advantages and benefits of telenursing, 43.75% (n=35) of students expressed familiarity, yielding mean scores of 2.12 for both areas. Less understanding was apparent regarding the disadvantages of telenursing and the resources used in the field, as only 25% (n=20) of students demonstrated knowledge in these aspects, resulting in mean scores of 1.75 each. Lastly, knowledge of guidelines for tele-nurse utilization was affirmed by 31.25% (n=25) of the students, rendering a mean score of 1.88.

DISCUSSION

The primary aim of this investigation was to explore and evaluate the knowledge base and attitudes of nursing students towards telenursing care. It sought to understand the cognitive grasp of this pivotal field of nursing and the emotional perceptions of the students towards it. The findings of the study offer crucial insights into the traits of the participating students, their level of awareness regarding telenursing, attitudes they hold towards this field, and the potential factors that influence their knowledge and attitudes. To enhance the understanding and significance of the findings, it is pertinent to compare them with previous studies and scholarly work in this area.

As per the understanding and knowledge regarding telenursing, the current study identified a moderate level of comprehension among the nursing students. This finding is harmonious with the outcomes of a previous study conducted by Ghaddaripouri et al., [12] which also noted a similar level of knowledge among nursing students. This correlation is essential as it confirms a trend within the field and offers a robust comparative basis. However, it is vital to consider that other studies, such as the one conducted by Ahmed et al.,[1], found a higher level of knowledge among nursing students. Such discrepancies in results could be attributed to several reasons including differences in the populations sampled for these studies, variations in the educational programs they were part of, and the dissimilarities in the curricula being followed.

CONCLUSION

These findings provide valuable insights into the current knowledge of nursing students towards telenursing care, highlighting areas for further education and training.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to the nursing students of Jouf University for their valuable participation in this study.

REFERENCES

- [1] T. J Ahmed, M. Baig, M. A, Bashir, Z. J., Gazzaz, Butt, N. S., & Khan, S. A. Knowledge, attitudes, and perceptions related to telemedicine among young doctors and nursing staff at the King Abdul-Aziz University Hospital Jeddah, KSA. *Nigerian Journal of clinical practice*, 24(4), 464-469. 2021.
- [2] A., Ashfaq,., S. F., Memon, A., Zehra, S., Barry, H., Jawed, M., Akhtar, & A.Khawaja, Knowledge and attitude regarding telemedicine among doctors in Karachi. *Cureus*, 12(2). 2020.
- [3] E., Asimakopoulou,. Telenursing in clinical practise and education. *International Journal of Caring Sciences*, 13(2), 781-2. 2020.
- [4] S Bali,. Enhancing the reach of health care through telemedicine: Status and new possibilities in developing countries. In *Health care delivery and clinical science: Concepts, methodologies, tools, and applications* (pp. 1382-1397). 2018. IGI Global.
- [5] W Bani Issa,., I Al Akour,., A.Ibrahim, , A Almarzouqi,., Abbas, S., Hisham, F., & Griffiths, J.). Privacy, confidentiality, security and patient safety concerns about electronic health records. *International nursing review*, 67(2), 218-230,2020.
- [6] F. W., Butta, Endehabtu, B. F., Tilahun, B., Melaku, M. S., Walle, & T.D. Nimani, Awareness and knowledge of telenursing care and its associated factors among nurses in a resource-limited setting, northwest Ethiopia: A cross-sectional study. *Informatics in Medicine Unlocked*, 101268. ,2023.
- [7] Y. J Choi, J Lee,., J. H., Park, & J. W. Choi, Factors affecting the acceptance of telemedicine for the elderly in Korea. *International journal of medical informatics*, 103, 91-98. 2017.
- [8] H.Das, , S., Panigrahi, & D. Swain, Telenursing-an emerging concept in reducing COVID-19 hospital occupancy. *International Journal of Community Medicine and Public Health*, 9(1), 414. 2022.
- [9] S., Yaghobian, R., Ohannessian, T., Iampetro, I., Riom, N., Salles, E. M., de Bustos, & A. Mathieu-Fritz, Knowledge, attitudes and practices of telemedicine education and training of French medical students and residents. *Journal of Telemedicine and Telecare*, 28(4), 248-257, 2022.
- [10] A., Omotosho, P., Ayegba, J., Emuoyibofarhe, & C. Meinel, Current state of ICT in healthcare delivery in developing countries. *Nternational Journal of Online Engineering*, 15(8), 91-107.2019.

- [11] K. A. D., Umayam, A. N. N., Rosadia, Tan, R. N. R., Salazar, D. J. R., Masakayan, R. L. L., G. M. B., Santiago, ... & C. S. M Concepcion,. (2022). Knowledge, Attitudes and Perceptions on the Use of Telemedicine Among Adults Aged 18-34 in Manila, Philippines During the COVID-19 Pandemic. *Journal of Medicine, University of Santo Tomas*, 6(1), 858-867.
- [12] K.Ghaddaripouri, , S. F.Mousavi Baigi, A., Abbaszadeh, & M. R. Mazaheri Habibi, Attitude, awareness, and knowledge of telemedicine among medical students: A systematic review of cross-sectional studies. *Health Science Reports*, 6(3), e1156. 2023.

5. Chapter

Extracurricular Activities –Factors for Interethnic Relations in Schools

Besa Havziu ^{1*}

Diellza Kelmendi ²

Ardita Ceka ¹

Afërdita Saliu ³

¹ University of Tetova, Faculty of Pedagogy, North Macedonia

² Diellza Kelmendi, Kosovo Olympic Academy, Kosovo Olympic Committee, Kosovo

³ Afërdita Saliu, Master of pedagogy, employed in primary school, Skopje

Email of the corresponding author: besa.havziu@unite.edu.mk

ABSTRACT

Modern society is pluralistic and requires a pluralistic model of inter – ethnic relations which is reflected in equality and the promotion of the development of ethnic identities. In the more important sense, interethnic relations have become an important social and scientific problem. Therefore, multiculturalism should be included in the education process as a global trend. The school has to provide interethnic activities in the framework of learning and other extra-curricular activities. School activities will help students to get to know other ethnicities and accept them as they practice their culture. And, teachers must be impartial and supportive. To prove this, we will use the theoretical analysis methods. The descriptive method with all its modalities dominates in the research that is analysis of the condition. Another method that I will use in this paper which is more important is generalization. The conclusion and the recommendation of this paper goes directly to the teachers, because they will have to know certain methods that help students with positive behavior and attitudes.

Keywords – Students, Education, Culture, Multiculturalism, School, Activities

INTRODUCTION

The principle of multiculturalism implies that it is possible to affirm the group and cultural identities of minorities and at the same time reduce ethnocentrism among young people with the final purpose of reducing xenophobia and discrimination in society (Katunarić, 1994). In the literature (Perotti, 1995), this purpose is described as the preparation of young people for life in a multicultural society, respectively a society in which, except members of the majority population, a significant number of people (minorities) and cultural groups (e.g. members of different religious communities). The main condition for achieving this purpose is the training of young people for multicultural communication and intercultural action, and in this way encouraging them to critical self-reflection on their own and others' identities (Gundara, 2000). Consequently from this, school is seen first of all as a meeting place of different cultures where it comes to (cultural enrichment) and this way, to a new and wider perception of others and ourselves. During this, is also important to work on avoiding eventual obstacles that complicate cultural exchange, and which can be understood as social-psychological, in the form of stereotypes, prejudices and differences in mentality, but also as a consequence of institutional discrimination and structural exclusion of minority groups (Auernheimer, 2003).

MATERIALS AND METHOD

Extracurricular activities at school are organized with purpose of creating content and action pedagogical conditions for the free development of bio-psychic-social potentials of students according to their desire, interests and inclinations. They are organized in the principle of voluntary determination and self-action. Teachers play the role of leader, initiator, organizer, coordinator and ultimately the role of controller and leader of the student's actions and behaviors (Murat X, 2022). In case of need, the teacher also exercises the influence of the corrector of relationships and behaviors that are not according to the norms of pedagogy (P. Pejić-Papak & S. Vidulin-Orbanić, 2015). With the help of these activities, the students will have the opportunity to get to know the students of the other community, the faith of the other, the respect of the differences between them, etc. Adolescents who participate in extracurricular activities demonstrate higher levels of academic achievement, greater character development, greater social development, and

a greater sense of the importance of community involvement (Christison, 2013).

The participation in extracurricular activities builds students' time management skills, leadership skills, self-confidence, resiliency, and ability to accept constructive criticism, which are all components important to character development (Lipscomb, S, 2027). It is seen that students who take part in extracurricular activities not only display fewer problematic behaviours (Pinhey, Perez, & Workman, 2002; Soytürk, 2011), but also develop their communication skills, which are an important social skill (Tepeköylü Öztürk, Özbey, & Çamlıyer, 2015). So, multicultural education rejects any form of discrimination in schools (ethnic, racial, religious, economic, gender, etc.) clarifies the practices of respecting cultural differences and enables a learning style that offers strategies of accepting new orientations to students, teachers and parents (Braz, Melisa & Kehle, Thomas, 2011). Interethnic integrated education is based on providing as many activities as possible between students, when joint activities is not possible to be held, then extracurricular activities should be organized. Based on the fact that extracurricular activities are oriented towards the personal and social development of students, it is very important to constantly keep in mind that it is not so important what the students of different groups will do, but that they do something together, which is in their common interest (Bujar, Sonja & Gzim, 2022). So, extracurricular activities are the most suitable forms for joint activities between students with different interethnic affiliations (Murati X., 2022).

Regardless of whether the activities are extracurricular or not, each activity must be carried out in order to be treated as a joint activity:

1. The group of students must be balanced according to ethnicity;
2. The activity must be developed by teachers from among the group represented ethnic, linguistic;
3. Participants from different communities must be treated equally and impartially by the organizers of the activities;
4. To use all teaching languages as equally as possible in an atmosphere of mutual cooperation;
5. Themes - activities that will be chosen jointly by all the communities represented;
6. Always work around concrete, tangible goals and results that are the result of the joint activity of all ethnic communities;

7. To organize regular meetings that will create the opportunity to raise the level of personal communication;

8. To work in an atmosphere of cooperation, and if a competition is organized, to do it with mixed groups of students (Stojanov, 2015).

WHICH ACTIVITIES WOULD HELP IN THE DEVELOPMENT OF INTERETHNIC COLSENESS AMONG STUDENTS?

They are numerous with the purpose of development and to create a work culture together with people of their age group, who belong to another ethnicity.

1. Cultural-artistic center,
2. Sports center,
3. Organization of excursions.

These activities constitute a wide scope with great educational-educational value, as they enable students to show their ideas, thoughts and attitudes, in coordination with their leader. (Murati, 2021).

WHAT SHOULD THE CULTURAL – ARTISTIC CENTER CONTAIN?

In the following, I will present the sections that should work based on the students' interest. They are:

1. Easement section,
2. Drama or shows section,
3. Ballet and dance section.

These are different activities, through which the inter-ethnic integration can be promoted and progressed, which as a result will also be promoted in the wider society.

The literature section is one of the activities with the help of which students can learn the language of their friend of a different ethnicity and it can be one of the most positive processes to get to know each other, because precisely learning the other's language it is one of the most important factors in understanding each other and breaking down barriers and stereotypes (Ceka, 2021).

Since students of different ethnicities will be involved in these activities, then in this part the students should be equipped with sufficient materials of the nature of the activity. The materials must be in different languages, they are:

1. Books, magazines, encyclopedias,
2. Map, globe,
3. Tales presented in various writings and drawings.

It is very important that these activities to be led by competent people. This section is usually led by Language and Literature teachers, who have leadership and demonstrate pedagogical skills to encourage the development of students' dispositions for literary creation (Ceka, 2019).

DRAMA OR SHOW SECTION

The drama or show section should be well planned by the teachers. Clothing and props should be provided with the help of which children will be able to play different roles, imitate what they want and what they actually see in everyday life. The activity or section of the drama or show will have a positive effect on bringing students of different ethnicities together and in this way they will get to know each other's culture better, so they will have an incentive to socialize more. For example, these are: jointly prepared dramatizations, joint school newspaper, exhibition of joint works, joint survey, knowledge quizzes, joint school choir. It is very important to present programs with content from different communities, to actually use ethnic languages, to have multicultural shows. This means that in the ideal case, mixed ethnic groups for joint activities should be balanced in terms of the socio-economic status of their participants or within each group with the same variations in terms of this status (Hofstede, 2011).

The shows contribute to interethnic integration when they meet these standards:

- Preparing jointly for execution that is mixed - with the participation of participants from all represented linguistic or ethnic groups
- The content is neutral or mutual, or for each ethnic community equally.

Neutral contents are those that are considered universal because they have no obvious relation to RM (for example, the interpretation of a popular foreign song, dramatizations about spring, etc.).

Mutual contents are those related to school, with narrower or wider communities and are of interest to all or most ethnic communities (for example, dramatizations about school reports, individual creations of students on the theme "My country", the execution of any dance performed in two or some communities).

1. Equal participation of ethnic contents with those contents that are related to the concrete identity of an ethnic, cultural community living in the Republic of Macedonia, for example, Albanian folk songs, Turkish dances, recitals for Goce Dellcevin, and plays performed by students from ethnic communities regardless of ethnic content.

Equal treatment of all ethnic linguistic communities, according to the representation and order of languages (Antovska, 2015).

DRAMA OR SHOW SECTION

Sports activities (Physical and health education) provide more opportunities for students to progress physically and healthily through participation in the sports sections organized by the school, depending on its spatial and material possibilities. In addition to regular education, the school also organizes free activities inside and outside the school. This is where the base is formed from which the teams of the sports sections are organized, and in addition to their recreational activities to satisfy their own desires, they prepare for sports competitions at school, between schools, municipalities, the city and why not even state. At the same time, they raise the possibility of raising the inter-ethnic relationship in the school (Havziu-Ismaili, *Aktivitete e lira të nxënësve të shkollave të mesme*, 2019). The sections that can be organized in schools, about which we will not comment, because they speak for themselves, are: the section for athletics, for gymnastics, volleyball, handball, football, the section for rhythmic and gymnastics sports, for swimmers, for skiers, ping pong, tennis, cycling, mountaineers, martial arts (wrestling, judo, karate and other martial arts) and other sacred. World-famous contestants and participants in the Olympic Games have often emerged from these activities (Kokovic, 2008). In the free sports activities for fun and recreation, the game prevails, but with the protection of the educational standards for the students of the lower classes I-III (straight landing, riding, penetration, etc.), while in the class IV-V through the game, the elements are applied the first technical - sports, from which psycho - physical effects are provided (Havziu, Besa & Mehmedi, Lulzimi, 2020). While in a school where special attention is paid to these activities, the inter-ethnic relationship of the students is undoubtedly improved and ensures the acceptance of the other's culture at a high level. Getting to know the music of a friend with another nationality, playing dances of different cultures, expands the range of thinking and at the same

time raises the awareness of students in terms of removing prejudices and accepting each other.

CONCLUSION AND RECOMMENDATION

Before the national education system was born, on the one hand, the problem of reviving and preserving the cultural potential of each ethnic group, and on the other - the formation of tolerance and national identity, overcoming xenophobia and solving the current problems of inter-ethnic relations. The proposed pedagogical conditions for the formation and correction of interethnic relations include the creation of a multicultural educational environment that will create opportunities for intercultural reflection, social activity and entry into constructive intercultural dialogue and interethnic relations (Greek, 2009).

bring new challenges to the education system in the country. During the past decades, European and other countries have taken measures to face these challenges through the reform of training for future teachers and for those who are involved in the educational process. Special emphasis has been placed on the social aspects of the teaching profession. Regardless of the fact of technological development and the fact that information is very easily obtained recently, teachers remain the backbone of our educational system. The profession, which offers you the opportunity to make changes in the lives of children and students every day, the opportunity to make changes, makes the profession unique.

The school as an educational-system for education and joint education of young generations and adults, in its long history, in addition to other functions and tasks, through free school activities, has a certain role in the formation of culture for used the free time of necessity, which represents a complex and extended process. "The contemporary school can efficiently prepare the new generation for life and work in today's conditions, only if it expands their importance in various fields, including modern production, which first of all depends on the human factor, especially from the development of production". But the purpose of school reforms should not only be the preparation of young people for production, but also for life outside of production, for life in general and at the same time for the social development of students, the development of self-awareness to live with others, the removal of stereotypes and prejudices. This important segment also speaks of an important development of the student's personality as well as the establishment of a culture for interpersonal relations and without

differences (Havziu-Ismaili, The role of the teacher in traditional and contemporary learning, 2019). And we can also say that extracurricular activities appear to us as a dominant factor for interethnic relations in schools. In the following, we will provide a model for teachers on how they can carry out extracurricular activities with school students, creating a work team with students of different nationalities. Although this model is given for one section, it can be changed and activities of different natures can be introduced based on the topics that the teacher should implement in the curriculum (Лозаноски, Ј. Лозаноски Р., 2013). It is understood that this activity will be part of the students' extracurricular activities (Будимир-Никович, 2008).

This annual program for work with students from the journalism sector is expressed as an example to demonstrate that in the field of teaching there can be many interesting and powerful topics that can stimulate the interest of students. But what is

particularly important is that, apart from the journalistic section, the school must at the same time create the conditions for other sections such as the Folklore section, the combined similarity coincides with the aforementioned annual program, then the drama section, the film section, the music section and others. In addition, students can also visit another school where they meet with students from that school who participate in various sections that are planned as part of their school, in which they share ideas about their experiences in a common way. This way of working in certain sections has a positive effect on socialization and friendship between students, at the same time they promote the dissemination of their understandings and at some point; they feel that working on a cello is a force for achieving many life goals.

The free school activities are carried out mainly in the free time of the students, namely in the extracurricular hours and are part of the establishment of the school program. For the realization and organization of the free activities, in addition to the professional service of the school, as important moderators of these activities, the teachers are also counted, who, within the framework of the lesson, also carry out free school activities, which mainly include students who show interest in their field. From this we say that the entire educational system must have a serious approach to the problem of free time and free school activities if the general educational goal is to be achieved (Barkoska, 2005). The educational system must strive for a

proper and real organization and realization of these activities, which present a unique opportunity to overcome the limitations that appear in teaching.

Our thoughts in this segment are directed at the types of free school activities and their possibilities in the educational influence of the student's personality, which also affects their mental and physical development.

Table 1. Annual work plan with members of the journalism section for primary and secondary schools

MONTHS OF WORK	HOURS	LEARNING CONTENTS
SEPTEMBER	1. 2. 3. 4.	Construction of the journalism section - selection for management and distribution. News and information about the holiday in the country. Understanding of news, information and values on a common basis. Wall paper about autumn and impressions of a trip, meaning on the road description
OCTOBER	1. 2. 3. 4.	Meeting and conversation with our professional journalists. News and information about the holidays of the month. Visit to the Krste Misirkov institution in Skopje. Visit to the first printing house in Veles and Tetovo
NOVEMBER	1. 2. 3. 4.	Reports - how to write a report about Skopje. Another day for our city in Vardar - news, information from the party and following the media. Wallpaper dedicated to our city.

	Organized visit to the memorial house of Blazhe Koneski
DECEMBER	<ol style="list-style-type: none"> 1. The role of the tape recorder, the camera and the camera in the journalist. 2. Visiting the memorial house of the author Koco Racin. 3. Wallpaper dedicated to winter, new year and other holidays. (Christian and Muslim holidays). 4. Description of a winter walked. On the Hill of the sun, or any other recreation center. Where students of different nationalities participate.
JANUARY	<ol style="list-style-type: none"> 1. Reviewing the columns of the student press "Our World", writing criticism, and familiarizing students with the notion of criticism and suggestions. 2. Visit to the house of journalism - meeting and conversation with its leaders.
FEBRUARY	<ol style="list-style-type: none"> 1. Our reports on holidays and winter impressions. 2. Content elements and forms of a prose text. (also by authors of different nationalities). 3. Conversation with the director and professional colleagues (psychologist, teacher) at the school. 4. A visit to the school.

REFERENCES

- [1] Antovska, T. (2015). Pikëpamje terike dhe praktike për zbatimin e integritetit ndëretnik në fakultete për arsimtarë, USAID. Skopje: USAID.
- [2] Auernheimer, G. (2003). Einführung in die Interkulturelle Paedagogik. Darmstadt: Wissenschaftliche Buchgesellschaft.
- [3] Barkoska, A. (2005). Педагогија на слободното време. Скопје: Доминант.
- [4] Braz, Melisa&Kehle,Thomas. (2011). School psychology. Oxford.

- [5] A, Bujar., P, Sonja., Gzim, Xh . (2022). Integrating intercultural education in the primary school curriculum. *Pedagogika-Pedagogy* Volume 94, Number 8, Педагогика (p. 1033). Goce Delchev University (North Macedonia).
- [6] Ceka, A. (2019). *Organizimi i shkollës*. Tetovë: Cabej.
- [7] Ceka, A. (2021). *Arsimi multikulturor*. Tetovë: Çabej.
- [8] Christison, C. (2013). The Benefits of Participating in Extracurricular Activities. *BU Journal of Graduate Studies in Education*, Volume 5, Issue 2,, 17.
- [9] Gundara, J. S. (2000). Issues of discrimination in European education systems. *Comparative. Education*, 36 (2), 223-234.
- [10] Grudeva, M. (2010). Social aspects of extracurricular activities for youth. *Trakia Journal of Sciences*, 8(3), 400-405.
- [11] Havziu, Besa & Mehmedi, Lulzim . (2020). Applying Sporting Activities on Secondary School in the Republic of North Macedonia,. *Education*, 2 (3-4). , 34-39.
- [12] Havziu-Ismaili, B. (2019). *Aktivitetet e lira të nxënësve të shkollave të mesme*. Tetovo: Arberia Desing.
- [13] Havziu-Ismaili, B. (2019). *Aktivitetet e lira të nxënësve të shkollave të mesme*. Tetovo: Arberia Desing.
- [14] Hofstede, G. (2011). *Cultures consequences: Comparing values, behaviors, institutions and organizations across nations*. London.
- [15] Kokovic, D. (2008). *Nacin zivota i slobodno vreme*. Novi Sad : Fakultet za sport i turizam.
- [16] Lipscomb, S. (2007). Secondary school extracurricular involvement and academic achievement: A fixed effects approach. *Economics of Education Review*, 26(4), 463-472 doi:10.1016/j.econedurev.2006.02.006
- [17] Murati, X. (. (2022). *Fëmijët, nxënësit dhe fuqia e edukatës*,. Tetovo: Çabej.
- [18] Murati, X. (2022). *Për didaktikën dhe mësimdhënien*. Tetovo: Çabej.
- [19] P. Pejić-Papak – S. Vidulin-Orbanić. (2015). Stimulating Active Learning in Extracurricular Activities Through Contemporary Work Strategies. *European Online Journal of Natural and Social Sciences /Metodički obzori* 6(2011), 639.
- [20] Pinhey, T. K., Perez, M. P., & Workman, R. L. (2002). The fighting behavior of asian-pacific males in Guam: Do high school extracurricular activities matter?. *Social Science Quarterly*, 83(4), 1086-1096. doi:10.1111/1540-6237.00135
- [21] Stojanov, T. (. (2015). *Pikëpamje teorike dhe praktike për zbatimin e integritetit ndëretnik në fakultete për arsimtarë*. Skopje: USAID.
- [22] Soytürk, M. (2011). *Ders dışı etkinlik olarak takım sporu yapan ve spor yapmayan orta öğretim öğrencilerinin davranış örüntülerinin karşılaştırılması* (Unpublished doctoral dissertation). Celal Bayar University, Manisa.
- [23] Tepeköylü Öztürk, Ö., Özbey, S., & Çamlıyer, H. (2015). Impact of sport-related games on high school students' communication skills. *Physical Culture and Sport. Studies and Research*, LXVII, 53-64. doi:10.1515/pcssr-2015-0017
- [24] Будимир-Никович, Г. (2008). *Педагогија слободног времена-Хрестоматија*. агодино: Педагошки факултет- Филипино.
- [25] Лозаноски,Ј.Лозаноски Р. (2013). *Поставеноста на вонредовната настава во училиштет-прирачник за работа на наставници во основното и во средното образование*. Скопје: Култура.

- [26] J. Breckling, Ed., *The Analysis of Directional Time Series: Applications to Wind Speed and Direction*, ser. *Lecture Notes in Statistics*. Berlin, Germany: Springer, 1989, vol. 61.
- [27] S. Zhang, C. Zhu, J. K. O. Sin, and P. K. T. Mok, "A novel ultrathin elevated channel low-temperature poly-Si TFT," *IEEE Electron Device Lett.*, vol. 20, pp. 569–571, Nov. 1999.
- [28] M. Wegmuller, J. P. von der Weid, P. Oberson, and N. Gisin, "High resolution fiber distributed measurements with coherent OFDR," in *Proc. ECOC'00*, 2000, paper 11.3.4, p. 109.
- [29] R. E. Sorace, V. S. Reinhardt, and S. A. Vaughn, "High-speed digital-to-RF converter," U.S. Patent 5 668 842, Sept. 16, 1997.
- [30] (2002) The IEEE website. [Online]. Available: <http://www.ieee.org/>
- [31] M. Shell. (2002) IEEEtran homepage on CTAN. [Online]. Available:<http://www.ctan.org/tex-archive/macros/latex/contrib/supported/IEEEtran/>
- [32] FLEXChip Signal Processor (MC68175/D), Motorola, 1996.
- [33] "PDCA12-70 data sheet," Opto Speed SA, Mezzovico, Switzerland.
- [34] A. Karnik, "Performance of TCP congestion control with rate feedback: TCP/ABR and rate adaptive TCP/IP," M. Eng. thesis, Indian Institute of Science, Bangalore, India, Jan. 1999.
- [35] J. Padhye, V. Firoiu, and D. Towsley, "A stochastic model of TCP Reno congestion avoidance and control," Univ. of Massachusetts, Amherst, MA, CMPSCI Tech. Rep. 99-02, 1999.
- [36] *Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification*, IEEE Std. 802.11, 1997.

6. Chapter

Climate-Responsive Design of Vernacular Architecture in Hot-Dry Climates: Lessons from the South of Algeria

Ahmed Kaihoul ^{1*}

Efisio Pitzalis ¹

¹ Department of Architecture and Industrial Design, University of Campania Luigi Vanvitelli,
Via San Lorenzo 4, 81031 Aversa, Italy

Email of the corresponding author: ahmed.kaihoul@unicampania.it

ABSTRACT

This study explores climate-responsive design and passive strategies in vernacular architecture, focusing on the South of Algeria as an exemplary region facing hot-dry climatic challenges.

We categorize building materials into natural-based and artificial-based, discussing their properties and applications. Material selection criteria include availability, density, thermal capacity, and more. These materials are employed in walls, roofs, windows and doors to suit various climatic zones.

Passive strategies are integral for maintaining indoor comfort. In summer, measures minimize heat gain, protect from solar radiation, and promote heat storage. In winter, strategies focus on heat retention and thermal comfort. These strategies have been integral to vernacular architecture in the region for generations.

Vernacular architecture offers valuable insights into sustainable building practices, including compact forms, thick walls, and materials with high thermal mass. It inspires contemporary architects to address extreme climate conditions.

This study underscores the importance of applying lessons from vernacular architecture in modern construction in hot-dry climates. The qualitative approach serves as a foundation for future research, emphasising the cultural and environmental significance of preserving vernacular heritage.

Keywords – Vernacular Architecture, Climate-Responsive Design, Hot-Dry Climate, South of Algeria, Building Materials, Passive Strategies, Sustainable Construction, Natural-Based Materials, Artificial-Based Materials, Thermal Mass, Heat Storage, Solar Shading, Wind Towers, Indoor Comfort, Traditional Construction, Cultural Heritage, Environmental Sustainability, Climate Adaptation, Material Selection, Building Envelope

INTRODUCTION

Southern Algeria experiences a harsh hot-dry climate for most of the year, making it crucial to design buildings that can adapt to these conditions. Vernacular architecture, which has evolved over centuries, offers unique insights into climate-responsive design and passive strategies. In this paper, we delve into the key elements of vernacular architecture and their applicability in contemporary architectural practices [1].

The architecture of hot-dry regions, like the South of Algeria, presents a unique blend of tradition, environment, and culture [2]. In these arid and challenging climates, vernacular architecture has thrived for centuries, offering valuable insights into climate-responsive design and passive strategies [3]. This study delves into the sustainable design principles employed by traditional architecture in the South of Algeria, aiming to extract lessons that can inform contemporary construction practices. Our research focuses on building materials, envelope design, passive strategies for different seasons, and the overall significance of vernacular heritage. By studying the climate-responsive design of vernacular architecture, we aim to encourage environmentally conscious building practices in hot-dry regions and promote the preservation of cultural and scientific heritage.

MATERIALS AND METHOD

In this paper, we provide a detailed examination of the building materials used in the South of Algeria, categorizing them into two primary groups: natural-based and artificial-based materials. These materials play a crucial role in constructing walls, roofs, windows and doors, with their selection criteria influenced by factors such as regional availability, density, thermal capacity, and cost.

Additionally, we explore the building envelope's design in hot-dry climates. We discuss the importance of external load-bearing walls, flat roof typology, and the materials employed for beams, roofs, and floors. The section also addresses the role of windows and doors in controlling solar radiation, emphasizing the significance of their size, form, and orientation.

CLIMATE-RESPONSIVE DESIGN OF VERNACULAR ARCHITECTURE IN HOT-DRY CLIMATE

Building Materials:

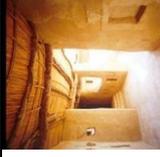
In the southern region of Algeria, vernacular architecture relies on a combination of natural and industrial-based materials. Natural-based materials include adobe bricks, lime-sand stone, stone for walls, palm trunks, branches, earthen slabs for roofs, and wood for doors and windows. Industrial-based materials encompass hollow bricks, hollow concrete blocks, and hollow polystyrene for walls, along with steel, aluminium, and glazing for doors and windows. The choice of materials is determined by regional availability, density, thermal capacity, thermal conductivity, life cycle, and cost.

Table 1 presents an overview of the most common building materials used in the South of Algeria, distinguishing between natural-based and artificial-based materials for different building elements.

Building Envelope:

In the hot-dry climate of Southern Algeria, the building envelope is carefully designed to minimize heat gain and maximize comfort. The external load-bearing walls are characterized by their thickness, homogeneity, and high albedo ratio. Roofs are typically flat and made of dense materials, with non-porous surfaces to store heat. Windows are constructed from wood or aluminium and include shutters to control direct solar radiation. The size and orientation of windows and the window-to-wall ratio (WWR) are tailored to specific needs. Special attention is paid to glazing, with the use of single or double glazing to maintain indoor thermal conditions and daylighting. Openings are strategically placed, being larger on the north side to allow natural daylight without direct solar radiation and smaller or non-existent on the west, south, and east sides. The concept of *Mushrabiya*, with small openings for daylighting and ventilation, is also considered (Table 2).

Table 1. Most common building materials used in the south of Algeria

Category	Natural-based				Artificial-based							
	Walls	Roofs	Windows and doors	Walls	Roofs	Windows and doors	Walls	Roofs	Windows and doors			
Building element	Adobe brick	Palm trunk and branches with earthen slab	Wood	Hollow brick	Hollow concrete block	Hollow brick with concrete slab	Hollow concrete block with concrete slab	Hollow polystyrene with concrete slab	Steel	Aluminium	Glazing	
Name	Lime-sand stone											
Illustration	 (1)	 (3)	 (4)	 (5)	 (6)	 (7)	 (8)	 (9)	 (10)	 (11)	 (12)	
Region zone	D, E, E1, F	D, E, E1, F	D, E, E1, F	D, E, E1, F	D, E, E1, F	D, E, E1, F	D, E, E1, F					
Density (Kg/m ³)	2567.6	1450	450	900	1300-2300	1150	1300	830	468	936	792	
Thermal capacity (J/Kg.K)	1075.1	984	2160	936	1000-1080	984	1080	1290	7780	2700	2700	
Conductivity (W/m.K)	0.817	0.7	0.17	0.48	1.1-175	1	1.45	0.22	52	230	1.1	

(1) Source: <https://www.thoughtco.com/what-is-adobe-sustainable-energy-efficient-177943>

(2) Source: <https://www.saladousa.com/about-limestone-sandstone>

(3) Source: <https://press.ierek.com/index.php/ESSD/rt/printerFriendly/173/189>

(4) Source: <https://www.pinterest.com/pin/25543922874106447/>

(5) Source: <https://www.indiamart.com/proddetail/clay-hollow-bricks-23369427812.html>

(6) Source: <https://brickcart.in/product/hollow-concrete-brick/>

(7) Source: <https://www.istockphoto.com/photo/lattice-joist-for-reinforced-concrete-floor-slab-and-clay-block-gm161993507-318578168>

(Accessed date: November 19th, 2021)

(8) Source: <https://www.amdgamatedconcrete.co.za/project-category/suspensive-slabs/>

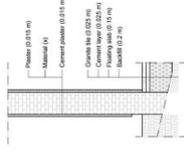
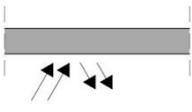
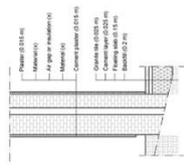
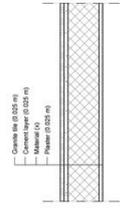
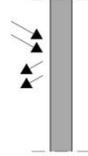
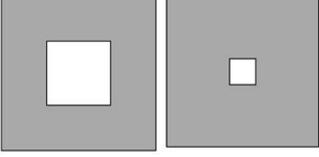
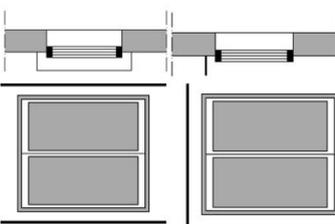
(9) Source: <https://www.pavebeton.fr/plancher-poutrelle-hourdis/>

(10) Source: <https://superiordoormapany.com.au/steel-doors/>

(11) Source: <https://www.thegaragedoorcentre.co.uk/entrancedoorsforthehome>

(12) Source: <https://www.aluminiumtradesupply.co.uk/steel-replacement-windows-doors/need-know-steel-look-doors-aluminium/>

Table 1. Most common envelope's parameters used in the south of Algeria

Building element	Walls			Roofs			Windows and doors		
	Section	Albedo	Section	Form	WWR	Shutters and overhang	Glazing		
Criteria	<p>Homogeneous</p> <p>One material layer</p> <p>With different thicknesses (x)</p>	<p>0 indicates a black body</p> <p>1 indicates a white body</p>	<p>Heterogeneous</p> <p>Two or more material layers</p> <p>With different thicknesses (x)</p>	<p>Heterogeneous</p> <p>Two or more material layers</p> <p>With different thicknesses (x)</p>	<p>Flat roof</p>	<p>The high ratio in the north and low in the west, south and east façades</p>	<p>Control direct solar radiation from the west, south and east</p>	<p>Simple ($U=5.871 \text{ W/m}^2\text{K}$)</p> <p>Double ($U=3.591 \text{ W/m}^2\text{K}$)</p> <p>Double + Kyrton gas ($U=1.267 \text{ W/m}^2\text{K}$)</p>	
Description									
Illustration								<p>Source:</p> <p>https://www.apexglass.ca/double-pane-windows-vs-single-pane-windows/ (Accessed date: November 19th, 2021)</p>	

Solar Shading:

Solar shading is a crucial aspect of building design in the hot-dry climate. It is achieved through horizontal or vertical overhangs, designed to protect the indoor environment from direct solar gain in summer and control illuminance and daylighting in winter. Shutters and Mushrabiya screens are employed to control daylight, natural ventilation, and heating.

Building Form and Orientation:

In the hot-dry climate, vernacular architecture features compact, staggered masses and volumes that minimize exposure to external surfaces. The form coefficient (S/V) is a key factor in determining the compactness of the structure, with a value less than 0.5 indicating a compact form (Figure 1). Shading is achieved through the mass and volume of the building itself. The north-south orientation is favoured, offering advantages in terms of minimizing solar radiation gain and harnessing monsoon winds.

Patio Design:

Vernacular architecture in hot-dry climates often incorporates patios, which serve as climate-regulating elements. These patios store cool air at night and release indoor hot air during the day, facilitating night flushing ventilation.

Wind Tower:

Wind towers, also known as air catchers, are employed to improve natural ventilation by harnessing cross-effect and stack-effect ventilation. They also facilitate night flushing ventilation by releasing hot indoor air.

Passive Strategies:

The philosophy of passive strategies is to enhance indoor microclimate comfort by cooling buildings in the summer and heating them in the winter without relying on active solutions. For example, in the summer, strategies include minimizing heat gains through compactness, thick walls, and thermal properties of envelope materials. Protection from solar radiation is achieved through shading, high albedo, and heat storage in thermal mass. Natural

ventilation is encouraged through cross-ventilation and stack-effect ventilation [4].

In the winter, strategies aim to minimize heat loss through compactness, small WWR, and envelope materials with favourable thermal properties. Passive solar heating is achieved through large WWR and shutters. Shading is used to avoid excessive indoor illuminance due to the lower sun elevation in winter, while thermal storage in thick walls helps maintain indoor comfort (Table 3).

Lessons from Vernacular Architecture:

Vernacular architecture in Southern Algeria provides valuable lessons for climate-responsive design and passive strategies. While qualitative observations suggest the effectiveness of these traditional practices, further quantitative studies, including in-situ measurements and dynamic simulations, are needed for a comprehensive assessment. These lessons can inspire architects in the region to adopt a combination of passive and low-energy solutions, such as mechanical fan-forced ventilation, evaporative cooling, and passive solar heating, to adapt to harsh climatic conditions. Ultimately, vernacular heritage should be preserved due to its valuable scientific and cultural insights [5].

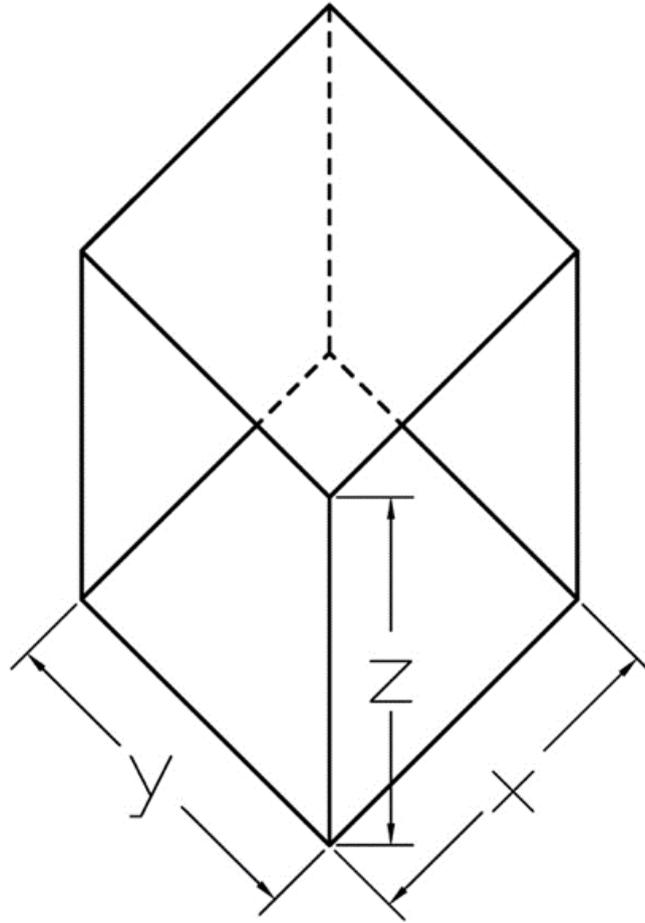
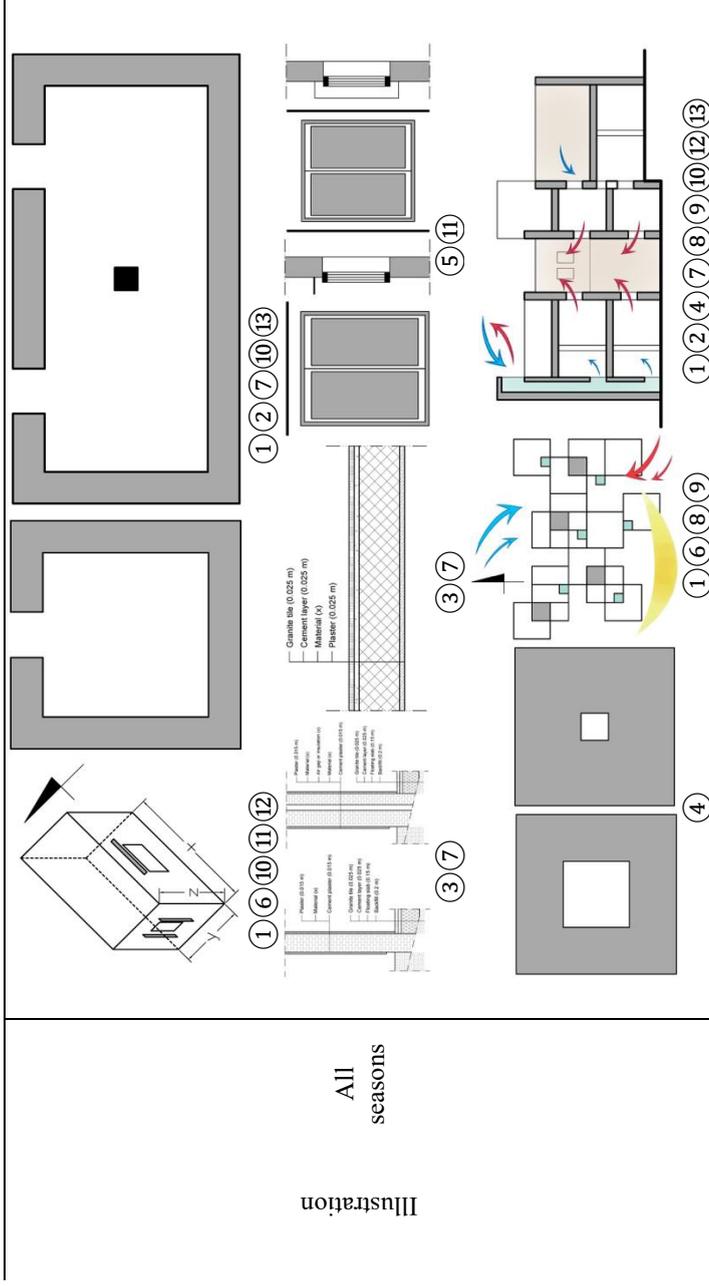


Figure 1. Form coefficient (S/V)

Table 3: Climate-responsive design and passive strategies of vernacular architecture in the south of Algeria

Criteria	Season	South of Algeria
Passive strategies	During summers	<ul style="list-style-type: none"> • Minimize heat gain in the building envelope • Protect against direct solar radiation • Store heat to regulate indoor temperature • Segment spaces into summer and winter zones based on various factors • Mitigate heat through proper orientation, shading, window shutters, and semi-open spaces • Leverage monsoon winds for enhanced ventilation and cooling • Include semi-open spaces for comfortable summer night sleeping
	During winters	<ul style="list-style-type: none"> • Minimize heat loss from the building envelope • Utilize passive solar heat gain • Protect against direct solar radiation • Incorporate heat storage
Climate-responsive design	All seasons	<ol style="list-style-type: none"> ① Staggered masses and compact volume ($S/V < 0.5$) ② Thick walls for insulation ③ Appropriate envelope materials ④ Strategic small openings (WWR) ⑤ Windows with 'Mushrabiya' shutters ⑥ North-south orientation for solar and wind control ⑦ Enhanced thermal mass in walls and roofs ⑧ Incorporate patios for climate control ⑨ Wind towers or 'Rozna' for ventilation ⑩ Well-placed windows for natural ventilation ⑪ Solar shades in the south (horizontal) and east/west (vertical) ⑫ Flat roofs for summer night use ⑬ Thermally efficient spaces on lower and upper levels



RESULTS

Our findings reveal the effectiveness of passive strategies employed in the South of Algeria's vernacular architecture. In the summer season, minimizing heat gains, protection from solar radiation, and heat storage are essential to maintaining indoor comfort. Our research emphasizes the advantages of natural ventilation through techniques such as cross-ventilation and stack-effect ventilation.

During the winter period, the focus shifts to minimizing heat loss, utilizing passive solar heat gain, and effective heat storage. The selection of materials and shading elements is explored in-depth, along with the importance of thermal mass for heat retention.

In the South of Algeria, the choice of building materials for vernacular architecture reflects the adaptation to the harsh hot-dry climate. Building materials are categorized into two primary groups: natural-based and industrial-based materials. Natural-based materials encompass adobe bricks, lime-sand stone, and stone for walls, as well as the use of palm trunks and branches combined with an earthen slab for traditional roofing. The versatile use of wood is prominent for doors and windows. In contrast, industrial-based materials include hollow bricks, hollow concrete blocks, and hollow polystyrene used in walls. For roofs, hollow bricks with concrete slabs and hollow concrete blocks with concrete slabs are employed. Doors and windows utilize steel, aluminium, and glazing. The selection of construction materials is influenced by various criteria, including regional availability, density, thermal capacity, thermal conductivity, life cycle, and cost.

DISCUSSION

In this section, we reflect on the significance of vernacular architecture in the South of Algeria and its contribution to climate-responsive design. The discussion highlights the value of compact forms, thick walls, and materials with high thermal mass. We also address the strategic placement of windows, shutters, and wind towers, emphasizing their role in maintaining indoor comfort and energy efficiency.

The choice of building materials in the South of Algeria is underpinned by the region's climatic conditions, and this indigenous wisdom informs

climate-responsive design. The use of natural-based materials like adobe bricks, lime-sand stone, and palm trunks demonstrates a sustainable approach by utilizing local resources. These materials possess unique properties, such as high thermal mass and low thermal conductivity, contributing to the region's energy-efficient architectural heritage.

On the other hand, the incorporation of industrial-based materials, such as hollow bricks and concrete blocks, showcases a fusion of traditional and modern building practices. While these materials might not possess the same thermal properties as natural-based ones, they offer structural advantages and are used judiciously in conjunction with climate-responsive design strategies.

CONCLUSION

Our research underscores the importance of drawing lessons from traditional architecture to address the challenges of contemporary construction in hot-dry climates. We emphasize the cultural and environmental significance of preserving vernacular heritage and promoting sustainable design practices.

The climate-responsive design of vernacular architecture in the hot-dry region of the South of Algeria presents a sustainable and adaptive approach to construction. Lessons drawn from the use of both natural-based and industrial-based materials illustrate the need to harmonize tradition with modernity in architectural practices. The meticulous selection of building materials aligns with the local environment, balancing thermal properties and structural requirements.

Moreover, the design principles applied in the building envelope, such as the use of thick walls, flat roofs, and careful selection of windows, shutters, and glazing, reflect a keen understanding of the climate's demands. The integration of passive strategies, including natural ventilation, shading, and the use of elements like patios and wind towers, showcases an innovative response to the climatic challenges in the region.

In conclusion, vernacular architecture in the South of Algeria offers valuable insights into climate-responsive design and sustainable construction practices. The adaptation of building materials and the strategic use of passive design strategies have allowed communities in this region to thrive

in a challenging environment while maintaining a harmonious relationship with nature. As we look to the future, these lessons should be preserved and integrated into contemporary architectural practices to address the ongoing challenges of climate change and environmental sustainability.

REFERENCES

- [1] Kaihoul, A., Sriti, L., Amraoui, K., Di Turi, S. and Ruggiero, F., 2021. The effect of climate-responsive design on thermal and energy performance: A simulation based study in the hot-dry Algerian South region. *Journal of Building Engineering*, 43, p.103023.
- [2] Kaihoul, A. and Sriti, L., 2019. The Cohesive Urban Social Fabric Between Local Architectural Identity and Climatic Response. *Arquitectonics: Mind, Land & Society*, (31), pp.141-167.
- [3] Amraoui, K., Sriti, L., Di Turi, S., Ruggiero, F. and Kaihoul, A., 2021, October. Exploring building's envelope thermal behavior of the neo-vernacular residential architecture in a hot and dry climate region of Algeria. In *Building Simulation* (Vol. 14, No. 5, pp. 1567-1584).
- [4] Fathi, H. and Abd al-Rahman, S., 1986. *Natural energy and vernacular architecture: principles and examples with reference to hot arid climates*. University of Chicago.
- [5] El-Miniawy, H., 2019. *Monography and thoughts of the architect*. Interview by the author Ahmed Kaihoul in person, June 17th, 2019.

7. Chapter

Urban Metallurgy: Reviving Industrial Sites through Architectural Valorization of Minerals

Melik Sami ¹

Khelil Sara ¹

¹ Department of Architecture, Faculty of Science and Technology, LaCoMoFa Laboratory
Biskra,,University of Biskra -Mohamed Khider, Algeria

Email of the corresponding author : sami.melik@univ-biskra.dz

ABSTRACT

With ongoing urbanization continually transforming the global landscape, the remnants of historical industrial frameworks are frequently left behind as underused or deserted locations, concurrently posing issues and prospects for repurposing in the redevelopment of urban areas. This research delves deep into an emergent concept termed 'Urban Metallurgy,' a unique strategy focusing on the architectural valorization of minerals to breathe new life into these fading industrial sites. Harnessing the intrinsic beauty and properties of a wide spectrum of minerals, the approach seeks to repurpose these materials, integrating them seamlessly into the design, aesthetics, and structural integrity of transformed industrial spaces. Drawing from comprehensive case studies spanning diverse geographic contexts including transformations like New York's High Line, London's Tate Modern, and the iconic industrial complexes in Essen, Germany this article offers a multifaceted exploration of the myriad economic, environmental, and sociocultural benefits emanating from this innovative strategy. Beyond mere aesthetic enhancements, the revitalized spaces promote environmental sustainability through reduced resource extraction, minimized transportation emissions, and enhanced urban greenery. Economically, these sites become catalysts for job creation, tourism, and local business growth, while socioculturally, they stand as beacons preserving historical narratives and fostering communal engagement. By drawing together these disparate results, this study emphasizes the immense promise inherent to urban metallurgy as an interconnecting crossroads, intimating its pivotal importance for the forthcoming pathways of urban strategizing, architectural shaping, and environmentally-conscious urban advancement.

Keywords – Urban Metallurgy, Architectural Valorization, Sustainable Redevelopment, Mineral Repurposing, Industrial Heritage.

INTRODUCTION

Cities have aging industrial sites left abandoned and polluted. A trend is emerging to rejuvenate these areas with innovative architectural methods. 'Urban metallurgy' focuses on using the mineral resources in these sites. This article delves into the architectural potential of these minerals. It emphasizes economic, environmental, and societal benefits. By integrating mineral extraction, design, and sustainability, urban metallurgy can transform these sites. This preserves history and boosts urban community welfare [1].

Urban metallurgy involves using minerals from old industrial sites for architectural purposes. Once-bustling industrial areas often become neglected and deserted. Despite this, they contain valuable mineral resources. Urban metallurgy taps into these minerals for architectural designs. This reinvigorates the sites and emphasizes the minerals' importance. The approach is sustainable, preserves industrial history, and creates distinct mineral-rich architectures. It also supports waste reduction and the circular economy in urban growth [2].

Urban metallurgy is crucial to the revitalization of industrial locations with abundant mineral resources. Communities can access a new source of income and improve local sustainability by reviving these sites. In addition to repurposing these locations for cultural and educational activities, the architectural valorization of these minerals promotes environmental sustainability by reducing the need for more mining. metropolitan metallurgy proposes an integrated strategy that offers financial, sociological, and ecological benefits for metropolitan districts and their people in a balanced, comprehensive way by fully applying the principles of a circular economy through optimizing metal reuse and recycling [3].

The architectural valorization of minerals is pivotal in the revival of industrial sites. This unique approach seamlessly merges respect for the site's history with its modern transformation. By incorporating these specific minerals into designs, architects not only highlight the identity and legacy of the area but also underscore the site's past industrial importance. Furthermore, the sustainable benefits of such an approach are evident; using locally sourced minerals minimizes the demand for energy-intensive processes. In essence, valorization is a critical tool in both preserving historical narratives and championing sustainable urban development [4].

The scientific article delves into the value of architectural valorizing minerals for revitalizing industrial sites. Through case studies, it

demonstrates how these minerals enhance urban areas both aesthetically and functionally. It underscores the multifaceted benefits: economic, social, and environmental implications of urban metallurgy. This method fosters a bond between the industrial past and modern urban development. The aim is to transform abandoned industrial locales into lively, contemporary spaces, honoring their rich history. This sustainable approach reduces resource extraction needs and encourages interdisciplinary urban design collaboration. Overall, it presents a future vision for vibrant and sustainable urban landscapes [5].

Problematic:

With the rapid urbanization and evolution of cities, many industrial sites have lost their operational relevance, becoming dormant spaces that punctuate the urban fabric with signs of decay and neglect. These sites, rich in their historical and mineralogical context, often lie abandoned, presenting challenges in terms of urban blight, wasted resources, and lost potential [6]. How can the principles of urban metallurgy and the architectural valorization of inherent minerals be leveraged to transform these derelict spaces? What is the potential of these minerals not just as symbolic remnants of an industrial era, but as viable, sustainable resources that can be integrated into contemporary architectural designs? How can this integration create a nexus between the rich industrial past of these sites and the pressing needs of modern urban development? The exploration of these questions becomes imperative to understand the full scope and application of urban metallurgy in addressing urban decay, sustainability challenges, and the need for preserving industrial heritage while advancing modern architectural practices.

METHOD

For the article titled "Urban Metallurgy: Reviving Industrial Sites through Architectural Valorization of Minerals," our methodology commences with defining the objectives, focusing on understanding the impact of urban metallurgy and mineral valorization on industrial site revival. A comprehensive literature review will be undertaken, drawing from academic databases such as JSTOR, Google Scholar, and ScienceDirect, targeting publications from the past 20 years that align with our objectives. Diverse industrial site case studies from various locations revitalized using urban

metallurgy principles will be chosen for a comparative analysis. This analysis will evaluate design methodologies, minerals utilized, economic outcomes, and community engagement. Expert feedback in architecture and metallurgy will validate the findings. Findings will be visualized using graphs and tables, acknowledging any study limitations. Conclusively, the study aims to encapsulate the potential and challenges of using mineral valorization in urban redevelopment.

RESULTS AND DISCUSSION

This study underscores the potential of using minerals to rejuvenate industrial sites architecturally. By integrating minerals with urban designs, sites gain enhanced aesthetic and cultural appeal, boosting economic activity. Digitally fabricated facades, inspired by mineral patterns, merge the site's industrial legacy with modern urban aesthetics. This blend maintains historical relevance while offering fresh architectural allure. Furthermore, the durability of mineral-based construction materials ensures both sustainability and resilience. These materials exhibit robust resistance to natural wear, ensuring long-lasting urban renewal. Conclusively, mineral valorization proves effective in converting old industrial zones into thriving urban spaces [7].

Urban Metallurgy: Understanding the Concept:

Urban metallurgy revitalizes industrial sites by valuing minerals architecturally. This approach reveals how urban spaces can champion sustainability and societal advancement. Architectural valorization integrates mineral materials into building designs, boosting aesthetics, environmental efficiency, and durability. It also advances the circular economy by repurposing waste and minimizing fresh resource extraction. Consequently, cities can refresh old industrial areas into dynamic spaces, merging history with modern needs. However, hurdles like technology, environmental concerns, and economic viability exist. Still, urban metallurgy provides a hopeful avenue for rejuvenating urban settings [8].

1. Definition and scope of urban metallurgy:

Urban metallurgy focuses on extracting and repurposing metals from urban constructions. Beyond mere recycling, it intertwines with the architectural

valorization of minerals, accentuating the aesthetics and cultural significance of metal reuse. This method enhances urban design by leveraging metals' distinct properties. It also embeds minerals into architectural features, fostering a harmonious blend with the built landscape. Embracing sustainability and the circular economy, urban metallurgy lessens primary metal extraction reliance and its environmental toll, offering a path to rejuvenate industrial sites and foster a greener urban milieu [9].

2. Historical context and evolution of urban metallurgy:

The industrial revolution of the 18th century can be seen as laying the initial groundwork for the development of modern urban metallurgy, as its seminal transformations at such a defining moment in the progression towards industrialization ultimately served to establish the fundamental architectural blueprints that subsequent advancements in the field would come to build upon in the following centuries. This era's swift urbanization and tech advancements spurred vast industrial sites, heavily reliant on metallurgy. Metals extraction and processing became vital for machinery and infrastructure production, fueling specialized urban districts. While these sites bolstered cities' economic, social, and cultural growth, the decline of heavy industry left many abandoned. Modern architects and planners now emphasize architectural valorizing minerals, striving to rejuvenate these sites while honoring their historic essence [10].

3. Significance of urban metallurgy in sustainable urban development:

In summation, urban metallurgy's role in fostering sustainable urban development is paramount. Architectural valorization of minerals offers a robust solution for rejuvenating industrial sites, bolstering urban sustainability. By integrating metallurgical procedures into architecture, cities witness resource conservation, waste reduction, and enhanced energy efficiency. Repurposing mining waste for construction not only diminishes environmental footprints but also preserves finite resources. Minerals, when embedded in designs, heighten urban aesthetics, crafting a distinctive urban identity. The case studies exemplify urban metallurgy's potential to breathe life into languished industrial areas. As cities grapple with resource and environmental challenges, urban metallurgy emerges as an essential blueprint for sustainable progression. Bridging science and architecture, this approach revitalizes cities, harmonizes the built and natural environments,

and underscores the potential of industry's legacy in molding a sustainable future [11].

Architectural Valorization of Minerals:

Architectural valorization of minerals rejuvenates industrial sites, emphasizing their role in shaping urban landscapes. Minerals in design pay tribute to sites' historic relevance, forging a community connection. For instance, weathering steel, or Corten steel, which oxidizes to a distinctive rust-like finish, is used in architectural endeavors. Containing elements like copper and chromium, its unique aesthetic turns structures into iconic reminders of a city's industrial past. Through urban metallurgy, these designs ensure industrial sites' cultural significance persists for upcoming generations [12].

1. Definition and principles of architectural valorization of minerals:

Architectural valorization of minerals rejuvenates industrial sites by weaving mineral elements into design. This transformation turns dormant industrial areas into lively, captivating spaces. The approach centers on identifying and preserving on-site mineral resources, then enriching architecture with these or new minerals. These can be industrial remnants or natural local minerals. Such integration accentuates a site's industrial legacy and introduces sustainable design. It celebrates each site's essence, fostering identity and championing material reuse in a circular economy framework [13].

2. Techniques and methods used in architectural valorization:

Architectural valorization rejuvenates industrial sites by creatively integrating minerals into design. This includes blending mineral-based materials like iron or copper into building façades, underscoring their historical value. Adaptive reuse transforms old factories into modern spaces, retaining their inherent features but often requiring extensive restoration. To accentuate aesthetics, mineral elements are added. Cutting-edge technologies, such as 3D printing, forge distinctive mineral-based architectural features, broadening design horizons. Collectively, these strategies emphasize a balance of history, sustainability, and modernity in urban revitalization [14].

3. Benefits and challenges of architectural valorization in urban metallurgy:

Architectural valorization in urban metallurgy melds historical preservation with sustainable urban renewal. This process conserves historical memory while fostering community identity. By infusing mineral elements into designs, cities can drive sustainability, lessening dependence on ecologically harmful construction materials. These minerals, with their varied aesthetics, can also economically benefit cities by drawing tourists. Yet, challenges arise, including ethical mineral sourcing and specialized skills for its integration. Overall, architectural valorization harnesses industrial sites' potential, transforming them into cultural landmarks. It blends past legacy with modernity, leveraging minerals for design and economic growth, ultimately weaving industrial spaces seamlessly into urban landscapes, fostering community engagement and sustainable city evolution [15].

Reviving Industrial Sites through Architectural Valorization:

Architectural valorization of minerals offers a fresh lens to rejuvenate urban industrial sites. By melding historical preservation with modern design, it creates sustainable, visually appealing spaces. This synergy between mineral materials and architecture beautifully marries the past with the present. These materials also promote sustainable elements, such as energy efficiency. Through proactively adopting this methodology, municipalities have the potential to stimulate financial expansion, entice capital ventures, and better citizens' prosperity. Thus, urban metallurgy's potential should be pivotal in urban redevelopment strategies [16].

1. Case studies of successful architectural valorization projects:

In summary, the showcased case studies underline the transformative power of architectural valorization in urban renewal, particularly with mining and metallurgical sites. By transforming these sites into cultural hubs or versatile developments, tangible heritage is preserved, driving economic opportunities and community enrichment. Incorporating site-specific minerals into designs elevates authenticity and narrative depth. Yet, balancing environmental concerns and ensuring community involvement is

crucial. Continued research is needed to fully grasp this method's expansive potential in urban regeneration [17].

2. Impact of architectural valorization on the revitalization of industrial sites:

To conclude, architectural valorization offers a transformative lens for industrial site renewal. By blending minerals and industrial facets into designs, these locales evolve into lively, sustainable hubs. This not only safeguards their historical essence but also stimulates economic and community growth. Spaces echoing industrial roots attract locals and tourists. However, prioritizing environmental stewardship and local needs is vital. A unified strategy merging innovative design, environmental consciousness, and community collaboration revitalizes once-forsaken industrial areas [18].

3. Economic, social, and environmental benefits of reviving industrial sites:

Revitalizing industrial sites presents multifaceted advantages. Economically, such endeavors foster job creation and economic expansion. Socially, they uplift community life through new amenities, housing, and public spaces while preserving the historical and cultural essence, enhancing communal identity. Environmentally, repurposing these sites addresses pollution, with rehabilitation of tainted lands preventing further degradation. Embracing eco-friendly practices further augments the environment. Thus, rejuvenating industrial spaces delivers notable economic, social, and environmental dividends to communities and society at large [19].

Sustainable Urban Development and Urban Metallurgy:

To sum up, sustainable urban development and urban metallurgy are pivotal in rejuvenating industrial sites via architectural valorizing minerals. Sustainable practices like recycling optimize resource use, while urban metallurgy repurposes neglected structures into architectural treasures. This elevates urban aesthetics and boosts city sustainability. Incorporating local mineral materials in designs minimizes environmental burdens. Additionally, this valorization attracts investments and creates jobs. Consequently, combining both methods fosters cities that are visually, environmentally, and economically balanced [20].

1. Role of urban metallurgy in achieving sustainable urban development goals:

In summary, urban metallurgy is pivotal for sustainable urban objectives, breathing life into industrial areas via mineral architectural valorization. Economically beneficial, it bolsters environmental sustainability by minimizing virgin resource needs and promoting recycling. This lessens fresh mining demands and crafts appealing landscapes, boosting tourism and community well-being. Embracing this approach helps cities counter rapid urbanization challenges, fostering economic growth, environmental care, and community inclusivity. Thus, stakeholders should prioritize urban metallurgy in their sustainable urban strategies [21].

2. Integration of architectural valorization of minerals in urban planning and design:

In essence, weaving architectural valorizing minerals into urban planning revitalizes industrial sites. Incorporating these minerals yields aesthetic and sustainable urban structures, conserving natural resources. Such practices can boost the local economy by supporting the mineral industries. Minerals also offer buildings enhanced durability and safety features. Yet, the environmental costs of mineral extraction demand attention. Emphasizing sustainable approaches, like recycling or reusing existing minerals, can mitigate such impacts. Thus, this integration promises both industrial site renewal and broader urban sustainability [22].

3. Potential future developments and advancements in urban metallurgy:

Emerging advancements in urban metallurgy stand poised to redefine industrial site transformation through architectural valorizing minerals. Advanced manufacturing technologies, like 3D printing, promise design flexibility and resource efficiency. Future metallurgical research may unveil innovative, robust alloys, further empowering architectural creativity. Integrating sensors and smart materials can evolve sites into self-sustaining entities, boosting safety and cost-effectiveness. Ultimately, such progress promises transformative, sustainable designs. Valorizing minerals in architecture conserves history, promotes sustainability, and enriches aesthetics, fostering community pride. This innovative fusion of architecture, metallurgy, and heritage holds the potential to sculpt our future urban

landscape, intertwining economic vitality, social unity, and ecological balance [23].

Case Study 1: The High Line, New York City:

The High Line in New York epitomizes the successful blend of architectural valorization of minerals in rejuvenating industrial locales. Once a forsaken freight rail, it's now a celebrated public park symbolizing urban renewal. Marrying the site's industrial legacy with inventive design, minerals like weathering steel augment the park's allure and durability. Beyond preserving its historical essence, the High Line spurs economic activity and fosters community interaction, underscoring the transformative power of architectural valorization in city regeneration [24].

1. Provide background information on the High Line:

The High Line in New York City exemplifies innovative architectural valorizing minerals. This elevated park, previously a deserted railway, has been repurposed for recreation and art, stretching 1.45 miles across Manhattan's West Side. Designed by James Corner Field Operations and Diller Scofidio + Renfro, it boasts wildflowers and grasses reminiscent of its railway origins. This adaptive reuse has rejuvenated its surroundings and stands as a global benchmark for similar endeavors [25].

2. Explain how architectural valorization of minerals was used:

Architectural valorization of minerals has been pivotal in transforming industrial spaces, evident in notable case studies. London's Tate Modern Museum, a redesigned power station, marries its industrial past with a modern cultural persona, using minerals for a distinct visual identity. Similarly, Germany's Ruhr Museum, set in a previous coal mine, integrates minerals structurally and decoratively, celebrating its mining lineage. These instances underscore how melding minerals into architectural designs can rejuvenate and breathe fresh life into urban zones [26].

3. Discuss the success of the project in reviving the industrial site:

The project's triumph in rejuvenating industrial space stems from blending historical preservation with vibrant modern use. Architectural valorization of minerals enabled a harmonious blend of heritage and innovation. Highlighting minerals' inherent beauty within the design both maintained the site's industrial essence and infused contemporary flair. Beyond aesthetics,

the project significantly benefited the community by drawing businesses, generating jobs, and stimulating the local economy. In essence, such architectural strategies can turn forgotten sites into bustling centers of progress and opportunity [27].

4. Analyze the impact of the project on the surrounding community:

The 'Urban Metallurgy' initiative's impact is evident in the community upliftment it has fostered. Reviving industrial sites through mineral architectural valorization has generated employment, bolstered the economy, and aesthetically enriched the surroundings, drawing tourists and benefiting local businesses. Beyond economic growth, these efforts celebrate and preserve local cultural heritage. A standout example is the repurposing of a once-dilapidated steel mill into a vibrant cultural nexus. The innovative integration of discarded metal into its design seamlessly combines historical resonance with modern aesthetics. This rejuvenation attracts a diverse mix of artists and entrepreneurs, showcasing the potential of urban metallurgy to metamorphose neglected spaces into dynamic cultural epicenters [28].

Case Study 2: Zollverein Coal Mine Industrial Complex, Germany:

The Zollverein Coal Mine Industrial Complex in Essen, Germany stands as a prime example of architectural valorizing minerals. Established in the 19th century, this industrial hub significantly influenced the Ruhr region's growth. Following its abandonment in the 1980s due to the coal industry's decline, a revitalization plan transformed Zollverein into a cultural and educational epicenter, housing museums, exhibitions, and educational spaces. Today, it stands as a testament to architectural innovation while preserving the region's rich industrial legacy [29].

1. Describe the history of the Zollverein Coal Mine:

The Zollverein Coal Mine in Essen, Germany, established in 1847, was pivotal in the Ruhr region's industrial growth. Designed by Fritz Schupp and Martin Kremmer, the complex epitomized the Bauhaus architectural style. Despite having ceased operations in 1986, the site took on fresh relevance when subsequently gaining UNESCO World Heritage status in the year 2001. It now thrives as a cultural and educational hub, exemplifying the value of rehabilitating post-industrial sites and highlighting the potential of architectural valorizing minerals in revitalizing such spaces [30].

2. Discuss the architectural valorization of minerals in the site's transformation:

The architectural valorization of minerals is pivotal in transforming industrial sites, with aesthetics and design being paramount in drawing visitors and investors. Architects integrate minerals, like metals for facades or precious stones for interiors, to enhance the structure's uniqueness and underline its historical significance. This not only creates a distinct narrative but bridges the site's industrial heritage with modern, innovative material use, resulting in a harmonious blend of the past and present in a captivating setting [31].

3. Evaluate the success of the project in revitalizing the industrial complex:

The architectural valorization of minerals has been instrumental in transforming the industrial complex from abandoned spaces to dynamic hubs. By integrating minerals into its design, not only was the aesthetic appeal enhanced, but it also attracted significant business and investment. Now a center for diverse industries, the complex boosts local employment and economic growth. Sustainable practices, from renewable energy to resource optimization, further amplify its success, offering both environmental benefits and cost efficiencies. Through extensive redevelopment initiatives, the area has undergone tremendous socio-economic transformation, precipitating wide-ranging repercussions profoundly impacting the lives of local inhabitants [32].

4. Examine the economic and cultural benefits brought by the project:

The "Urban Metallurgy: Reviving Industrial Sites through Architectural Valorization of Minerals" project has profoundly impacted economic and cultural landscapes. Economically speaking, the phenomenon has sparked local job growth while simultaneously luring overseas financiers and vacationers alike to the region, bolstering industries across the board. Architecturally, the project emphasizes the value of industrial minerals like steel and iron, preserving historical significance while generating revenue through tourism. This also reinforces the community's cultural identity, drawing artists and cultural innovators, enhancing regional vibrancy. One exemplary case is London's BedZED development, where minerals like timber, hemp, and clay were integrated, yielding both aesthetic and

sustainability benefits. With its distinctive design and commitment to environment-friendly practices, BedZED underscores the project's potential in fostering sustainable, revitalized communities [33].

Case Study 3: Tate Modern, London:

London's Tate Modern serves as an example of how to successfully value minerals in architecture by converting an old power plant into a top-tier cultural facility. The project, created by Herzog & de Meuron in 2000, uses raw elements including brick, concrete, and steel to combine the site's industrial background with modern aesthetics. This minimalist approach resulted in a seamless fusion of historical and contemporary elements. Today, Tate Modern stands as an architectural marvel, drawing millions yearly and cementing its status among the world's top art museums [34].

1. Provide an overview of the Tate Modern museum:

The Herzog & de Meuron-designed Tate Modern museum, located in a converted power plant in London, debuted in 2000 and rapidly became a top tourist destination. The museum proudly houses its expansive holdings of modern and contemporary creative works, ranging from pieces on canvas to technologically integrated installations. The museum's iconic turbine hall, a nod to its industrial past, frequently features large-scale, site-specific artworks. The Tate Modern's dedication to innovation and inclusivity has significantly impacted London's cultural scene and broadened contemporary art appreciation [35].

2. Explain how architectural valorization of minerals was incorporated into the design:

Architectural valorization of minerals was pivotal in renewing industrial sites, utilizing mineral waste like industrial byproducts for design elements. This approach minimized the environmental toll from mining and enriched design aesthetics. Materials like slag, a steel industry byproduct, became innovative components like decorative tiles. Thus, architects highlighted the untapped beauty of industrial waste, elevating its value. This practice significantly contributed to the metamorphosis of desolate industrial zones into lively, sustainable urban locales [36].

3. Discuss the impact of the project on the surrounding area:

The project's transformation of derelict industrial sites into dynamic cultural spaces has profoundly rejuvenated the region, drawing both locals and tourists. This revitalization has spurred economic growth, benefiting local enterprises like cafes and galleries. Additionally, the emphasis on sustainable practices, from energy-efficient designs to green spaces, enhances environmental benefits. The initiative has also created employment in sectors like architecture and tourism, bolstering community ties. Overall, the endeavor has redefined the area's identity, showcasing it as a progressive urban hub [37].

4. Analyze the cultural significance of the museum's transformation:

The museum's transformation underscores the importance of preserving and celebrating a site's industrial heritage. By converting the old factory into a museum, it bridges the past with the present, emphasizing the region's deep-rooted industrial history. The architectural integration of minerals further elevates the site's historical and artistic significance, drawing visitors and facilitating cultural exchange. Similarly, the "Urban Metallurgy" case study reveals how a former steel mill was rejuvenated into a multifunctional hub, blending residential, commercial, and leisure spaces, thus preserving history while fostering economic and community growth [38].

Case Study 4: Ruhr Museum, Germany:

The Ruhr Museum in Germany, nestled within the Zollverein Coal Mine Complex, exemplifies the power of architectural valorization in rejuvenating industrial sites. A UNESCO World Heritage Site, the museum intricately blends the historical essence of the region with its mineral-rich backdrop. Designed by HG Merz, it bridges the region's coal industry legacy with modern times. Through the creative use of materials like concrete and steel, the museum both conserves its industrial heritage and offers an immersive narrative of the bygone industrial age, establishing itself as a benchmark in industrial site revitalization [39].

1. Describe the Ruhr Museum and its location in a former coal mine:

The Ruhr Museum, situated in Germany's coal-rich Ruhr region, masterfully revitalizes a former coal washing plant through architectural valorizing minerals. Seamlessly integrating the area's industrial past into its design, the museum offers an immersive experience, enriched by its

contextually significant location within an old coal mine. Visitors are drawn into the history and culture of the Ruhr coal industry through a myriad of artifacts, interactive showcases, and informative presentations. This museum epitomizes the harmonious blending of rejuvenation with historical and cultural preservation in industrial settings [40].

2. Discuss the architectural valorization of minerals in the museum's design:

The architectural valorization of minerals is pivotal in the museum's design, intricately weaving the beauty and significance of these materials into the fabric of the structure. These minerals, carefully integrated, both honor and elevate the site's industrial heritage, bridging its past and present. The transformative journey from abandoned industrial spaces to vibrant cultural landmarks is accentuated by these materials. Through preserving its past amid renewal, the museum now bears witness to the location's strength of spirit as it surrounds visitors in an all-enveloping chronicle highlighting both the story and rejuvenation of the former worksites' topography [41].

3. Evaluate the success of the project in preserving industrial heritage:

The effectiveness of a project in preserving industrial heritage hinges on several criteria. Key among them is the project's capacity to transform once-abandoned industrial sites into dynamic, economically beneficial spaces through architectural valorization of minerals. A crucial marker of success is the conscientious preservation of historical elements and artifacts tied to the site's original industrial operations. By equally enhancing local economic opportunity and fostering civic pride in their shared industrial roots, the project aims to both stimulate activity and reinforce residents' bond with the legacy which unites them, cultivating a deep-seated, communal sense of identity [42].

4. Examine the educational and tourism benefits brought by the project:

The architectural valorization of minerals in urban metallurgy offers multifaceted benefits, notably in education and tourism. Repurposing industrial landmarks creates immersive educational spaces, where learners can delve into the historical and technical aspects of the industry. Moreover, such transformations draw tourists, spotlighting regional heritage and innovation. For instance, Germany's Duisburg-Nord Industrial Complex, once a thriving steel hub, now thrives as an urban park. While preserving

industrial remnants like blast furnaces and coal bunkers, it intertwines sustainability with heritage, showcasing green spaces and renewable energy, illustrating the potential of melding past and future in urban redevelopment [43].

Comparative study:

Table 1. Comparative Study

Aspect / Case Study	The High Line, NYC	Zollverein Coal Mine Industrial Complex, Germany	Tate Modern, London	Ruhr Museum, Germany
Original Purpose	Abandoned freight rail line	Coal mine and industrial complex	Power station	Coal mine
Current Purpose	Elevated public park	Cultural and educational center	Art museum	Museum showcasing regional industrial heritage
Architectural Elements	Weathering steel railings	Renovated coal mine structures, contemporary buildings	Minimalist use of brick, concrete, and steel	Repurposed coal washing plant structures
Preservation of Heritage	Maintains tracks, preserves rail line's structure	Preserves old coal mine structures	Preserves power plant's industrial character	Integrates remnants of steel production
Economic Impact	Boosts tourism, spurs local business growth	Attracts tourism, serves as educational hub	Attracts millions of visitors annually	Acts as a cultural hub, drawing tourists
Connection to Urban Metallurgy	Incorporates industrial elements into design	Represents the coal mining heritage through architectural design	Emphasizes raw materials, connecting to industrial past	Showcases the interplay of industrial past and present

<p>Architectural Valorization</p>	<p>Integrates old rail line structures</p>	<p>Utilizes and showcases the coal mining heritage</p>	<p>Incorporates power plant structures with contemporary design</p>	<p>Merges industrial remnants with modern exhibition spaces</p>
--	--	--	---	---

Diversity of Original Purposes: The four sites span a variety of original purposes, from rail lines to coal mines to power stations. This underscores the breadth of possibilities for architectural valorization, demonstrating that a myriad of industrial sites can be repurposed creatively.

Transformative Utility: Each site has undergone significant transformation to serve contemporary purposes that substantially differ from their original use. For instance, where once trains traversed, now visitors stroll in the High Line, and a once-functional power station now hosts world-class art in Tate Modern.

Retention of Heritage: A common theme across all sites is the emphasis on preserving and highlighting industrial heritage. Whether it's maintaining the old railway tracks in the High Line or repurposing coal mine structures in the Zollverein Complex, each site pays homage to its past.

Economic Rejuvenation: All four sites have transitioned into major attractions that boost local economies, either by directly attracting tourists or by spurring surrounding business growth.

Aesthetic Approaches: The architectural valorization manifests differently in each case, from the minimalist juxtaposition at Tate Modern to the more direct incorporation of industrial structures at the Ruhr Museum. Each approach is tailored to the site's unique history and the vision of the involved architects.

Significance in Urban Metallurgy: The sites exemplify the principle of urban metallurgy by either directly incorporating minerals and metals or by representing the industrial processes that extracted and used those materials.

Unique Outcomes: While all four sites share the overarching theme of industrial revival through architectural valorization, each provides a distinct outcome. For example, the Ruhr Museum directly educates visitors about the region's industrial past, while the High Line provides a more passive experience of the integration of industrial remnants into an urban park.

In conclusion, the table effectively captures the essence of "Urban Metallurgy: Reviving Industrial Sites through Architectural Valorization of Minerals" across diverse sites. It illustrates that while each site's specific journey of transformation is unique, the overarching principles of architectural valorization and sustainable urban redevelopment are consistent themes.

Comparison and analysis of the case studies:

Diversity of Original Purposes: The four sites span a variety of original purposes, from rail lines to coal mines to power stations. This underscores the breadth of possibilities for architectural valorization, demonstrating that a myriad of industrial sites can be repurposed creatively.

Transformative Utility: Each site has undergone significant transformation to serve contemporary purposes that substantially differ from their original use. For instance, where once trains traversed, now visitors stroll in the High Line, and a once-functional power station now hosts world-class art in Tate Modern.

Retention of Heritage: A common theme across all sites is the emphasis on preserving and highlighting industrial heritage. Whether it's maintaining the old railway tracks in the High Line or repurposing coal mine structures in the Zollverein Complex, each site pays homage to its past.

Economic Rejuvenation: All four sites have transitioned into major attractions that boost local economies, either by directly attracting tourists or by spurring surrounding business growth.

Aesthetic Approaches: The architectural valorization manifests differently in each case, from the minimalist juxtaposition at Tate Modern to the more direct incorporation of industrial structures at the Ruhr Museum. Each approach is tailored to the site's unique history and the vision of the involved architects.

Significance in Urban Metallurgy: The sites exemplify the principle of urban metallurgy by either directly incorporating minerals and metals or by representing the industrial processes that extracted and used those materials.

Unique Outcomes: While all four sites share the overarching theme of industrial revival through architectural valorization, each provides a distinct outcome. For example, the Ruhr Museum directly educates visitors about the

region's industrial past, while the High Line provides a more passive experience of the integration of industrial remnants into an urban park.

In conclusion, the table effectively captures the essence of "Urban Metallurgy: Reviving Industrial Sites through Architectural Valorization of Minerals" across diverse sites. It illustrates that while each site's specific journey of transformation is unique, the overarching principles of architectural valorization and sustainable urban redevelopment are consistent themes.

CONCLUSION

Harnessing the architectural valorization of minerals in urban metallurgy can transform industrial sites into lively urban hubs. Minerals' inherent beauty enables architects to design structures that marry industrial history with modern design. Using local minerals bolsters sustainability by curbing transportation costs and emissions. Moreover, revitalizing these sites boosts the economy, attracting tourism and cultural engagements. Thus, urban metallurgy, when executed with thoughtful planning, fuses history, sustainability, and architectural brilliance [44].

ACKNOWLEDGMENT

The authors express gratitude towards all contributors to this research on 'Synergizing Design and Engineering: Holistic Approaches to Noise Reduction.' Appreciation is extended to the Department of Architecture faculty, participating architects, industry professionals, and researchers whose works were instrumental for the literature review. They also thank their supportive families and friends. The study was self-funded, and the authors take responsibility for any errors or omissions.

REFERENCES

- [1] T. Nakamura and K. Halada, "Potential of Urban Mine," in *Urban Mining Systems*, Springer Briefs in Applied Sciences and Technology, 2015, pp. 7-29.
- [2] F. Aldebei and M. Dombi, "Mining the Built Environment: Telling the Story of Urban Mining," *Buildings*, vol. 11, no. 9, p. 388, 2021.
- [3] S. Lehmann, "The future of urban mining," presented at the 5th International Conference on Open Source Solutions for Sustainable Development (OSS4SD), Skopje, Macedonia, 2018.

- [4] R. J. Grant and M. Oteng-Ababio, "The Global Transformation of Materials and the Emergence of Informal Urban Mining in Accra, Ghana," *Afr. Today*, vol. 62, no. 1, pp. 3-20, 2016.
- [5] S. Chand, P. Ranjan Rout, and P. Pathak, "Basic Concepts, Potentials, and Challenges of Urban Mining," in *Urban Mining for Waste Management and Resource Recovery: Sustainable Approaches*, CRC Press, Taylor & Francis Group, 2022, pp. 1-11.
- [6] T. Nakamura and K. Halada, "Urban Mining: Key Parts of the Emerging Urban Metabolism," *Building and Environment*, vol. 144, pp. 73-81, 2018.
- [7] "A Critical Review on the Sustainable Approaches for the Removal of Toxic Heavy Metals from Water Systems," ACS Publications, May 26, 2023.
- [8] "Metallurgical processes unveil the unexplored 'sleeping mines' e-waste: a review," September 20, 2023.
- [9] "Phytomanagement of Metal(loid)-Contaminated Soils: Options, Efficiency and Value," June 21, 2021.
- [10] "Environmental Perspectives on Emerging Resource Recovery Systems of Mine Tailings: A Life Cycle Consideration," *Rehabilitation of Disturbed Lands with Industrial Wastewater Sludge – MDPI*, March 18, 2022.
- [11] L. Smith, "The Uses of Heritage," Routledge, 2006.
- [12] G. Fairclough and R. Harrison, "The Heritage Reader," Routledge, 2015.
- [13] S. Labadi and C. Long, "Heritage and Globalisation," Routledge, 2010.
- [14] R. Skeates, "Debating Archaeological Heritage," Duckworth, 2010.
- [15] J. Carman and P. Skeates, "Archaeological Heritage Management in the Modern World," Routledge, 2018.
- [16] J. R. Logan, "Urban heritage and the challenge of industrialization," *Journal of Urban History*, vol. 45, no. 1, pp. 3-16, 2019.
- [17] M. J. de Waal, "Industrial heritage and urban regeneration: A case study of the Amsterdam Houthavens," *Journal of Urban Regeneration and Renewal*, vol. 11, no. 3, pp. 273-287, 2018.
- [18] J. M. Fladmark and K. H. Sørensen, "Industrial heritage and urban transformation: The case of the Aker river in Oslo," *Journal of Urban Regeneration and Renewal*, vol. 11, no. 3, pp. 288-301, 2018.
- [19] M. J. de Waal and J. M. Fladmark, "Industrial heritage and urban transformation: A comparative study of Amsterdam and Oslo," *Journal of Urban Regeneration and Renewal*, vol. 11, no. 3, pp. 302-315, 2018.
- [20] S. J. Kim, "Industrial heritage and urban regeneration: A case study of the Brooklyn Navy Yard," *Journal of Urban Design*, vol. 24, no. 2, pp. 272-289, 2019.
- [21] Z. Sun, Y. Xiao, H. Agterhuis, J. Sietsma, and Y. Yang, "Recycling of metals from urban mines—a strategic evaluation," *Journal of Cleaner Production*, vol. 112, pp. 2977-2987, 2016.
- [22] X. Zeng, J. A. Mathews, and J. Li, "Urban mining of e-waste is becoming more cost-effective than virgin mining," *Environmental Science & Technology*, vol. 52, no. 8, pp. 4835-4841, 2018.
- [23] K. Avarmaa, L. Klemettinen, H. O'Brien, and P. Taskinen, "Urban mining of precious metals via oxidizing copper smelting," *Minerals Engineering*, vol. 133, pp. 95-102, 2019.
- [24] A. Washburn, "The nature of urban design: A New York perspective on resilience," Washington, DC: Island Press, 2013.

- [25] M. Zhang, "Urban Portal: High Line, New York," 2023.
- [26] S. Arya and S. Kumar, "Bioleaching: urban mining option to curb the menace of E-waste challenge," *Bioengineered*, vol. 11, no. 1, pp. 640-660, 2020.
- [27] B. Deng, D. X. Luong, Z. Wang, C. Kittrell, E. A. McHugh, and J. M. Tour, "Urban mining by flash Joule heating," *Nature Communications*, vol. 12, no. 1, p. 5794, 2021.
- [28] J. Goody, "Metals, culture and capitalism: an essay on the origins of the modern world," Cambridge University Press, 2012.
- [29] U. Stottrop and U. Scheer, "Field trip E14: Ruhr Museum–Zollverein Coal Mining-Complex–Industrial Nature," *Schriftenreihe der Deutschen Gesellschaft für Geowissenschaften*, 2010.
- [30] S. Čopić, J. Đorđević, T. Lukić, V. Stojanović, S. Đukićin, S. Besermenji, and A. Tumarić, "Transformation of industrial heritage: An example of tourism industry development in the Ruhr area (Germany)," *Geographica Pannonica*, vol. 18, no. 2, pp. 43-50, 2014.
- [31] H. Oevermann and H. A. Mieg, "Urban development planning and world cultural heritage: two perspectives of planning practice dealing with industrial heritage," *Planning Practice & Research*, vol. 36, no. 4, pp. 430-441, 2021.
- [32] R. Madlener and Y. Sunak, "Impacts of urbanization on urban structures and energy demand: What can we learn for urban energy planning and urbanization management?," *Sustainable Cities and Society*, vol. 1, no. 1, pp. 45-53, 2011.
- [33] L. H. Xavier, M. Ottoni, and L. P. P. Abreu, "A comprehensive review of urban mining and the value recovery from e-waste materials," *Resources, Conservation and Recycling*, vol. 190, p. 106840, 2023.
- [34] C. Dean, C. Donnellan, and A. C. Pratt, "Tate Modern: Pushing the limits of regeneration," *City, Culture and Society*, vol. 1, no. 2, pp. 79-87, 2010.
- [35] C. Ruddell, "Pervasive Animation Symposium, Tate Modern, London, 2—4 March 2007," *Animation*, vol. 2, no. 3, pp. 304-309, 2007.
- [36] C. Johansson, J. Elfsberg, T. C. Larsson, M. Frank, L. J. Leifer, N. Nilsson, and V. Söderberg, "Urban Mining as a Case for PSS," *Procedia CIRP*, vol. 47, pp. 460-465, 2016.
- [37] U. Mining, "Urban mining: Concepts, terminology, challenges," *Waste Management*, vol. 45, pp. 1-3, 2015.
- [38] J. Krook and L. Baas, "Getting serious about mining the technosphere: a review of recent landfill mining and urban mining research," *Journal of Cleaner production*, vol. 55, pp. 1-9, 2013.
- [39] Y. J. Cho and K. J. Shin, "A Case Study on Conversion of Idle Industrial Facilities-Focus on Tate Modern, Baltic Center for Contemporary Art, and Ruhr Museum," *Korean Institute of Interior Design Journal*, vol. 20, no. 3, pp. 59-68, 2011.
- [40] W. Hauser, "The Ruhr Museum at the Zollverein Colliery in Essen, Germany," 2011.
- [41] U. Borsdorf, "The Ruhr Museum at Zollverein," *Cultures of History Forum*, June 2014.
- [42] U. Stottrop and U. Scheer, "Field trip E14: Ruhr Museum–Zollverein Coal Mining-Complex–Industrial Nature," *Schriftenreihe der Deutschen Gesellschaft für Geowissenschaften*, 2010.

- [43] L. H. Xavier, E. C. Giese, A. C. Ribeiro-Duthie, and F. A. F. Lins, "Sustainability and the circular economy: A theoretical approach focused on e-waste urban mining," *Resources Policy*, vol. 74, p. 101467, 2021.
- [44] M. S. S. R. Tejaswini, P. Pathak, and D. K. Gupta, "Sustainable approach for valorization of solid wastes as a secondary resource through urban mining," *Journal of Environmental Management*, vol. 319, p. 115727, 2022.

8. Chapter

Scattering of Plane Wave from Rectangular Plate in NID Space

Fawad A. K. Faraz ^{1*}

Fazal Muhammad ¹

Salman Khan ¹

Muhammad Ismail ¹

Zeeshan Khan ²

¹ Department of Electrical Engineering, University of Engineering and Technology Mardan, 23200 Mardan, Pakistan

² Department of Electrical Engineering, University of Engineering and Technology Peshawar, 25000 Peshawar, Pakistan

Email of the corresponding author: fawadfaraz321@gmail.com

ABSTRACT

The behavior of electromagnetic waves can be analyzed in integer dimensional space for normal geometrical shape structures. But there are many irregular shape structures in nature that cannot be analyzed by integer base analysis. So, in such a case, fractional dimensional space analysis is quite helpful. The complex shape structures can be analyzed using a non-integer dimensional space (NID) analysis. That is why the study of fractional dimensional space has recently increased significantly. D-Dimension is used in fractional dimensional space analysis while the D value is in fraction. Scattering phenomena have been studied in fractional dimension space for many situations.

In this dissertation, we will study scattering from a basic structure. A uniform plane wave is incident on a rectangular PEC plate while the surrounding is considered as fraction dimensional space. Different methods can be used to determine the scattered fields, but here we will use Physical Optics (PO) approximation method to determine the scattered magnetic and electric fields. We will also find the Radar cross-section area of a plate. The Physical Optics (PO) approximation method is preferred because of its simplicity and easy calculation of complex shape structures. Numerical results of fractional dimensional space study have been plotted and discussed. Comparisons have been made with integer base analysis.

Keywords – Electromagnetics; Fractional dimensional space; Plane wave scattering; Cross section area; Scattering from rectangular Flat

INTRODUCTION

There are many objects in our environment that have irregular shapes like ocean waves, trees, dust particles, clouds, etc... which cannot be measured by Euclidean geometry. To solve this problem the idea of fractal and non-fractal arises. In fractal analysis, irregular shapes are divided into equal parts which confine the whole shape. The classification of fractals and non-fractals was first analyzed by Mandelbrot [1]. Using a fractional space an anisotropic structure is replaced by an isotropic fractional space where it is measured in fractional dimensions [2], [3]. An anisotropic object space was first transformed to a corresponding isotropic object in fractional space using the alpha dimension (αD). Where α is a fraction ($0 \leq \alpha \leq 3$) that describes the degree of anisotropy [3]. Fractals simplify complex geometries because all fractals are identical and repeat themselves. Such complex structures can be visualized at macroscopic as well as microscopic levels by using the fractional dimension D [4]. Due to the importance of fractals, the concept of an axiomatic basis for fractional dimensional space was developed. In which fractional space 2-spatial coordinate space is explained [5].

Fractal and non-fractal phenomena were used first time by Mandelbrot [6]. The analysis of axiomatic bases in fractional space was studied by Stellingner [7]. While equations of motion in a fractional space was studied by Palmer and Stavrinou [8]. Similarly, Tarasov worked on electromagnetic fields in fractals [9]. As a result of advances in electromagnetic studies, Laplace's and Poisson's equations have been reformulated in partial space [3]. Similarly Ampere's law and Faraday's law have been also modified in fractals [10]. After studying the differential equations in fractals, the solutions of the wave equations and the plane wave were also derived [11][12]. Using vector potentials, Cylindrical and Spherical wave equations have also been developed in fractional space [13]. Mughal and Zubair first developed this idea by analyzing antenna radiations in fractional space using vector potentials and then using this idea to analyze dipole antennas placed in fractional space [14], [15]. Wave reflection and transmission efficiency have been analyzed in many cases. Reflection and transmission, when a wave passes through a layer of fractals sandwiched between non-fractals, was analyzed. [14], [15]. Similarly, the reflection coefficient at an interface that develops when a fractal half-space meets a non-fractal half-space is analyzed [16]. Omar and Mughal analyzed reflection from a fractal-fractal interface and then further modified reflection and transmission coefficient for chiral-fractal dielectric interface [16]. Vector calculus and its applications in non-

integer dimensional space were analyzed by Tarasov [17]. PEC, PMC and PEMC surface interfaces have been studied in fractional space by Mughal[18]. Multilayered structures were analyzed in fractional dimensional space[19]. Fourier series have been transformed in fractional space[20]. Wave behavior at dielectric fractal -fractal interface in fractional dimensional spaces have been analyzed by Mughal[21]. TE, TM and TEM wave resolution and wave passes through rectangular waveguide were also transformed in fractional spaces[22]. In electromagnetics, Green's function has been transformed into fractional dimensional space by Asad [23]. The scaling method and its applications were analyzed[24]. Zubair analyzed the solution of a spherical wave in fractional space [25]. The waveguide modes were discussed in Fractional Space by Khan [26]. A wave propagating in a cylindrical waveguide was analyzed in fractional dimensional space[27].

Shaukat studied the scattering of an electromagnetic plane wave from a circular cylinder coated with nihility circular cylinder[28]. Scattering of electromagnetic plane wave from a perfect electric conducting strip placed at interface of topological insulator–chiral medium and from a perfect electric conducting strip located in topological insulator medium were also analyzed by Shaukat [29]. Noureen has been studied scattering from a PEC strip located at planar interface of free-space and lossy dispersive dielectric-magnetic medium using Kobayashi potential method[30]. Scattering from a PEC strip buried in fractional dimensional space planar grounded dielectric slab by using Kobayashi potential method [31][32]. Scattering of plane wave from PEC strip placed at the interface of non-integer dimensional spaces[33]. Scattering of electromagnetic plane wave from a perfect electric conducting strip placed at free space–chiral interface analyzed by M. Afzaal [28].

In this study we have analyzed here the scattering of a plane wave when it strikes a rectangular conducting plate. Whereas the surrounding space is assumed as a fractional dimensional space. The incident and scattered electric and magnetic fields are developed for fractional space. The behavior is different compared to integer dimensional space.

MATERIALS AND METHOD

An inclined uniform wave is incident on perfect electric conductor plate of dimension a and b . An EM wave is propagating in the y - z plane and perpendicular to x axis. Scattering of uniform plane wave from a PEC

rectangular plate in fractional space is analyzed in this section. Only z-dimension is assumed as fractional. For simplification, a uniform plane wave is assumed in TEx wave mode or perpendicular polarization as shown in Figure.1.

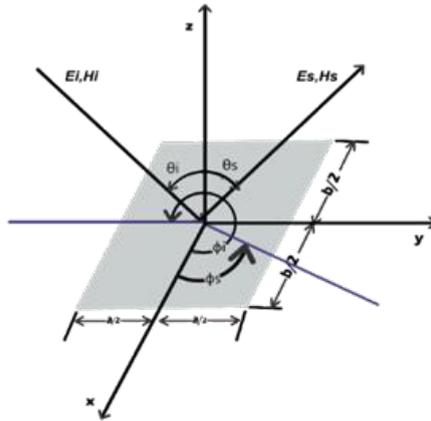


Figure 1. Uniform plane wave scattering from a rectangular plate placed in a fractional dimensional space.

PEC plate is placed parallel to x-y plane at $z = d$ as in figure 2.

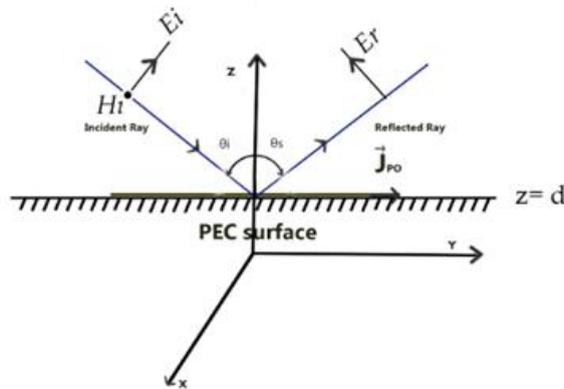


Figure 2. Boundary and edge conditions at $z=d$

As the surface is PEC so there is no transmitted wave The current density can be find using boundary conditions as follow.

$$J_s \cong 2\hat{n} \times H |_{(z=d, y=y'')}$$

We will first find mathematical expressions of electric and magnetic fields for a plane wave in fractional dimensional space. As the plane wave is

propagating in the y-z plane and only z- direction is assume fractional so the expression for incident electric field and magnetic field as [34]

$$E^i = \eta H_o \sqrt{\frac{\pi}{2}} (\hat{a}_y \cos \theta_i + \hat{a}_z \sin \theta_i) (\beta z \cos \theta_i)^n e^{-j\beta(y \sin \theta_i)} H_n^{-1}(\beta z \cos \theta_i)$$

and

$$H^i = \hat{a}_x H_o \sqrt{\frac{\pi}{2}} (\beta z \cos \theta_i)^n e^{-j\beta(y \sin \theta_i)} H_n^{-1}(\beta z \cos \theta_i)$$

Where η is wave impedance of medium as $\eta = \sqrt{\mu \epsilon}$ and β is the wave number in medium which is $= \omega \sqrt{\mu \epsilon}$. $H_n^{-1}(\beta z \cos \theta_i)$ is the Hankel function of the first kind with a negative fractional z -axis and $H_n^2(\beta z \cos \theta_i)$ is the Hankel function of the second kind and with a positive fractional z -axis as proposed [2]. The value of n can be calculated as $n = \frac{|4-D|}{2}$, [3]

Where H_o represent magnitude of magnetic fields. Since z-dimension is considered as fractional only and neglecting edge effects, we can find the field scattered from current density 'J_s' induced at the surface of the PEC plate.

Where J_s is defined as

$$J_s \cong 2n \times H_i |_{(z=d, y=y')}$$

$$J_s \cong 2\hat{a}_y H_o \sqrt{\frac{\pi}{2}} (\beta z \cos \theta_i)^n e^{-j\beta(y' \sin \theta_i)} H_n^{-1}(\beta z \cos \theta_i)$$

$$\cong 2\hat{a}_y H_o \sqrt{\frac{\pi}{2}} (\beta d \cos \theta_i)^n e^{-j\beta(y' \sin \theta_i)} H_n^{-1}(\beta d \cos \theta_i)$$

Thus,

$$J_x = J_z = 0$$

And

$$I_y = 2\hat{a}_y H_0 \sqrt{\frac{\pi}{2}} (\beta z \cos\theta_i)^n e^{-j\beta(y'' \sin\theta_i)} H_n^{-1}(\beta z \cos\theta_i)$$

The above current density equation provides an accurate solution for an infinite plate, while for finite size it produces only approximations, with slightly reduced accuracy. By using potential vector scattered fields are obtained in fractional dimensional space, as in[34].

$$A = \frac{\mu 2^{3-D} \Gamma(\frac{3}{2})}{4\pi \Gamma(\frac{D}{2})} \iiint J(x'', y'', z'') \frac{H_n^{-2}(\beta R)}{R^{(D-\frac{5}{2})}} dV''$$

Using far field ($\beta r \gg 1$) observations[35], R represent distance between the source point and the observation point, while r' is the distance between source and origin, and r is the distance of the observation point from the origin is given by

$$R = \begin{cases} r - r'' \cos\psi & \text{Phase variation} \\ r & \text{Amplitude variation} \end{cases}$$

The angle between r' and r is denoted by ψ . The far-field approximations are valid only if the observation point is $(2D^2)/\lambda$ away. Here D represents the maximum dimension of the rectangular plate. So vector potential reduces to

$$A = \frac{\mu 2^{3-D} \Gamma(\frac{3}{2}) e^{-j\beta r}}{4\pi \Gamma(\frac{D}{2}) r^{(D-2)}} N$$

Where

$$N = \iiint J(x'', y'', z'') e^{-j\beta r'' \cos\psi} dV''$$

We can write that [34],

$$N_\theta = 2abH_0 \sqrt{\frac{\pi}{2}} (\beta z \cos\theta_i)^n H_n^{-1}(\beta z \cos\theta_i) \{ \cos\theta_s \sin\theta_s \left[\frac{\sin A}{A} \right] \left[\frac{\sin B}{B} \right] \}$$

Where

$$A = \frac{\beta a}{2} \cos \phi_s \sin \theta_s ,$$

$$B = \frac{\beta b}{2} (\sin \phi_s \sin \theta_s - \sin \theta_i) .$$

Similarly

$$N_\theta = 2abH_0 \sqrt{\frac{\pi}{2}} (\beta z \cos \theta_i)^n H_n^{-1} (\beta z \cos \theta_i) \left\{ \cos \theta_s \left[\frac{\sin A}{A} \right] \left[\frac{\sin B}{B} \right] \right\}$$

Therefore, the scattered fields expressed in fractional space as obtained in [32].

$$E_\theta^s \cong -j\beta \frac{2^{3-D} \Gamma\left(\frac{3}{2}\right) e^{-j\beta r}}{4\pi \Gamma\left(\frac{D}{2}\right) r^{D-2}} (L_\phi + \eta N_\theta)$$

As $L_\phi = 0$ for E_θ^s component and C' value is consider as

$$C' = -j\eta \frac{abH_0 \sqrt{\frac{\pi}{2}} (\beta z \cos \theta_i)^n H_n^{-1} (\beta z \cos \theta_i) \beta 2^{3-D} \Gamma\left(\frac{3}{2}\right)}{2\pi \Gamma\left(\frac{D}{2}\right)}$$

So,

$$E_\theta^s \cong C' \frac{e^{-j\beta r}}{r^{D-2}} \left\{ \cos \theta_s \sin \theta_s \left[\frac{\sin A}{A} \right] \left[\frac{\sin B}{B} \right] \right\}$$

While

$$E_\phi^s \cong +j\beta \frac{2^{3-D} \Gamma\left(\frac{3}{2}\right) e^{-j\beta r}}{4\pi \Gamma\left(\frac{D}{2}\right) r^{D-2}} (L_\theta - \eta N_\phi)$$

For E_ϕ component L_θ become zero

$$E_\phi^s \cong C' \frac{e^{-j\beta r}}{r^{D-2}} \left\{ \cos \theta_s \left[\frac{\sin A}{A} \right] \left[\frac{\sin B}{B} \right] \right\} .$$

Where the magnetic fields are,

$$\text{as } H_r^s \cong E_r^s \cong 0$$

$$H_{\theta}^s \cong -\frac{E_{\phi}^s}{\eta}$$

and

$$H_{\phi}^s \cong -\frac{E_{\theta}^s}{\eta}$$

Electric fields components can be reduced to E-Plane and H-Plane

To get E-plane put $\phi_s = \frac{\pi}{2}$ in equation

$$E_{\phi}^s = E_r^s = 0$$

$$E_{\theta}^s \cong C' \frac{e^{-j\beta r}}{r^{D-2}} \left\{ \cos\theta_s \left[\frac{\sin\frac{\beta b}{2}(\sin\theta_s - \sin\theta_i)}{\frac{\beta b}{2}(\sin\theta_s - \sin\theta_i)} \right] \right\}$$

To get H-plane put $\phi_s = 0$ and $\theta_s = \theta_i$ in equation (3.18)

$$E_{\theta}^s = E_r^s = 0$$

$$E_{\phi}^s \cong C' \frac{e^{-j\beta r}}{r^{D-2}} \left\{ \left[\frac{\sin\frac{\beta b}{2}(\sin\theta_i)}{\frac{\beta b}{2}(\sin\theta_i)} \right] \left[\frac{\sin\frac{\beta b}{2}(\sin\theta_s)}{\frac{\beta b}{2}(\sin\theta_s)} \right] \right\}$$

Total scattered Field is

$$E_s = \sqrt{E_{\theta}^{s2} + E_{\phi}^{s2} + E_r^{s2}}$$

$$\cong \sqrt{E_{\theta}^{s2} + E_{\phi}^{s2}}$$

RESULTS AND DISCUSSION

Maximum scattered field can be obtained from fields Equations (3.16) and (3.18) by putting the values of $\phi_s = \pi/2, 3\pi/2$ and $0 \leq \theta_s \leq \pi/2$. Then these equations can be reduced to equations (3.22) and (3.24) for $b \gg \lambda$. The maximum scattering will occur at approximately for an angle ($\theta_s = \theta_i$) (Specular reflection).

Figure 4 and Figure 5 shows the behaviors of normalize scattering field for different observation angles $\theta_s = (30^\circ, 60^\circ, 0^\circ)$, $\phi_s = \frac{\pi}{2}$ and $\frac{3\pi}{2}$ respectively. The length (a) and width (b) of PEC rectangular plate is 5λ .

While the medium is consider as free space ($\mu_r = 1$ and $\epsilon_r = 1$). These results show that an increase in the incidence angle causes a decrease in the observation angle of the main lobe. So the maximum scattered field is obtained at $\theta_i = 0^\circ$.

Figure 6 shows the comparison of fractional space with integer dimension space. The value of D in fractional space are taken 2.1 and 3. The length (a) and width (b) of PEC rectangular plate is 5λ , while medium is consider as free space ($\mu_r = 1$ and $\epsilon_r = 1$). The results are varied for different values of D in fraction. The scattered field of the main lobe increases in fractional space.

Figure 7 shows the comparison of non-integer dimension space (NID) with integer dimension space. The value of D in fractional space are taken 2.5 and 3. The length (a) and width (b) of PEC rectangular plate is 7λ , medium is consider as free space ($\mu_r = 1$ and $\epsilon_r = 1$). These results show the variation for D value equal to 2.5. The scattered field of the main lobe increases.

Figure 8 show the normalize scattered field at $\theta_i = 0^\circ$ for both fractional space and Integer dimension space. But the medium is consider as perfect Dielectric($\mu_r = 4$ and $\epsilon_r = 4$), length and width of a plate is 7λ . These results also show a prominent change in scattered field. The scattered field at the main lobe is greater than integer base analysis.

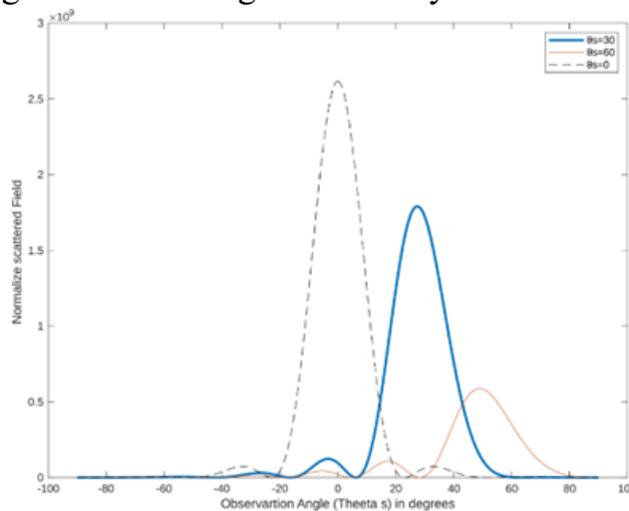


Figure 3. Behavior of normalized scattered field versus observation angle for $\theta_s = (30^\circ, 60^\circ, 0^\circ)$, $\varphi_s = 90^\circ$, $\mu_r = 1$, $b = 5\lambda$, $\epsilon_r = 1$, $a = 5\lambda$ and $D = 2.5$

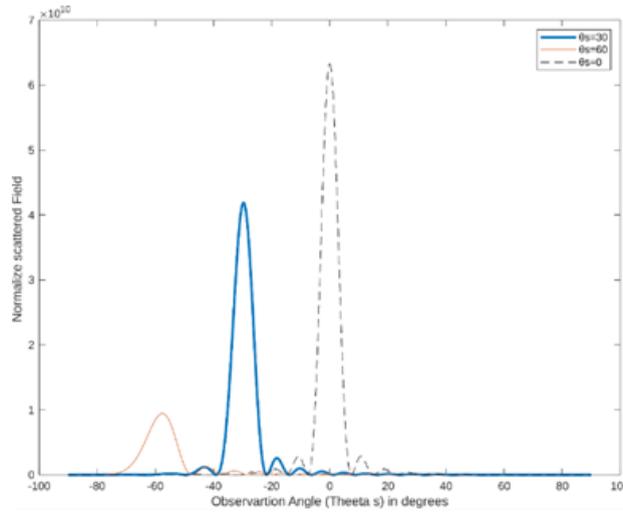


Figure 4. Behavior of normalized scattered field versus observation angle for $\theta_s = (30^\circ, 60^\circ, 0^\circ)$, $\varphi_s = 270$, $\mu_r = 1$, $b = 5\lambda$, $\epsilon_r = 1$, $a = 5\lambda$ and $D = 2.5$

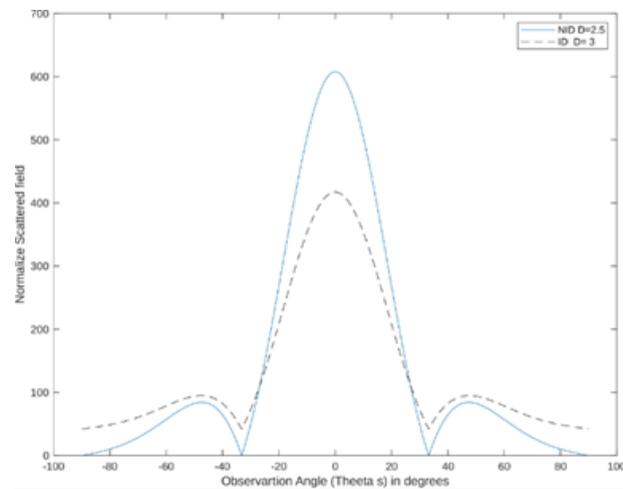


Figure 5. Comparison of NID and ID, behavior of normalized scattered field for a PEC rectangular plate versus observation angle; $\mu_r = 1$, $b = 7\lambda$, $\epsilon_r = 1$, $a = 7\lambda$ and $D = 2.5$ and 3

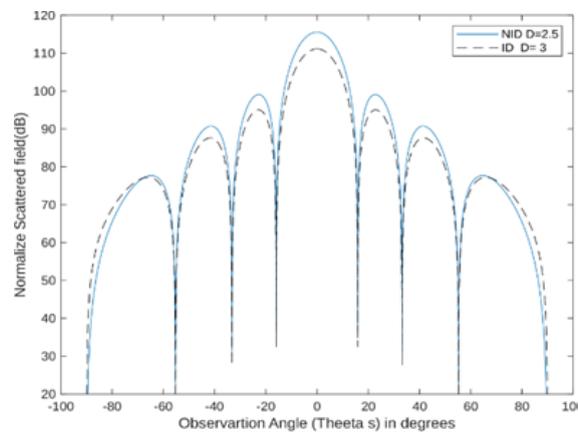


Figure 6. Comparison of NID and ID, behavior of normalized scattered field for a PEC rectangular plate versus observation angle; $\mu_r = 1$, $b = 7\lambda$, $\epsilon_r = 1$, $a = 7\lambda$ and $D = 2.5$ and 3 .

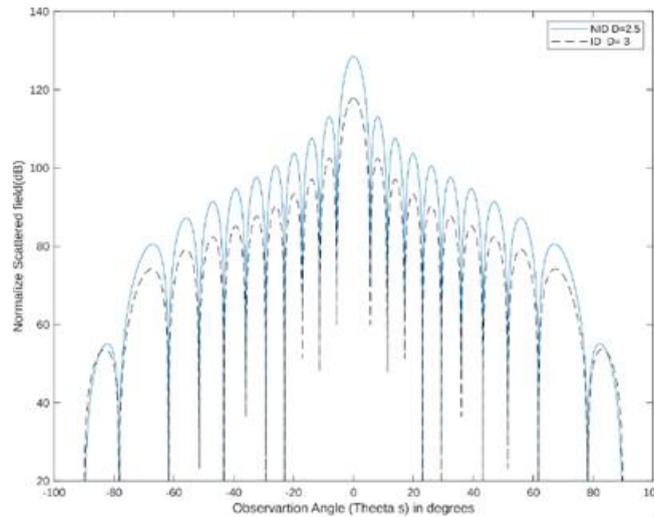


Figure 7. Comparison of NID and ID, behavior of normalized scattered field for a PEC rectangular plate versus observation angle; $\mu_r = 4$, $b = 5\lambda$, $\epsilon_r = 4$, $a = 5\lambda$ and $D = 2.5$ and 3 .

CONCLUSION

This work express and investigate the scattering of electromagnetics wave in fractional dimension space. Analytical expressions for scattered electric and magnetic fields have been derived in fractional space when uniform plane wave strike the rectangular plate. Only z-direction is assume as Fraction. The parameters in this study are taken same as done by Balanis, for integer dimensional spaces. As this study investigate the scattering from basic rectangular structure. So this can be used to investigate and analyze for any other complex shape structure.

REFERENCES

- [1] B. B. . W. Mandelbrot John A., "The Fractal Geometry of Nature," Am. J. Phys., vol. 51, no. 3, pp. 286–287, 1983, doi: 10.1119/1.13295.
- [2] X. F. He, "Anisotropy and isotropy: A model of fraction-dimensional space," Solid State Commun., vol. 75, no. 2, pp. 111–114, 1990, doi: 10.1016/0038-1098(90)90352-c.
- [3] M. Ostoja-Starzewski, "Electromagnetism on Anisotropic Fractals," Zeitschrift für Angew. Math. und Phys., vol. 64, no. 2, pp. 381–390, 2012, doi: 10.1007/s00033-012-0230-z.
- [4] H. T. E. Teng Hong Tat; Tan, Sin Leng, "MULTIFRACTAL DIMENSION AND ITS GEOMETRICAL TERRAIN PROPERTIES FOR CLASSIFICATION OF MULTI-BAND MULTI-POLARIZED SAR IMAGE," Prog. Electromagn. Res., vol. 104, no. NA, pp. 221–237, 2010, doi: 10.2528/pier10022001.

- [5] B. Robert and E. B. Brown, "The Fractal Geometry of Nature," *J. R. Stat. Soc. Ser. A*, vol. 147, no. 1, 2004.
- [6] B. B. Mandelbrot, "The Fractal Geometry of Nature," *J. R. Stat. Soc. Ser. A*, vol. 147, no. 4, pp. 616–618, 1984, doi: 10.2307/2981858.
- [7] F. H. Stillinger, "Axiomatic basis for spaces with noninteger dimension," *J. Math. Phys.*, vol. 18, no. 6, pp. 1224–1234, 1977, doi: 10.1063/1.523395.
- [8] C. S. Palmer Paul N., "Equations of motion in a non-integer-dimensional space," *J. Phys. A: Math. Gen.*, vol. 37, no. 27, pp. 6987–7003, 2004, doi: 10.1088/0305-4470/37/27/009.
- [9] V. E. Tarasov, "Electromagnetic Fields on Fractals," *Mod. Phys. Lett. A*, vol. 21, no. 20, pp. 1587–1600, 2006, doi: 10.1142/s0217732306020974.
- [10] S. I. . B. Muslih Dumitru, "Fractional multipoles in fractional space," *Nonlinear Anal. Real World Appl.*, vol. 8, no. 1, pp. 198–203, 2007, doi: 10.1016/j.nonrwa.2005.07.001.
- [11] M. M. Zubair Muhammad Junaid; Naqvi, and Qaisar, "THE WAVE EQUATION AND GENERAL PLANE WAVE SOLUTIONS IN FRACTIONAL SPACE," *Prog. Electromagn. Res. Lett.*, vol. 19, no. NA, pp. 137–146, 2010, doi: 10.2528/pier110102103.
- [12] M. M. Zubair Muhammad Junaid; Naqvi, Qaisar Abbas; Rizvi, Azhar Abbas, "DIFFERENTIAL ELECTROMAGNETIC EQUATIONS IN FRACTIONAL SPACE," *Prog. Electromagn. Res.*, vol. 114, no. NA, pp. 255–269, 2011, doi: 10.2528/pier11011403.
- [13] M. M. Zubair Muhammad Junaid; Naqvi, Qaisar Abbas, "An Exact Solution of the Cylindrical Wave Equation for Electromagnetic Field in Fractional Dimensional Space," *Prog. Electromagn. Res.*, vol. 114, no. NA, pp. 443–455, 2011, doi: 10.2528/pier11021508.
- [14] J. D. Anguera Jean Pierre; Borja, C.; Mumburu, Josep; Puente, Carles; Leduc, Tiphaine; Sayegrih, Khalid; Van Roy, and Peter, "Metallized Foams for Antenna Design: Application to Fractal-Shaped Sierpinski-Carpet Monopole," *Prog. Electromagn. Res.*, vol. 104, no. NA, pp. 239–251, 2010, doi: 10.2528/pier10032003.
- [15] C. A. Balanis, "Antenna theory : analysis and design," NA, vol. NA, no. NA. p. NA-NA, 2005. doi: NA.
- [16] Q. A. Naqvi, "Scattering from a cylindrical obstacle buried in non-integer dimensional dielectric half-space using Kobayashi potential method," *Optik (Stuttg.)*, vol. 141, no. NA, pp. 39–49, 2017, doi: 10.1016/j.ijleo.2017.05.043.
- [17] V. E. Tarasov, "Vector calculus in non-integer dimensional space and its applications to fractal media," *Commun. Nonlinear Sci. Numer. Simul.*, vol. 20, no. 2, pp. 360–374, 2015, doi: 10.1016/j.cnsns.2014.05.025.
- [18] M. Mughal, G. Ali, and M. Mughal, PEC, PMC and PEMC interfaces in fractional space. 2018. doi: 10.1109/ICOMET.2018.8346434.
- [19] S. Khan, M. Mughal, N. Amin, and M. Mughal, An Exact Solution and Analysis of Multilayered Structures in Fractional Dimension Space. 2014. doi: 10.1109/ECTIcon.2014.6839895.
- [20] A. Dorostkar and A. Sabihi, Fourier Series in Fractional Dimensional Space. 2022.

- [21] M. Mughal and M. Mughal, "Behavior of electromagnetic waves at dielectric fractal-fractal interface in fractional spaces," *Prog. Electromagn. Res. M*, vol. 28, pp. 229–244, Jan. 2013, doi: 10.2528/PIERM12121903.
- [22] S. Khan and M. J. Mughal, *General solution for TEM, TE, and TM waves in fractional dimensional space and its application in rectangular waveguide filled with fractional space*, vol. 27, no. 18. Taylor & Francis, 2013. doi: 10.1080/09205071.2013.840543.
- [23] H. . M. Asad Muhammad Junaid; Zubair, Muhammad; Naqvi, Qaisar Abbas, "Electromagnetic Green's function for fractional space," *J. Electromagn. Waves Appl.*, vol. 26, no. 14–15, pp. 1903–1910, 2012, doi: 10.1080/09205071.2012.720748.
- [24] S. I. . A. Muslih Om P., "A scaling method and its applications to problems in fractional dimensional space," *J. Math. Phys.*, vol. 50, no. 12, p. 123501, 2009, doi: 10.1063/1.3263940.
- [25] M. M. Zubair Muhammad Junaid; Naqvi, Qaisar Abbas, "AN EXACT SOLUTION OF THE SPHERICAL WAVE EQUATION IN D-DIMENSIONAL FRACTIONAL SPACE," *J. Electromagn. Waves Appl.*, vol. 25, no. 10, pp. 1481–1491, 2011, doi: 10.1163/156939311796351605.
- [26] S. H. . N. Khan Adnan; Mughal, Muhammad Junaid, "GENERAL SOLUTION FOR WAVEGUIDE MODES IN FRACTIONAL SPACE," *Prog. Electromagn. Res. M*, vol. 33, no. NA, pp. 105–120, 2013, doi: 10.2528/pierm13062807.
- [27] S. Khan, F. M. A. Khan, Gulalai, and A. Noor, "General solution for electromagnetic wave propagation in cylindrical waveguide filled with fractional space," *Waves in Random and Complex Media*, vol. 33, no. 1, pp. 49–61, Jan. 2023, doi: 10.1080/17455030.2021.1874076.
- [28] S. Ahmed and Q. Naqvi, "Scattering of Electromagnetic Waves by a Coated Nihility Cylinder," *J. Infrared, Millimeter, Terahertz Waves*, vol. 30, pp. 1044–1052, Oct. 2009, doi: 10.1007/s10762-009-9531-5.
- [29] S. N. Shoukat Qaisar Abbas, "Scattering of electromagnetic plane wave from a perfect electric conducting strip placed at interface of topological insulator–chiral medium," *Opt. Commun.*, vol. 381, no. NA, pp. 77–84, 2016, doi: 10.1016/j.optcom.2016.06.076.
- [30] S. A. Shoukat M.; Syed, Aqeel A.; Naqvi, Qaisar Abbas, "Scattering of electromagnetic plane wave from a perfect electric conducting strip located in topological insulator medium," *J. Mod. Opt.*, vol. 63, no. 21, pp. 2138–2145, 2016, doi: 10.1080/09500340.2016.1185176.
- [31] M. . J. Afzaal Allah Ditta Ulfat; Naqvi, Qaisar Abbas; Hongo, K., "Scattering of electromagnetic plane wave from a perfect electric conducting strip placed at free space–chiral interface," *J. Mod. Opt.*, vol. 62, no. 16, pp. 1308–1315, 2015, doi: 10.1080/09500340.2015.1036819.
- [32] S. F. A. Javed Musarat; Naqvi, Qaisar Abbas, "Scattering from a PEC strip buried in non-integer dimensional planar grounded dielectric slab by using Kobayashi potential method," *Phys. Lett. A*, vol. 383, no. 11, pp. 1071–1083, 2019, doi: 10.1016/j.physleta.2018.12.037.
- [33] H. Shoukat, S. Shoukat, and Q. Naqvi, "Plane-wave electromagnetic scattering from a PEC strip placed at the interface of non-integer dimensional

spaces,” *Optik (Stuttg.)*, vol. 218, p. 165007, Jul. 2020, doi: 10.1016/j.ijleo.2020.165007.

[34] M. M. Zubair Muhammad Junaid; Naqvi, Qaisar Abbas, *Electromagnetic Fields and Waves in Fractional Dimensional Space - Electromagnetic Fields and Waves in Fractional Dimensional Space*, vol. NA, no. NA. 2012. doi: 10.1007/978-3-642-25358-4.

[35] Constantine A. Balanis, “*Advanced Engineering Electromagnetics (Balanis-1989).pdf*,” vol. 2nd, 1989.

9. Chapter

Body Composition and Health Status of Female Physical Education Students During the Summer Outdoor Activities Camp On-Site at Gazivode Lake

Jasna Popović^{1*}

Miloš Popović¹

Tatjana Popović Ilić¹

Ružena Popović²

Vladimir Miletić³

Tijana Purenović-Ivanović²

¹ Faculty of Sport and Physical Education, University of Priština in Kosovska Mitrovica, Dositeja Obradovića b.b., 38218 Leposavić

² Faculty of Sport and Physical Education, University of Niš, Niš, Serbia

³ Faculty of Sport and Physical Education, University of Belgrade, Belgrade, Serbia

Email of the corresponding author: popovicmilos1983@yahoo.com

ABSTRACT

Worldwide cardiovascular diseases are the leading cause of death, and they are caused by a variety of risk factors (obesity, high blood pressure, insufficient physical activity, poor diet, un healthy lifestyle). Given that most of these risk factors tend to remain constant or even increase with age, particularly after the second or third decade of life, this means that if young adults are at risk for cardiovascular disease, they are likely to remain so throughout their lives. Therefore, this study aimed to examine the body composition and health status of female PE students, aged 19 to 20. In addition to Age, the essential anthropometric variables (body height, body mass, BMI), body composition parameters (relative body fat– BF%, visceral fat– VF, relative skeletal muscle mass– SM%, resting metabolic rate– RMR) and health status parameters (systolic blood pressure– SYS, diastolic blood pressure– DIA, resting heart rate– RHR) were established during summer practical course of Outdoor activities on-site at Gazivode lake. A bioimpedance device Omron BF511 was used for the assessment of body composition parameters and health status evaluation was performed using PRIZMA digital device. The data were analyzed (descriptive statistics, the Kolmogorov-Smirnov test, Pearson's correlation coefficient) using SPSS 21.0. The results of the analysis indicated that the most of the examinees are of normal BMI, BF%, VF, SM% values, i.e. one is underweighted and two have low BF%. Concerning RHR, bradycardia is noted only in case of one PE student, tachycardia in two, and concerning blood pressure values, four are normotensive, two have elevated blood pressure, and one has hypertension stage II. Strong, mostly positive correlations, between most of the selected body composition parameters and blood pressure were determined. Statistically significant correlations were established between body mass and VF ($r=.902$, $p=0.005$); between DIA and body mass ($r=-.811$, $p=0.027$), BMI ($r=-.775$, $p=0.041$) and RMR ($r=-.803$, $p=0.030$), between SYS and BF% ($r=-.767$, $p=0.044$). It is unequivocal that the reduction of body mass at the expense of adipose tissue is necessary, as well as an increase in the moderate physical activity level and regularity, in order to reduce the risk of cardiovascular diseases in female PE students now as well as in older age.

Keywords – body fat, visceral fat, muscle mass, blood pressure, physical activity

INTRODUCTION

Many studies testify that physical appearance or constitutional type is the starting point (recommendation) when interpreting the state of health, level of physical fitness, sports success, and personality traits of people. Body composition indicates the relative amount of bodily substances, such as internal organs, subcutaneous fat tissue, skeletal muscle, bone, blood, water, and other content [1]. Assessment of body composition provides an excellent opportunity to pre-distribution a person's body size into two major structural components— body fat and lean (non-fat) body mass, and relative body fat and muscle mass are of extreme importance in practice, as indicated by [2]. The size and body composition are primarily predetermined by genetic inheritance, but may change with proper diet (dietary regime) and exercise. Data now suggest that the distribution of body fat, especially accumulation in the abdominal area, and total body fat are significant risk factors for cardiovascular diseases such as hypertension, i.e. elevated blood pressure, and diabetes [3]. Therefore, assessment of body composition in individuals and populations, or specifically selected samples, is vital for clinical trials, medical practices, and specific purpose needs, like evaluating applicants for enrollment to Physical Education (PE) studies. Namely, individuals engaged in active sports activities differ significantly in many somatic traits from those who practice a more sedentary lifestyle. PE studies require above-average physical and sports performance because in many previous studies a significant relationship was found between PE students' physical status and their motor activity achievement [4]–[6].

The primary purpose of this study was to determine the status of the basic anthropometric parameters, body composition and health status parameters, which are considered essential factors for PE study success. The additional purpose of this study is an among-groups comparative analysis (with the results of the previously realized research presented concisely in tables) to examine the possible differences between those of the same age and give an insight into the status of the specific groups regarding the estimated results, which could also indicate possible omissions in the "primary evaluation process" on the entrance exam for PE studies.

MATERIALS AND METHOD

Sample of Examinees:

The total sample comprises seven (N=7) undergraduate female PE students (aged 19–20) who participated in this study after receiving basic information about the research, its scientific importance, and personal benefits for them and in general. The total sample was assessed from June 16 to 18, 2022, along with the practical lessons of summer Outdoor activity camp at Gazivode Lake in Kosovo (as pre-exam, practical study curriculum requirements).

Measuring Instruments and Procedures:

The testing protocol follows the principles established by the Helsinki Declaration [7], and it was performed with the same well-guided examiners (authors) in bright rooms with optimal microclimatic conditions, with the participants in their underwear. Collected data was entered in measure lists prepared for the needs of this research. Anthropometric measurements were performed according to the International Biological Program [8] – Martin's anthropometer was used for establishment of examinees' body height (Height, in 0.1 cm). Their body mass (Weight, in 0.1 kg), as well as their body mass index (BMI, in 0.1 kg/m²), body fat percentage (BF%, in 0.1%), visceral fat (VF, in levels), skeletal muscles percentage (SM%, in 0.1%), resting metabolic rate (RMR, in kcal), were determined using a bioimpedance device Omron BF511 (Kyoto, Japan), and after entering data on their age, gender and body height. Health status assessment was realized with the application of digital tensiometer PRIZMA YE660E, with which we obtained data on systolic blood pressure (SYS, in mmHg), diastolic blood pressure (DIA, in mmHg), and resting heart rate, i.e., pulse (RHR, in bpm). [31].

Program of Summer Outdoor Activities in the Areas of Teaching:

On-site at the Center for Ecology and Development of Sports on Gazivode Lake, the planned field teaching was conducted for two working days. The classes were designed so that the program contents were mixed and carried out in the lake's water area and the surrounding territory. The program contents represented were Mountaineering, Basics of camp life, Rope work

and knots, Organization of evening programs, Rescue procedures on the water, Applied swimming, Nautical, Paddling, Rafting, demonstration of Kayaking and Water Skiing, Water competitions, and Theoretical lectures, presented in Tables 1. According to the number of students present and the available teaching aids (tools), two working groups were created, covered by the teaching staff. The primary methodological task was to achieve concentrated teaching, i.e. to provide students with all-day engagement with standard breaks during meals.

Statistical procedures:

All the data were analysed using the SPSS, version 21.0. The descriptive statistics (average value– Mean, standard deviation– SD, minimum value– Min, maximum value– Max) were summarized for the participant's body composition and health status parameters. The normality of distribution was tested (Kolmogorov-Smirnov test– K-S). In order to determine the significance and the strength of the linear relationship between the selected cardiovascular risk factors in physically active female university students, Pearson’s correlation coefficient (r) was applied. The level of significance was set at $p < 0.05$.

Table 1. Schedule on the first and second day of field classes

First day	Groups	
	1	2
08:00-08:45	Breakfast	
09:00-12:00	Mountaineering tour	
12:00-13:00	Rope work and knots in Outdoor activities	
14:00-14:45	Lunch	
15:00-16:00	Paddling 1	Basics of camp life
16:00-17:00	Basics of camp life	Paddling 1
17:00-17:30	Brunch	
17:30-18:30	Paddling 2	Rescue procedures 1
18:30-19:30	Rescue procedures 1	Paddling 2
20:00-21:00	Dinner	
21:00-22:30	Evening program: social games	
22:30-	Student's free night activities	
Second Day	Groups	
	1	2
08:00-08:45	Breakfast	

09:00-10:00	Paddling 3	Nautical
10:00-11:00	Nautical	Paddling 3
11:00-11:30	Demonstration: Kayaking	
11:30-12:00	Demonstration: Water skiing	
12:00-13:00	Rescue procedures 2	
14:00-14:45	Lunch	
15:00-16:00	Paddling 4	Applied swimming
16:00-17:00	Applied swimming	Paddling 4
17:00-17:30	Brunch	
17:30-18:30	Preparation for the competition	
18:00-20:00	Theoretical lectures	
20:00-21:00	Dinner	
21:00-22:30	Evening program: quiz competition	
22:30-	Student's free night activities	

RESULTS AND DISCUSSION

Table 2 shows the baseline characteristics of the current sample estimated within the female PE students of the University in Priština. Inspecting Table 2, and based on the BMI cut-off points for adults [9], it can be stated that the BMI value of most of the examinees ($n=6$, i.e. 85.71%) is within the normal range; only one has BMI value slightly below the recommended ones ($BMI=18.2 \text{ kg/m}^2$). Many refer to the pulse as "the key to the biological information system" since it is a readily available metric that offers information on a variety of changes in the body. It is important to note that RHR is a metric that should not be disregarded because some authors [10] view it as a measure of a person's entire well-being rather than just their cardiovascular health. Normal RHR in young, healthy individuals is between 60 and 100 bpm [11], and it falls with age. The pulse is lower in physically inactive people because of a lower heart rate and sympathetic dominance, and it is higher in well-trained athletes because of a higher stroke volume and increased parasympathetic activity.

Table 2. The baseline characteristics of the examinees

Variables	Mean±SD	Min – Max	K-S (Sig.)
Age (yrs)	19.66±0.35	19.3 – 20.18	.688
Height (cm)	172.57±3.56	168.0 – 178.0	.984
Weight (kg)	59.61±5.24	52.8 – 68.1	.987
BMI (kg/m²)	20.01±1.51	18.2 – 22.4	.797
RMR (kcal)	1357.57±66.54	1282 – 1474	.995
RHR (bpm)	85.57±22.39	54 – 120	.872

When it comes to the RHR values of the examinees (Table 2), on average, recorded RHR is within normal, i.e. health desirable range (60–100 bpm), which is higher than the RHR values recorded in female PE students from Niš [12], as well as than non-athlete female university students from America, and their average RHR value was 78.7±12.9 bpm [13]. In most of the participants (n=4, i.e. 57.14%) normal RHR values were recorded; in two of them (28.57%) tachycardia was noted (RHR>100 bpm) and bradycardia (RHR=54 bpm) in only one (14.29%). Due to the fact that bradycardia (RHR<60 bpm) is a common physiological phenomenon among the population of athletes, especially in endurance sports [14] as a chronic response of the cardiovascular system to intense training [15], the obtained data are bit of a surprise. The low percentage of strong training evidence among female PE students may be explained by the fact that many of them are likely former athletes whose only physical activity these days is attending university-level practical classes. Naturally, we believe that these two recorded high RHR values of the examinees are likely only a reflection of their current (emotional) state, or possible device errors, since electronic devices can introduce measurement errors [12]. After all, RHR is a very sensitive parameter that at rest shows large variations.

Table 3 shows the basic statistics of the selected body composition parameters in female PE students. The mean values of all the parameters are within the recommended ones, i.e. health-appropriate values, because the skeletal muscle mass values are above the normal range [16], but that is appropriate for physically active student athletes. Almost all of the

examinees (n=5, i.e. 71.43%) have a normal value for their age and sex, however there are students with low BF% value: in two (28.57%) a low percentage of this parameter was found (BF<21.0%).

Table 3. The body composition parameters of the examinees

Variables	Mean±SD	Min – Max	K-S (Sig.)
BF%	22.79±4.09	15.9 – 26.7	.901
VF	2.14±0.69	1 – 3	.571
SM%	33.2±1.99	30.5 – 36.1	1.000

Blood pressure readings and the risk of cardiovascular disease have a continuous, reliable association that is unaffected by other variables. As a result, the likelihood of a heart attack, stroke, or renal illness increases with increasing blood pressure [17]. This highlights how crucial it is to monitor this parameter. When it comes to blood pressure, more than half of the examinees (n=4, i.e. 57.14%) have normotension (90<SYS<120 mmHg and 60<DIA<80 mmHg); two (28.57%) have elevated blood pressure (120<SYS<129 mmHg and 60<DIA<80 mmHg). Only one (14.29%) have hypertension stage II (SYS>140 mmHg or DIA>90 mmHg) according to the SYS value (her BP is 143/77 mmHg) [18], [19], and she is the only one with low percentage of BF. It is not uncommon for people aged 15 to 25– to have an elevated systolic blood pressure and normal values of diastolic [20], but low BF%, it is not in accordance with previous researches [21], [22]. Compared to other studies, slightly lower average value of SYS (118.4±14.1 mmHg and 113.66±10.23 mmHg, respectively) was found in 2828 American non-athlete female university students [13] and 53 physically active female PE students [12], while the average DIA value in both of the studies was higher (73.5±9.4 mmHg and 72.77±7.66 mmHg, respectively) than those recorded in this study.

Table 4. The blood pressure values of the examinees

Variables	Mean±SD	Min – Max	K-S (Sig.)
SYS (mmHg)	122.0±10.55	112 – 143	.890
DIA (mmHg)	68.29±6.65	60 – 77	.985

The intercorrelation matrix of all of the examined variables of female PE students showed a large number of positive, mostly moderate to strong, and statistically significant correlations ($p < 0.001$). Body mass has a very strong, positive and statistically significant correlation with RMR ($r = .985$, $p = 0.000$) and VF ($r = .902$, $p = 0.005$) and negative correlation with DIA ($r = -.811$, $p = 0.027$). Also, strong, negative and statistically significant correlation with DIA was found with BMI ($r = -.775$, $p = 0.041$) and with RMR ($r = -.803$, $p = 0.030$). However, SYS has only strong, but negative and statistically significant correlation with BF% ($r = -.767$, $p = 0.044$). The obtained data differ from those obtained in the study [12] which could be due to small sample of examinees in the current study.

CONCLUSION

The results of this and many other studies point out that it is necessary to make efforts to develop and identify techniques and markers that can be used to assess cardiovascular risks which even affects young people, including PE students. This will allow for early population triage, monitoring, and necessary therapy. Up until now, focus has been on the health of the elderly, but regrettably, emphasis must now be focused on younger groups as well, including individuals who lead healthy lifestyles, exercise frequently, and may not initially appear to have certain risk indicators. All of this is required since many diseases, including cardiovascular problems in adults, are essentially "pediatric" issues, which means that young individuals with cardiovascular risk factors (high body fat percentage, high visceral fat level, hypertension) are more likely to stay in this group later in life, so early detection and preventative measure, i.e. efforts to reduce and mitigate cardiovascular risk factors, are necessary. Based on this study results it is unequivocal that the reduction of body mass at the expense of adipose tissue

is necessary, as well as increase in the moderate physical activity level and regularity and decrease of sedentary behavior as much as possible, in order to reduce the risk of cardiovascular diseases in female PE students now as well as in older age.

REFERENCES

- [1] Purenović-Ivanović, T., Popović, R., Đorđević, M., & Živković, D. (2013). Body type and composition of the PE students. In S. Pantelić (Ed.), *Book of Proceedings of the XVI Scientific Conference „FIS COMMUNICATIONS 2013“ in physical education, sport and recreation, and I International Scientific Conference*, (pp. 405–412). October, 18–19, 2013, Niš (Serbia): Faculty of Sport and Physical Education, University of Niš.
- [2] Cvetković, M., Obradović, J. & Kalajdžić, J. (2008). Effects of Pilates on morphological characteristics of female Faculty of Physical Education students. *Glasnik Antropološkog društva Srbije*, 43, 605–613.
- [3] Escobedo-de la Pena, J., Ramírez-Hernández, J. A., Fernández-Ramos, M. T., González-Figueroa, E., & Champagne, B. (2020). Body fat percentage rather than body mass index related to the high occurrence of type 2 diabetes. *Archives of Medical Research*, 51(6), 564–571.
- [4] Bale, P. (1978). The physiques of physical education students and their relationships to performance. *Research Papers in Physical Education*, 3(4), 30–33.
- [5] Bale, P. (1979). The relationship between physique and basic motor performance in a group of female physical education students. *Research Papers in Physical Education*, 1, 26–32.
- [6] Bale, P. (1980). The relationship of physique and body composition to strength in a group of physical education students. *Brit J Sports Med*, 14(4), 193–198.
- [7] World Medical Association (2013). *World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects*. Retrieved February 18, 2019 from file:///C:/Users/PC/Downloads/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects.pdf
- [8] Weiner, J.S., & Lourie, J.A. (1969). *Human biology, a guide to field methods*. International Biological Programme. Edinburgh, UK: Blackwell Scientific Publications.
- [9] Ross, R., & Janssen, I. (2007). Physical activity, fitness and obesity. In C. Bouchard, S.N. Blair, & W.L. Haskell (Eds.), *Physical activity and health*, (pp. 173–189). Champaign, IL: Human Kinetics.
- [10] Alhalabi, L., Singleton, M.J., Oseni, A.O., Shah, A.J., Zhang, Z.M., & Soliman, E.Z. (2017). Relation of higher resting heart rate to risk of cardiovascular versus noncardiovascular death. *The American Journal of Cardiology*, 119(7), 1003–1007.
- [11] American Heart Association (2023). All about heart rate (pulse). Retrieved December 3, 2023 from <https://www.heart.org/en/health-topics/high-blood-pressure/the-facts-about-high-blood-pressure/all-about-heart-rate-pulse>

- [12] Purenović-Ivanović, T., Stojanović, S., Veličković, V., Živković, D., & Došić, A. (2022). Cardiovascular risk factors in physically active female university students. *Facta Universitatis, Series: Physical Education & Sport*, 20(2), 101–112.
- [13] Pribis, P., Burtneck, C.A., McKenzie, S.O., & Thayer, J. (2010). Trends in body fat, body mass index and physical fitness among male and female college students. *Nutrients*, 2(10), 1075–1085.
- [14] Doyen, B., Matelot, D., & Carré, F. (2019). Asymptomatic bradycardia amongst endurance athletes. *The Physician & Sports Medicine*, 47(3), 249–252.
- [15] Bahrainy, S., Levy, W.C., Busey, J.M., Caldwell, J.H., & Stratton, J.R. (2016). Exercise training bradycardia is largely explained by reduced intrinsic heart rate. *International Journal of Cardiology*, 222, 213–216.
- [16] Omron Healthcare (2017). BF511 Body composition monitor: Instruction manual. Retrieved December 3, 2023 from <https://www.manualslib.com/manual/887289/Omron-Bf511.html>
- [17] National Heart, Lung, and Blood Institute (2004). The seventh report of the Joint National Committee on Prevention, detection, evaluation, and treatment of high blood pressure. Retrieved on February 2, 2022 from https://www.ncbi.nlm.nih.gov/books/NBK9630/pdf/Bookshelf_NBK9630.pdf
- [18] Börjesson, M., Kjeldsen, S., & Dahlöf, B. (2010). Hypertension. In M. Börjesson, M. Hellenius, E. Jansson, J. Karlsson, M. Leijon, A. Ståhle, C.J. Sundberg, & J. Taube (Eds.), *Physical activity in the prevention and treatment of diseases*, (pp. 410–425). Stockholm, SE: Swedish National Institute of Public Health.
- [19] American Heart Association (2018). Understanding blood pressure readings. Retrieved on February 1, 2022 from <https://www.heart.org/en/health-topics/high-blood-pressure/understanding-blood-pressure-readings>
- [20] O'Rourke, M.F., Vlachopoulos, C., & Graham, R.M. (2000). Spurious systolic hypertension in youth. *Vascular Medicine*, 5(3), 141–145.
- [21] Han, T.S., Al-Gindan, Y.Y., Govan, L., Hankey, C.R., & Lean, M.E. (2019). Associations of body fat and skeletal muscle with hypertension. *The Journal of Clinical Hypertension*, 21(2), 230–238.
- [22] Seok Lee, H., Park, Y.M., Han, K., Yang, J.H., Lee, S., Lee, S.-S., Yo, S., & Kim, S.R. (2020). Obesity-related hypertension: findings from The Korea National Health and Nutrition Examination Survey 2008–2010. *PLoS One*, 15(4), e0230616.

10. Chapter

The impact of human migration in the Durrës Region after 1990

Lindita Kiri ^{1*}

¹ Department of humanities Qiriazi University, Albania

Email of the corresponding author: linditakiri@yahoo.com

ABSTRACT

Emigration has been part of the development of human history. In different historical stages, the composition of migratory flows has also changed. The goals and motives of the international movement of people will continue in the era of globalization. The mobility of people after 1990 in the region of Albania has led to an increase in population migration to other countries and regions of the world. Migration in Durres County, the movement of people from Durres County to another county within the country or abroad has played a major role in the development history of this county. The purpose of the paper is to present the migration of the population in the Durres County after 1990. In many countries of the world, migrations have reached large proportions, strengthening or weakening large states. The world would have been very different without historical patterns of international migration.

Keywords – external migration, ethnic origin, Albanian immigrant status

INTRODUCTION

In Albania policy, has taken part district of Durres in primary international coordination and in cooperation. Now we have embraced the philosophy that migration policies should not only consider economic aspects, but to keep the school of thought that external migration produces social consequences, cultural, and even political is not only something between being rich, or poor, but the models themselves societies where people want to live.

In the transition period, since 1990, by the totalitarian regime to democracy, as well as Albania Durres district experienced a migration performance with lots of curves and changes. However, in summary we had to face some major problems that deserve special sight: "brain drain", smuggling and human trafficking, remittances, return with the desire of Albanian immigrants, legal and unauthorized movements for economic reasons.

MATERIALS AND METHOD

For this paper I have used quantitative and qualitative methods, empirical data obtained from different sources. For this purpose, I have investigated and interviewed the population of the Durres district and have concluded as follows: external migration population of Durres district after 90 s began and increased rapidly as a result of the economic and social consequences of the country. Was used the method of analysis and synthesis of data. In this paper, I compared the external of migrating of Durres district population with other regions of the country. Finally, all parts in theoretical frame of reference and the empirical findings where analysed and conclusions where drawn.

Foreign Migrationconsequences and is Impact on The Albanian Population:

Migration in the region of Durres, the movement of people from Durres district to another region within the country or abroad (where they migrated and a greater number of people), has played a main role in the development history of this county. In many countries of the world, regions or negligible States, took major proportions, while powerful states are weakened or strengthened, thanks to the international movement of people. The world

would have been very different without historical patterns of international migration. Migration brings benefits in a cost-benefit balance, unless managed properly for the benefit of the individuals, the family, but also societies of origin and the host country.

If we link properly the emigration with development, then we will this phenomenon precious for us. However, this process has the other side of the coin. That's why not only evokes heated debates, but also divides schools of thought. For instance, migration can deprive countries of origin of the best skills and talents and brilliant minds, as it may affect the cleavage / break-up of the family; often it is used for smuggling purposes and trafficking in human beings to go till the use of migration flows from criminal and terrorist organizations.

It is never too much to affirm and reaffirm that many of the problems can be resolved through engagement, debate, within the country involving all key actors, as well as through international cooperation. This will lead to a better knowledge and understanding of gains and premature volumes that provides migration (Ex General Secretary of Assembly of the United Nations, Kofi Anan is expressed in 2010).

None of us is likely to solve alone immigration problems, but each of us holds in his hand a piece of solving puzzle. The migration experiences were not always positive: immigrants of both sexes are exposed more and more to exploitation and abuse by smugglers of human beings; others, as a result of rising social tensions, religious and cultural rights in some societies see themselves involved and in front of walls of discrimination, xenophobia and racism.

International migration policies do not exist in isolation, all have global consequences. Costs and benefits of migration are not shared equally among countries, as well as between social groups (Ministry of Foreign Affairs is responsible for managing the visa system and providing migration services abroad).

In Albania policies, in which Durres district is part of, takes a primary place the international cooperation and coordination. Now we have embraced the philosophy that migration policies should not only consider economic aspects, but keeping to the school of thought that the external migration produces social cultural, and even political consequences, is not

only something between being rich or poor, but the models themselves societies where people want to live.

In the transition period, since 1990, by the totalitarian regime to democracy, Albania as well as Durres district experienced a migratory trend with many curves and changes. However, in summary we had to face some major problems that deserve special sight: "brain drain", smuggling and human trafficking, remittances from migrants, voluntary return of Albanian emigrants, legal and unauthorized movements for economic reasons (INSTAT is an institution that collects and analyzes data on migratory flows).

External migration of the population of the district of Durres and Albanians as a whole is affecting the creation of some essential factors of External Emigraton Durres district population but he Albanians from whole is affecting the creation of some essential factors.

Age factor: the first generation of emigrants is reaching retirement age;

Second generation, still in school, or on the periphery of the labor market;

Ethnic origin: the majority part of Albanian migratory community is located in Greece and Italy, being the first host country with more than 70% of the total emigrant population there, followed by the presence in another country; in daily life the Albanian emigration encounters with prejudice, victimization phenomenon, incrimination and often based on perceptions and not on facts.

This public perception is mainly conceived and fueled by certain media, especially local ones. Geographical proximity raised expectations that Albanian emigrants in these countries would be closer, but they feel the distance and miss the relatives. As well, they are not always close to the local population, despite acultural, geographical, linguistic familiarity, at least compared to initial expectations.

"Ethnic ghettos" prohibit the integration of emigrants, but this phenomenon touches just a few easy the Albanian migration, as our immigrants tend not to focus on these "ghetto" (Ministry of Interior, Directorate of Border and Migration Police. MI has an important role in the implementation of readmission agreements).

Human capital: the majority of emigrants of Durres district have still low level of professional training and education; highly skilled emigrants and

outstanding talents are employed in jobs of not their skills and not appropriate sectors. This has slowed the integration, creating anti-migratory feelings, perceptions and reactions, especially those that are illegal and stay on the periphery of social institutions. Currently, not only by the presence, especially in the two countries Greece and Italy, Albanian emigrants make significant contributions to social care system (Ministry of Foreign Affairs is responsible for managing the visa system and providing migration services abroad).

Albanian immigrant status: In the early migratory flows, Albania was unprepared for their management. Similarly, the two main host countries, Greece and Italy were not prepared to wait properly the mass flows, most of them unauthorized (Ministry of Labour, Social Affairs and Equal Opportunities Directorate of Migration Policy responses to migration for employment purposes, in cooperation with the SHKP, ZRP, SHSSH and ISSH. MPCSSHB is responsible for the design and implementation of the employment agreements).

The Ratio of Irregular Regular / Began in 1998:

During the period 1998-2005, approximately 70.000 Albanian illegal emigrants adjusted their status each year in Italy and Greece (Ministry of Labour and Social Affairs 2012). During the period 2003-2007, the proportion of regular / irregular was 1.5-1 in Greece and 3-1 in Italy.

Active versus passive migration: More and more had increased the family migration, conditioned and favored by the cultural, linguistic and geographical vicinity, as well as low cost to migrate to neighboring countries. Emigration was accompanied by high levels of juvenile emigration, accompanied or not.

Step by step the external emigration in Durres region, but also the Albanian as a whole, followed the general trend of feminisation of his subject, conditioned and favored by real amenities of female employment in certain sectors, such as services, household work etc. But according to a global emigration trend, the unemployment rate among emigrants was much higher compared to the locals.

Short-term versus long-term migration: Employment opportunities offered by migration policies of neighboring countries. Geographical

proximity favors periodic returns home (Ministry of Foreign Affairs is responsible for managing the visa system and providing migration services abroad).

Synergy between economic and professional activities in the host countries and Albania –the emigration of the survival and consumption to be a development factor: In the first 15 years, the emigration served as a source of survival and consumption. In recent years, were made and are still made efforts to use external emigration in Durres region a factor of economic, social, cultural and political development. Thus, special attention is being paid to return policies and programs, supported and programmed. More and more people are passed from the findings into action to use remittances and virtual skills of emigrants as a source of financing, the creation of jobs and developmental factors in the community.

Changes in the structure of migration flows: The growing number of skilled immigrants. Growing number of students who choose and are able to complete their studies abroad. Feminization of migration in general, not just through passive migration (family reunification), but independent female migration (almost) equal ratio emigrant / immigrant.

Changes in the composition of migration flows: The trend of strengthening the entrepreneurial initiative of Albanian immigrants in two main host countries, Greece and Italy. The venture remains a male activity, which leads to the task of promoting this initiative to female migration (National Institute of Diaspora, as structure Ministry of Foreign Labours).

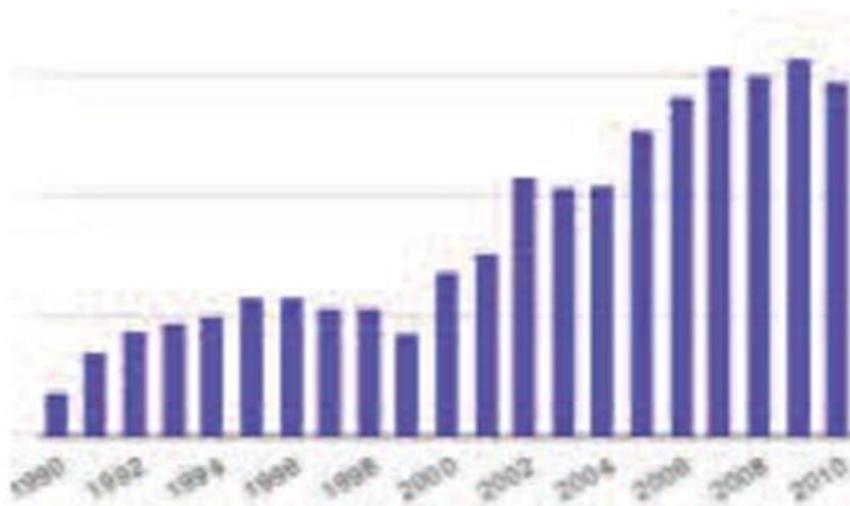


Figure 1. Albanian emigrants, INSTAT, (1990-2010) [5]

Albanian emigrants are those individuals who have applied and received emigrant status in the territory of a given country. Applications for asylum

and emigrant status are set out in the Convention and internationally recognized protocols.

Performance and Features to External Migration in The Early 1990:

Albanian migration is divided into three periods that are known nationally. The division into three periods of Albanian migration is analyzed on the basis of cause and effect that followed in the history of Albanian emigrants. External migration can be divided into three periods:

1. Migration flows, before 1944; a recent diaspora, in small proportions, who emigrated during the period 1945- 1990; substantial inflows after 1990s, or the collapse of the totalitarian communist regime. Before 1944, the main directions were the United States and several Latin American countries. There are lack of accurate data on the size of these flows, although small-scale and mostly with economic motivation.

2. After 1945, with the establishment of the communist regime in Albania was formed a class of political emigrants, always small size. Albanian government strongly opposed by all means even with punitive measures, put in place strict legal and political, even calling it a crime leaving the country. This was the second phase

3. The third phase started after 1990s, divided into several sub phases: migration flows time frame 1991-92, completely uncontrolled. At this time approximately 300 thousand Albanian citizens left the homeland by any means; ii) flows of 1992-96 when pulled roughly as citizens, often illegally, despite the temporary improvement in the economy, political stability of the country, better border controls and, from time to time, “soft” policies of some states; flows in 1996-97, after the collapse of the various pyramid schemes and socio-political turmoil that followed the collapse.

Several factors combined as: unemployment, insecurity, poverty, general economic deterioration led to nearly 100 thousand people to leave the country within a few months; since 1998 there has been an improvement in socio-economic and political conditions; these along with some favorable policies of the time of two neighboring countries, Italy and Greece led to growing legal migration flows and sit them illegal; and finally after the visa liberalization occurs another population migration focused family reunification, relatives, but this emigration was focused and directed that

every immigrant should not stay more than 90 days in a six-month (Republic of Albania, Ministry of Foreign 2012).

The massive emigration that characterizes the post-communist period began in July 1990, when over 5 thousand people entered the embassies of Italy, Germany and France to leave the country.

□ At the end of 1990, over 20 thousand Albanian citizens fled overland to Greece where they sought asylum.

□ In March 1991, a large number of Albanians entered the port of Durres, the largest in the country. Once seized several ships merchant marine fleet, sent them landed in the ports of southern Italy. The same situation was repeated a few months later, in August, when about 18 thousand people, as took control of several ships, landed on the coast of Italy. Illegal immigration rose sharply during the subsequent years.

□ Immigration suffered a decline during 1992-1996. The reason was attributable to improved political stability and socio-economic situation. At the end of 1996 the number of Albanian citizens living abroad amounted to 350 thousand people. Became massive migration flows in 1997, as a result of the collapse of pyramid schemes and political chaos that accompanied the event.

Durres district immigrants and emigrants in general, rational selection of countries have direction or not consciously interact with several factors such as: the geographical vicinity, cultural and linguistic, supported by legal access opportunities in these countries.

In the collective memory of Albanians from Durres district, in the migration to places remote areas, traditional, USA. Canada, Australia, Argentina, New Zealand, from where they returned, the phenomenon of "exile" in popular memory, synthesized and made merchandise concern Durres district immigrants tend towards immigration in adjacent or neighboring countries. However, subsequent opportunities to find better employment, legal status and socio-cultural conditions for themselves and children pushed Albanians even farther than these countries.

Greece, Italy and Western Europe were the main direction in the period 1992-96. An earlier preference for countries like Germany, Switzerland and other countries in Western Europe increased hand-in-hand, because of their immigration policies, and more.

In the collective memory of Albanians from Durres district, in the migration to places remote areas, traditional, USA. Canada, Australia, Argentina, New Zealand, from where he returned, the phenomenon of "exile" in popular memory, synthesized and made merchandise concern Durres district immigrants tend towards immigration in adjacent or neighboring countries. However, subsequent opportunities to find better employment, legal status and socio-cultural conditions for themselves and children pushed Albanians even farther than these countries.

---The first wave of immigration: 1991-1992 period was due to the a destabilizing political environment, social and economic development;

---1992-1996 period relative called characterized by political stability and socio-economic progress;

---The period December 1996-April 1997 was the third wave of emigration. (collapse of pyramid schemes);

---1998-2012 period onwards, Albanian governments implemented and are implementing a National Stabilization Program.

The performance and features of outward migration after In Durres region, as in the entire country of emigration abroad was at the heart of economic and social changes that have occurred in Albania since 1990. It is estimated that more than percent of Albanians living abroad. No other country in Central or Eastern Europe is not so much affected by emigration for so short a period of time.

Albania can be seen as a laboratory for the study of new processes of migration (King Russel & V. Julie, *Migration and Development in Albania*, December 2005). The data show that starting in 1990, 710,000 to 1,000,000 Albanians moved out temporarily or for all. In a country with no more than 3 million of population, this figure is relatively high, so as to attract and justify the attention of researchers. As migration has been chaotic, illegal and unregistered, the figures on this phenomenon are un-specified.

Albanian migration model after 1990 has been described as unique. It is characterized by several features (UNICEF Institute for Urban Research *Albanian migration after the 90s and its impact on economic and social life of children left behind Final Report August 2009*).

Firstly, migration displayed as an immediate phenomenon, impetuous and explosive, after a stop about 45 years.

Combined with a powerful internal migration, results have moving in and out of Albania to about half of its population.

Second, its size, relative to the population of Albania have been greater than in other countries. Albania is one of the few countries with a 1/4 of its population in emigration.

Thirdly, migration has played an important role in the survival of the population, especially in two key moments. In the early 1990s, migration relates to the consequences that accompanied the economic and political changes. During the period 1993-1996 economic stability and GDP growth contributed to the reduction of migratory flows. Also remittances, which accounted for 25% of GDP, made an important contribution to the survival of a large number of Albanians (World Bank, Albania, Urban growth, Migration and Poverty Reduction, June 2010). In 1997, political chaos, economic and social development created by:

- Collapse of fraudulent pyramid firms, and negative impact on the well-being of Albanians increased migratory flows again.
- The district of Durres immigrants have and are playing an important role in the development of this country, to be clearer and better understanding of Durres district .
- Population migration is necessary to divide them into several definitions that are used in about immigrants, this applies not only to immigrants Durres region but for all immigrants of the Republic of Albania (UNICEF Institute for Urban Research Albanian migration after the 90s and its impact on economic and social life of children left behind Final Report August 2009).
- Permanent migrants are those family members who currently reside abroad for employment purposes.
- Temporary migrants are persons currently residing in Albania family, who have been abroad for at least a month since 1990 and the purpose of migration has been employment.
- Illegal Migrants (irregular) are those who have entered a country to look for work / working without visa or stay in this country after the visa and residence permit has expired.
- Union familiar: people who are members of a family, who join members abroad. Some states recognize the right of family re-union, other labor contract system, denying this right.

- Remittances are remittances that someone does for someone or for household distance.1990s

Destination Countries of Albanian Emigration:

In 2003 in Greece, according to the European Commission's Annual Report on Asylum and Migration Statistics Bounce, lived and worked 434 810 Albanian citizens of these immigrant shows that 6% of them were from the region of Durres (European Commission's Annual Report on Asylum and Migration Statistics Returns 2002).

In 2006 in Italy, according to ISTAT and Italian Statistical Office, lived and worked 348,813 Albanian citizens, of which about 30% were immigrants from Durres district (INSTAT and Italian Statistical Office 2005) it shows in neighboring Italy immigrants from Durres district and number great as to affect directly in physical geographical position of this region w In 2005 in the U.S., according to the General Census of Population, lived and worked 113,661 Albanian citizens and by these immigrant results more than 15% were immigrants from Durres district (General Census of Population 2005).

In 2005 in the UK, according resources MoLSAEO, lived and worked 50,000 Albanian citizens. In 2001 in Canada, according to the General Census lived and worked 14,935 Albanian citizens. In 2002 in Germany, according to the Federal Statistical Office, living and working 11. 630 Albanian citizens (MPCSSHB Sources 2005). From these sources shows that about 12.5% of emigrants who had migrated to these countries were immigrants from Durres district. Durres Region played in immigrant supply almost count greater neighboring countries and beyond affecting the non-uniform distribution of migrants from one country to another, but immigrants from Durres district are sweeping across the states where the Albanian immigrants are.ith the neighboring country Italy.

In 2005 in the U.S., according to the General Census of Population, lived and worked 113,661 Albanian citizens and by these immigrant results more than 15% were immigrants from Durres district (General Census of Population 2005).

In 2005 in the UK, according resources MoLSAEO, lived and worked 50,000 Albanian citizens. In 2001 in Canada, according to the General

Census lived and worked 14,935 Albanian citizens. In 2002 in Germany, according to the Federal Statistical Office, living and working 11. 630 Albanian citizens (MPÇSSHB Sources 2005). From these sources shows that about 12.5% of emigrants who had migrated to these countries were immigrants from Durres district. Durres Region played in immigrant supply almost count greater neighboring countries and beyond affecting the non-uniform distribution of migrants from one country to another, but immigrants from Durres district are sweeping across the states where the Albanian immigrants are.

CONCLUSION

At the current stage we suffer from not collecting statistical data on a variety of factors and contemporary interpretation and processing, this absence of proper legal, institutional coordination and appropriate human and material resources in key ministries dealing with the migration phenomenon. This bid is not and will not remain alone in implementing appropriate measures to create registry of immigrants and other interventions in the Civil Registry.

- Start monitoring system implementation / coordination of the National Strategy on Migration and PKZSKM through the lead unit of the Department of Immigrant Policy, among others will have one of exerting positive pressure's priorities, including all institutions, according to tasks. But statistics are not an end in itself.

- It will assist in the design of better immigration policies, in their ongoing monitoring, improved successor. If so, they will help you quickly and properly understand what is happening, helping policy-makers and decision-makers to take informed positions on all aspects of migration, irregular migration, migration for employment purposes, protection and integration of immigrants.

RECOMANDATIONS

By accepting this challenge institutions have started to throw the first steps for the creation of relevant records, the Department of Policy, as well as the Regional Offices and Local Immigrant Employment.

Measures for sustainable development of these areas are:

- Promoting an active desire for a quality environment which should not be an obstacle for local community but an incentive for economic development
 - Encourage local communities to see them more functional aspects of rural areas
 - Promotion of agricultural products that respect the environment and come up with competitive prices, so that the income can grow
 - Saving the best traditions and the promotion of alternative youth activities in these areas
 - Provision of investment in agriculture and other sectors and open the way for economically sustainable economic activities
 - Prevention interventions that can damage the ecological balance of these areas
 - Improve infrastructure social cultural and communication

REFERENCES

1. Albanian Ministry of Health "Health Care Reform in Albania", Background Document No.1 'Situation analysis' Tirana 1997
2. Albanian National Observatory "Albanian National Observatory national report" 1999 UNDP, Human Development Report, 1998
3. Arlinda Ymeraj, "The role of Social Protection to social exclusion and social capital" Robert MacNamara Fellowship Program, 1999 CIGO, "Urgent Rehabilitation of Schools and Prisons in Albania", July 1998
4. INSTAT, «labor market» 1990-1999 INSTAT, "Albania in Figures", 1998 INSTAT, "Albania in Figures", 2000 INSTAT, "Annual Social Indicators", 1999 INSTAT, Social indicators by region, 1998
5. INSTAT, and Social Security Protection System in Albania, 1996 INSTAT, Statistical Yearbook of Education, the December 1998 NICEF, "national study to cover vaccine", 1999
6. Brian Munday & George Lane, "The old and new. Changes in social care in Central and Eastearn Europe "Eissa, 1999 Albanian National Observatory "Albanian National Observatory national report" 1998
7. Council of Ministers, Department of Development and Foreign Aid Coordination, "Public Investment Program" 1998-2000
8. Ministry of Labour and Social Affairs, Statistics, 1999
9. Ministry of Labour and Social Affairs, Statistics semiannually, 2000
10. Ministry of Health, "Evaluation of primary health service" analysis report statistics conducted by IMC in collaboration with the Ministry of Health, Tirana 1999. Statistics Monthly Statistical Bulletin 3. No.4 Tirana 1999..
11. NACSS, Paper, "Social Assistance and Welfare in Albania", May 1999

12. UNICEF, the rights of women and children, 1998
13. UNFPA, "Programme review and strategy development", 1997
14. World Bank, "Institutional and Capacity assessment of social services for vulnerable groups", 2000 World Bank, Albania, "filling the Vulnerability Gap", Mansoura Rashid, Vajeera Dorabawila

11. Chapter

Geology of the Walsh and Naopurdan formations (groups) in the Soran area, Arbil Governorate, NE-Iraq

Kamal Haji Karim ^{1*}

Sherzad Tofiq Mohamad Al-Barzinjy ¹

Bashar Jalil Hamza ¹

¹ Department of Geology, University of Sulaimani, Iraq

Email of the corresponding author: kamal.karim@univsul.edu.iq

ABSTRACT

The present study focuses on finding the relations between the Walsh and Naopurdan formations in the thrust zone of the Soran area with the Kolosh and Khurmala Formations in High-Folded Zones of the Shaqlawa area. The study also tries to indicate the relation of these four units with the Iraqi ophiolite, volcanic rocks and Gimo sequence in the Soran area. The present study modeled and reconstructed the tectonic setting and depositional environment of the above units in a single foreland basin. The present study changed the Walsh and Naopurdan Groups to formations and indicated that the type sections of the claimed two groups belong to the same succession. The main difference between the two type sections is the metamorphism of the type section of Walsh Group. same as whereas the Walsh Formation consists of conglomerate, sandstone and siliceous shale south of Soran town. The Naopurdan Formation consists of two parts, the lower part contains sparse nummulite and alveolinas while the upper part is mainly comprised of coralline limestone and the thickness of the two parts are about 100 m thick. To the north, and northwest the Walsh and Naopurdan formations are metamorphosed regionally which is previously called the ophiolite and Gimo sequence. We documented that the ophiolite is the regionally metamorphosed felsic and mafic volcanoclastic sandstone (greywackes) of the Walsh Formation and deposited inside the shelf of the foreland basin. While the Kolosh Formation is indicated as basal facies of the Walsh Formation and it represents the fine siliciclastic sediments (shale and sandstone) that are transported to a deep basin of the foreland basin by a turbidity current. In the basin, Naopurdan and Khurmala Formations are deposited as reefal facies on the top of the Walsh and Kolosh Formations during the Early Eocene.

The changing of the ophiolite to metamorphosed Walsh Formation is based on many signals which are finding pervasive laminations, granular textures, planar bedding surfaces, erosional surfaces, and lensoidal submarine channels, in the rocks that are previously considered ophiolite in Soran areas. All the grains of the claimed igneous rocks are angular and show breakage edges and pitted surfaces which show that the grains are crystalloclasts and volcanic lithic fragments deposited by water currents. Other evidence for the absence of ophiolite and igneous rocks in northern Iraq are the absence of dykes, pillow lava, volcanic flow, contact metamorphism, sheet -channalized lava flows and mineralization. Another piece of evidence is the similarity between Kolosh and Walsh Formations in mineralogy, and ages, and both formations consist mainly of fragments of plagioclase, hornblende, and pyroxene with minor olivine. The stratigraphic columns, depositional models and geologic cross section are drawn for the Soran area which are relevant to the Mawat and Chwarta areas.

Keywords – Walsh Group, Naopurdan Group, Volcanoclastic Succession, Northern Iraq Geology, Walsh Formation.

INTRODUCTION

Soran (Rawanduz) area is in the northern part of the Arbil Governorate near the border with Iran (Figs.1 and 2). The area is among the most famous regions in Iraq due to its tourism attraction and historical events during WW1 and the Kurdish revolution during the seventieth of last century. Moreover, it has geological significance since previously mentioned that it hosts the sedimentary, igneous (plutonic and volcanic) and metamorphic rocks side by side (see Buday 1980), Buday and Jassim (1987) and Jassim and Goff (2006). In this area many stratigraphic units are defined by geologists of Oil companies 70 years ago, these units are the Naopurdan and Walsh groups in addition to the Barsarine, and Naokelekan formations.

Unfortunately, despite its importance, there are no serious and objective updates about geological studies of the area. There are some studies in the area but our field studies disagree with their results. The present study aims to update the stratigraphy and tectonics of the Soran area in addition to establishing relations between the Walsh and Naopurdan Groups on one side and their relation with Tanjero, Kolosh and Sinjar formations on the other side. The study highlights the false and truth of igneous rocks inside the two groups and ophiolite obduction in the area.

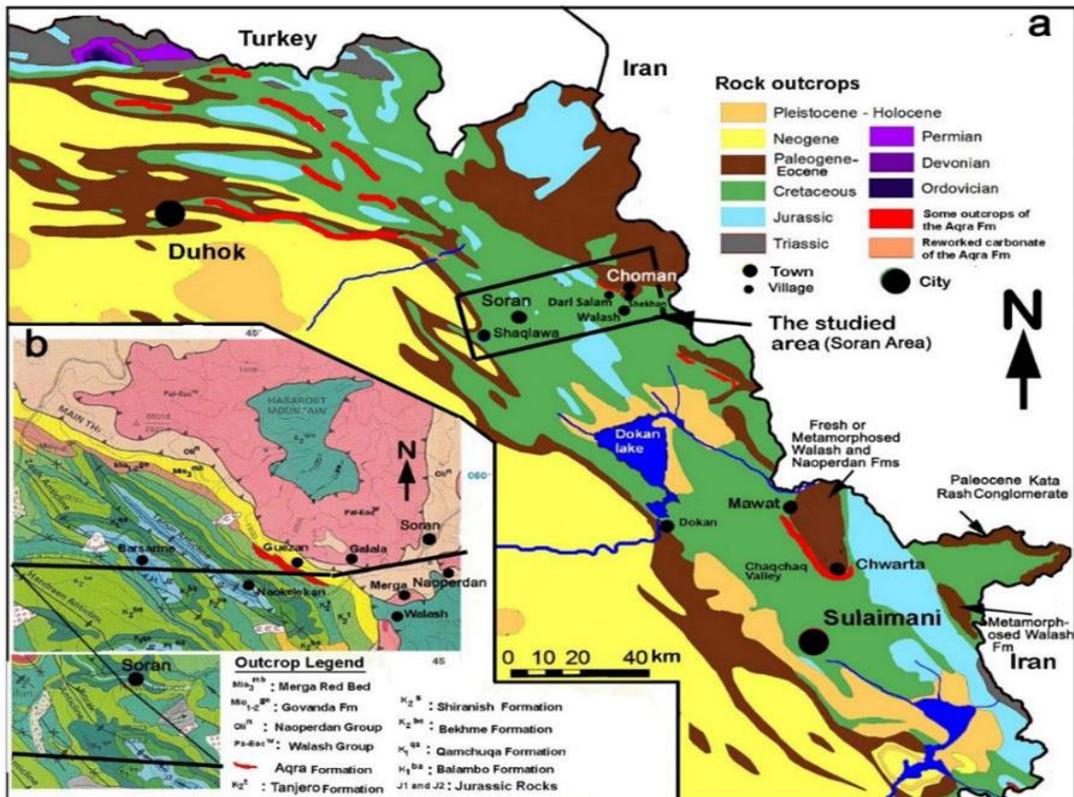


Figure 1. Location map of the Soran and Penjween areas, b) geological map of the modified from Sissakian (2000).

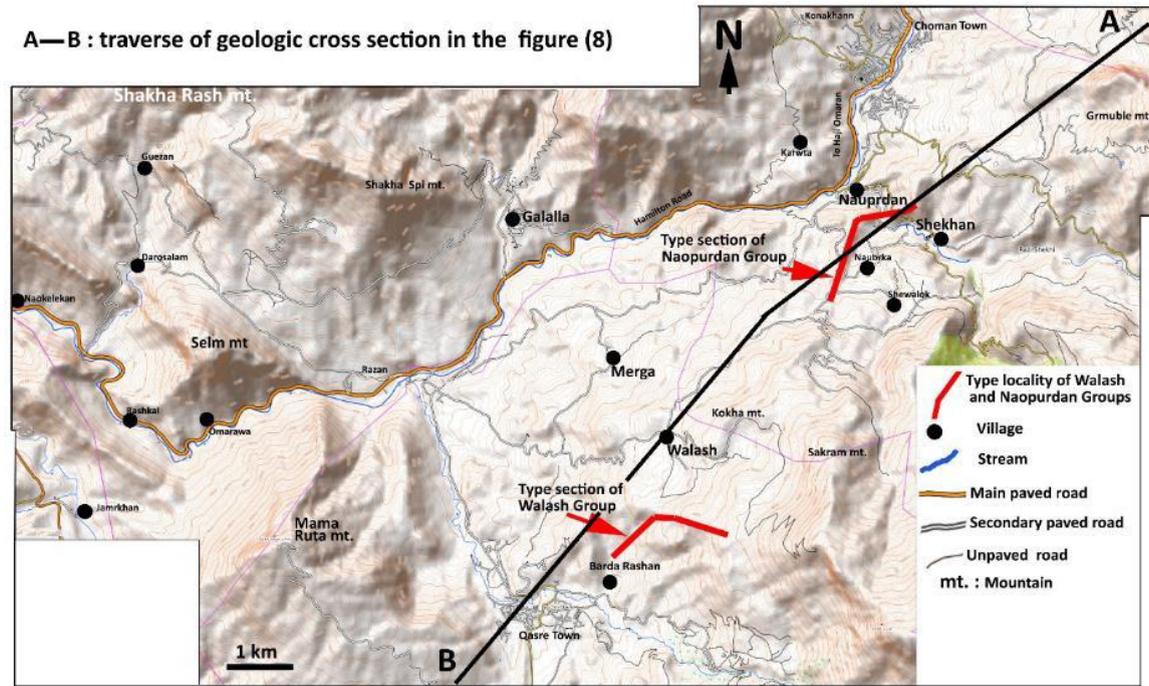


Figure 2. Topographic map of the Soran area shows the location of the Naopurdan and Walsh groups (bold red lines).

Walash Formation (Group):

The type section Walsh group is located 7 km south of Choman town between Soran and Haji Omaran towns. The defined section passes along the eastern boundary of the Walsh (locally called Wilash) Village and its top is located 2 km northeast of the latter village while its base is 3 km north of Barda Rashaan village on the southwest side of the Kokha mountain (south-western end of Sakran Mountain) (Fig. 2). According to Buday, (1980) and Qayim et al. (2014), The Walsh Volcanic Group (present Walsh Formation) was first described by C.M. Bolton (1958) as the stratigraphic unit of the Thrust Zone of the Paleocene-Eocene age. According to the above authors, the group is composed of volcanic rocks passing laterally into sedimentary rocks in the type section area, and they mentioned that the section comprised five units. (1) The base consists of red mudstone with cherty siltstone and shales which is called “Lower Red Beds Unit”. (2) Above the latter unit comes the “Lower Volcanic Unit” which consists mainly of mafic and subsidiary acidic lava and pillow lava which are associated with pyroclasts. They mentioned that the volcanics commonly occur as volcanic cones and change laterally into tuffaceous rocks with radiolarite and milky limestone.

(3) In the middle of the section there is a siliciclastic succession that passes laterally into tuffaceous rocks, red mudstone, red and gray shales, sandstone, conglomerate and limestone all these lithologies are called “Middle Red Beds Unit” by the above authors. (4) The fourth unit is called the “Upper Volcanic Unit” which is composed predominantly of basalt and andesitic flows, pyroclastics, and associated sediments. These units contain volcanic cones that pass laterally into marine sequences with limestone. (5) The top unit is called the “Upper Red Beds Unit” which includes Red mudstone and conglomerate at its base, and brown–red mudstone and greywacke sandstone at its top.

Buday (1980) aged the group by large benthic forams such as Nummulites and Alveolina and indicated generally Paleogene. At the Mawat area 30 km north of Sulamaniyah city, Al-Mehaidi (1975) mentioned that the group consists of a complex sequence of volcanic rocks including tuff, basaltic rocks, and lava flows of mafic and intermediate composition, with grey shale, red shale, greywacke, and red limestone. He added that his succession is cut by dykes and sills of diabase and its top is occupied by 60 m limestone. Ali et al. (2013, 2017), and Aswad et al. (2016), studied the geochemistry and tectonic of the Walsh Group and indicated a back-arc tectonic setting for the group (Fig. 4). Moreover, Mustafa et al. (2023) returned volcanic rock inside Walsh group geochemically mostly to Oceanic Island arc and partially to mid-oceanic ridge. These three articles considered the Choman-Gallala area (areas of the Walsh and Napurdan Groups) as Allochthonous units transported from Iran by thrusts and obduction. However, this study will prove and aids the studies of Karim, (2023), Karim and Khafor (2021) and Karim and Hamza (2021) about the autochthonous setting of the two groups and their deposition in the Zagros Foreland Basin not in Oceanic basin.

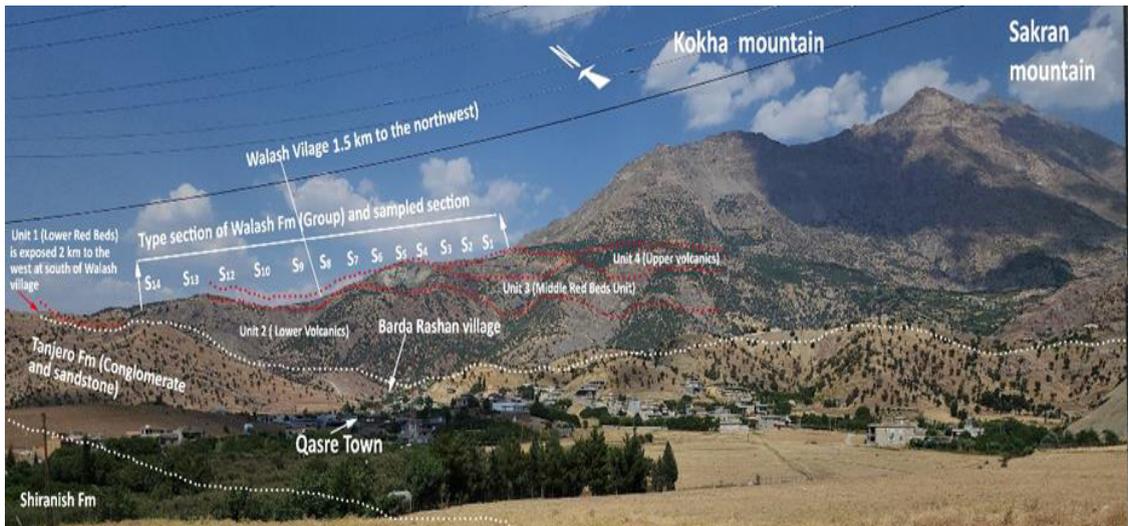


Figure 3. Type locality of Walsh Group (Present Walsh Formation) and the areas around Qasre town including southwest of Walsh (originally Wilash) village.

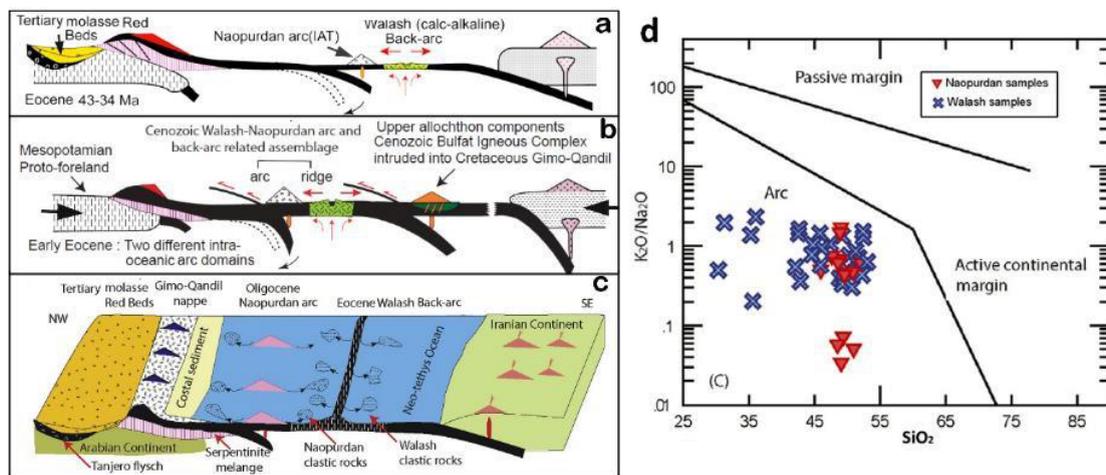


Figure 4. Previous models of the Walsh and Naopurdan Groups (present formations) in different areas of northeastern Iran. In these models, the authors considered rocks of the back arc and arc (a) Ali et al. (2013), b) Aswad et al. (2016), and c) Ali et al. (2017) respectively. The present study considered them as deposits of the Paleocene-Eocene Foreland basin, d) Tectonic discrimination diagrams of Ti/Zr vs Zr (Woodhead et al. 1993) on which the data of Walsh volcanic rocks (Walash formation) and Naopurdan volcanic rocks (Walash Formation) arc plotted by Ali et, al. 2017 they get a back-arc tectonic setting for the two groups.

Naopurdan Formation (Group):

Its type section is located between the Naopurdan and Shekhan villages at 2 km southwest of Choman Town (Figs.5 and 6). According to the definition of Bolton (1958) and Buday (1980), the lithology of this group (present formation) is nearly like the Walsh Group since they mentioned its content of volcanic rocks, flysch sediment (greywackes), sills, shale, red beds,

jasper, and limestone bearing nummulites. They mentioned two main differences between the two groups, the first is thicker coralline limestone in the base of the Naopurdan Group and the second is relatively finer sediments.

They divided the group into five units from its base to the top, the first unit consisted mainly of grey shaly beds with thin green greywackes (fine rhythmic shaly flysch). These beds contain lenticular conglomerates (with pebbles of mafic volcanic pebbles), lenticular limestone interbeds, and basic volcanic sills, associated with reddish mudstones, jaspers, limestones and radiolarites. The thickness of the division is over 500 m, the base is not cropping out.

The second unit consists of coralline limestone beds about 150m thick which includes two parts, the lower part consists mostly of thin beds of coralline limestone. The upper part is more massive and contains lenticular limestone bodies. The upper limestones are nummulitic and are overlain by red shales. The Nummulites indicate a Paleocene-Lower Eocene age. The third unit (middle unit) encompassed grey slaty shaly tuffaceous beds which are called needle slates. They occasionally contain basic pillow lavas and their total thickness reaches 250 m.

The fourth unit covers felsitic and andesitic volcanic rocks with agglomerates and tuffaceous beds. The thickness of this unit in the type area reaches 200 m. The fourth unit consists of basic thin beds of shaly conglomerates and shaly grits whereas the pebbles, composed almost entirely of basic volcanic rocks, are embedded in the soft flysch-like matrix, its thickness reaches 400 m.

The fifth unit (claimed upper unit or Choman Clastics) is composed of thin beds of grey and gritty greywackes, alternating with some sandy shales. The grains and pebbles are mostly composed of igneous rocks. Aswad, et al. (2011) mentioned that during Late Mesozoic–Early Cenozoic, fore-arc type sedimentary basins (i.e. Naopurdan, Palaeogene) were separated from flexural foreland basins (e.g. Tertiary molasse basin) by these sedimentary and serpentinite mélanges (i.e. Qulqula Rise). While Ali et al. (2017) and Aswad et al. (2016) put the tectonic and depositional setting of the Naopurdan Group in the arc and back-arc setting inside the Neo-Tethys ocean (Fig.4a, b). Zhazhlayi and Surdashy (2022) depicted a

paleogeographic-tectonic model of the Soran (Rawanduz) area during Late Cretaceous and Paleocene-Eocene and they indicated Naopurdan and Walsh formations (groups) the inside Neo- Tethys Sea on an island arc and a back-arc respectively (Fig.7). Neary the same result is obtained geochemically by Mustafa et al. (2023). On the contrary, Qaragaghi and Mirza (2023) modeled the development of the Walsh Group on the Neo-They's oceanic floor not on the island arc and introduced peperite to the group.

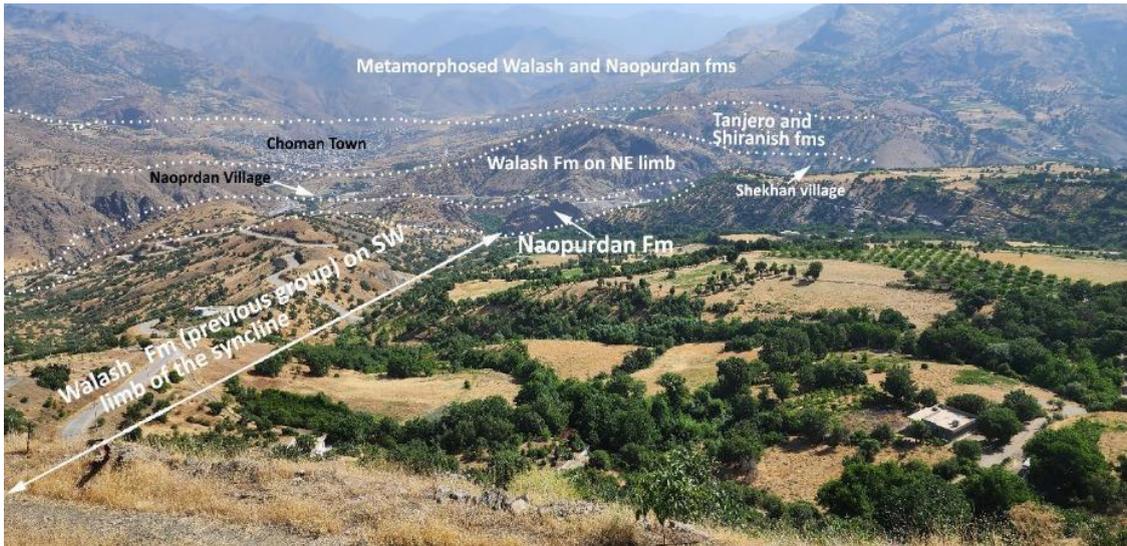


Figure 5. Type locality of the Naopurdan Group (Present Naopurdan Formation) and its surrounding formations. The photo was taken inside Shewalok village and looks northeast.

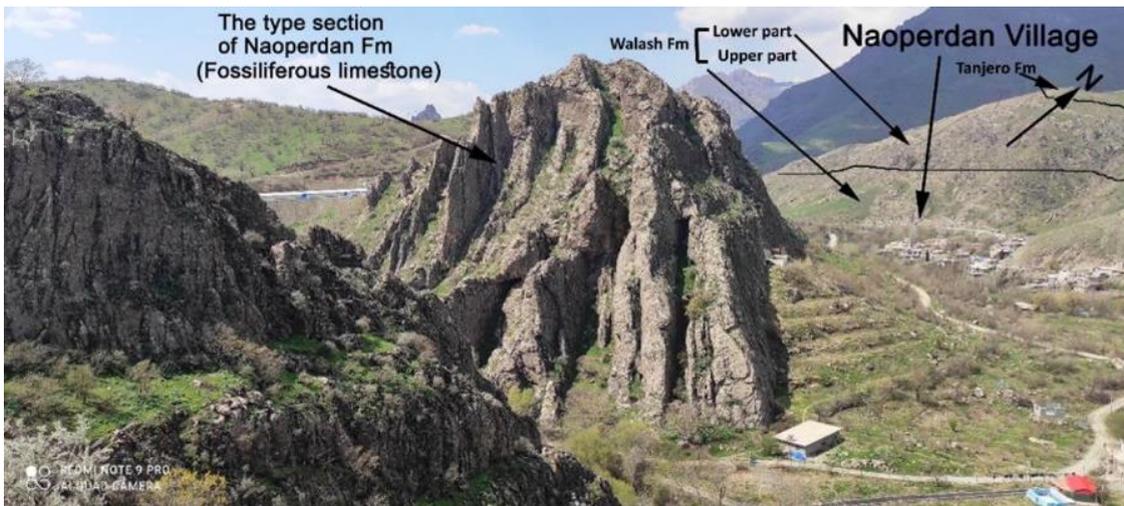


Figure 6. Type locality of Naopurdan Formation near the Naoprdan Village, 2.2 km south of Soran Town.

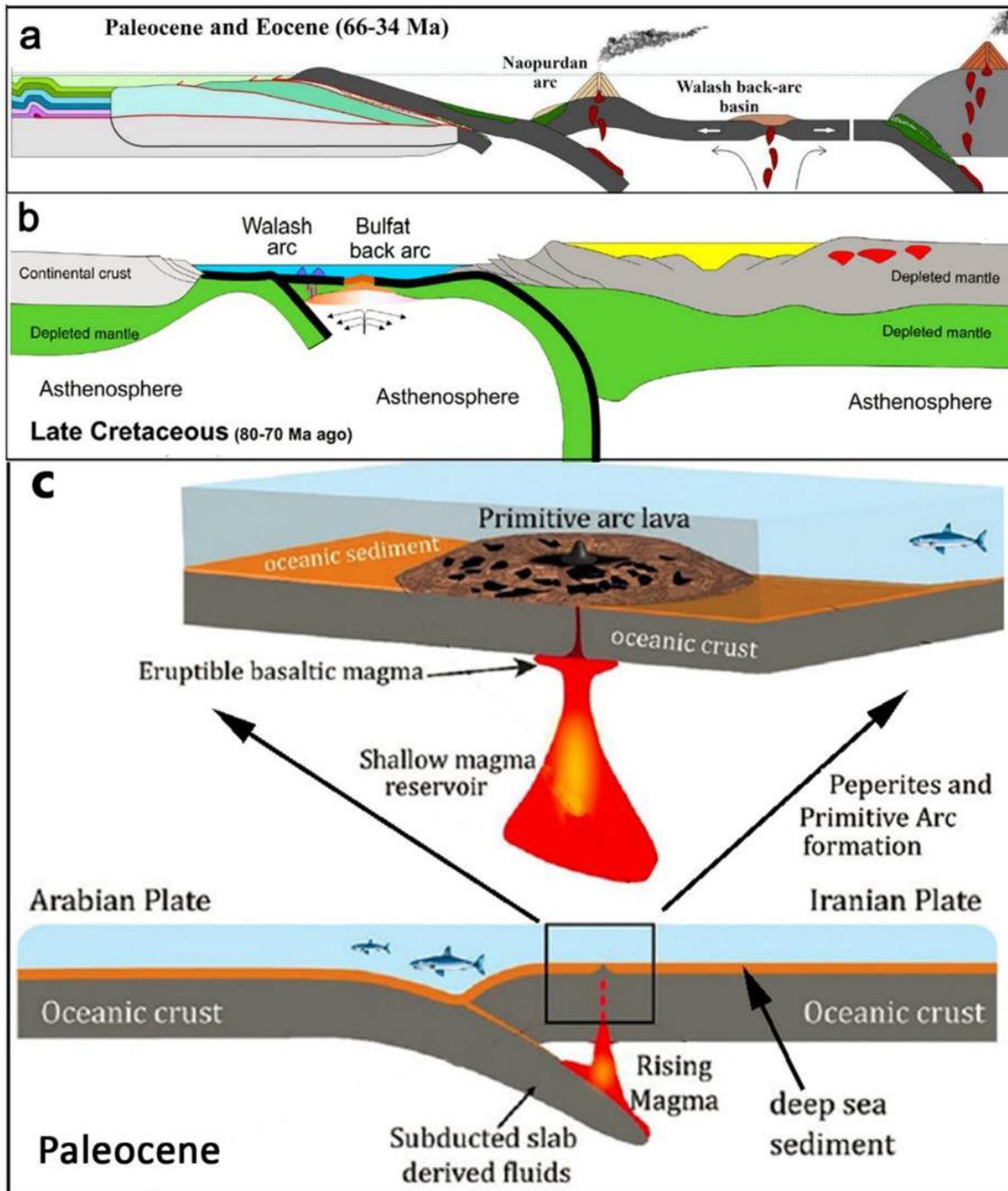


Figure 7. Different paleogeographic and tectonic settings of the Walsh Group, a) during the Paleocene-Eocene by Zhazhlayi and Surdashy (2022) who indicated deposition of the Naopurdan and Walsh formations (groups) on the Island arc and back-arc inside Neo-Tethys Sea. b) while Ali et al. (2013) and Mohammad et al. (2023) reversed the location of the two groups since they put Walsh Group on the arc and put Bulfat Group (ophiolite) in the location of Walsh Group. Additionally, they extended the age of Walsh to 80-70 Ma instead of 66-34 Ma. c) During Paleocene by Qaradaghi and Mirza who changed tectonic setting to development on the Neo-Tethys Oceanic floor.

LOCATION AND GEOMORPHOLOGY OF THE SORAN AREA

The area is known as Rawanduz-Haji Omaran valley inside which the famous Hamilton road passes the valley and connects Erbil town to the Iranian border. The most prominent geomorphic characteristic of the area is its high cliffs and narrow gorges which are common features in the valleys and cut across the high mountains. The most famous cliff is Gali Ali Beg, along which a high waterfall exists with the same name. In the valleys, the type sections of the Walsh and Naopurdan groups (formations) in addition to the Naokelekan and Barsarine formations are located and defined in this area by Bolton (1958) and Bellen et al. (1959). The type section of the Naopurdan Group is located between two high mountains which are Grmubl (Kodo) at the northeast and the Sakaran at the south.

On the other side, the type locality of Walsh Group (Formation) is located between Mama Ruta mountains (anticlines) at the south and Kokha mountain (northwestern end of the Sakran mountain) at the north. The well-known residential features are the Soran and Choman towns in addition to many villages such as Galala, Shekhan, Naoprdan, Darul Al-Salam, Barsarine, Naokelekan and Guezan (Fig.2). Near the latter village, Karim et al. (2022) found and studied in detail Aqra Formation for the first time that is located directly to the east of the Guezan village in the Roste Valley at 2 km north of Dar Al-Salam village at the latitude and longitude of 36° 37' 20.96" N, 44° 45' 35.32" E. The type sections of the Naopurdan and Walsh Formation are in the latitudes and longitudes of 36° 36' 48.48" N, 44° 53' 08.477" E and 36° 33' 59.32" N, 44° 51' 17.33" E respectively.

METHODOLOGY

The study depends on the inspection of the boundary conditions of the Walsh, and Naopurdan Formations (groups) in the Soran area and their relation with the Kolosh and Sinjar formations in the Shaqlaw area. These formations are studied carefully for tens of kilometers around their type localities whereas their properties and lateral changes are investigated in the deep valleys and narrow gorges. In these topographic features, well-exposed sedimentary and metamorphic rocks are cropped out and their internal and boundary properties are studied. These properties are such as uncovering

stratigraphic setting and sedimentology of different units, contact types and structures (deformations) features in addition to its internal characteristics.

These properties are manifested in the cross-section and stratigraphic column. Despite the boundary properties, the petrography, and sedimentary structure (bedding, grain size, texture and stacking pattern) of the two type sections are analyzed in the field using X10 lens. A total of 30 samples are taken for lab analysis including thin section preparation and XRD testing. The tectonic and paleogeographic models are drawn depending on reverse modeling in which all pieces of the puzzle (structure, stratigraphy, lithology) are linked together to unlock the true geologic setting of the Soran area. Thus, a geologic cross-section, a stratigraphic column of the type sections of the Walsh and Naopurdan groups are drawn and plotted on a topographic map for the first time (Figs.2, 8 and 9). Reverse modeling is widely used in mechanic and software engineering in which the pieces of an engine or a program are separated to unlock the original functions and properties of the items and improve their design. All available literature on the Soran and Shaqlawa areas is reviewed and compared with the result of the present study.

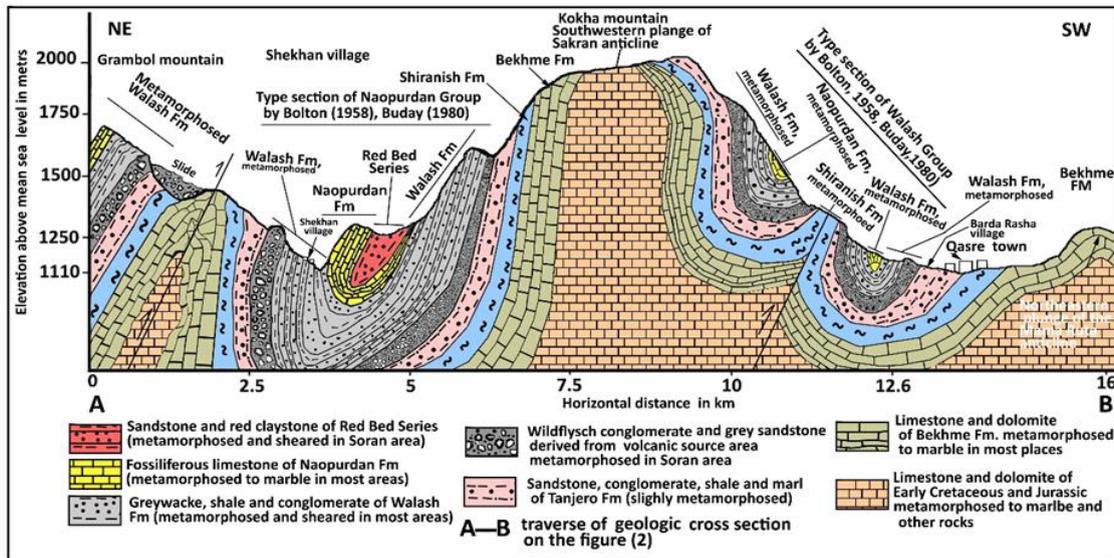


Figure 8. Geologic cross-section of the part of the Soran area passing through type section of the Naopurdan and Walsh groups (formations).

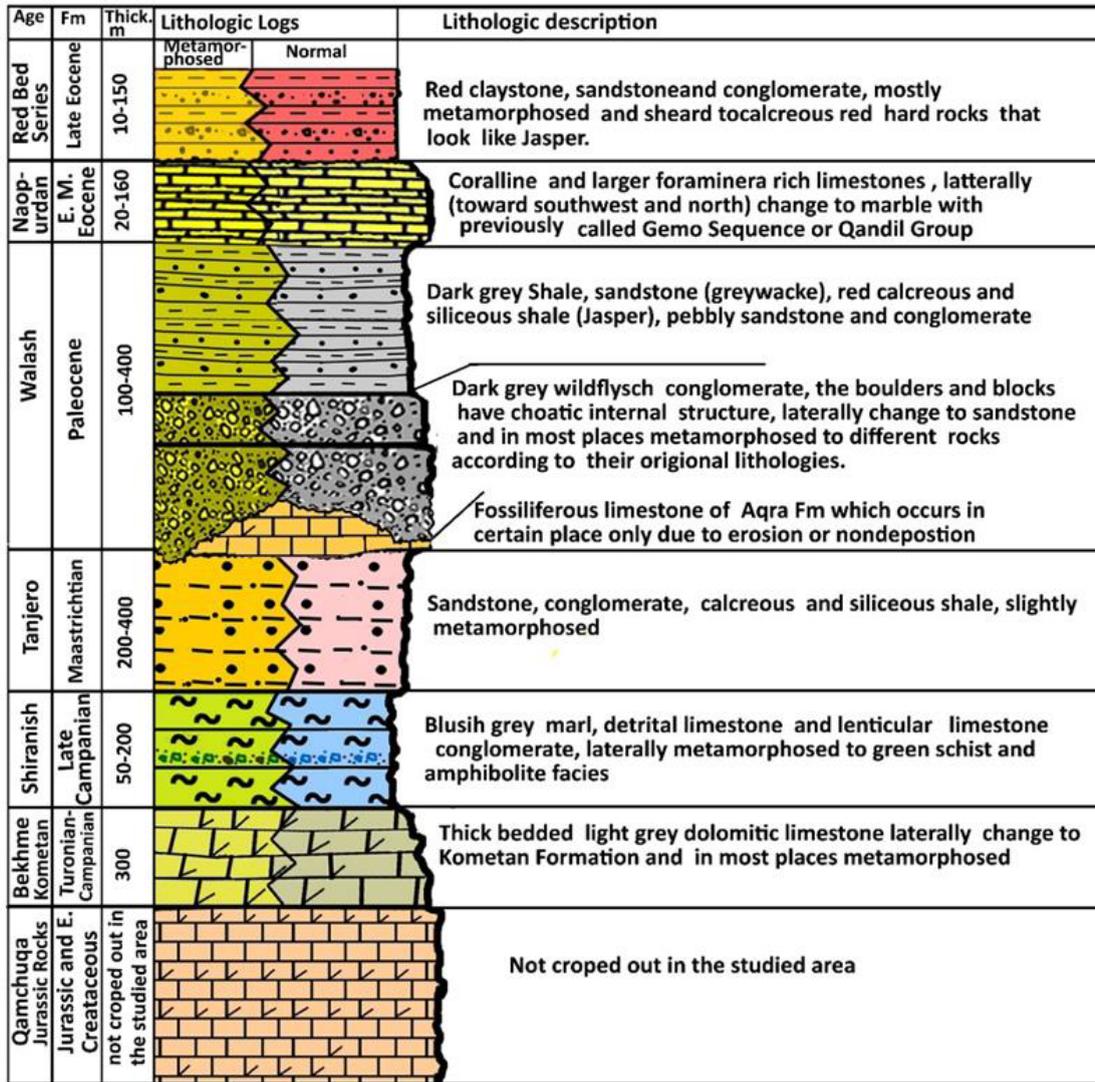


Figure 9. Stratigraphic column of the type section of both the Walsh and Naopurdan formations and their surrounding areas in the Soran area, the yellow shaded left part is regional metamorphism of the two formation.

RESULT AND DISCUSSION

Geology of the Soran area:

The studied area is the Soran District in the Erbil Governorate, Kurdistan Region, northeastern Iraq (Figs.1 and 2). The present study surveyed the outcrops of the Walsh and Naopurdan Formations (Groups) in the Soran area in addition to the Shaqlawa area where the Kolosh Formation is well exposed at its southern boundary. The Soran area is more complex and less studied than the Mawat and Penjween areas and most of the stratigraphic units are different from the latter two areas. According to Ameen and Karim

(2008), in this area, the deep marine Balambo and Kometan formations are replaced by the thick and massive Cretaceous Qamchuqa and Bekhme Formations. In the Soran area, most of the high mountains (anticlines) are built of these two formations at the south of Choman, Qasre and Merga Sur towns. In the north of these towns the high mountain buildup of metamorphic sedimentary rocks of the Walsh and Naopurdan formations which were previously considered as volcanic rocks and ophiolite Rocks.

The geologic setting of the Walsh and Naopurdan formations is more complex in the Soran area than Sulaimanyiah Governorate due to more deformation and scarcity of geological studies. The lithologies of the two areas are nearly the same but conglomerate and fine sandstone and shale are more common in the Sulaimanyiah Governorate than the Soran area. The soft siliciclastic sediments such as Shiranish, Tanjero, and Walsh Formations are compressed inside synclines by the anticlines that are shaped by massive and stiff Qamchuqa and Bekhme formations in Soran area (Figs.3 and 8). These soft rocks are mostly eroded during the Pliocene and Recent due to the high energy streams that flow inside synclines which mostly coincide with deep valleys and gorges of the Soran area.

Most of the valleys and mountains coincide with the synclines and anticlines which are highly deformed especially the rocks inside the synclines such as Walsh and Naopurdan formations. The type localities of these two formations are located inside Walsh-Qasre and Shekhan-Naoperdan synclines respectively. Therefore, when the synclines are tight and isoclinal the structural repetition of the sedimentary successions, along its two limbs, may be considered stratigraphic one and measured as a true thickness. More than that each syncline contains several minor folds and faults that repeat many units of the two formations and exaggerate their thickness. These repetition by structures are not considered by the geologists who first defined these formations during the fiftieth of the last century. This is observed by Al-Khafaf et al. (2016) during the study of the type locality of the Balambo Formation in Sirwan Valley. They found that the type locality contains five folds that are not considered in the definition of the formation and doubled the thickness of the formation.

Al-Jubury et al (2023) studied dunite and Harzburgite (peridotite) near Gallala village and near the type section of Walsh and Naopurdan Groups

(about 4 km north of the Walsh type section). According to geochemistry and mineralogy, they attributed these rocks to the Alpine-type ophiolites. However, according to the geological map of Sissakian (2000) and study of Mustafa et al. (2023), the sections of Al-Jubury et al (2023) belonged to the Walsh Group but they do not refer to it in their study. But they admit that the ophiolitic rocks contain huge reddish-brown blocks of the Walsh Volcano-sedimentary Series. They are not the first who recorded ophiolite in Soran (Choman) area, previously Ali, et al. (2017) showed ophiolite in the Soran area near Haji Omaran Town on their published map. Similarly, Arai et al. (2006) and Ismail et al. (2009) studied Chromitites in the latter area, (near the Rayat village) and concluded that they belong to ophiolite. During their studies of the Soran area, Ali et al. (2017), Zhazhlayi and Surdashy (2022) modeled the deposition of two groups (present two formations) in the oceanic basin of the Neo-Tethys as Island arcs (Fig.4). Mustafa et al. (2020) concluded the same result by geochemistry. These models and results disagree with the result of the present study which confirms the deposition of the two formations in the Zagros Foreland Basin during the Paleocene-Eocene not inside the ocean or on an island arc.

Problems with the definitions of the Naopurdan and Walsh formations (Groups):

The original definitions of the two formations (previous groups) by Bolton (1958) and Buday, 1980) have ten problems, the first is the absence of a precise determination of the location of the type localities of the two formations. There are neither descriptions, photos nor the latitudes and longitudes of the type localities. The second is the acquisition of the names of the two formations from the name of two villages of Nauprdan and Welash villages (ناوبردان و ویلاش) in the Soran area but their direct vicinities are widely covered by soil and not suitable for the type localities. Therefore, we surveyed the surrounding areas for finding the type sections whereas we depended on the lithologic description given by Bolton, (1958) and Buday (1980). The third is the structure of the two type localities since there is no mention of their relations with the structure of their type sections either syncline, anticline, or limbs. The related structure is important to decide if there are repetitions or not. In this regard, the definitions by the latter two authors do not consider the structure of the two formations since they are

located inside the synclines and the definition includes both limbs of the synclines as true thickness not repetition.

The fourth problem is the repetitions of two units in the definition of the Naopurdan Group since Bolton (1958) and Buday (1980) defined the formation across the two limbs of the Shekhan-Naoperdan syncline. The definition of the latter authors starts at the southeast limb of the syncline from the Shiwalug village and passes through Naubarga village (Fig.8). On this limb unit one, (lower unit) is located which represents (according to the current study) the Walsh Formation and has a thickness of 700m. This unit consists of grey shale, greywackes, a thick alternation of basic lenticular conglomerate, sheared jasper, and a few thin beds of marly limestone and reddish mudstone. At the trough of the syncline (Bottom of the Shekhan-Naoperdan or Sakran valley), the limestone unit (unit two) cropped out and it is considered as the middle part of the Naopurdan Group by the latter authors. The current study considers this limestone unit as Naopurdan Formation and represents the newest unit at the top of the Paleocene -Eocene succession since it is in the syncline trough and contain rich assemblages of rich corals and nummulites (Figs.8 and 9). The field study of the present study determined that unit one is repeated on the northern eastern limb where the conglomerate is thicker and coarse than on the southwestern limb due to its location closer to the source area. The rocks on this limb are slightly metamorphosed, and intensely sheared tectonically.

Due to metamorphism and shearing, Bolton (1958) and Buday (1980) divided the repetition of the unit one on this limb into four units which are: slaty shale and needle slate unit, lava flow and agglomerate unit, a conglomerate unit with volcanic pebbles, the uppermost unit is greywacke and shale units. They regarded them as upper (younger) and independent units of the Naopurdan Group while the present study considers them as a repetition of the parts of Unit One on the southeast limb but shows some differences due to metamorphism, shearing and facies changes. The metamorphism, shearing and facies change are due to the location of the northern limb which is relatively closer to the Sanandaj-Sirjan Zone where grain size and tectonic are more than the southern limb of the syncline.

The fifth problem is the Choman clastic unit (unit five) which is considered the youngest unit of the Naopurdan Group by the latter two

authors. They mentioned that it consists of thin beds of sandy shale, greywacke and some conglomerates whose age may extend to Miocene. The present study refuses these properties and the age of the Choman clastics unit since it represents the oldest rock of the Shekhan-Naoperdan Syncline and we think it is the upper part of the Tanjero Formation and its lithology same as the lithologies of the Tanjero Formation. Its lithology is composed of calcareous shale and sandstone (with chert and limestone clasts) with some granule conglomerate but it is slightly metamorphosed that why it may look like greywacke. The Tanjero Formation can be seen clearly inside Choman Town and contains *Omphalocyclus* larger foram (Fig.10) in addition to chert and limestone clasts.

The sixth problem is a record of basic and felsic sills, pillow lava and volcanic cones in the claimed Naopurdan and Walash groups by Bolton (1958) and Buday (1980) while the present study strongly disagrees with the presence of any type of igneous rocks in the two groups. The claimed volcanic cone are channelized lenticular conglomerate that is scoured its channels in soft submarine sediment. This fact was indirectly confirmed by Bolton (1958) and Buday (1980) who mentioned that the cones lateral change to marine sedimentary succession. The clasts of the conglomerate are derived from a volcanic source area inside Iran (See Karim and Abioui, 2023), while the sills are beds of greywackes (slightly metamorphosed regionally) that contain lithic detritus (clasts) and crystalloclast (broken or worn crystals) of igneous rocks and transported to the Paleocene-Eocene foreland basin of the Walash and Naopurdan formations.

The seventh problem is the proximity of the two type localities to each other which are in two nearby valleys that are separated only by one anticline (Sakran anticline) and there is only a distance of 7 km between them. The proximity, Paleocene-Eocene age and their location by Tanjero Formation of the two groups indicate that they belong to the same depositional succession and its separation into two groups is not true work and the two groups are the repetition of one group, not two independent groups which separated, in this study into two formations not two groups.

The eighth problem is the relationship between the Khwakurk Series and the two groups. This series is located about 50 km north of the type locality of the Walash Formation and the same distance to the north of Rawanduz

town in the Khwakurk valley. The lithology of the series is like the Walsh Formation and Kata Rash Conglomerate which consists of acid and basic lavas and derived agglomerates, cherts, jaspers, and purple slates with some limestones.

The most significant and dangerous problem is the relatively intense metamorphism of the Walsh Formation in the Walsh-Qasre syncline while it slightly metamorphosed in the Shekhan-Naopurdan syncline. One doesn't know how metamorphosed succession can be designed for the type locality of a group volcano sedimentary succession since half of the formation is metamorphosed to greenschist and amphibolite facies and the other half metamorphosed to low-grade greenschist facies which appear as slate when the parent rock is shale. Some of these metamorphosed sediments look like gabbro or basalt (hornblende and plagioclase of low-grade amphibolite facies) therefore, Bolton, (1958) and Buday (1980), considered these metamorphosed sediments as basalt, andesite and gabbro.

The Ninth problem is the attribution of rich coral assemblage (Fig.11) to the lower part of the Naopurdan Group but the present study concluded that it belongs to the upper part of the formation while its lower part contains Numulites and alveolina foraminiferas. The final problem is the relation of the Walsh Formation with the claimed metagabbro, basalt, and peridotite or ophiolite (see Al-Jubury, et al. 2023) in the direct vicinity of the Walsh Formation. In this connection, Karim and Al-Bidry (Karim, (2021), Karim and Ghafor, (2021), (Karim, 2023) studied Walsh and Naopurdan Groups in the Bulfat, Mawat and proved that contain no igneous rocks. They added that the claimed ophiolite and basalts are metamorphosed sediment of the Walsh and Shiranish formations. This study verifies the results of the studies and confirms that what is called Ophiolite and igneous rocks, in the Soran area, are metamorphosed greywackes and volcanoclastic sandstone of the Walsh Formation in the Soran area. Toward the north of Choman, Gallala, and Mergasur, the Walsh and Naopurdan are metamorphosed and intensely sheared and previously studied as Ophiolite and Gimo sequence on the Hasanbag and Qalander mountains (see Ali et al., 2012 and Al-Jubury et al (2023).

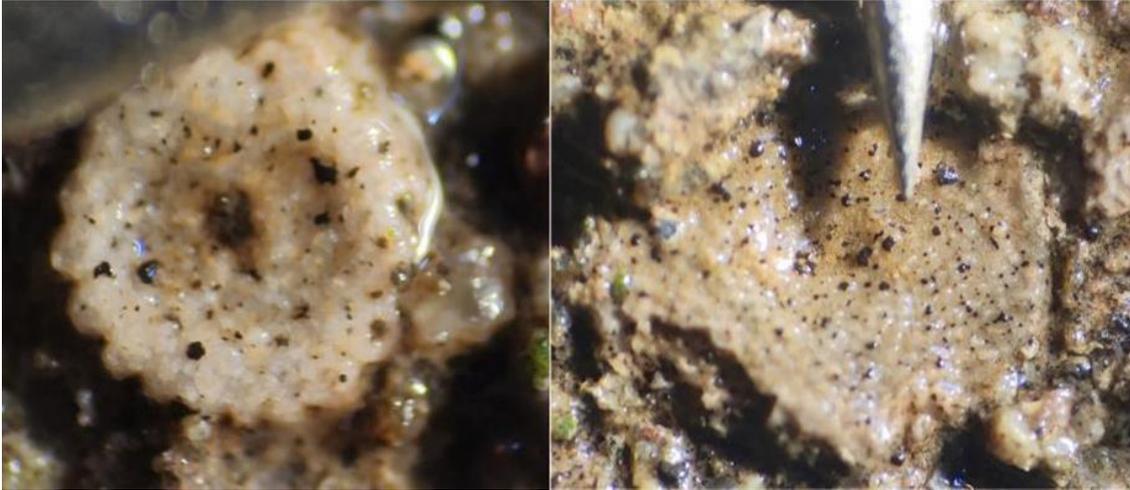


Figure 10. Agglutinated *Omphalocyclus* in calcareous sandstone of the upper part of the Tanjero Formation (Aqra Formation).

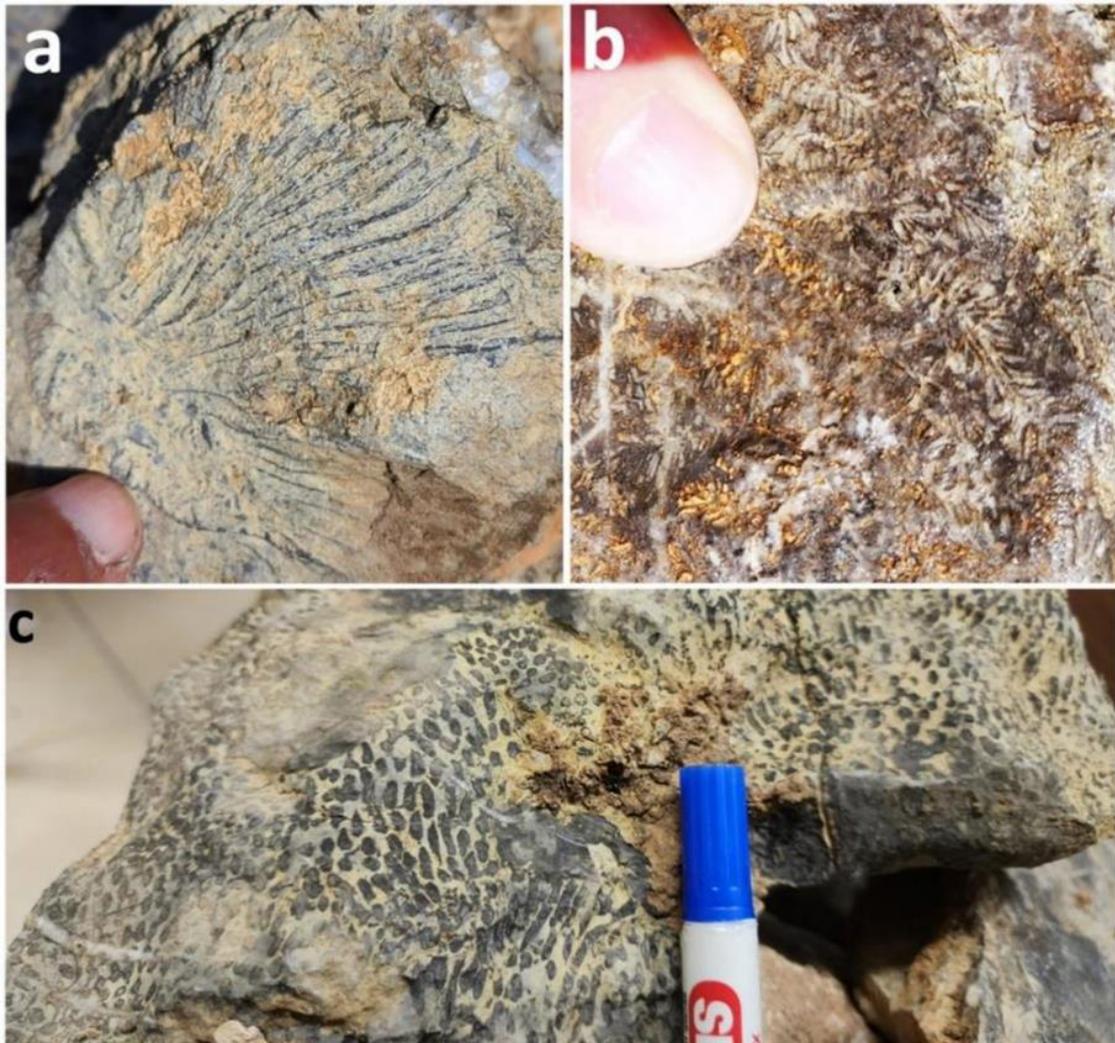


Figure 11. Encrusting coral (b, c) and branching (erected) corals at the top of the section of the upper part of type Naopurdan Formation near the Naoprdan village (ناوپردان).

Structure of the location of the Walsh Formation:

The present location of the type locality of the Walsh Formation is syncline like that of the Naopurdan Formation since it is located on the northwestern limb of the Mama Ruta anticline. This limb is now scored into a valley called Qasre (or Ballain) valley in which Shiranish and Tanjero Formations (Campanian-Maastrichtian) are exposed (Fig.3). This latter unit is comprised mostly of sandstone and conglomerate which host chert and limestone grains (clasts). These two formations are located stratigraphically and topographically below the Walsh Formation which is cropped out on the northwestern side of the valley 4 km northeast of Qasre Town (Figs.3 and 8).

This location coincides with the southwestern side of Kokha mountain (southwestern end of Sakran anticline). The Qasre-Walash syncline is large and it includes several small anticlines and synclines either in the strata of Tanjero or Walsh Formations. In the Walsh Formation, there is a small anticline that is faulted and the Shiranish Formation is exposed and metamorphosed to amphibolite facies (Fig.12c). One does not know how a type section of a stratigraphic unit can be defined and established across both limbs of a syncline which repeat twice the lithology and thickness of the unit. This type of definition is true for type sections of both Walsh and Naopurdan Groups (present formations), therefore, the two type sections must be abandoned and a new type section defined for the two-formation due to metamorphism and repetition.

According to Bolton, (1958) and Buday (1980) Walsh Formation consists of five units but we think that two of them are repeated, such as lower and upper red bed units in addition to lower and upper volcanic. The unit of the “lower sediment” (unit three) is in the middle of the Formation and contains Eocene fossils and located in the trough of the syncline and represents the equivalent of the Naopurdan Formation. Therefore, the four units are repeated along the two limbs and they are the same as the Naopurdan Group (current formation) but with more metamorphism, some facies change and more tectonic deformations. Our fieldwork showed that the Lower Red beds (unit one) are laterally passing to Merga Red Bed and most possibly they are the same unit mistakenly included in unit two.

Stratigraphy of the Walsh and Naopurdan formations (groups) in the Soran Area:

Previously several studies published about the two groups (formations) in the Sulaimayyah Governorate, these studies such as Karim and Al-Bidry (2020), Karim and Ghafur (2021), Karim (2021, 2023), Karim and Hamza (2021), Karim and Abioui (2023). In these studies, the two groups changed to two formations one of them is limestone which is called “Naopurdan Formation” (Eocene) and the other one is siliciclastic rocks and called “Walsh Formation” (Paleocene). They concluded the barrenness of the two formations of igneous rocks and their similarity to the Sinjar and Kolosh formations stratigraphically, chronologically and lithologically. They added that the formation shared the same foreland basin during the Paleocene-Eocene.

The present study evaluated the above facts in the Soran area especially the type localities of the two Groups located in this area. According to Karim (2023) Karim and Ghafur (2021), in the Mawat area the Walsh Formation (Group) is located on the Shiranish Formation and topped by the Naopurdan Formation. They added that during the Early Paleocene, the latter area was the source area and the Walsh Formation was deposited on an unconformity (scored inside the Shiranish Formation). In the Soran area, the Walsh Formation is located on the Tanjero Formation and is overlain by the reefal limestone of the Naopurdan Formation (Early-Middle Eocene) (Figs.10 and 11). Our inspection of the type localities of the claimed Walsh and Naopurdan groups indicated that the two groups are one group of the same age and the same stratigraphic position at the top of the Tanjero Formation, therefore, one group is ignored in the present study and the other one divided into two formations. The type section of the Walsh group is disregarded and we call for ignoring it due to metamorphism and tectonic shearing which altered all its original textures and mineralogies of its sediments. While the Naopurdan Group is divided into two formations, the thick reefal limestone of this latter group is allocated as the Naopurdan Formation (Figs.5 and 6). Whereas its siliciclastic succession and claimed volcanic rocks (present greywackes and conglomerate) are assigned as the Walsh Formation (Figs.11, 12 and 13).

There are many reasons to abandon the type section of the Walsh Group, the first is the metamorphism of all rocks whereas all rocks lost their textures, structures and some of their mineralogies. The second is the deformation of the type section by, at least, two folds (a syncline and an anticline) that doubled the thickness of the group. The third is the occurrence of wild flysch conglomerate (10- 50 m thick) at the base of the two groups and consists of the block and boulder conglomerate with bad sorting and chaotic internal organization (Fig.13). This conglomerate indicates that the two groups are one succession and needs no two groups. This conglomerate is equivalent to the Kata Rash Conglomerate (Karim and Abioui, 2023) in Shalair Valley in age and type of lithology and clasts caliber which was previously considered as volcanic rocks and named Cretaceous Kata Rash Arc by Ali et al. (2016).

The best outcrop of this conglomerate is located 2 km west of Shekhan village and 4 km south of Chaman town inside the Naopurdan Group while inside the Walsh Group, it cropped out at 1 km north of Bard Rahan village (Fig. 10a). There are two other outcrops on the Gallala mountain, at 2km and 3k northeast of Gallala village respectively (Fig. 14). In the Soran area, Kata Rash Conglomerate has a thickness of 10- 50 m and its texture and internal organization refer to wildflysch sedimentary rocks. According to Bate and Jackson (1980), is a type of flysch facies that represents a stratigraphic unit with irregularly sorted boulders resulting from fragmentation, with twisted and confused beds resulting from slumping or sliding due to the influence of gravity. Kata Rash conglomerate (Wild-flysch), in the Soran area, contains both andesitic and basaltic boulders and gravels that are floating in a fine mafic matrix of sand, silt and shale (Figs. 2a, 11, 12,13 and 14). The distortion and clasts floating inside fine matrix indicate transportation by debris flow in high tectonic conditions. In addition to the wild-flysch conglomerate, the Walsh Formation contains gravel (normal) conglomerate (Figs.13,15 and 16).

The third is the presence of limestone in both groups in the middle of the two groups (at the upper part of the two groups of the present study in the trough of the syncline). In the present study, this limestone is called Naopurdan Formation (Figs.6, 8 and 9) but it metamorphosed to marble inside the Walsh Group and it is called chemical limestone by Bolton,

(1958) and Buday (1980). The fourth is the similarity of the lithology of both groups since both contain claimed volcanic rock, sill and dykes, shale, limestone, red beds, tuff, greywacke and conglomerate. In this connection, recent studies manifested similar properties of both Walsh and Naopurdan formations (or groups) since Ali et al. (2017) mentioned that both groups (formations) contain a nearly equal amount of quartz, feldspar, pyroxene and amphibole, rock fragments, carbonate and chert grain, foraminifers.

The fourth is the presence of some differences in the lithologies and units are attributed to the nature of the deposition process of the two groups. Both are deposited by turbidity current and the submarine processes of mass transport deposits which according to Bouma, (1985, 2000) and García et al. (2015) contain different sediment and topographic features such as conglomerate, arenite, shale, debris flow, slump, slide, channelized sediments, submarine levee and fan surface sediments. Therefore, the caliber and mineralogies of the turbidite are changing suddenly due to the submarine process. Moreover, each fan has its source area and thus supplies different volcanic detritus and crystaloclasts from the Iranian Sanandaj-Sirjan Zone. Therefore, the two groups belong to the same age, basin and same processes but their differences are attributed to the complexity of the submarine deposition and sediment supply which changes in short distances in the same basin. The Tanjero Formation is the underlying Walsh Formation which is observable 1km north of the Shekhan and East of Naoprdan village (Figs.2 and 13). Although proper Aqra formation is not found in the area near these two villages, However, Karim et al. (2022) found it above the Tanjero Formation 11 km southwest of the Choman Area inside Guezan village (Fig.2).



Figure 12. a) type section of Walsh Group (Formation) at the north of Qasre town, the photo looks northeast, b) wild flysch conglomerate at the lower part of the group, c) Shiranish Formation which is metamorphosed to Amphibolite facies at the middle part of the group, d) Metamorphosed conglomerate (grit conglomerate) at the top of the group.



Figure 13. Shekhan-Naoprdan syncline in which Walash and Tanjero Formations are exposed, the name Kata Rash conglomerate is taken from the same name and the same type of conglomerate in Shalair valley (see Karim and Hamza, 2022).



Figure 14. a) The Kato conglomerate (as a wildflysch on the Gallala mountain at 36° 38' 36.11" N, 44° 50' 15.70" E, b) A fragment of the conglomerate whereas its clasts belong to volcanic rocks.

According to the stratigraphic column of the western part of the Soran area, its stratigraphy is nearly like that of the Mawat area since the Tanjero, Aqra Formations, in addition to the Red Bed Series (or Merga Red Bed), and the Walash, Naopurdan Formations are in their comparable stratigraphic order age-wise. In some locations, the Walash Formation (as the equivalent of the Kolosh Formation) eroded and the Red Bed Series is deposited above the Tanjero Formation (or Aqra) Formation unconformably such as near Guezan village.

The Walash and Naopurdan formations in addition to the Kata Rash Conglomerate (previous volcanic rocks) are like the Penjween area. However, the conglomerate in the Soran area is coarser and consists of a boulder conglomerate and contain chaotic clasts of different rocks, but the volcanic arc-derived clasts are abundant (Fig.15.and 16).

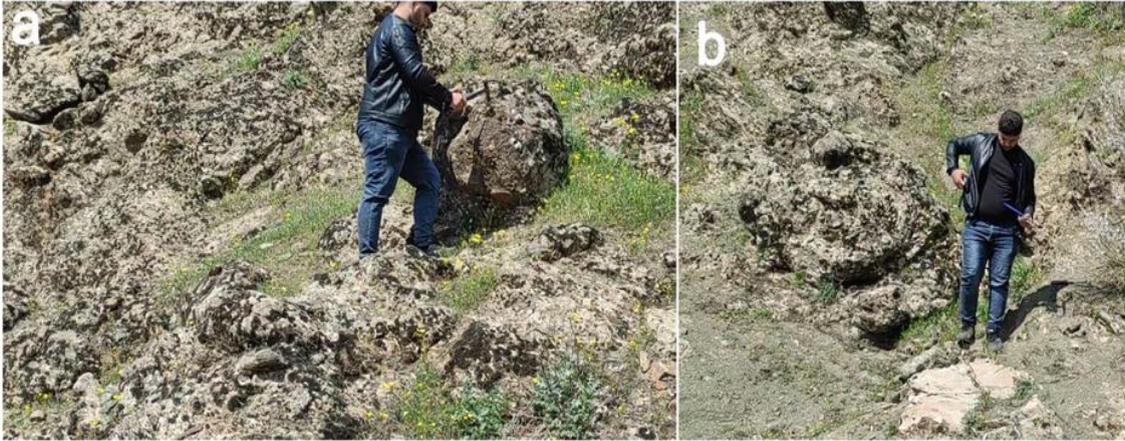


Figure 15. Wild-flysch conglomerate of Walash Formation between Naoperdan and Shekhan villages, shows, a) a boulder of andesitic rocks, b) the same conglomerate shows distorted block and a boulder of felsic rock.



Figure 16. Gravel (a normal conglomerate of andesitic composition at the lower part of Walash Formation).

Relation of the Walash Formation to the Kolosh Formation in the Shaqlawa area:

In the Iraqi Thrust Zone, the Walash and Naopurda formations are sediments of Paleocene -Eocene, while the Kolosh and Sinjar formations belong to the same age in the Shaqlawa area (in the High Folded Zone) (Buday, 1980 and Jassim and Goff, 2006). In the latter area, the Kolosh Formation is located between the Tanjero and Khurmala (Sinjar) formations (Fig.17) and this stratigraphic setting is nearly the same as the Soran area since the Walash Formation (Paleocene) is located between the Tanjero and Naopurdan formations (Figs. 8 and 9). Recently Ghafor and Muhammad (2022) studied in detail the biozonation of the Naopurdan Formation in the Chwarta area and concluded the Early-Middle Eocene age of the formation.

These facts indicate that these two carbonates- siliciclastic successions (Kolosh-Khurmala and Walash-Naopurdan) have nearly the same age (Paleocene- Eocene) and were deposited synchronously and shared the same source area and foreland basin.

The geochemistry and petrography manifested that the source area of the Walash Formation was volcanic arcs which are confirmed in previous studies such as Ali et al. (2013), Aswad et al. (2016) Ali et al. (2017) and Zhazhlayi and Surdashy (2022). The same conclusion is true for the Kolosh Formation since Mashaikie and Mohammed (2018) recorded olivine/pyroxene-rich sandstone beds of the formation in the Dohuk area. Ali et al. (2019) studied the geochemistry of the shales inside the Kolosh Formation and concluded sourcing from an island arc (Fig.18). The field observation revealed that some unmetamorphosed part of the Walash Formation is exactly like the Kolosh Formation in the color bedding thickness and staking pattern (Fig.19).

The thin section study showed a close relation between the two formations since both contain mainly volcanic lithic detritus (clasts) (Fig.20) and crystalloclasts of hornblende, plagioclase (Figs.21 and 22). However, there are four differences, the first is the more sediment softness of the Kolosh Formation than the Walash Formation due to remoteness from the source area. The second is the presence of sedimentary clasts such as chert and limestone in addition to volcanic lithic clasts and crystalloclasts in the Kolosh Formation. The third is the hosting of thick conglomerate beds by the Walash Formation (previous group) and its pebbles and boulders are derived from volcanic rocks. The fourth difference medium grade of the metamorphism of the rocks of the Walash Formation near its type section while toward the north and northeast changes to high-grade greenschist and amphibolite facies which were previously considered as volcanic rocks and ophiolite by Bolton, 1958 and Buday, (1980). The metamorphism is gradual for the same rock but due to the diversity of lithology and mineralogy of beds of the Walash Formation unexpected relatively high degree of metamorphism can be found in a low grade especially when the original rocks are rich in crystalloclasts of amphibole, pyroxene and plagioclase derived from erosion of source rocks inside Iran.

Although the igneous clasts (mainly hornblende) are observable in thin sections of Kolosh formation, the XRD does not show them due to alteration instead they shows Analcime which according to Zhu, et al. (2020) and Wang et al. (2022) formed from burial alteration of volcanic materials (Fig. 3). The presence of this mineral agrees with the result of the present study that the Walsh, Kolosh formations are source originally from Volcanic arc inside Iran (see Karim, 2023 for detail).

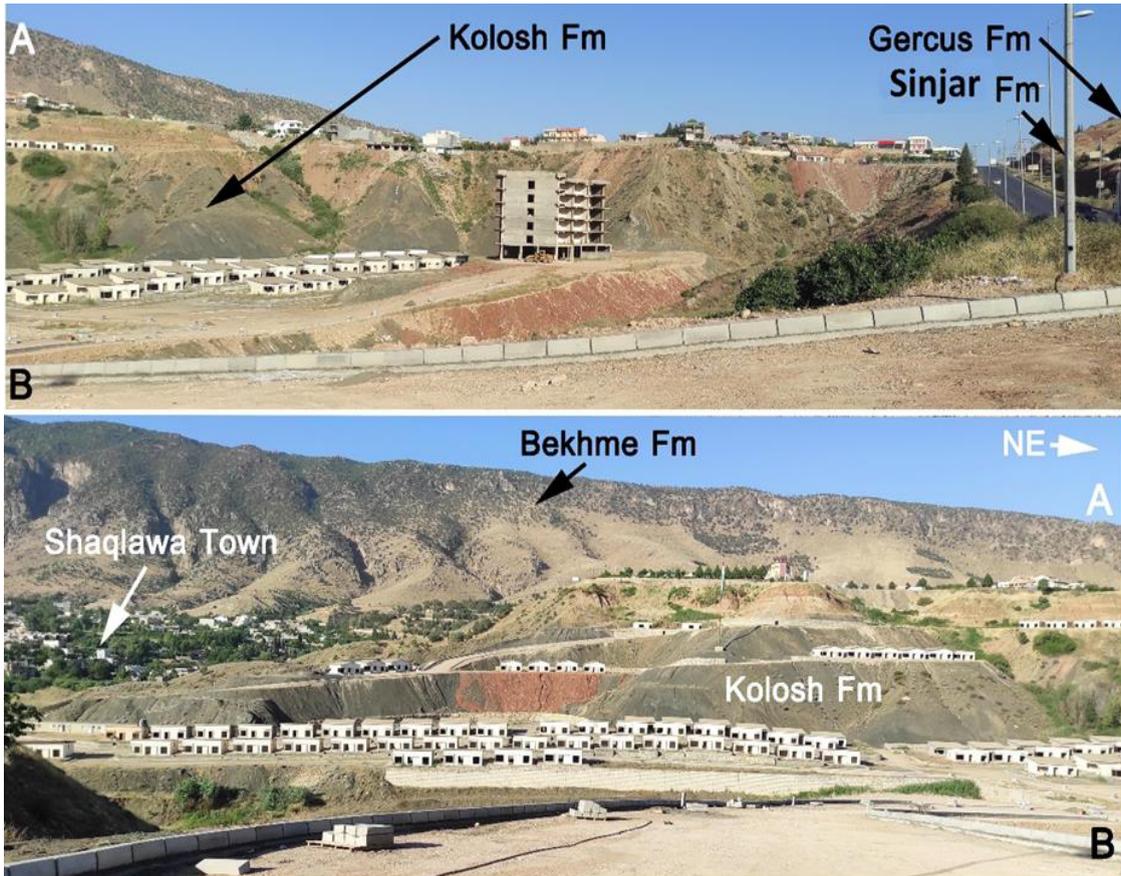


Figure 17. Outcrop of the Kolosh Formation inside the Shaqlawa town between Sinjar and Tanjero (covered) Formations (showed by two panoramic photos which split across AB).

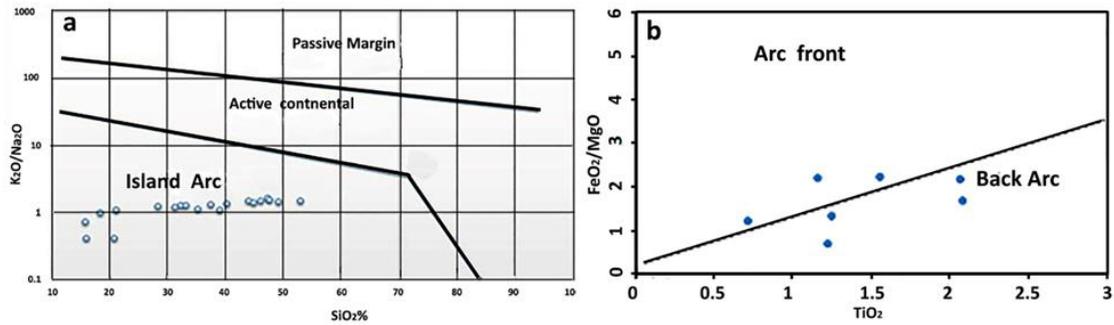


Figure 18. a) Plotting of shale geochemistry of Kolosh Formation by Ali et al. (2019) on the diagram of Roster and Korsh (1986) indicated the provenance of Island Arc, b) The same plotting is true for the Walash Group by Ahmed et al. (2023).

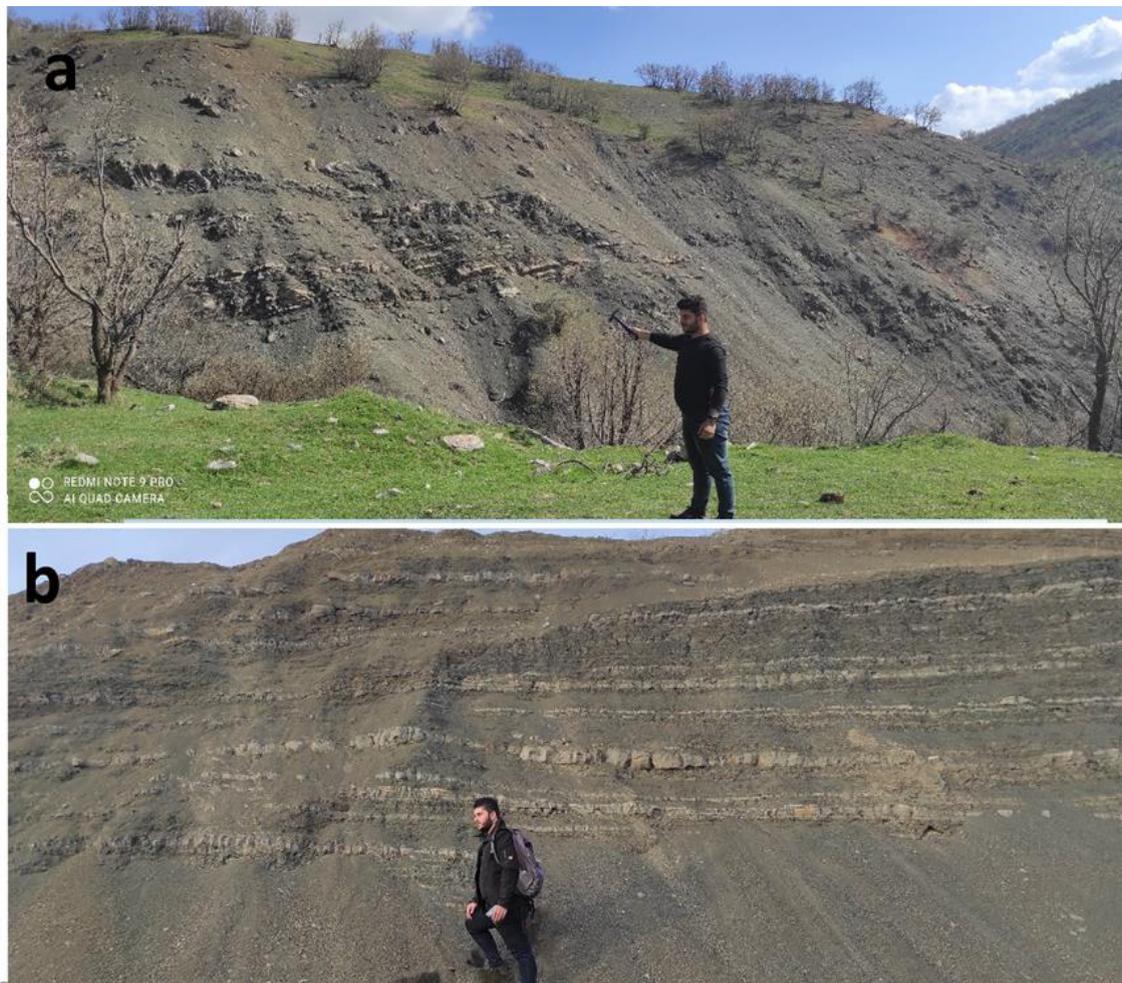


Figure 19. a) An interval of unmetamorphosed middle part of the Walash Formation at 1 km south of Walash village, Soran area. It is very similar to the Kolosh Formation in the Shaqlawa area (b).

Recently, Bamarni (2022) and Bamarni et al. (2022) Found well-preserved impact spherules bed at the K/Pg (K/T) boundary which hosts impact silica spherules at the K-Pg contact between Shiranish and Aaliji formations. They

considered that they were transported from Mexico during the Chicxulub impact at the K-Pg boundary 65 million years ago. About the above finding we express three facts, the first is Shiranish and Aaliji formations are equivalent to the Tanjero and Kolosh Formations in the Dohuk area. The second is the facies change of the Kolosh formation to marl in the Dohuk area which they called the Aaliji Formation. The third is the conclusion of the present study about the volcanic origin of the sediments of the Kolosh Formation and Walash Formation. Therefore, it is not necessary (and impossible) for the claimed spherules to be transported ten thousand kms from Mexico to Iraq. We estimated that they come from the well-known volcanic arc of the Urumieh-Dokhtar Magmatic Arc during vigorous volcanic eruptions and reached Duhok area by turbidity current transportation. Therefore, there were no barriers between Soran and Shaqlawa areas during the Paleocene-Middle Eocene and the model in Figure (23) is applicable for Soran-Shaqlawa areas.

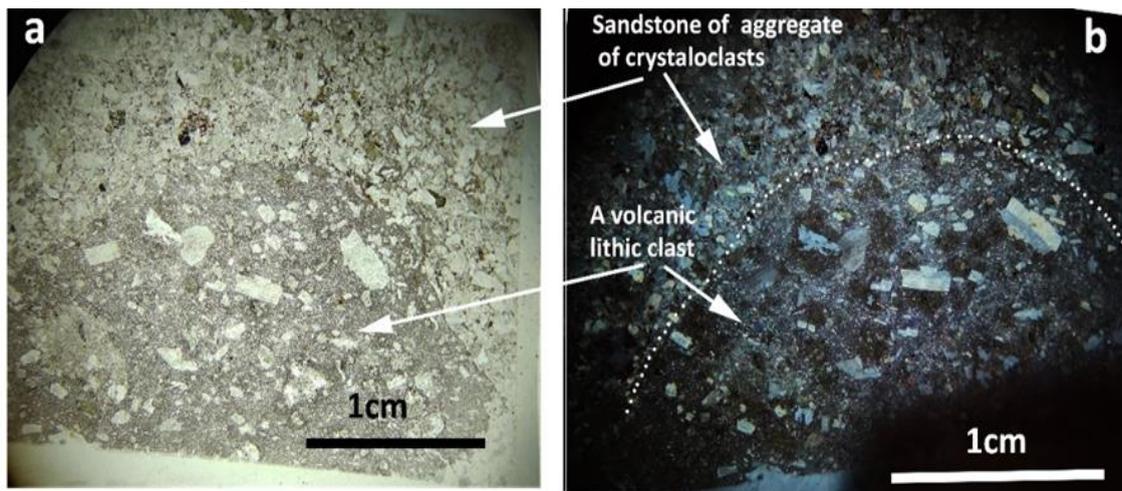


Figure 20. Most of the sandstone and conglomerate of the Walsh Formation contain volcanic lithic fragments surrounded by the aggregate of crystalloclasts, a) under normal light, b) under cross-polar light.

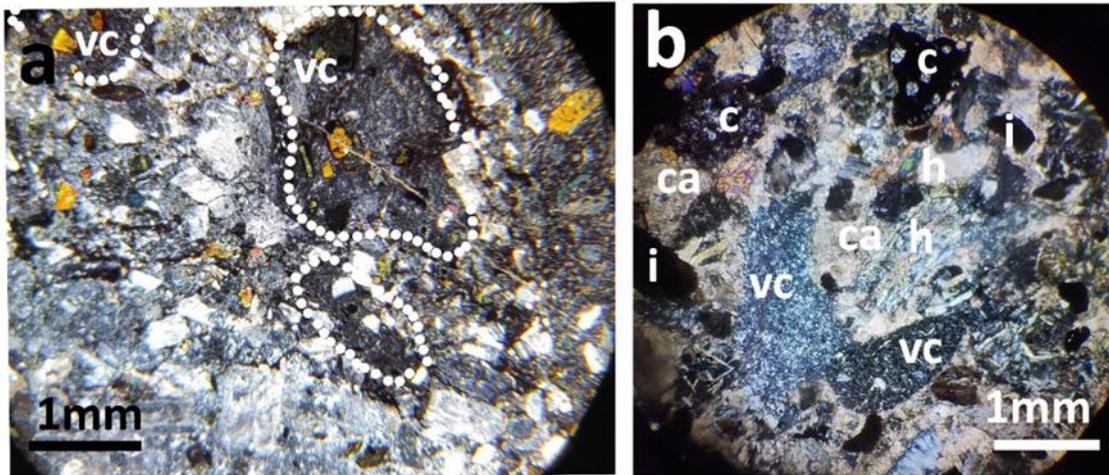


Figure 21. Two thin sections of the sandstones of the lower part of the Kolosh Formation which are very similar to the Walsh Formation in mineral constituents, a) S.N. 5K, XPL, b) S.N. 7K, XPL. vc: volcanic clast, ca: carbonate grain, c: chert, i: Iron oxide grain.

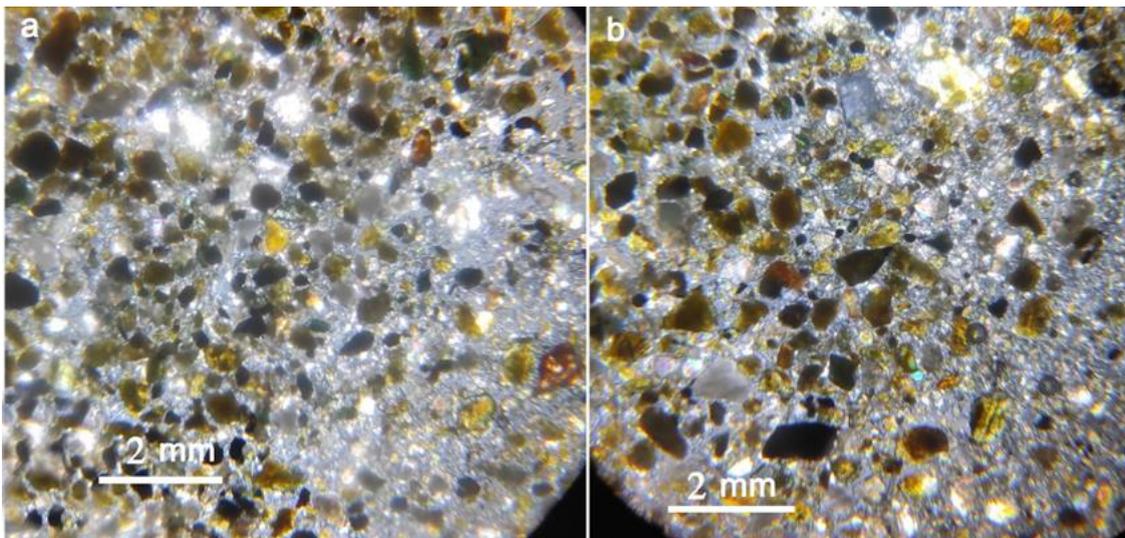


Figure 22. Thin section of the greywacke of Kolosh formation in the Shaqlawa area shows amphibole mineral (green and brown), limestone clasts (grey) and iron oxides (black), The carbonate cement materials are removed by a weak acid, S.N. 10K, XPL.

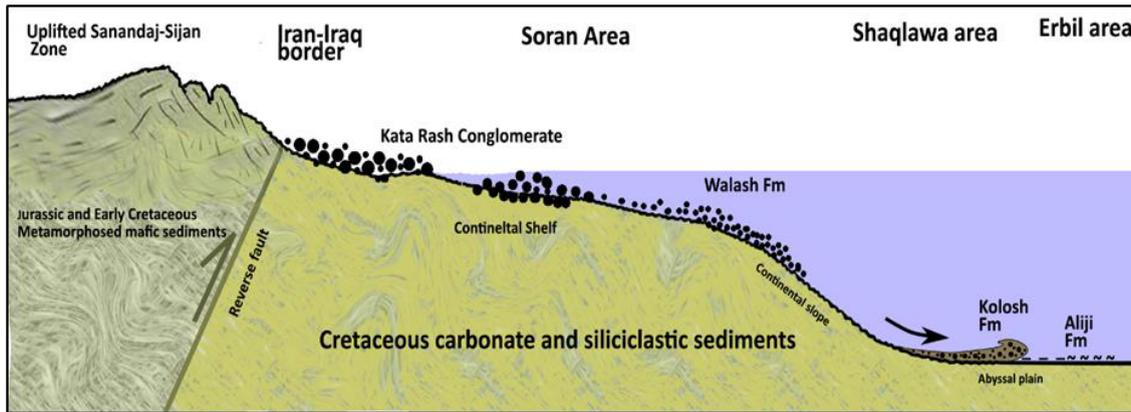


Figure 23. A diagram shows the location of the Kata Rash Conglomerate (as coastal facies), metamorphosed Walsh Formation (slope facies), Kolosh Formation (deep basin turbidite facies), and Aali Formation in the Soran, Shaqlawa and Erbil areas respectively. The name Kata Rash conglomerate is taken from the same name and the same type of conglomerate in Shalair Valley (see Karim and Hamza, 2022).

The provenance of the lithic detritus and crystalloclasts in the two groups:

All the previous studies considered the sediment and volcanic rocks of the Walsh and Naopurdan groups (present formations) deposited on a volcanic arc inside the Neo-Tethys Ocean and they later obducted on the Arabian Plate Margin (Figs. 4 and 7). According to these studies, the whole rocks of the two groups were transported long distance as part of the Oceanic floor of the Neo-Tethys to their presence in Iraq and they are considered Allochthonous units. The present study confirms that the two groups are autochthonous pure sedimentary succession that was deposited in the Zagros Foreland Basin but accepts that their grains (lithic detritus and crystalloclasts) are transported by turbidity currents from uplifted volcanic source areas in Iran.

These studies deserve three criticisms, the first is their dependence on geochemistry and thin section studies for concluding the volcanic setting of the two groups. These two methods are unable to indicate if the constituents of rocks are in situ crystallization or transported from a remote distance. All their thin-section photos show angular and cracked grains that have wearied edges and outlines indicating transporting by fluids not crystallized in magma. The figure (24 a and b) published by Ahmed et al. (2020) to manifest euhedral crystals of Cr-spinel, however, they show anhedral grains that are wearied crystalloclasts either deposited by fluid or replaced

preexisting lithic detritus in the Soran area. Similar aerial photos are used by Ismail et al. (2009, their fig.4), Arai et al. (2006, their fig.2) and Mirza and Rashid (2019, their fig.4) to show crystals of the latter minerals. In the Soran area, the latter article used the term “brecciated” instead of angular grain to not contradict their magmatic origin which must be mostly euhedral. The same angular bodies are shown in Soran area by Ahmed et al. (2023) (Fig. 24c and d) to indicate amygdaloidal basalt, however, the present study interprets the bodies as lithic clasts replaced by calcite or other minerals in a metamorphosed badly sorted pebbly sandstone (greywackes) because the amygdales must have some roundness.

The second is the ignorance of sediments of the Neo-Tethys ocean which was surrounded by volcanic arcs. Instead of volcanogenic sediments of the ocean, they are concerned with arcs in the Neo-Tethys. These arcs are manifested in tens of studies without direct evidence such as lava flow, volcanic dike, volcanic caldera, lava channels or sheets, and pillow lavas. They showed few outcrops of claimed pillow lava but the present study inspected all of them and depicted that they are pillow-like bodies formed inside metamorphosed volcanoclastic sandstones (greywackes) by tectonic shearing in fault zones as boudinage. The direction of shearing is clear around these claimed pillows and their elongated direction is all upward toward the earth's surface not toward the paleoslope of the basin or land. In the areas of the claimed pillows and volcanic arcs, there are no any study concerned with the direction of lava flow although they have structures that clearly show the direction of flow.

The third criticism is the claim of magmatic chromitite pods in the Soran area near Rayat village by Arai et al. (2006), Ismail et al. (2009) and Ahmad et al. (2020). The same pods are mentioned by many authors in the Mawat area, however, the present study does not aid their presence because they are never shown in their locations by all authors. The visit to the claimed pods in the Mawat area manifested that they are irregular bodies that have no characteristic pods. In the Soran area, near Rayat village the latter above three studies showed dislocated blocks of chromitite on the soil slope of the Rayat area (Fig.25). The field study of the present study prefers two possible origins of these chromitites, the first is hydrothermal origin either by direct precipitation from Cr rich solution or by replacement of other minerals such

as calcite and dolomite. The pods of the Soran area are associated with or close to limestone (Fig.25a) and according to Mirza and Rashid (2019), they are rich in carbonates (calcite and dolomite) to various extents. Recently all the iron ore of the Soran and Penjween area are proven to be associated with limestone and attributed to hydrothermal origin not magmatic by Karim et al. (2015), Mirza and Rashid (2019) and Abdalla et al. (2023), therefore, the origin of chromitite is also hydrothermal due to close relation between Cr and Fe.

The fourth criticism is the idea of volcanic arc not only restricted to, Soran, Mawat, Bulfat, and Penjween areas but recently they changed the Duhok and Hamrin (Baquba Governorate) areas to volcanic arc during Eocene and Pliocene by Kettanah and Bamarni, (2018), Kettanah et al. (2021) depending on geochemistry. However, these ideas are discussed objectively by Karim et al. (2020) and Karim (2022) and proved that they neither arc nor contain volcanic intrusions, but they are greywackes (volcaniclastic sandstones) that their lithic detritus and crystalloclasts are transported by water from remote source areas. Recently Karim and Abioui, (2023); and Karim (2023) discussed and modeled in detail how and where the components of greywackes (volcanogenic sediments) are transported to northern Iraq. They considered the Sanandaj-Sirjan Zone as a remnant of the deep Neo-Tethys Sea and refused the consideration that the zone is a continental block or volcanic arc by previous studies. They added that inside the Neo-Tethys thick pile of volcanogenic sandstones and shale were accumulated during the Jurassic and Early Cretaceous in a thickness of several tens of kilometers.

Due to the stresses that were associated with the colliding of the Arabian and Iranian plates, these sediments deformed, metamorphosed and uplifted slowly. In the early stage, the deformation, the light-weight sediments such as radiolarite and limestones were uplifted and eroded resulting in the deposition of the Shiranish and Tanjero Formations during the late Cretaceous in the Zagros Foreland Basin. With the increase of stress and narrowing of Neo-Tethys (present Sanandaj-Sirjan Zone), the heavy-weight sediments such as volcanogenic sediments (greywackes, volcaniclastic sandstone, mafic shale and mafic conglomerate) were uplifted and eroded during the Paleocene inside the Iranian Sanandaj-Sirjan Zone. The sediments

of this Paleocene erosion were transported, from Iran to the Soran and other parts of Northern Iraq by turbidity currents in the deep foreland basin and deposited as the Walsh and Naopurdan groups (Figs.26 and 27). Therefore, the present study refuses arc and ophiolite obduction in the Soran area and stresses the deposition of the two groups in their present locations as autochthonous units. Due to their heavy- weight, the sediments of these two groups were deeply buried and regionally metamorphosed during the Late Eocene- Oligocene to the greenschist and amphibolite facies which were unfortunately previously regarded as volcanic and ophiolite rocks. The buried and metamorphosed sediments uplifted as a Metamorphic Core Complex during the Late Miocene-Pliocene. The erosion of the core complex supplied conglomerates and sandstone sediments to the foreland basin and deposited as Upper Fars and Upper Bakhtiari formations.

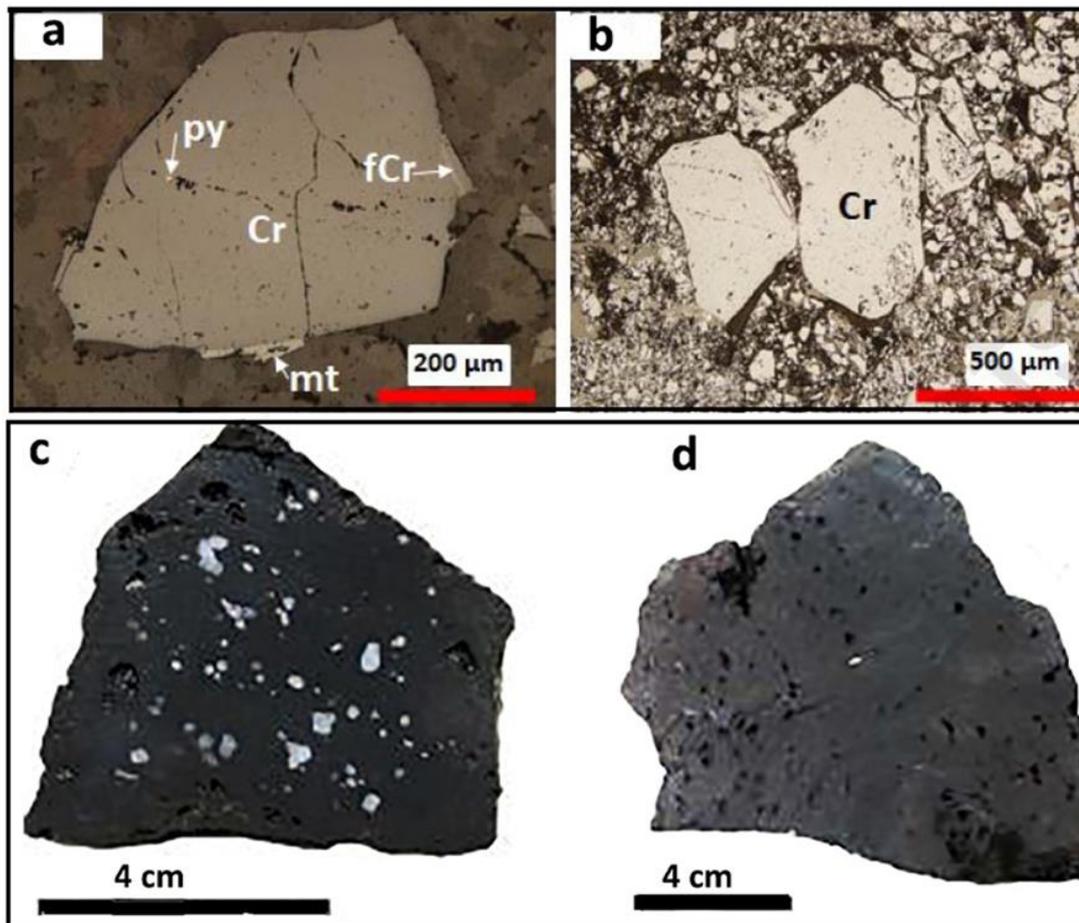


Figure 24. Four photos of Ahmed et al. (2020) intended to manifest euhedral crystals of Cr-spinel (a, b), while (c and d) proposed to indicate amygdaloidal basalt, however, the present study interprets the bodies as lithic clasts replace by calcite or other minerals in a metamorphosed badly sorted pebbly sandstone (greywackes).

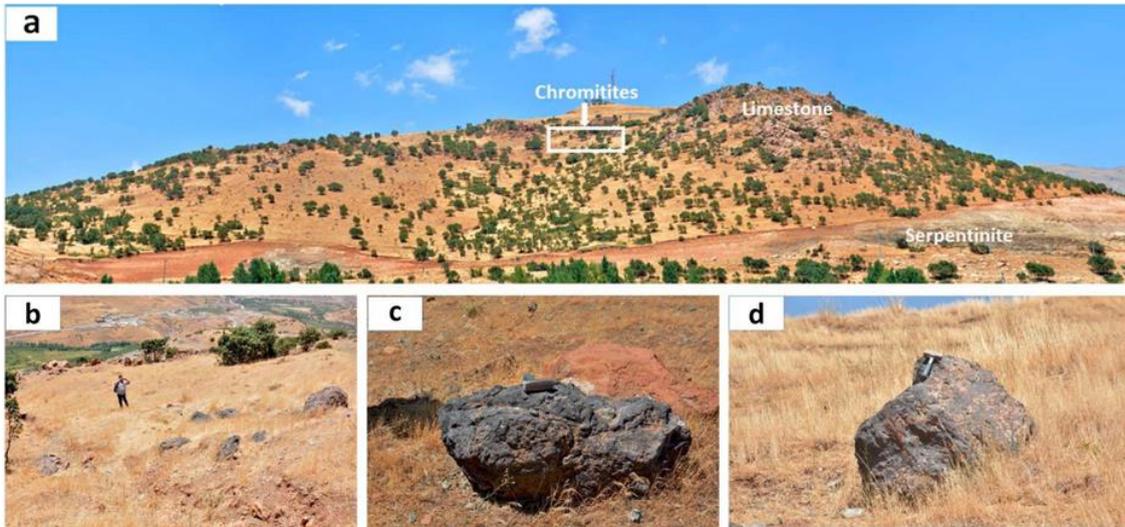


Figure 25. For the photo published by Ahmed et al. (2020) to show pod- form chromitite in near Rayat village, Soran area. The present study has two notes about these photos, the first is they present near limestone which indicates possible replacement of their origin, and the second is the resting of the claimed pods on slope soil which can't be called pods but are better called doslocated blocks of chromitite.

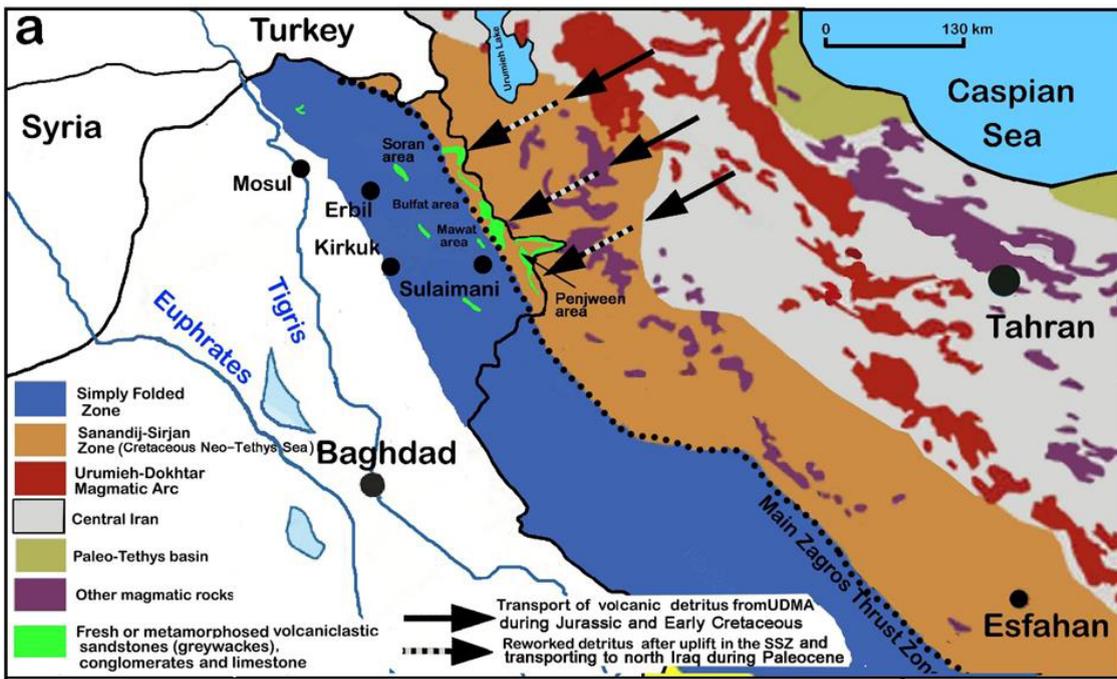


Figure 26. Zonal Tectonic map of the Zagros Belt shows the transportation of the volcaniclastic sediments in two stages of deposition, metamorphism, uplifting, and erosion (Karim and Abioui, 2023).

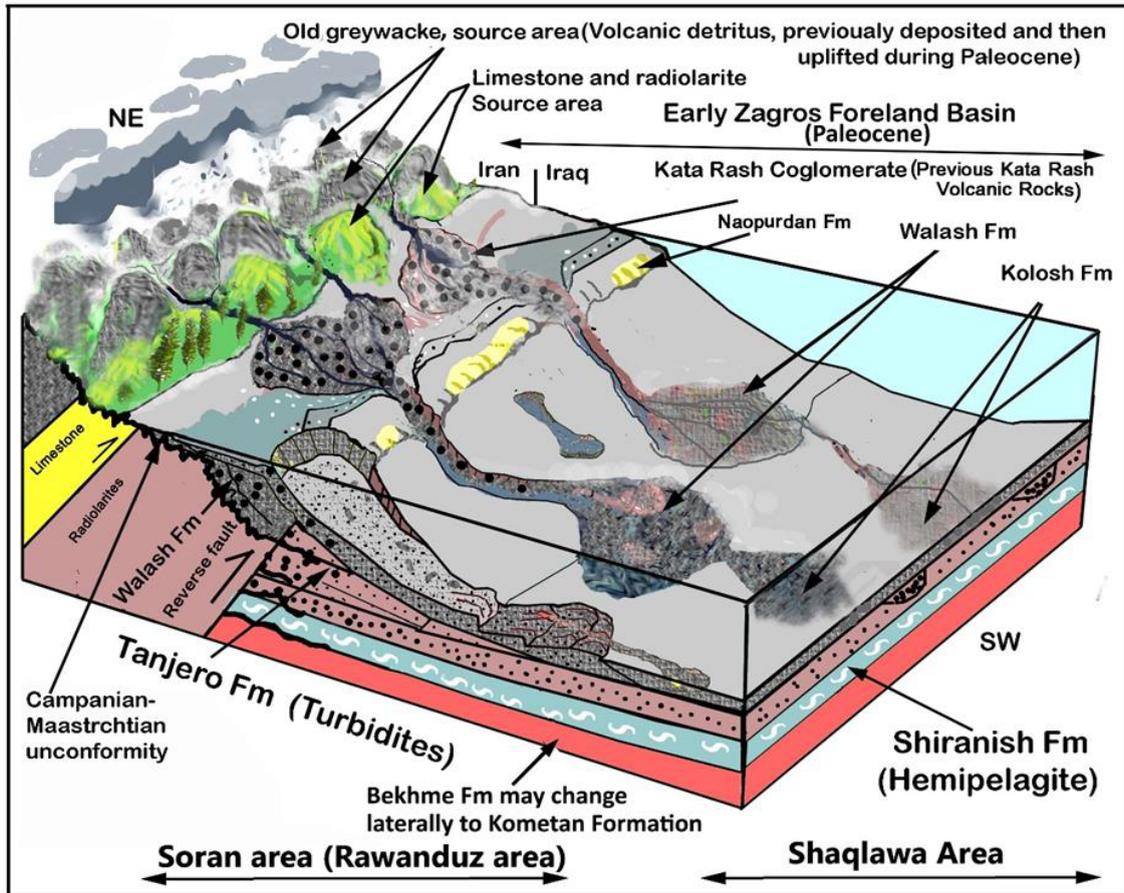


Figure 27. Paleogeographic and tectonic model during the Paleocene shows the deposition of the Walsh and Naopurdan formations, including the Kata Rash conglomerate. The name “Kata Rash Conglomerate” is taken from the same name and the same type of conglomerate in Shalair Valley (see Karim and Hamza, 2022).

Age and tectonic setting controversies of Walsh Formation:

There is strong controversy in the form of opposing views in previous literature about the age and tectonic setting of the Walsh Group (current Formation). Very recently, a new result was documented by Mohammad et al. (2023) and Zhazhlayi and Surdashy (2022) who inferred that the age of the Walsh Group is 70 ma (Early Maastrichtian) and 66 ma (Late Maastrichtian) by Zircon and stratigraphic position respectively (Fig.7 band c). Al-Saady et al. (2023) confirmed the former age (Late Cretaceous) for the deposition of the Walsh Group. While other authors indicated different ages such as 48 ma (Early Eocene) by Al-Qayim et al. (2014) and Koyi (2009) by index fossils and 87Rb/86Sr ratio, 43 ma (Middle Eocene) by Ali, et al. (2013, 2017), Aswad et al. (2014) and Al-Banna and Al-Metawali (2008) by 40Ar–39Ar, index fossils dating, and Zircon. Other ages are 1800-1650 Ma,

(Palaeoproterozoic) by Ali, & Aswad (2013) by Zircon aging. Therefore, there are five different ages for the Walsh Group which are 70, 66 48, 44 and 1650 Ma. The same controversy can be seen regarding the tectonic-paleogeographic settings since Zhazhlayi and Surdashy (2022) indicated deposition of the Naopurdan and Walsh formations (groups) on the Island arc and back-arc inside Neo-Tethys Sea. while Mohammad et al.2023) reversed the location of the two groups since they put the Walsh Group on the arc and put the Bulfat Group (ophiolite in the location of the Walsh Group of former articles (Fig. 7band c). Another disagreement is the location of the ophiolite in the Neo-Tethys basin since the same location (in the same age) indicated as ophiolite (Bulfat Group) by Mohammad et al. (2023) while this location is considered as Walsh Group by Zhazhlayi and Surdashy (2022), Ali et al. (2013, 2017) (Fig7 b and c). Another problem is the consideration of Qaradaghi and Mirza (2023) in which depicted the deposition of the Walsh Group on an Oceanic floor not on an island arc opposite all other studies (Fig.7c).

Another serious disagreement is the Semi-arid palaeoclimatic conditions of the Walsh Group by Ali et al.(2017) (Fig.28) which contradicts the previous studies that indicated the environment of the Group as an Island Arc in the middle of deep Neo-Tethys Ocean by Ali et al. (2013), b) Aswad et al. (2016), c) Ali et al. (2017) (Fig.4 a, b and c) respectively and Mustafa et al. (2023) in addition to model of Zhazhlayi and Surdashy (2022) and Mohammad et al. (2023) (Fig.7b and c). Therefore, the semi-arid palaeoclimatic conditions (such as that of the Iraqi present days) do not agree with the island arc in the ocean which must be humid. The semi-arid palaeoclimatic conditions, a very wide range of ages and different tectonic setting of previous studies, position confusion with ophiolite of the Walsh group (current formation) strongly support the result of the present study which indicated that the group was deposited in the foreland basin as an autochthonous unit in the Soran area (Fig.23 and 27). Its sediments, in the area, are coarse mafic sandstones (greywackes and volcaniclastic sandstones) and conglomerate while their fine grain equivalents are transported to the Shaqlawa area synchronously and deposited there as the KoloshFormation (Figs.23 and 27). The age of the Walsh Formation is Paleocene since it is located between Tanjero (Mastrichtian) and Nauperdan

(Lower -Middle Eocene according to Ghafor and Muhammad, 2022) in the studied area. The age of Paleocene-Eocene is confirmed by Buday (1980), Qaradaghi and Mirza (2023) for the Walsh Group which is the same that of the Kolosh Formation. Therefore, the wide range of the zircon age from 1800 to 43 ma is due to the sedimentary origin of the group that received sediments (including Zircons) from source areas of different ages.

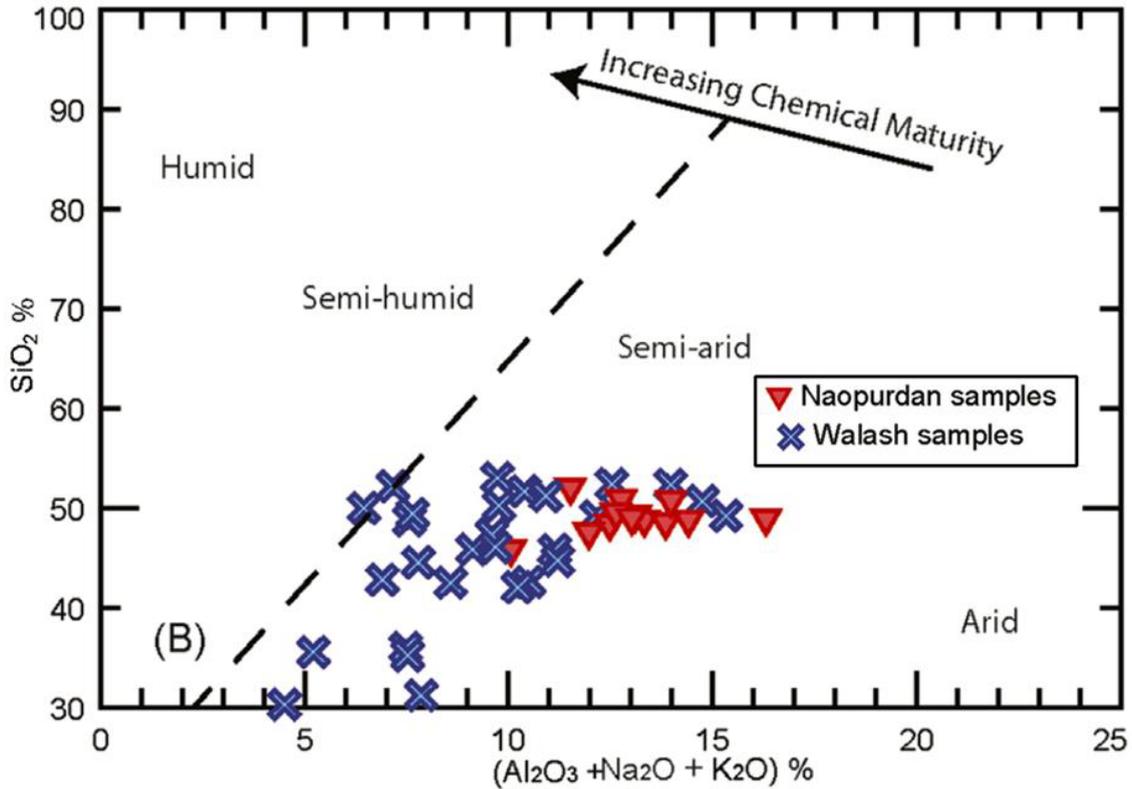


Figure 28. Palaeoclimatic conditions of the Walsh and Naopurdan Groups (Ali et al. 2017) in Soran area.

CONCLUSION

For the first time, the type sections of Walsh and Naopurdan groups are indicated by maps, geologic cross-section, photos and their geomorphology, geologic setting, structures and metamorphism are described. The stratigraphy, structure, age, number and type of units, and proximity showed that the two groups are one succession which must not be divided into two groups. The two groups are originally defined across synclines which resulted in the repetition of their units twice and their thickness is twice. The Walsh group is metamorphosed to low greenschist facies and amphibolite which lost most of the sedimentary structures and textures. Therefore, the

present study calls for the abandoning of this group and splitting the Naopurdan Group into two formations “Naoperdan and Walsh formations”.

This study confirms that Naopurdan consists of fossiliferous limestone of the Early and Middle Eocene while the Walsh consists of a siliciclastic succession of the Paleocene and its lithic clasts and crystalloclasts were derived from a volcanic arc inside Iran. The two groups are barren of volcanic and igneous rocks and what are called igneous rocks are metamorphosed greywackes (volcaniclastic sandstones) which are the constituent of volcanic lithic grains and crystalloclasts (broken crystals) transported by turbidity current to the Soran area from Iran and deposited in the Zagros Foreland basin. The models are drawn to show the relation of the two groups with the Kolosh and Sinjar Formations inside High Folded Zone

REFERENCES

- Abdalla, S. O., Mirza, T. A., Salih. N. (2023) Petrography and Mineralogy of the iron ore from Nawgwezany Mishao area– Shalair Valley, KRG - Iraq: Insights on the Genesis, *Iraqi Journal of Science*, 2023, Vol. 64, No. 9, pp: 5355- 5373.
- Ahmed M. A., Mirza, T.A., and Kalaitzidis S P (2023) Petrography and Geochemistry of the Baska Piwaza Ore Mineralization, Halgurd Mountain, Iraqi Kurdistan Region: Insights on the Genesis, *Iraqi Geological Journal*, 56 (2B), 114-136.
- Al-Saady, Y.I.; Othman, A.A.; Mohammad, Y.O.; Ali, S.S.; Ali, S.A.; Liesenberg, V.; Hasan, S.E. (2023) Composition of Rare Earth Elements in Fluvial Sediments of the Lesser Zab River Basin, Northeastern Iraq: Implications for Tectonic Setting and Provenance. *Geosciences* 2023, 13, 373.<https://doi.org/10.3390/geosciences13120373>
- Ahmed, I. N., Kettanah, Y. A., & Ismail, S. A. (2020). Genesis and tectonic setting of high-Cr podiform chromitites of the Rayat ophiolite in the Zagros Suture Zone, northeastern Iraq. *Ore Geology Reviews*, 123, 103583.
- Al-Banna, N., & Al-Metwali, M. (2008). Microfacies and age determination of the sedimentary sequences within Walsh volcanosedimentary series, Mawat nappes, NE Iraq. *Tikrit Journal of Pure Science*, 13, 308-314.
- Ali, A.R., Al-Mufti, T.M.H., Ahmed, M.S. (2019). Shales Geochemistry within Kolosh Formation (Paleocene-Early Eocene) in Dokan Region–Northeastern Iraq; Implications for Provenance, Paleoweathering and Tectonic Setting. *Kirkuk University Journal /Scientific Studies (KUJSS)*, 4 (2): 125-144.
- Ali, S. A., & Aswad, K. J. (2013). SHRIMP U-Pb dating of zircon inheritance in Walsh arc volcanic rocks (Paleogene age), Zagros Suture Zone, NE Iraq: new insights into crustal contributions to trachytic andesite generation. *Iraqi NJ Earth Sci*, 13(1), 45-58.
- Ali, S. A., Buckman, S., Aswad, K. J., Jones, B. G., Ismail, S. A., & Nutman, A. P. (2013). The tectonic evolution of a Neo-Tethyan (Eocene–Oligocene) island-arc

(Walash and Naopurdan groups) in the Kurdistan region of the Northeast Iraqi Zagros Suture Zone. *Island Arc*, 22(1), 104-125.

Ali, S. A., Ismail, S. A., Nutman, A. P., Bennett, V. C., Jones, B. G., & Buckman, S. (2016). The intra-oceanic Cretaceous (~ 108 Ma) Kata–Rash arc fragment in the Kurdistan segment of Iraqi Zagros suture zone: Implications for Neotethys evolution and closure. *Lithos*, 260, 154-163.

Ali, S. A., Sleabi, R. S., Talabani, M. J., & Jones, B. G. (2017). Provenance of the Walash-Naopurdan back-arc–arc clastic sequences in the Iraqi Zagros Suture Zone. *Journal of African Earth Sciences*, 125, 73-87.

Ali, S. A., Sleabi, R. S., Talabani, M. J., & Jones, B. G. (2017). Provenance of the Walash-Naopurdan back-arc–arc clastic sequences in the Iraqi Zagros Suture Zone. *Journal of African Earth Sciences*, 125, 73-87.

Ali, S.A., Buckman, S., Aswad, K.J., Jones, B.G., Ismail, S.A., Nutman, A.P., (2013). The tectonic evolution of a Neo-tethyan (Eocene-Oligocene) island- arc (Walash and Naopurdan groups) in the Kurdistan region of the northeast Iraqi Zagros suture zone. *Isl. Arc* 22, 104-125.

Ali, S.A., Sleabi R.S., Talabani M.J.A., and Jones B.G. (2017). Provenance of the Walash-Naopurdan back-arc-arc clastic sequences in the Iraqi Zagros Suture Zone. *Journal of African Earth Sciences*, 125: 73-87

Al-Jubury, H. E., Agha, M. Y. T., & Aqrawi, A. M. (2023). Petrography and Geochemical Relationships of the Ultramafic Rocks in Galalah area within Erbil Governorate, NE Iraq. *Iraqi Journal of Science*, 228-252.

Al-Qayim, B., Ghafor, I., & Jaff, R. (2014). Contribution to the stratigraphy of the Walash Group, Sulaimani area, Kurdistan, Iraq. *Arabian Journal of Geosciences*, 7, 181-192.

Arai, S., Shimizu, Y., Ismail, S. A., & Ahmed, A. H. (2006). Low-T formation of high-Cr spinel with apparently primary chemical characteristics within podiform chromitite from Rayat, northeastern Iraq. *Mineralogical Magazine*, 70(5), 499-508.

Aswad, K. J., Al-Samman, A. H., Aziz, N. R., & Koyi, A. M. (2014). The geochronology and petrogenesis of Walash volcanic rocks, Mawat nappes: constraints on the evolution of the northwestern Zagros suture zone, Kurdistan Region, Iraq. *Arabian Journal of Geosciences*, 7, 1403-1432.

Aswad, K. J., Aziz, N. R., & Koyi, H. A. (2011). Cr-spinel compositions in serpentinites and their implications for the petro-tectonic history of the Zagros Suture Zone, Kurdistan Region, Iraq. *Geological Magazine*, 148(5-6), 802-818.

Aswad, K.J, [Ali S.A.](#), Al-Sheraefy R.M., Nutman P., [Buckman S.](#), Jones B.G., [Jourdan F.](#) (2016). 40Ar/39Ar hornblende and biotite geochronology of the Bulfat Igneous Complex, Zagros Suture Zone, NE Iraq: New insights on complexities of Paleogene arc magmatism during the closure of the Neotethys Ocean. [Lithos](#), [266–267](#): 406-413.

Bouma, A.H. 1985. Introduction to submarine fans and related turbidite systems. In: Bouma, A., Normark, W. and Barnes, N. (eds.), *Submarine Fans and Related Turbidite Systems*. Springer-Verlag, New York, 3–6.

Bouma, A.H. 2000. Coarse-grained and fine-grained turbidite systems as end member models: Applicability and dangers. *Marine and Petroleum Geology*, 17, 137-143.

García, M., Ercilla, G., Alonso, B., Estrada, F., Jané, G., Mena, A., Alvés, T. and Juan, C., 2015. Deep-water turbidite systems: a review of their elements,

- sedimentary processes and depositional models. Their characteristics on the Iberian margins. *Boletín Geológico y Minero*, 126 (2-3): 189-218.
- Ghafor, I. M., & Muhammad, H. F. (2022). Biostratigraphy of Eocene Sediments from Naopurdan Group, Chwarta Area, Kurdistan Region, NE Iraq: Paleogeographic Implication. *Iraqi National Journal of Earth Science*, 22(2), 192-208.)
- Ismail, S. A., Arai, S., Ahmed, A. H., & Shimizu, Y. (2009). Chromitite and peridotite from Rayat, northeastern Iraq, as fragments of a Tethyan ophiolite. *Island Arc*, 18(1), 175-183.
- Karim, K. H., & Abioui, M. (2021). Geology of the Zagros basaltic bodies: examples from the Avroman Mountains, Kurdistan Region, Northeast Iraq. *Journal of Sedimentary Environments*, 6(2), 169-188.
- Karim, K. H., & Abioui, M. (2023). Significance of the lithic volcanic detritus and crystalloclasts in development of paleogeography of the Zagros collisional belt: evidence from the Kurdistan Region, Northeastern Iraq. *Journal of Sedimentary Environments*, 1-16.
- Karim, K. H., Aziz, N. R., & Al-Bidary, M. A. (2015). Paragenesis and geochemical studies of Asnawa Iron Ore by the isotope and mineral chemistry in Penjween Area, Zagros Suture Zone Kurdistan Region, NE Iraq. *Iranian Journal of Earth Sciences*, 7(2), 164-178.
- Karim, K. H., Khanaqa, P.A. and Babashekh, S.M., 2020. Revisiting the “Gercus Basalt within the Eocene Gercus Formation”: Implications for the sedimentary origin of a basaltic body, Kurdistan Region, Northern Iraq, *Ore and Energy Resource Geology* 4–5: 100008, <https://doi.org/10.1016/j.oreoa.2020.100008>
- Karim, K.H. (2023) Metamorphosed marl as a candidate for a previous gabbro: examples from the Iraqi Zagros Collisional Belt, Mawat Ophiolite Complex, Chapter 4: pp.55-86), contemporary Approaches in Advanced Research edited by Umut ÖZKAYA, All Science Academi, Turkey.
- Karim, K.H. and Al-Bidry M., (2020). Zagros Metamorphic Core Complex: Example from Bulfat Mountain, Qala Diza Area, Kurdistan Region, Northeast Iraq. *Jordan Journal of Earth and Environmental Sciences (JJEES)*, 11 (2): 113-125.
- Karim, K.H. and Ghafur, I.M. (2021) Updated stratigraphy, tectonics and boundary conditions of the Mawat and Bulfat Ophiolite Complexes, Kurdistan Region, NE-Iraq, The Second International & the Fourth Scientific Conference of College of Science - Tikrit University
- Karim, K.H., & Hamza, B.J., (2021). Relation between Walsh Group and Kolosh Formation: a key to the stratigraphy of the Penjween area. In The 1st International Conference for Natural Resources Research Center, Geo Iraq1, Tikrit city, University of Tikrit.
- Karim, K.H., (2021). Geology of Zagros metamorphosed volcanoclastic sandstones: a key for changing the Mawat Ophiolite Complex to a metamorphic core complex, Kurdistan Region, NE-Iraq Conf. Ser. Earth Environ. Sci., 906 012024, doi:10.1088/1755-1315/906/1/012024
- Karim, K.H., and Hamza, B (2022). Relation between Walsh Group and Kolosh Formation: a key to the stratigraphy of the Penjween area. The 1st International Conference for Natural Resources Research Center, Tikrit University, Department of Geology, p.95-107.

- Karim, K.H. (2022) Reevaluation of the basalt intrusion and extrusion on Hamrin Mountain (Hemrin Hills) near Tikrit town, Baquba Governorate Iraq, Researchgate, DOI: [10.13140/RG.2.2.17637.47849](https://doi.org/10.13140/RG.2.2.17637.47849)
- Kettanah, Y. A., Abdulrahman, A. S., Ismail, S. A., MacDonald, D. J., & Al Humadi, H. (2021). Petrography, mineralogy, and geochemistry of the Hemrin Basalt, Northern Iraq: Implications for petrogenesis and geotectonics. *Lithos*, 390, 106109.
- Kettanah, Y.A., Bamarni A.H., 2018. Petrogenesis, geochemistry and tectonic setting of a basaltic body within the Gercus Formation of northern Iraq: first record for Eocene anorogenic volcanic activity in the region. *Turk. J. Earth Sci.* 27 (6): 460–491.
- Koyi, A. M. (2009). Sr-Nd isotopical significance of Walash volcanic rocks, Mawat area, NE Iraq. *Zanco Journal of Pure Science*, Salahaddin University, Hawler, 21, 39-45.
- Mirza, T. A., & Rashid, S. G. (2019). Chromitite and platinum group elements in the Iraqi Zagros Suture Zone, NE Kurdistan Region, Iraq: an overview. *Iraqi Bulletin of Geology and Mining*, (8), 65-85.
- Mohammad, Y., Abdulla, K. and Azizi, H. (2023) Late Cretaceous-Paleocene Arc and Back-Arc System in the Neotethys Ocean, Zagros Suture Zone, *Minerals* 2023, 13, 1367. <https://doi.org/10.3390/min13111367>
- Mustafa, T. A., Mirza, T.A. and Kalitzidi S.P. (2023) Petrographical and Geochemical features of sulfides mineralization in the Walash Group, Gallala area, Kurdistan Region of Iraq. *Iraqi Geological Journal*, 56(2F).
- Qaradaghi, J.M. A. and Mirza, T. A. (2023) Peperites: Insight into the Submarine Eruptions within Walash Volcanosedimentary Group, Mawat Area, Iraqi Kurdistan Region, *ARO- The Scientific Journal of Koya University* Vol.1, No. (2):1-23, DOI: 10.14500/aro.1136
- Roser B. P. and Korsch, R.J. (1986) Determination of tectonic settings of sandstone-mudstone suits using SiO₂ content and K₂O/Na₂O ratio", *The Journal of Geology*, 94, 635.
- Wang, J., Liang, C., Cao, Y., & Tian, Y. (2022). Occurrence, Genesis, and Significance of Analcime in Fine-Grained Sedimentary Rocks. *Geofluids*, 2022.
- Zhazhlayi, P. K., & Surdashy, A. (2022). Neo-Tectonism and Quantitative Morphotectonic Analysis of Roste Valley at Imbricated-Suture Zones, Kurdistan Region, Iraq. *The Iraqi Geological Journal*, 55 (2E), 35-58.
- Zhu, S., Cui, H., Jia, Y., Zhu, X., Tong, H., & Ma, L. (2020). Occurrence, composition, and origin of analcime in sedimentary rocks of non-marine petroliferous basins in China. *Marine and Petroleum Geology*, 113, 104164.