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Towards Developing Empathetic Engineers for The Rural Road Project Management

Norwati Mohamad Ali[1,*], Yusouf Latif[1], Alexa Ray Fernando[1], Abdelrahim Mohamed Minalla[1], Chin Chia Yuan[1], Syed Ahmad Helmi Syed Hassan[1], Khairiyah Mohd Yusof[1]

[1] Centre for Engineering Education, Faculty of Engineering, Universiti Teknologi Malaysia , Johor Bahru, Malaysia

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ABSTRACT

Education of empathetic engineering for the rural road project management and professional excellence for young engineers is very important as the end product can highly impact the rural community. The current research focused on the analysis of the concept from the explicit meaning of empathy of recent literature from five publishers through an advanced computer search. The goal of this paper is to provide a theoretical framework from a holistic list of empathy perceptions affecting the engineer in managing projects. Two research questions were addressed: first, what does empathy mean when the element of engineering is the centre of the study? and; secondly, from what perspective of project management construction stages does empathy influences engineer? Factors contributing to project failure can be categorized into three major factors namely physical and financial constraints, other minor issues, and empathy issues. Empathy issues are the combination of empathy keywords and empathetic perspectives that could be developed and incorporated in the management of rural roads during the feasibility study, planning, design, and construction stage of the project. Towards developing empathetic engineers and further reducing project failures, intervention through empathy training is a viable option for the enhancement of emotional intelligence and project management skill.

1. Introduction

Rural roads are often a lifeline for the rural community and they are the last critical link of the transport network. Construction of roads will facilitate access to other development of rural areas but building rural roads require skill, proper planning, experienced supervision, good workmanship and the selection of the correct technology and work methods of the engineer. One way to truly understand the rural community needs and develop a successful rural road project is by becoming an empathetic engineer.

Empathy—the ability for one person (a perceiver) to share and understand the internal states of someone else (a target) is a social bridge that allows people to connect [1]. It is the ability to step

* *Norwati Mohamad Ali*
E-mail address: norwati@graduate.utm.my

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into the shoes of another person, aiming to understand their feelings and perspectives and to use that understanding to guide our actions [2]. Empathic individuals are those who can identify and understand situations, feelings, motives, and perspectives, and recognize and appreciate the concerns of another person [3].

Empathy, if conditioned or engineered it would help us to better accurately anticipate others' actions and contributions. Empathetic engineering would allow the targeted individuals, organizations, and communities to be resilient and strive to understand the position of others. Therefore, empathetic engineering is highly needed here to live and mentalize the needs and feelings of others [4].

Developing an empathetic engineer is crucial as valuable emotional intelligence skills like this is very hard to learn and unlearn. Empathetic engineering skills are innate and they are built over the years and take time and practice, but by building a training program to develop the skill among young engineers, it is believed that this can contribute to the success of rural road projects due to the enhancement of emotional skill even when the engineer is lacking in having those years of experience in managing rural road projects.

1.1 Engineers and Empathy

It [Empathy] is a core strategy for engaging with controversial situations [5]. Some factors negatively influence the development of empathy not only because of the high number of projects that engineers have to manage within the inadequate timeframe given, but also the lack of education in empathy [6]. Engineers somewhat lessened empathy and tendency to downplay the perspectives of other people, likely reduces their ability to engage with, and fully grasp, the value of another person's perspective and often grapple with how to deal with issues that "involve emotions and irrational beliefs and opinions" [7]. Traditionally, engineering as a profession has only focused on technical skills such as design, modelling, and problem-solving.

For young engineers especially, these skills are undeniably important but if engineers were to become more empathetic and caring, diversity may increase, and solving people's problems would become more prudent [8]. Advancements in technology, the drastic transformation in societal needs, and a knowledge-based economy are creating a strong need for engineers to continuously improve their skills and competencies [9]. To remain competitive, engineers must practice lifelong learning and exhibit outstanding leadership qualities. In this context, learning is not restricted to the ability to sharpen and enhance technical knowledge and skills.

2. Engineers to Prevent Engineering Project Management Failure

Each year, the government has been funding infrastructure projects such as low-volume rural road programs to improve economic growth for the population in remote areas. The infrastructure project is integral to the development of rural areas as the conditions of roads and modes of transportation are not in a well-developed state, which are imposing problems for individuals transferring from one place to another [10]. In Malaysia, Public Works Department (PWD) is the executing agency in managing the development of the Low Volume Rural Road (LVRR) and the program is under the purview of the Ministry of Rural Development Malaysia.

Rural roads are the last critical link of the transport network and building good quality rural roads requires skill, proper planning, experienced supervision, good workmanship, and the selection of the correct technology and work methods. The construction of roads will facilitate

access to other development of rural areas and engineers must be able to understand the requirements for properly managing the rural road projects.

Unfortunately, the Abandonment of Construction Projects (ACP) is considered one of the most common and serious problems plaguing the Malaysian construction industry given the number and the value of the projects involved [11]. Prior research in project management has found that empathy issues, among other reasons, are the major factor contributing to the project failure, and based on the study by Rauth I *et al.,* [12], the project failure correlates strongly with a lack of empathy towards the citizens' needs.

The engineer can prevent future disputes and failed engineering projects by employing a design strategy that incorporates empathy in all professional matters. The empathetic view can prevent disputes by considering the possible harm suffered as the result of engineering decisions [13]. Furthermore, to date, there was no prior study on the empathy of engineers dealing with rural road projects.

Tang [14] suggested two alternative conceptions of empathy in engineering: i) empathy as a commitment to communicating and understanding across different cultural and epistemic communities; and ii) empathy as professional excellence for engineers. Empathy describes both the skillset and the outlook of an excellent engineer, and like other virtues, it can be cultivated through education.

3. Awareness of Empathy among Engineers Managing Rural Road Projects

A survey on awareness of empathy among engineers for the management of rural road projects was conducted and had received 14 respondents. Each of these respondents rated the provided online self-report questionnaires comprising 20 items on a 5-point Likert scale. The questionnaires direction is towards positive predisposition towards empathy and 15 themes of empathy were used for this questionnaire to gauge the degree of strength and intensity of confidence of engineers with the proposed empathy to be inculcated in their daily work as a professional in this area of engineering.

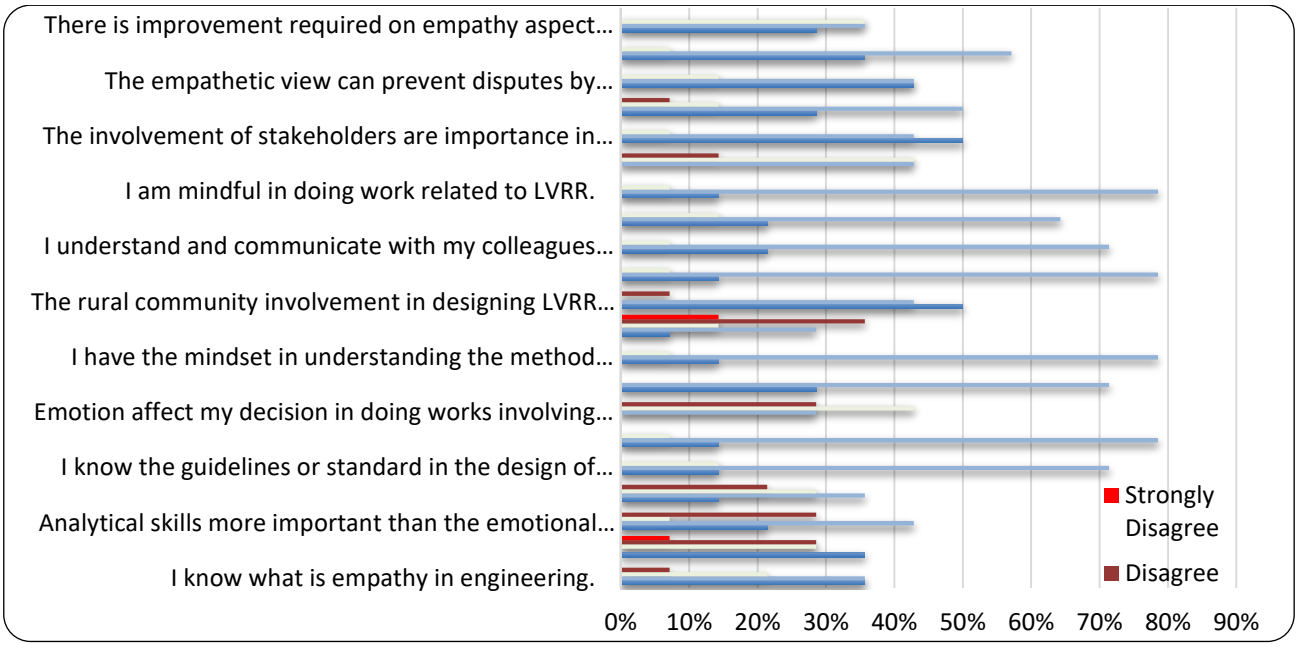

Fig. 1. Empathy perception among rural road project engineers in Sarawak Public Works Department, Malaysia

Based on the survey as in Figure 1, these responses indicate a high varying degree of agreement and confidence towards the incorporation of empathy through education would enhance engineers' project management skills. Hence, the finding of this paper is vital for the development of empathetic engineers' rural road project management education.

4. Objective and Scope of the Research

The objective of the research is to analyse the concept of empathy and emphasize its importance to the engineers involved in the project management of rural roads development through a systematic literature review. The research questions under consideration are as follows: first, what does empathy mean when the element of engineering is the centre of the study? and secondly, from what perspective of project management construction stages does empathy influences engineer?

The boundary of the research is engineers involved in managing the LVRR Program under the Ministry of Rural Development Malaysia in the state of Sarawak. The study conceptualized a literature review from the publisher of IEEE, Elsevier B.V., Springer, Emerald Publishing and Taylor & Francis. The keyword used for the search in the online database is empathy and after that further select only papers in engineering areas.

The Guidelines for The Design of Low Volume Rural Roads (LVRR) is used for the analysis of the empathetic perspective of the research. The key assumption is that the analysis of empathy explicit meaning from papers where the element of engineering is the centre of the study can be used to further conceptualize the LVRR Guideline for further development of empathetic engineer training guidelines.

5. Methodology

5.1 Data Collection

The literature review was conducted by searching through an advanced computer search on the publisher databases of IEEE, Elsevier B.V., Springer, Emerald Publishing and Taylor & Francis. By using the keyword 'Empathy' and paper published from October 2016 until October 2021, 1,077 papers were found (with open access) in Engineering, Psychology, Nursing, Health and Rehabilitation, Art, Education, Museology, Social, Hospitality, and many other various disciplines. Out of the search, 63 papers were identified where the element of engineering is the centre of the study.

5.2 Data Analysis

Conceptual analysis is used for this research whereby papers with explicit meaning were compiled, discussed, and analysed. Guided by grounded theory, findings from the examination and analysis of the study lead to the formulation of empathy alternative keywords and views in engineering that influence empathy the most.

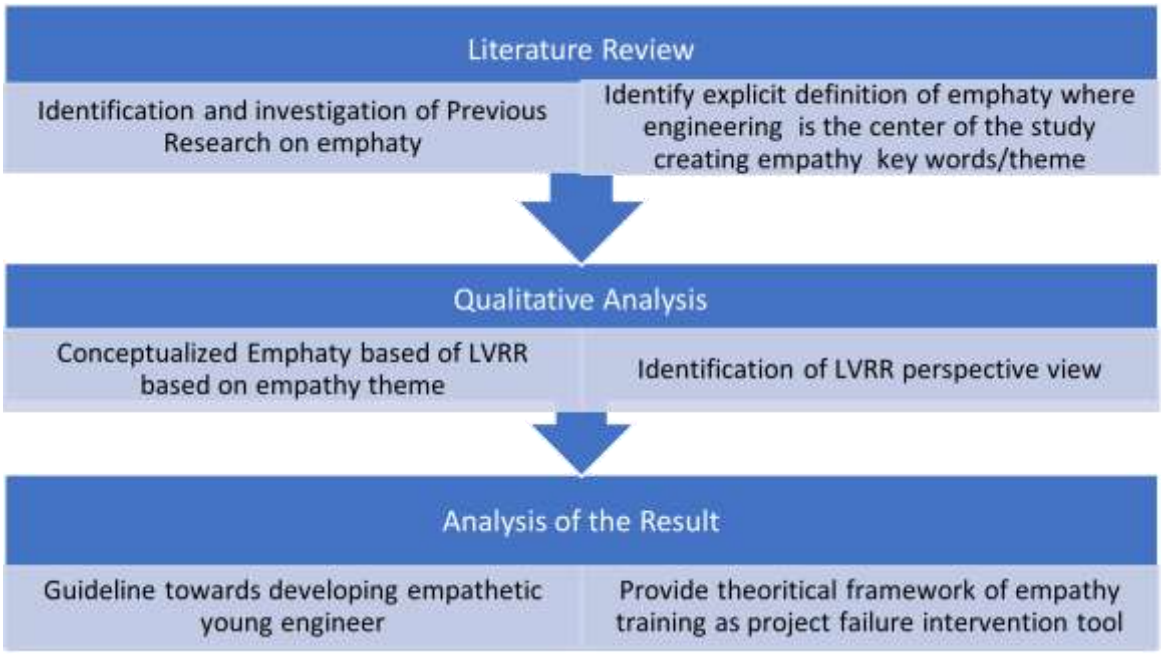

Fig. 2. Summary of the research methodology

6. Finding

Through the literature review, 15 alternative keywords were found and further analysed its empathetic perspective as conceptualized in the LVRR guideline:

Table 1
Empathy alternative keywords and empathetic perspective

Alternative Keywords	Empathetic Perspective
As if it were	Feasibility Study/Planning/Design/Construction
Feels with	Feasibility Study/Planning/Construction
Compassion	Feasibility Study/Planning/Design
Behaviours reflective	Feasibility Study/Planning/Design
Mindful	Feasibility Study/Planning/Design/Construction
Ethical thinking	Planning/Construction
Mindset understanding behaviour	Feasibility Study/Planning/Design
Mindset understanding method	Planning/Design/Construction
Community involvement	Planning/Design
Understand perspective	Planning/Design
Understanding and without bonding	Planning/Construction
Understanding and communicate	Feasibility Study/Planning/Design
Emotional reaction	Planning/Design
Experience sharing	Planning/Design/Construction
Experiencing emotions	Planning/Construction

6.1 Planning

Planning consists of setting specific targets and goals and specifying in detail the necessary resources and actions to reach those targets. The road project planning is the stage at which the overall road project and its strategic objectives are determined, potential budgets are defined, and

strategic financial and engineering risks are identified. This process considers government policies and programmes that impact road development, which is examined in a very wide socio-economic and policy orientated context.

Design, construction, and maintenance decisions will impact local communities and other sector activities, e.g., agriculture, water, health, and education, as well as commercial activities such as local transporters, suppliers and traders. Consideration of these impacts and consultation with stakeholders at this early stage will help mobilise support and maximise the beneficial impacts of the road works.

Road project planning, which is commonly related to a specific development project, normally involves either construction of a new road or improvement or rehabilitation of one road section. Engineer shall identify all possible alignments for a road project and subsequently select and determine the optimum/best route for a detailed ground survey. The determination of a good alignment is dependent on experience and good judgment of the engineer with mindset understanding the possible correct method of the engineering project.

The benefits of a road project must be weighed against the long-term costs and impacts of the project. Once a road is built into an area, it can lead to long-term land-use changes and unplanned growth. The social, environmental and cost-effectiveness of the road need to be examined.

6.2 Feasibility Study

It is important to identify and investigate the major technical, financial, economic, social, and environmental constraints to obtain a broad appreciation of the viability of the competing options. For low volume roads, one of the most important aspects of the feasibility study is communication with the people who will be affected by the road.

Necessary data and information are collected for feasibility study and analysis shall include but not necessarily be limited to engineering data, social data, economic data, and environmental studies. It is best to involve the community as early as possible in the engineering project. This can prevent misunderstanding and misconception of the overall project. Community and stakeholders' involvement will provide all this necessary data that could contribute to a better understanding of the unique new project areas. Communication with the resident during the site visit will provide the required perspective of the study.

The engineer shall familiarize himself with the site and the surroundings to understand better the nature of the work involved. For the improvement of an existing road, the new proposed alignment shall as far as possibly lie within the existing Right of Way (ROW). If the project is a new road, a feasibility study shall be made on the various alternative route corridors to determine the most feasible one. In determining the route, the engineer shall take into consideration factors such as current transportation in the region, existing road and logging tracks network, location of existing or future Rural Growth Centre, location of longhouses and villages, the ground terrain profile (for cut and fill balancing), existing rivers and waterways, existing properties, and subsoil conditions. An estimate of the length of the road shall also be made.

The technical feasibility starts with a rapid assessment of whether it is possible to carry out the project from a technical point of view. Some aspects of LVRR construction may not be obvious to everybody involved in the decision-making process. It is therefore useful to secure some guidance at an early stage to ensure that a particular proposal is technically feasible.

By doing so, it is possible to rule out impracticable projects such as proposals with very large bridge crossings, alignments through very difficult terrain or through areas where land cannot be (or difficult to be) made available for purpose of road construction (for example, cemeteries).

Investments in the development of LVRR can be difficult to justify solely based on an economic basis. As such, social benefits should also be included as the basis of facilitating the provision of basic access to social services.

It is necessary to balance benefits from road schemes with adverse environmental effects due to their project implementations. Consideration of the environmental impacts such as soil erosion, water pollution, severance, noise and air pollution, land issue, health and safety should be given in selecting the appropriate route corridor. The environmental impact assessment study is to assess and evaluate the environmental and socio-economic impacts associated with the proposed route corridors before the road alignment is finalized.

6.3 Design Specification

Engineer shall put up conceptual design report with alternative options following standard design guidelines, instructions, and manuals. The design shall consider the advantages and disadvantages of each option respectively including cost comparison. The design standard shall meet the functional requirements dictated by the users of such facilities. Rural roads are often characterized by their dispersed geographical coverage to the entire population living in the rural thereby providing all-weather access to the entire population living in the rural areas. Field reconnaissance site visit enables the engineer to familiarize himself/herself with the site and the surroundings to understand better the nature of the work involved.

The designer may also carry out a site reconnaissance survey to ascertain the suitability of the selected alignment. While in the field, additional local information can also be collected as part of the data collection process to further assist in the feasibility study process. The determination of a good alignment is more dependent on the experience and good judgment of the designer than the availability of advanced surveying and processing equipment.

Rural roads are built to improve access and usually do not have stringent requirements regarding road curvature. Before the construction of a road, the communities most probably rely on a track or a trail. Thus, the alignment of existing tracks will in most cases, have the least effect on the surrounding environment. Often, the alignment of existing tracks also provides the best solution in terms of reducing the number of earthworks.

When planning the construction of a new road, there are always several possible choices of alignments. By selecting an alignment that follows the terrain and minimizes earthworks, both initial construction costs, as well as future maintenance requirements, can be reduced.

Before the recommended alignment is finally adopted, the engineer shall discuss and seek approval from the Design Committee. The Route Location Report shall discuss the alternative routes considered and the advantages and disadvantages of each route including cost comparisons. Problems such as those about technical, social-economic and land acquisition aspects should also be highlighted. The recommended optimum alignment to be submitted for approval is to be clearly stated. To create an affordable road network, it is therefore important to find cost-effective solutions, which still meet vital performance requirements and essentially keep the roads open and accessible throughout the year in all types of weather [15].

Designing a geometric for an entirely new road where nothing existed before is a considerably complex process because of the many different route alignments that are possible and the relative lack of information available at the beginning of the process. Identification of possible corridors for the road needs to be carried out to decide whether the project is likely to be viable. This will then need to be followed by a routes location study to determine the best route within the best corridor and, finally, a detailed engineering design based on the route selected. The level of detail in this

process depends critically on the class of road being designed and the terrain through which it will pass. Errors at this stage can be costly and, once the road is built, can also impose serious burdens in the future if the road requires excessive maintenance.

The route selection is not only based on surveys of various kinds that provide information about all the technical engineering issues but also surveys concerned with environmental and social issues as well. The final design will be a compromise between many competing factors and there is no formal way of resolving all of them to everyone's satisfaction. Engineering judgment and consensus will be required to arrive at a satisfactory alignment of the road.

Any changes in the cross-section should be introduced over an appropriate transition length, with suitable signing. Isolated reductions in cross-section width may be unavoidable in some cases, such as at existing narrow bridges. Drivers should be warned of the discontinuity of using signs and road markings. Vertical alignment has two aspects: Vertical Curvature and Gradient of the road. The designer must always keep an eye on the economy in selecting the alignment and the longitudinal profile; it is general practice to follow as closely as possible the natural terrain profile.

Desirably there should be no change within the distance of 150 meters of two vertical curves in the same direction with a short tangent. The longitudinal profile should be co-coordinated suitably with the horizontal alignment. Decks of small drainage structures (culverts and minor bridges) should follow the same profile as the flanking road section without any break in the grade line.

6.4 Construction

The design engineer shall help to explain and make the necessary adjustment on the methodology required best suited the site condition of the rural area. The acceptability of the project by the local community is important and continuous communication with stakeholders could help in the decision-making during this stage of construction. Appropriate use of locally available materials is a fundamental issue in the design and construction of sustainable pavements and surfacing of the LVRR.

The construction shall support cost-effective methods of construction and maintenance such as labour-based or intermediate technology approaches that benefit the community. The geometric design standards provide the link between the cost of road construction and the benefits to road users. Usually, the higher the geometric standard, the higher the construction cost and the greater the road user benefits. Hence, the engineer shall make a judgement to decide the best option based on the understanding of the community needs of the area.

The design engineer shall also correlate his design (and documentation) with the requirements and construction methods set out in the Standard Specification of Road Works (SSRW) [16]. Where changes from the SSRW are desired or necessary to suit the project work, such changes shall require the approval of the Government, and be covered by Particular Specification Clauses.

7. Significant of the Study

Developing empathetic skills can improve young engineers' capabilities to communicate with others, to be part of a team, and to enhance communication skills as empathy is an emotional skill that is built through understanding others and for further career success. The data collected from this study will be used in the training guidelines towards developing empathetic engineers for LVRR project management. The conceptual framework of the study is depicted in Figure 3.

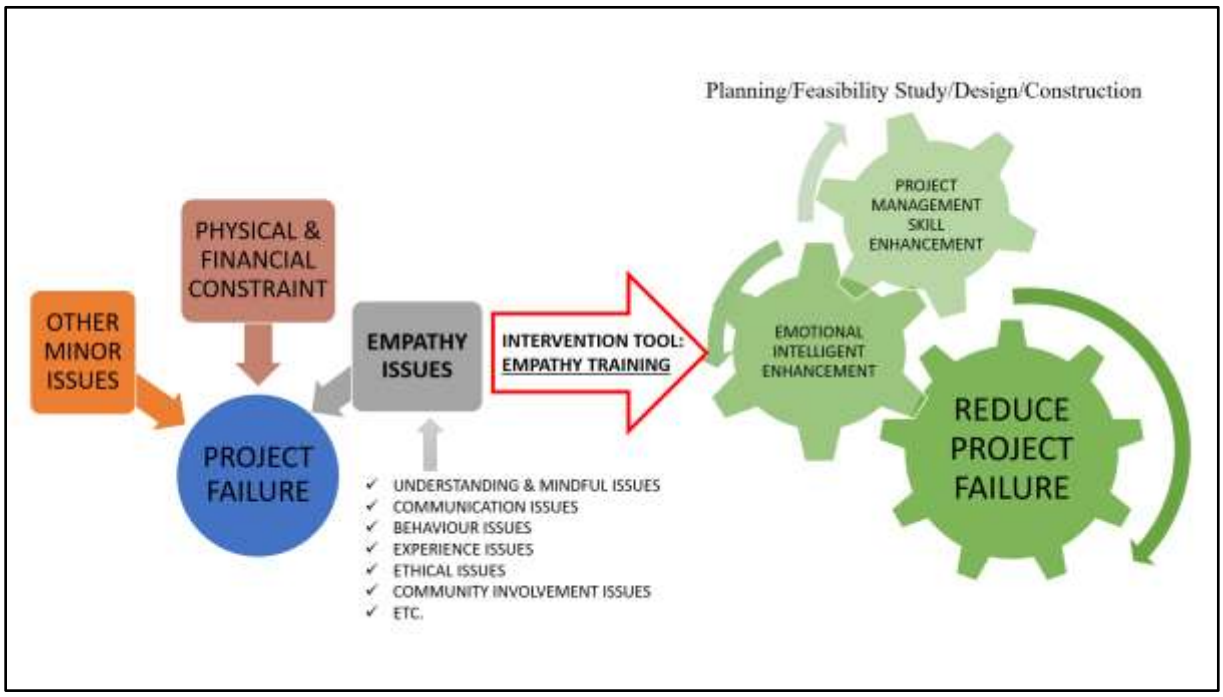

Fig. 3. Theoretical framework: empathy training as a tool for project failure intervention

8. Conclusion

Based on the finding, many factors are contributing to project failure, and these failures are categorized into three major factors namely physical and financial constraints, other minor issues, and empathy issues. Empathy issues are the combination of empathy keywords and empathetic views that could be developed and instilled in the management of rural roads during the planning, feasibility study, design, and construction stage of the project. Towards developing empathetic engineers and further reducing project failures, intervention through empathy training is a viable option for the enhancement of emotional intelligence and project management skill.

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