Effectiveness of Fixed 'Pole-Jurin' Compared to Conventional Methods in Practical Work in Kuching Polytechnic Sarawak: A Comparative Study

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Abstract
Land survey is a measurement work on the ground marked with boundary stones or temporary bench mark while using tools such as theodolite or total station and two prisms to measure the angle and distance between certain points in the field. Usually the prism will be erected on rear and front view stations as markers and the angle will be measured using the total station. This practice is common for Diploma in Geomatic (DGU) students to carry out traverse survey work around the Kuching Polytechnic Sarawak (PKS) area every time they practice it. The practice of cadastral surveying in Sarawak allows the use of 'pole-jurin' to replace the prism in the marking of the observed measuring stations. Usually in minimal use only one prism is carried along with the total station. Thus, the large amount of equipment, weight and long period of time providing the station using 'pole jurin' became a constraint for DGU students in PKS. Pole-jurin is permanently designed using readily available materials. The results showed that the weight of the fixed pole-jurin was 1 kg and the time to set up for only 2 minutes on average. Prototypes are tested for effectiveness throughout field tests that are evaluated in terms of durability. Questionnaires are carried out to obtain feedback from students and lecturers. In fact, the questionnaire found that the 4th item fixed pole-jurin was easier to use with the highest score of M=4.67. Therefore, the use of fixed pole-jurin remains easier to take to the field and stored in survey workshops using minimal space. Thus, in the cadastral survey work in PKS students will bring one total station, one prism and the rest is a pole-jurin whose number depends on the need.

Keywords: Traverse, Pole-Jurin, Prism, Total Station, Theodolite

1.0 Introduction
The field encompasses various scientific disciplines in geomatics, including Engineering Surveys, Hydrographic Surveys, Topographic Surveys, Geodetic Surveys, Astronomy, and Global Positioning Systems (GPS). Central to surveying practices are traverse measurements, where precise control is established by measuring angles between successive lines, with a stringent minimum closing accuracy ratio of 1:8000 required to maintain precision at known points (Nabillah, 2019). This necessitates using specialised tools such as prisms positioned at rear and front stations for sighting, alongside total stations or theodolites for accurate angle measurements. At Politeknik Kuching, Sarawak (PKS), students with a Diploma in Geomatics (DGU) traditionally utilize prisms. At the same time, Sarawak's cadastral survey methods introduce the "pole-jurin," a slender stick employed to mark stations, reducing environmental impact and enhancing operational efficiency

(Nabillah, 2019). PKS students typically equip themselves with one total station, one prism, and multiple pole-jurins for cadastral surveys, optimizing their fieldwork strategies.

Sivarajan's (2022) studies and observations highlight the practical challenges students face during traverse survey work, involving transporting multiple tools like a total station, two prisms, and three tripods to remote and forested sites. This logistical burden contrasts with surveying requirements outlined by Nur Alia (2020), which mandate a minimum of two reference marks at original positions to commence survey tasks, illustrating variations in survey methodologies across Sarawak, Peninsular Malaysia, and Sabah as noted by Ainn (2023). The implementation of pole-jurins, as illustrated in Figure 1, typically involves crafting temporary markers from tree branches, a process demanding time, energy, and skill for each setup, underscoring the importance of equipment proficiency among students as emphasized by Mustafa (2016). To address these complexities, researchers aim to compare the efficacy of traditional disposable pole-jurins with fixed installations, seeking to streamline operations and enhance practicality in student fieldwork (Mustafa, 2016).

In response to these challenges, the author outlines three primary research objectives. First, the comparative weight implications of fixed pole-jurins versus conventional surveying tools carried by students will be assessed. Second, the time efficiency in deploying fixed pole-jurins should be evaluated compared to traditional methods during practical exercises. Lastly, user feedback on their experiences with fixed pole-jurins in field applications will be solicited. These objectives are designed to gauge the feasibility and effectiveness of adopting fixed pole-jurins to improve efficiency and reduce logistical complexities in student-led surveying practices.

In geomatics, the breadth of scientific knowledge spans Engineering Surveys, Hydrographic Surveys, Topographic Surveys, Geodetic Surveys, Astronomy, and Global Positioning Systems (GPS). Traverse measurements in surveying involve establishing control by measuring angles between successive lines, with precision requirements stipulating a minimum closing accuracy ratio of 1:8000, reflecting the relationship between length and closure distance at a known point (Nabillah, 2019). This necessitates using precise tools, such as prisms atop rear and front stations for sighting and either total stations or theodolites for angle measurement. While Diploma in Geomatics (DGU) students at Polytechnic Kuching, Sarawak (PKS) traditionally use prisms, cadastral survey practices in Sarawak introduce the "pole-jurin," a tapered stick marking stations, reducing survey team load and environmental impact (Nabillah, 2019). PKS students typically carry one total station, one prism, and multiple pole-jurins for cadastral surveys, optimising efficiency and sustainability in field operations.

Figure 1: Pole-Jurin Made From Wood and Branches

Figure 2: Tripod and Prism

2.0 Literature Review

Surveying equipment plays a crucial role in various surveying techniques such as traverse surveying, topographic mapping, boundary delineation, and construction layout. It helps surveyors gather precise measurements and create detailed maps and plans for engineering, construction, land development, and other applications. Based on the literature studies conducted, Aminigbo (2022) stated the importance of choosing measuring equipment in order to achieve the purpose of a survey work. Among the factors to consider are the appropriate cost, tools that can help to achieve the necessary accuracy, suitable for all kinds of surrounding conditions at the work site as well as easy-to-obtain equipment. This statement is supported by Sivarajan (2022) stated that the surveyor will decide on the control point placement, the control precision needed and the necessary survey equipment. So as stated by Ogundare (2015) hich is land surveying is a highly specialized branch of geodetic engineering that focuses on establishing boundary line of real property ownerships, which include establishing new boundaries or in land partitioning. Practically the employee will choose the most convenient method of carrying since the equipment for one-on-one survey work is numerous and heavy. Thus, reducing the equipment to set up the rear bearing will directly reduce the load that needs to be carried on the field. Just trees and branches found around the work area can help with the process of preparing the rear bering.

In fact, according to Aminigbo (2022), it also suggests that the control survey work must be a three-foot stand of instruments firmly fixed to the ground to avoid instability of the instrument on the ground. The instrument is also firmly fastened to the three-foot stand and each necessary temporary adjustment (centralizing, leveling and focusing) has been carried out correctly. Hence, the importance of one piece of equipment that can meet those criteria. In the meantime, Adenan (2018) states that excessive insights or redundancy are a good work practice as revisions can be done. Also, Ismat (2019) stated that the important results is to establish three dimensional positions of points to be used as control for construction engineering or photogrammetric mapping, digital elevation model formation and some other purposes. However, following the practice of back-range observation work is not a requirement in fieldwork procedures in the measurement of traverse. Therefore, the required alternative is sufficient to produce a sign of insight where the mark must be directly vertical with the station on the ground surface.

3.0 Methodology

The methodology consists of several phases so that its structure can meet the objectives of the next study to overcome the problems of the study. The phases are:

i. Planning Phase - The planning phase aims to identify the same goals and objectives as the original tools. Preliminary discussions on prototypes are carried out in order to get the best results. Results will be tested to find out the feasibility with which the identified problems can be solved. Then, the information obtained is analyzed in accordance with the requirements of use before the establishment of the system. Next the production of the system is documented.

ii. Analise Phase - The survey and observation run at this phase. It aims to gain input on the identified problem as well as its solution. Moreover, the scope of work, system objectives, and methodology are seen for the construction of a good and easy-to-use prototype.

iii. Design Phase - Design is very important so that the expected results meet the functions and objectives of the study. Design drawings are produced and technically discussed in relation to the mechanical functions involved.

iv. Implementation Phase - In this phase, the design translates into a prototype called Fixed 'Pole-Jurin'. Appropriate materials are identified so that the planned functions in the design phase can be achieved.

v. Test and Improvement Phase - This phase involves the process of testing tools by the user. Here the usability of the system can be found out whether it can run properly or not based on the results of the questionnaire.

4.0 Results and Discussion

4.1 Fixed Pole-Jurin Production

Fixed pole-jurin is made from used materials from plumbing workshop in PKS. Its main material is PVC pipes alongside other small accessories such as screws, bolts and nuts. Technically, a set of pole-jurin consists of one rather large-sized main spike that guides the observatory to perform insights. Then the main spikes are supported by two small legs so that they can stand firmly. Figure 3 below shows the completed fixed pole-jurin.

Figure 3: Fixed Pole-Jurin Made of Wasted Materials

Figure 4 below shows the fixed pole-jurin design layout. The design consists of two main parts, namely the main spikes and the supporting legs. On the main spike there is a tapered end of the part that serves as a sign of sculpting and also hangs the plumb-bob.

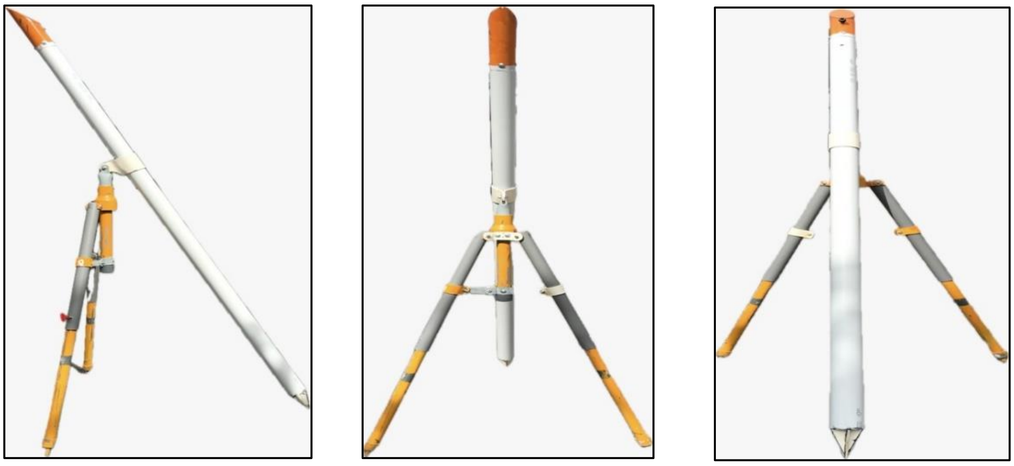

Figure 4: Fixed Pole-Jurin Design from Side, Front and Rear View consisting of Main Spike, Retainer Legs and Observation Mark with Plumb-Bob

The first part is the main spike section which is the observation mark for the observatory as shown in Figure 5. These spikes need to be clear so that the observatory does not have difficulty tracing and picking the mark. These spikes have a fresh mark position upright with a station on the ground surface. These spikes can also be adjusted in height according to the needs and ease of observation.

Figure 5: Main Spike Section with Dimensions

The second part is the part of the legs that supports the main spike in the standing conditions as Figure 6. These legs are designed so that they can be adjusted in length and opening of their legs. These legs play a very important role in the process of centralizing the observation marks on the main spikes to the station on the ground surface through the plumb-bob.

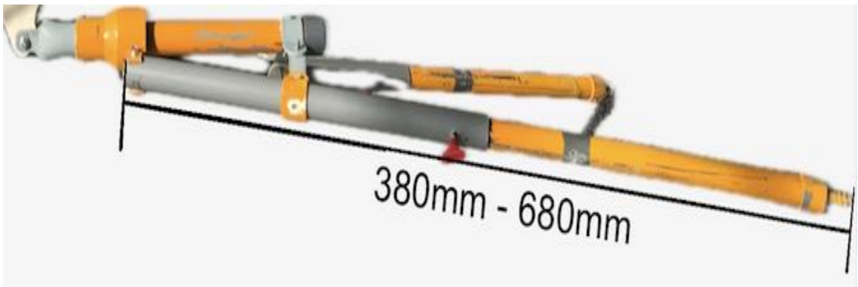

Figure 6: Supporting Leg with Dimensions Showing the Size of Openings

Based on the preliminary test results at the Kuching Polytechnic Sarawak, Table 1 shows the results obtained in terms of time and gross weight compared to the existing practice. Table 2 shows the respondent's level of acceptance of the questionnaire given.

Table 1: Comparison Between Disposable and Fixed Pole-Jurin

EQUIPMENT	Comparison of the gross weight of the tool	Comparison of time periods for set up tools
Disposable Pole-Jurin	3-5 kg	5-10 minutes (starting from pruning branches and cutting wood to set up)
Tripod with prism	5 kg	3 mins
Fixed Pole-Jurin	1 kg	2 mins

4.2 Comparing The Gross Weight Between The Fixed Pole-Jurin With The Conventional Tools That Students Need To Carry.

By estimating the average weight of the old method consisting of five to ten centimetres in diameter wood and two wooden sticks either short branches or large twigs as legs to hold as shown in Figure 1 above is around three to five kilograms. While for the use of triple legs and prism, the weight is five kilograms. Compared to fixed pole-jurin made from used PVC pipes weighs only about 1 kg. This will make it easier for students to take it into the forest or during practical work.

4.3 Comparing The Time Frame For The Device To Set Up Between The Fixed Pole-Jurin With The Conventional Method During The Practical Work.

As for the length of time, the time required to set up the fixed pole-jurin tool differs significantly because the it only needs to set up around 2 minutes only. It is not much different from using tripod and prism where the time taken is 3 minutes. In the meantime, the use of disposable poles takes longer from trimming, cutting, squealing to preparing a device that takes 5 to 10 minutes. Therefore, the use of fixed pole-jurin innovations does not require additional work and energy as the current method.

4.4 Questionnaire Analysis

The survey was conducted on 36 respondents comprising students and lecturers. Table 2 shows the respondent's score on the level of acceptance based on the questionnaire given. The average score for all questionnaire items earned more than 4.5. This reflects the majority of respondents scoring between a scale of 4 and 5. The result obtained by calculation using Microsoft Excel.

Table 2: Results on Product Acceptance Level

BILL	THINGS	LEVEL OF ACCEPTANCE					MIN
		1	2	3	4	5	
		%	%	%	%	%	
1.	FIXED POLE-JURIN is more suitable compare to the previous method	0	0	11	28	61	4.50
2.	FIXED POLE-JURIN consume lesser time than previous method	0	0	6	28	67	4.61
3.	FIXED POLE-JURIN have stronger durability than previous method	0	0	6	22	72	4.67
4.	FIXED POLE JURIN is easier to use	0	0	6	22	72	4.67
5.	FIXED POLE-JURIN more effective than the previous method	0	0	6	28	67	4.61

4.5 Getting The User's Response Using Fixed Pole-Jurin In The Field During Practical Work.

Based on the table above, it is found that users prefer to use fixed pole-jurin innovations on two things. It is evaluated through five items on questionnaire and the 4th item which is easier to use ~~which has~~ obtained the highest scored M=4.67. While the pole-jurin innovation remained more durable than the previous method on the 3rd item also scored M=4.67. This can be seen from the use of more sensitive prism and should be handled with caution during practical time to prevent it from falling. As ~~been told~~ identified by M. Anjang (2016) where the equipment must be used with care and caution. This is because all measuring equipment is expensive. Students need to ensure that tools are used carefully and correctly. In fact, the use of disposable poles is required to look for a straight, not too large stick, cut and trim the branches for the process to be ready. For them this work is a chewing and a waste of time while practicing.

Figure 7 below shows a graph of the level of consumer acceptance of the products produced. The results of the questionnaire reflect the positive impact in terms of cost, time, durability, suitability and effectiveness compared to existing methods. It can be said that almost two-thirds of the respondents gave the maximum score on the prototype.

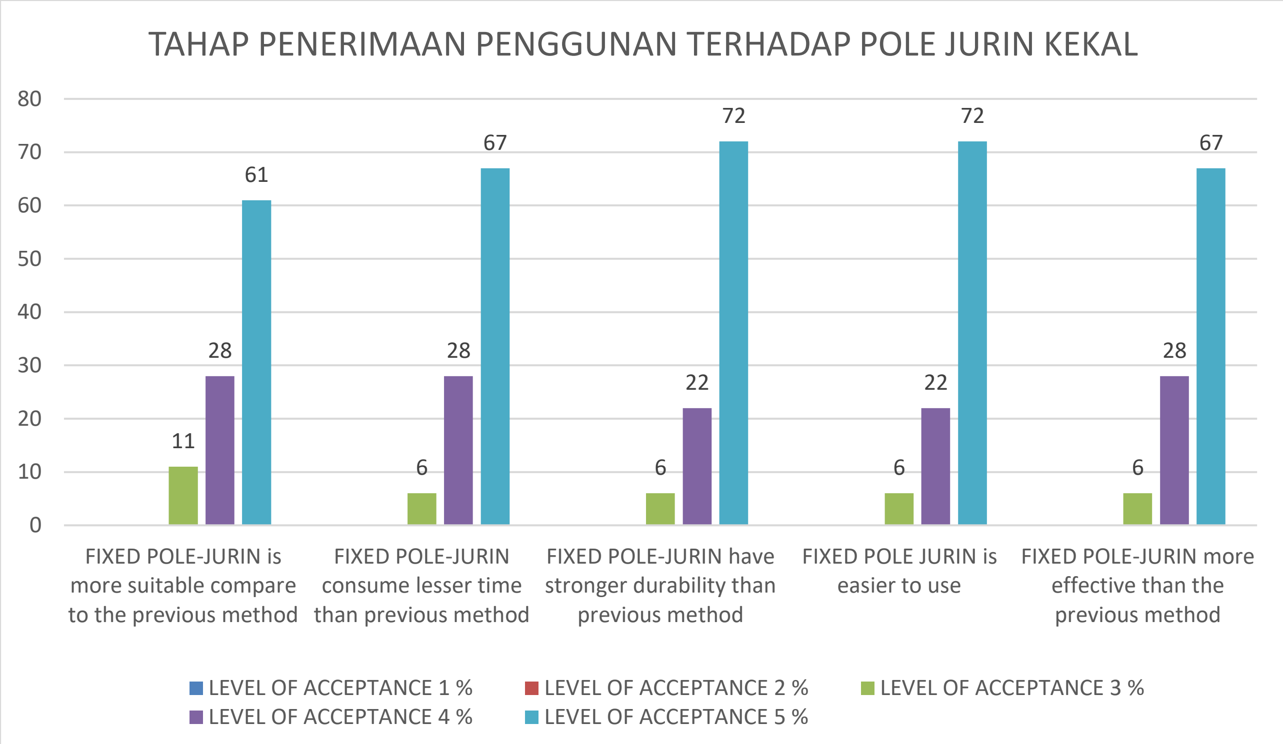

Figure 7: Graph of User Feedback Results

5.0 Conclusions

As a result of the feedback received, a good acceptance of all criteria has been achieved. In conclusion, the use of fixed pole-jurin can ease the burden of students in practical work in terms of the number of tools that need to be brought to the field and speed up the process of practical work in general. Therefore, the prototype is ready to be used for the upcoming learning session with several suggestions for improvements such as the stepping platform and the slow-motion adjuster level can be worked on in the future. With the use of this prototype directly it can make fieldwork assignments easier as well as more productive in the future.

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Author Contributions

Lukman Nul Hakim, M. T.: Conceptualization, Methodology, Writing Original Draft Preparation; **Mohd Fadli, C. A.:** Validation, Supervision, Writing-Reviewing and Editing; **Alvadjuri, A.:** Data Curation, Validation

Conflicts Of Interest

The manuscript has not been published elsewhere and is not under consideration by other journals. All authors have approved the review, agree with its Submission and declare no conflict of interest in the manuscript.

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