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Students' Perceptions of Homework as a Support for Improving Learning and Knowledge Retention in Vocational Engineering Education: An Action Research Study

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Abstract

Background and Aim: The inclusion of homework in the engineering vocational curriculum is uncommon, and its effects remain underexplored. To address this gap in the literature, this research focused on students' perceptions of homework to better understand its impact on learning and knowledge retention. To achieve the aim and objectives of this study, both quantitative and qualitative data were collected from 10 learners enrolled at a college in a socioeconomically deprived city in Northern England. The hybrid data collection technique was adopted to ascertain extensively the design and extent to which homework influences learning, based on participants' lived experiences.

Materials and Methods: A participatory Action Research (AR) approach adopted in this research began by identifying homework as an intervention to support learning and knowledge retention. This was followed by an evaluation of learners' perceptions of how homework supported learning and knowledge retention. The evaluation process involved assigning two sets of homework to the selected cohort. Feedback from completing the first set of homework helped redesign the second set. Tasks in both homework sets were problem-based and involved applying and memorizing formulas. The feedback collection method involved both quantitative and qualitative approaches, using survey questionnaires and open-ended interviews, respectively.

Results: Analysis of the quantitative data showed that students strongly agreed that completing their homework helped their learning and knowledge retention (with the highest mean score of 94%). The lowest-rated question was whether homework should be given more frequently (with the lowest mean score of 48%). The qualitative data provided deeper explanations of the quantitative findings. Self-efficacy through autonomous learning, stress from work-life imbalance, and workload appropriateness were prominent themes identified in the final analysis. These two datasets demonstrate the issues and benefits of homework, and how it can significantly improve students' understanding of core engineering principles.

Conclusion: It is evident that homework in vocational engineering education can be used as a pedagogical strategy to support learning and knowledge retention. However, care should be taken in its design and delivery, as it can also be a barrier to learning. Possible mitigating strategies suggested in the study included cascading submissions before the deadline. These findings offer valuable insights for educators and policymakers on how homework is designed and integrated into the academic curriculum to enrich students' overall learning experience.

Keywords: Further Education, Engineering Education, Vocational Education, Homework Design, Knowledge Retention, Foundation to T-Level, Socioeconomic Deprivation, Action Research, Learning Outcomes

Introduction

A vocational education establishment is a learning institution, such as a college or private training provider. This establishment offers soft (theory) and hard (experiential) training for young adults (16 -18 years or older) to prepare for specific jobs, trades, or careers. In the UK, vocational education is often referred to as Further Education (FE). FE enables learners to pursue post-secondary education, and it is central to providing the practical and technical skills required for a nation's economic growth (Cedefop, 2026).

A large number of learners are enrolled in colleges year in, year out, but a recent trend shows that many learners, especially in engineering courses, either drop out or fail to complete their courses (Korumaz & Ekşioğlu, 2021). Key reasons for the high percentage of non-achievement are likely linked to learners' difficulty in matching learned practical skills with the retention of new knowledge, as well as the effects of poor schooling caused by the COVID-19 pandemic (Howard et al., 2021).

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To address low achievement rates in FE engineering education, the UK government has implemented various initiatives, including a focus on knowledge development and access to up-to-date educational technology, to bridge the skills gap in technical careers and ensure the national workforce is ready for the future.

Despite the UK government's continued and extensive investment since the COVID-19 pandemic to improve learning and achievement in vocational qualifications, the situation has yet to yield the desired results. It remains evident that most learners are struggling to retain knowledge and complete their qualifications (Vigar, 2025).

Research literature remains sparse in vocational education. UK FE colleges have historically been underfunded and have attracted less research interest than other educational sectors, such as universities and compulsory primary education. Since colleges are not considered part of compulsory education, there is also a lack of public interest and low funding in this sector (Lewis et al., 2025).

Given the peculiar nature of vocational education, FE lecturers have, through self-reflection, investigated and published numerous papers and reports on improving achievement in vocational education. These papers and reports highlight factors that can support student learning and knowledge retention. However, very little has been done to date to determine the impact of extended learning through homework on learning and achievement in FE engineering (Eren & Henderson, 2008).

According to Cooper et al. (2006) and Grodner & Rupp (2013), homework can serve as a learning tool to reinforce learning and improve memory retention. On the other hand, according to Cooper & Valentine (2001), it can cause stress, frustration, and burnout if it does not include learners' lived experiences.

To ascertain students' perception of homework on learning, this study uses a self-participatory AR methodology to enable self-reflection, participation, and the provision of an intervention to support learning and knowledge retention.

The scope of this study is specific to a group of 16-18-year-old students enrolled in a Foundation to Technical Level (FTL) course at a UK vocational FE college situated in the Northern part of the country. This cohort of students all live locally in a socioeconomically deprived urban area.

The minimum enrolment grade for Maths and English in this FTL course is a 4. This grade represents the minimum pass grade in the UK educational system. The economic situation and enrolment criteria in the FTL engineering course both represent the peculiarity of this study.

The overall framework of this study is guided by the following research aim and objectives: 1) to what extent learners perceive homework as a support for improving learning and knowledge retention, 2) factors influencing those perceptions, and 3) determining the appropriate amount of homework that is pedagogically suitable for learners in general.

Results from this research can also inform stakeholders in engineering education about the role of homework in education and offer evidence-based recommendations for assigning the right amount of homework to engage learners.

Literature Review

Educators, as part of their Continuing Professional Development (CPD), reflect on their practice and identify areas for improvement. In the educational sector, improvement in practice is mostly carried out through an AR stepwise cycle. This involves investigating an intervention to bring about a change in practice (Codina & Robinson, 2024).

Action Research methodology was first introduced and originally applied in the field of social psychology by Kurt Lewin in 1946 (Adelman, 1993). It has since been applied in other sectors, such as education and healthcare.

A common issue in FE requiring an intervention is the typical class session lasting an hour and a half. This can be problematic for some vocational learners, especially where there is a high volume of theories and formula memorization. McDermott & Roediger (2025) noted that the process of learning and retrieving a new skill involves multiple stages, from encoding what you hear or see the teacher do to short- or long-term memorization, and finally to retrieval. In a typical FE practical or classroom

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session, not much of these learning processes can be achieved when a high volume of information is transmitted (Bishop, 2018).

As such, in engineering courses, completing homework can help support the typical learning session and enrich learning and knowledge retrieval via the principles of Cognitive Load Theory (CLT). Assigning homework in vocational engineering education is supported by the CLT because it allows learners to break down information, understand it, and apply new knowledge to complete assigned tasks (Sweller, 2020).

Also, completing homework strongly aligns with the Retrieval Learning Theory (RLT). The RLT strengthens long-term memory by allowing learners to learn at their own pace and recall what they had previously learned (Ding & Zhu, 2021). Learners in FE education would benefit from learning at their own pace if their curriculum included homework as an extracurricular activity.

From a constructivist viewpoint, homework strengthens long-term memory and can help learners build on their knowledge rather than relying solely on tutors for instruction (Wibowo et al., 2025; Trautwein & Köller, 2003; Grodner & Rupp, 2013; Guo et al., 2024).

It is often assumed that homework is completed at home in a space suitable for learning, with support from older siblings/parents. This unconscious assumption already excludes students from poor socioeconomic backgrounds.

Some students do not have a home or a conducive environment to complete their homework. Etim et al. (2022) acknowledged the effect of poverty on learning and suggested that failing schools and colleges are usually located in regions of socioeconomic deprivation. A key reason for this failure could be that various learning interventions, such as homework to support learning, are not equally received by privileged and underprivileged learners (Villarreal Arroyo et al., 2023).

Some students from a poor socioeconomic background become burned out when they have to contend with, for example, a lack of internet access and a lack of quiet space to complete their homework. Consequently, these students from low socioeconomic backgrounds may look for ways to cheat or rush through the homework tasks, which does not truly reflect the knowledge gained from completing homework.

To investigate the breadth of existing research in the use of homework as a learning support in FE education, an advanced search was conducted using Google Scholar. Using broad search criteria, "perception and impact of homework in education" yielded 420,000 results. These results mostly focused on the effects and perceptions of homework in secondary and university education. When these results were further narrowed using the advanced search option, replacing “education” with the exact phrase "vocational education” + “technical education", only 60 outcomes were produced. Most of the generated results focused on a variety of contexts, including digital learning interventions, teachers’ perceptions of interventions, and work-based learning. The majority of the 60 results were from compulsory secondary education settings, and none referred to homework as a learning intervention.

This literature survey identifies a knowledge gap in assessing students' perceptions of homework in FE vocational college settings. However, findings from the search results serve as a starting point for acknowledging the concerns about the competence gap between vocational students' skills and the need to extend learning beyond the classroom.

The effect of homework on learning, as indicated by the broad literature search, is clear: it substantially impacts students’ learning and achievement (Trautwein, 2007; Hellem & Loras, 2020; Cooper & Nye, 1994). However, FE learners are more diverse in prior educational experiences, academic readiness, and age. Hence, their perceptions of the effect of homework on knowledge retention are pertinent.

Rahmani et al. (2024) clearly explain how students benefit from homework and how it enables them to acquire factual knowledge by allowing them to control their learning pace. Vygotsky and Piaget, as cited in MacNaul et al. (2021), highlight the active role of learners in setting the pace of their learning.

The above benefits of homework logically imply that it can be effective in vocational engineering education settings, as long as the design takes into account the diverse nature of learners. Well-designed homework that takes into consideration the diverse nature of learners, including their

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socioeconomic backgrounds, can support deeper learning. Ryan and Deci's Self-Determination Theory (SDT) examines intrinsic motivation to learn when barriers to learning are removed (Vu et al., 2021).

Designing homework that balances personal responsibilities with studying outside college hours is very important and can influence engagement. Recent studies have linked student engagement and achievement to homework design. MacNaul et al. (2021) also revealed that offering learners a choice of homework format increased their engagement.

In assessing participants' perceptions of a change in practice, qualitative and quantitative methods are widely used (Nielsen et al., 2022; Reed et al., 2021). Quantitative methods involve collecting empirical data using fixed or closed-ended questions and numerical scales to understand trends and reduce bias (Slater & Hasson, 2024). On the other hand, qualitative methods involve collecting empirical data using open-ended questions and interviews to understand the degree of belief in personalized data (Ahuvia et al., 2024).

In the closed-ended questionnaire, a simple yes-or-no scale has been used to analyze empirical data; however, this approach has generally been criticized for offering participants limited opportunity to capture the depth of their opinions (Fareed et al., 2024).

Consequently, some recent studies have used a broader spectrum of weighting, such as the Likert scale (Letterman, 2013).

There are several criticisms of the use of Likert scales and associated linear rescaling techniques, mainly due to concerns about the uneven distribution of data weight. However, the Likert scale remains popular for its simplicity in analyzing empirical data, particularly in educational studies (Boone & Boone, 2012; Rosário et al., 2014).

Also, in defense of using a broader spectrum of weights for empirical data, Boone & Boone (2012) argue that it is acceptable to average Likert-scale responses when several respondents score differently to even out anomalies. Also, to increase the reliability of the data, the coefficient of variation can be calculated by dividing the Standard Deviation (SD) of the data by the average score (Groeneveld, 2011). Hence, the use of the Likert scale in empirical research is robust and not subject to poor data analysis (Norman, 2010).

Open-ended questions, telephone interviews, and in-person interviews or focus groups have been used extensively to assess the depth of participants' feelings and perceptions (Hand, 2013). In this method, participants share information in their own words.

Both quantitative and qualitative methods have their drawbacks: the former lack depth and overrepresent data as numbers, while the latter is prone to misinterpretation and can be difficult to analyze. Given the merits and drawbacks of these methods, it is now common for researchers to employ a hybrid approach, combining the advantages of one with the disadvantages of the other.

Murphy-Sabella (2020) used a mixed-methods approach, combining qualitative and quantitative methods to evaluate parents' perceptions of their ability to help with homework. By using both methods, Murphy-Sabella was able to cross-validate their findings, thereby improving the trustworthiness and credibility of their work. Other advantages of using mixed methodology in research, as reported by Songsirisak & Jitpranee (2019), included conducting multiple data analyses to compensate for the weaknesses of a single method.

Despite the numerous and significant advantages of the mixed-methods approach, there are some drawbacks. One is the challenge of data representation and integration (Onwuegbuzie & Johnson, 2006). Given this major drawback, a well-known integration method is the convergent parallel design. This approach can be used to address data representation and integration challenges. This integration method is widely used to provide a comprehensive, in-depth overview of research, both narratively and numerically (Alrawashdeh et al., 2021).

The development of the questions in the questionnaires and interviews is inspired by professional experience and draws from the works of Biggs et al. (2022), Ramesh & Rao (2015), and Lynch et al. (2018). The research framework incorporated in the AR cycles is presented in Figure 1.

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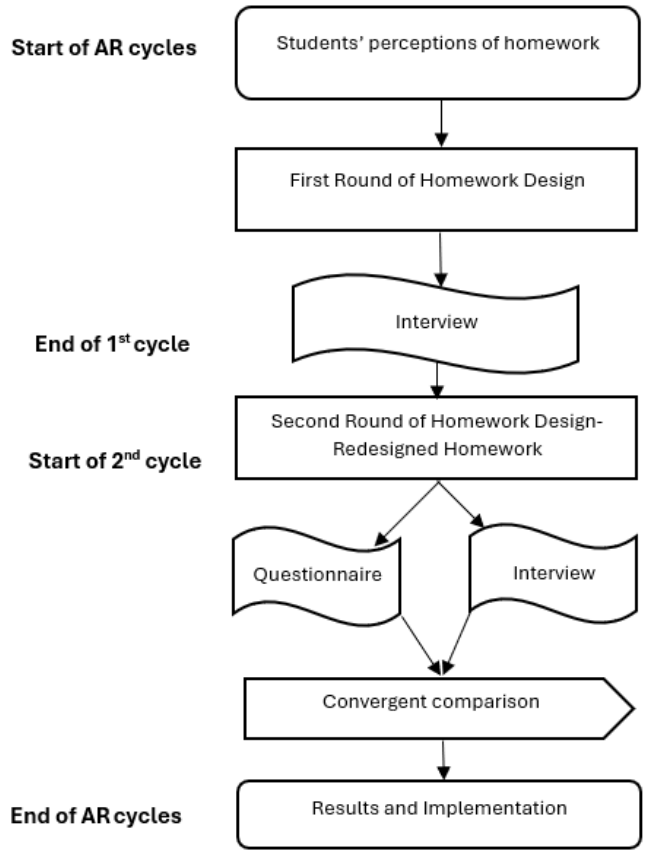


Figure 1: Research Framework

Methodology

Research Approach

AR methodology is a preferred option over traditional research methods because it closes the distance between researchers and participants (Coghlan, 2022). A hybrid method combining quantitative and qualitative data is employed with AR methodology to propose (plan) and implement (act) homework into the engineering curriculum. This combined approach in the AR methodology was employed to reflect on and intervene in any adjustments made to the homework design. A convergent parallel design is used in this study to integrate and compare data sets.

The plan-act-reflect cyclic process of the AR methodology involves assigning two sets of homework. The first set was used to gain insight into the design of an appropriate amount of homework that is pedagogically suitable for learners. The second set informed the redesign of homework that meets learners' needs. This continuous, cyclical process in the first and second sets of homework design was used to gauge students' overall perceptions of homework. The main modification to the first set of homework was to reduce the number of tasks and lower the cognitive load of completing the second set.

Sample/Participants

The FTL engineering cohort consists of 15 students; however, only 10 students voluntarily participated in the study. Of the 5 participants who opted out, 3 confided that they have caring responsibilities for their siblings and that completing any homework would be difficult. The FTL engineering cohort, all 15 males, aged 16 to 18, was drawn from a college in a socioeconomically deprived UK urban city. These participants are from a culturally diverse city with lower employment rates and slower projected growth than other UK cities (ONS, 2023). Even with the small sample size,

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it is worth noting that the present study prioritizes depth over breadth and focuses on localized patterns rather than statistical generalization.

Development of Research Tools

To generate evidence required to answer the research questions, questionnaires and interviews were developed. The development of the questionnaire and interview questions was informed by self-reflection gained through seven (7) years of lecturing experience and peer collaboration. A 5-point Likert scale is employed in this study to provide greater granularity in capturing the degree of belief in responses. This approach will present a precise and representative understanding of feedback from the developed questionnaire.

The issue of uneven data weight distribution when using a Likert scale will be addressed by averaging respondents' scores and calculating the Coefficient of Variation (CV). The formula for CV is given by:

$$CV = \frac{SD}{\bar{x}} \quad \text{.....(1)}$$

and

$$SD = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}} \quad \text{.....(2)}$$

Where:

SD: Sample Standard Deviation
$\bar{x}$: Mean sample
x_i: Each individual score
n: Number of participants
$\sum$: Sum of the values

CV is used to check for consistency and anomalies in collected data. A high CV≥1 score indicates several outliers in the data, whereas a low score, CV<1, indicates relative consistency with the average score.

The sets of questions in the questionnaire and interview were peer-reviewed by 5 senior colleagues, each with at least 10 years of teaching experience. Research verification is achieved through the use of consistent data collection methods across all 10 participants.

Ethical Consideration

To mitigate the risk of power dynamics, the AR methodology provides guiding principles of respect and collaboration between the researcher and participants to ensure data integrity. In the data collection stage, participants were reminded of their rights and safety and were briefed on how these would be guaranteed. Participants were reminded to be honest in completing the questionnaire and not to feel pressured to provide biased or favorable data/feedback. They were reminded that everyone, including the researcher, was an integral part of the investigation and that there was no power hierarchy. They were briefed on the purpose of the research and assured that their names and other sensitive data would not be published or shared with third parties.

A codification of participants' identities was used to replace their real names with pseudonyms such as A_1, A_2, …, A_n (for questionnaire responses) and B_1, B_2, …, B_n (for interview responses) to ensure confidentiality and protection of identity. The codification of names enabled the incorporation of direct quotes from participants into the qualitative data analysis, enhancing the validity of the research. However, when direct quotes could reveal participants' identities, responses would be rephrased. To ensure transparency and address the potential influence of my dual role as their lecturer and researcher, participants were informed of their right to withdraw at any time during the research process. Only those who have completed the consent form will participate, thus emphasizing their voluntary participation in the research.

This research strictly adhered to the guidelines of the British Educational Research Association (BERA), a leading authority on educational research in the UK. Ethical approval for this investigation was granted by the College Research Ethics Committee (REC). Additionally, the data collected in this study were processed in accordance with the college's GDPR requirements.

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Data Analysis

Data from the questionnaires were analyzed using a 1-5 Likert scale. Where, 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree. Data collected for each questionnaire item were averaged by mapping responses to the Likert scale using a linear rescaling technique. Here, the subjective rating (or point) is divided by the highest Likert scale value (Misra & Panda, 2017). This is then followed by CV calculation to identify any anomalies in the data.

Thematic analysis was used to analyze interview data and understand factors influencing participants' perceptions of homework. This method is robust and reputable for interpreting personalized data (Lochmiller, 2021; Ayre & McCaffery, 2022). The thematic analysis involved assigning codes to recorded data on a spreadsheet. These generated codes were fed into the Canva word cloud generator—a digital visualization tool—where the most frequent codes appeared in larger font sizes, while less frequent codes were displayed in smaller font sizes. Themes were then developed to summarise the results. The development of codes and themes was peer-reviewed by the same 5 senior colleagues to ensure the reliability of the process.

Results

In the first cycle, feedback codes from the first interview mainly pointed to 2 broader themes: the lengthy time it took participants to complete the homework tasks and the excessive number of tasks, which led to a loss of motivation. See the feedback data represented visually in a Canva word cloud generator in Figure 2:

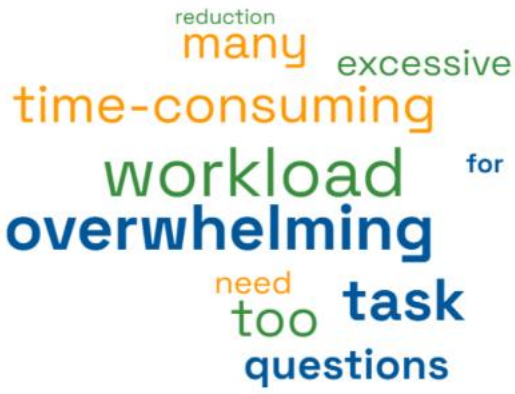


Figure 2: Word cloud analysis from interview 1(Canva,n.d.)

In the second cycle, data collected via questionnaire showed, on average, a positive perception of homework. One of the ten (10) survey questions in the questionnaire reads “Completing this homework has improved my understanding of the topic: moment and transposition of formulae.” High scores of 5s and 4s were selected from the Likert scale. Table 1 shows a sample of the raw data collected from the returned questionnaires.

Table 1: Overview of the data collected

S/N	Statement	Participant	Rating/score
1	Completing this homework has improved my understanding of the topic “moment and transposition of formulae”	A_1	4
		A_2	5
		A_3	4
		A_4	4
		A_5	5
		A_6	3
		A_7	5
		A_8	4

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S/N	Statement	Participant	Rating/score
		A_9	4
		A_{10}	4
2	Compared to the class session, I think I am more confident in applying the concept of moment and transposition to practical tasks.	A_1	4
		A_2	5
		A_3	5
		A_4	4
		A_5	3
		A_6	3
		A_7	4
		A_8	4
		A_9	5
		A_{10}	5
3	The workload/tasks in the homework were appropriate	A_1	4
		A_2	3
		A_3	4
		A_4	5
		A_5	3
		A_6	4
		A_7	5
		A_8	3
		A_9	5
		A_{10}	4
4	I put in so much effort and time into completing this homework	A_1	4
		A_2	4
		A_3	4
		A_4	5
		A_5	4
		A_6	3
		A_7	4
		A_8	4
		A_9	5
		A_{10}	5
5	I found the homework more engaging than classroom sessions	A_1	5
		A_2	4
		A_3	4
		A_4	3
		A_5	5
		A_6	5
		A_7	5
		A_8	5
		A_9	5
		A_{10}	4
6	Homework helps me to retain formulae more.	A_1	5
		A_2	5
		A_3	5
		A_4	5
		A_5	4
		A_6	5

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S/N	Statement	Participant	Rating/score
		A_7	4
		A_8	5
		A_9	4
		A_{10}	4
7	Homework plays an important part in learning and should be included in our curriculum.	A_1	5
		A_2	5
		A_3	5
		A_4	4
		A_5	5
		A_6	5
		A_7	5
		A_8	5
		A_9	5
		A_{10}	3
8	Homework should be given at the end of every lesson	A_1	3
		A_2	3
		A_3	2
		A_4	1
		A_5	1
		A_6	2
		A_7	3
		A_8	5
		A_9	2
		A_{10}	2
9	I had enough time to complete my homework	A_1	3
		A_2	3
		A_3	4
		A_4	4
		A_5	2
		A_6	3
		A_7	1
		A_8	4
		A_9	2
		A_{10}	3
10	Homework is helpful for my learning, generally	A_1	5
		A_2	4
		A_3	4
		A_4	5
		A_5	4
		A_6	4
		A_7	4
		A_8	5
		A_9	4
		A_{10}	3

Table 2 presents the mean scores for each survey question. According to the results in Table 2, the majority of participants believe homework is important for learning and should be part of the curriculum, with the highest mean score being 94%. The CV value for this question was 0.14, which

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was <1, indicating homogeneity in the data. This high score aligns with Ryan and Deci's self-determination theory, in which learners are intrinsically motivated to learn because they have autonomy and a say in the learning process.

Questions 8 and 9 received the lowest ratings. Assigning homework at the end of each class was not widely accepted, with a mean score of 48%, and nearly half of the respondents reported struggling to find enough time to complete their assignments, with a mean score of 58%. These imply that students prefer a healthy balance between study and life. These results agree with Maslow's hierarchy of needs, which suggests that learners learn better when there is a healthy balance between study and family life (Niemela & Kim, 2023).

Although the individual CV values for questions 8 and 9 were relatively low (<1), they still showed moderate disagreement. This is still acceptable; however, if the data from the 5 students who pulled out had been collected, it could have reduced variability around the mean ratings for the survey questions.

Table 2: Cumulative data from the questionnaire

S/N	Survey Question	Average rating for (A_1 - A_{10})	% score	Coefficient of Variation = SD/Average rating
1	Completing this homework has improved my understanding of the topic "moment and transposition of formulae"	4.5	90%	0.15
2	Compared to the class session, I think I am more confident in applying the concept of moment and transposition to practical tasks.	4.2	84%	0.18
3	The workload/tasks in the homework were appropriate	4.0	80%	0.20
4	I put in so much effort and time into completing this homework	4.2	84%	0.15
5	I found the homework more engaging than the classroom sessions	4.5	90%	0.16
6	Homework helps me to retain formulae more	4.6	92%	0.11
7	Homework plays an important part in learning and should be included in our curriculum	4.7	94%	0.14
8	Homework should be given at the end of every lesson	2.4	48%	0.49
9	I had enough time to complete my homework	2.9	58%	0.34
10	Homework is helpful for my learning, generally	4.2	84%	0.15

To provide a visual summary of the survey questions rated from agree to strongly agree (above 50), neutral (50), and disagree to strongly disagree (below 50), a graph of the quantitative data is shown in Figure 3.

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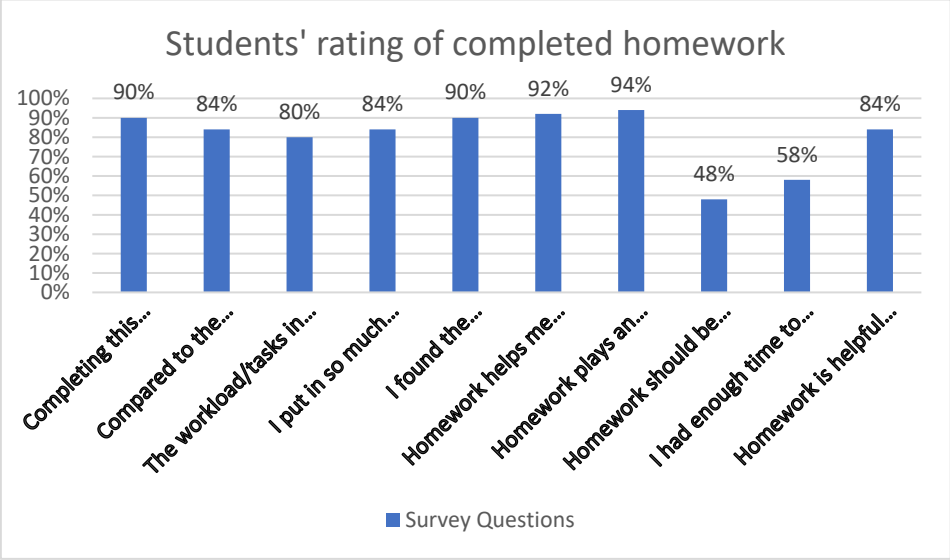


Figure 3: Quantitative analysis of the impact of homework on knowledge retention

While the results from the questionnaire showed a clear, measurable students' perception of homework, the results from the interviews provided more personalized insights into the factors influencing those perceptions.

Table 3 presents students' responses and associated response codes to questions about their perceptions of homework and the factors that influenced their answers in the completed questionnaire.

Table 3: Interview response

S/N	Students' statement on their perception/feedback from completing the homework	Developed code (s)
B_1	Yeah, doing the assignment helped me see how the formulas actually apply to stuff outside the classroom.	Real-world relevance, improved knowledge retention
B_2	Doing my homework kinda made the topic stick in my head more because I had the chance to go over my notes or ask my mate for help, whereas in class there is not much time to think about the topic more.	Self-paced learning, improved knowledge retention
B_3	The questions were not so lengthy; I completed them and checked with my mates to compare answers. I finally got to know how the distance from the fulcrum changes the balance of a seesaw.	Self-efficacy, improved knowledge retention, manageable workload
B_4	To be honest, I used to guess the calculation of the clockwise and anti-clockwise moment, but now I get it. I was able to do bits and pieces of the homework before I completed the whole thing.	Self-efficacy, improved knowledge retention, flexible learning, self-paced learning
B_5	Completing the homework didn't really add to my knowledge; it just made it easy for me to remember the formulae used.	Lack of benefit, improved knowledge retention
B_6	I would have done better if I hadn't had to look after my younger brother at home.	Home distractions, stress
B_7	I had to wait for everyone to go to bed in our house so I could complete my homework. I like that I could work at	Self-paced learning, home distraction, stress

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S/N	Students' statement on their perception/feedback from completing the homework	Developed code (s)
	my own pace without being rushed, even though I was tired.	
B_8	I now know that clockwise movement is positive, while anticlockwise is negative.	Improved knowledge retention, Self-efficacy
B_9	I didn't have to rush through the questions as I do in class; the homework improved my understanding.	Self-paced learning, improved knowledge retention
B_{10}	Homework is stressful, sir. I totally forgot about the homework; I managed to complete one of the questions this morning in college.	Home obligation, stress

The developed codes were input into a word cloud generator to visually highlight the most frequent terms, as shown in Figure 4 for the Canva word cloud.



Figure 4: Word cloud analysis from interview 2 (Canva,n.d.)

Self-paced learning and improved knowledge retention were the most prominent codes derived from the interviews. This was unexpected, as low grades in participants' maths and English are usually associated with difficulties in problem-solving and knowledge retention.

By contrast, some participants reported difficulty concentrating at home while completing their homework. This made "stress" a prominent theme in the data analysis. This result is expected from a cohort of students living in a socioeconomically deprived area. In theory, according to Maslow's hierarchy of needs, students learn better if barriers to learning, such as home obligations, distractions, and work overload, are absent.

Although one participant reported forgetting their homework due to home obligations, this research also accounts for other students who opted out due to perceived stress and work overload associated with homework. Also, based on the recorded interview data, no participant reported feeling overwhelmed by the homework, which suggests that the redesign and reduction of homework tasks were pedagogically appropriate for the students.

In a nutshell, three themes of "self-efficacy through autonomous learning", "stress caused by work-life imbalance", and "workload being appropriate" have been derived from the thematic analysis.

The integration of quantitative and qualitative data analyses is shown in Figure 5, highlighting agreement and disagreement between the two data sets to better understand students' perceptions of homework, including its design and effects. High cumulative scores of each item in the quantitative data show strong agreement with the qualitative data. Diverse cumulative scores in items linked to

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"stress caused by work-life imbalance" imply the positive wording used in the questionnaire. It can be deduced that assigning homework at the end of every session would cause stress, hence the low rating. Also, many learners put in a lot of effort and time to complete this homework, which invariably causes stress, hence the high rating.

These findings align with the idea that completing homework can enrich learning and knowledge retrieval, in line with the principles of Cognitive Load Theory (CLT) and the Retrieval Learning Theory (RLT). On the other hand, results from this study align with Cooper et al. (2006), Grodner & Rupp (2013), and Cooper & Valentine (2001) in that homework can serve as both a learning tool and a barrier to learning when it causes stress.

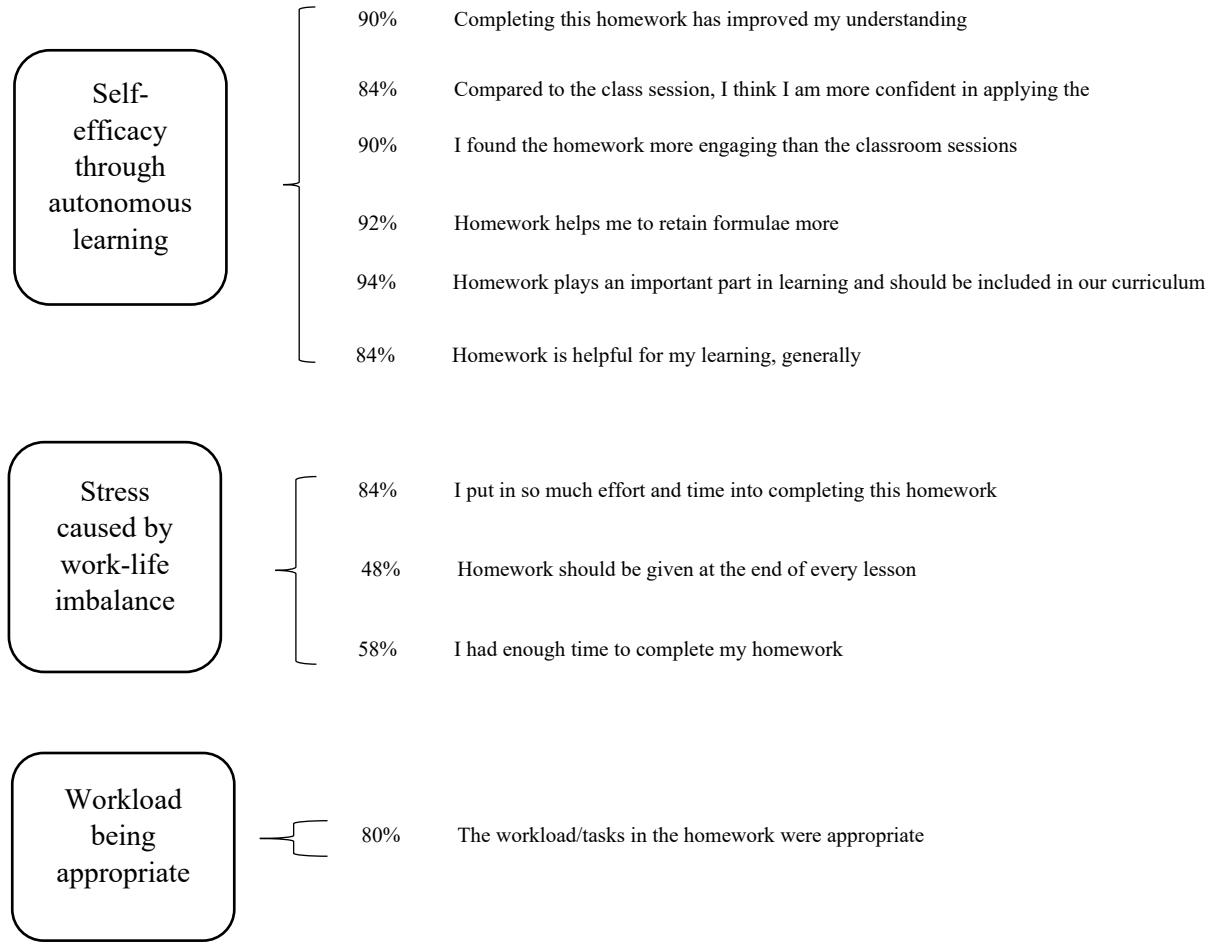


Figure 5: Convergent parallel data integration

Discussion

The exploration of students' perceptions of homework to support knowledge retention among the FTL cohort was conducted over two (2) rounds of homework tasks. Both rounds involved ten (10) participants completing twenty (20) questions from the "Engineering Principles" unit. Two (2) topics from this unit, titled "the turning moment of a force" and "transposition of engineering formulas," were selected to develop the tasks for the two (2) sets of homework. These topics were chosen because they involve several formulas and steps to recall when solving a problem. These topics can be difficult for some pre-university students with grade 4 in maths.

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These topics were first introduced/taught in the class over 2 sessions before homework was assigned. The practical applications of the "moment" topic were also introduced. Upon submission of the homework, a colleague assisted with the open-ended interview questions to gather immediate feedback. Questions asked during the first round of homework focused on the workload and how long it took to complete it.

Feedback from the first round of interviews was used to design a more manageable homework load.

Following the completion of the second homework, a combination of structured questionnaires and open-ended interview questions was used to collect feedback from participants. The total interview sessions for the first and second rounds lasted approximately 20 and 45 minutes, respectively. The questionnaire was designed to be completed anywhere and returned in the next scheduled class.

Conclusion and Recommendation

The plan-act-reflect cycle of the AR methodology helped first identify what is considered overwhelming homework and, second, understand how learners perceive homework as supporting learning. However, no general rule still exists for determining the right number of homework tasks. However, educators can find a balance between overwhelming and engaging homework by first consulting with their learners. Homework design that reflects learners' realities can reduce the risk of cheating or rushing through questions. To prevent burnout and reduce the risk of students plagiarizing from the internet because of home obligations and cognitive overload, educators should allow cascading submissions before the deadline. In addition, educators can include an unannounced grace period for homework submission in their yearly scheme of work.

A key dialectical finding from this study reveals the connection between homework's high impact on learning and the barriers to learning caused by poor socioeconomic backgrounds. Also, participants' low grades in math and English did not necessarily indicate difficulties with problem-solving, communication, or knowledge retention, but these can be linked to students' well-being and disadvantaged backgrounds.

Despite the study's valuable findings, the sample size, lack of gender diversity, and participants' geographic location remain significant limitations. Even with these limitations, the present study prioritizes depth over breadth and focuses on localized patterns rather than statistical generalization. Nevertheless, these limitations will restrict the study's generalisability to other colleges offering vocational engineering education.

Future research should include a more diverse group of participants and a larger sample size from diverse economic backgrounds to strengthen students' perceptions of how homework improves learning in vocational engineering education. Another recommendation for future research is to compare the barriers to using homework as a learning tool in both low-income and high-income areas. Lastly, education stakeholders can support FE colleges by funding professional development to find better ways to support learning in underfunded settings, while taking students' lived experiences into account.

Knowledge Contribution

This study has demonstrated the effects of homework from students' perspective by comparing both quantitative and qualitative data using a convergent parallel integration method. This integration method reveals explicitly how homework can simultaneously support and hinder learning. Homework and other learning interventions should be designed inclusively, taking consensus opinions into account to determine appropriate workload. Homework should not just be assigned to learners as part of a routine. Designing homework with workload management in mind is as important as the content for student engagement. This strongly supports CLT and RTL, as students can break down information and retain knowledge to solve problems. This is so because they do not need to rush through or cheat and can learn at their own pace. The findings from this study can help educators and stakeholders design

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and mitigate barriers posed by homework interventions in the FE vocational sector, where more hands-on students can develop soft skills to advance engineering.

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