Exploring the Level of Scientific Thinking, Business Performance and Factors Influencing Application of Scientific Thinking among Small and Medium Entrepreneurs in Kabwe Urban Town in Zambia

Helen Mfune[1*], Mukwalikuli Mundia[2]

[*1]Department of Business Studies, Danford Chirwa Secondary School Kabwe, Zambia

[2]School of Business Studies, Kwame Nkrumah University, Kabwe, Zambia

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ABSTRACT

This study explored the level of scientific thinking, business performance and factors influencing the application of scientific thinking among selected Small and Medium Entrepreneurs (SMEs) in Kabwe urban town, Zambia. The study was guided by three objectives: to assess the level of scientific thinking among SMEs, to investigate SMEs' perceptions of their business performance, and to identify factors influencing the application of scientific thinking in business operations. The study employed a convergent parallel mixed-method research design within a mixed-method approach. Data were collected from 25 SMEs selected through purposive and convenience sampling from Bwacha Market, Green Market, Kawama Township, Mukobeko Township, and Tedcas Market in Kabwe urban town. Structured questionnaires and focus group discussions were used to collect quantitative and qualitative data respectively. Quantitative data were analysed using descriptive statistics, while qualitative data were analysed thematically. The findings revealed generally low and inconsistent levels of scientific thinking among participants. Most participants reported limited use of experimentation, systematic record keeping, customer feedback, and evidence-based decision-making. The majority of the participants reported relying on intuition and informal practices rather than analytical reasoning. The study further establish that education, business training, access to information, technology, financial resources, and social support positively influenced scientific thinking, while fear of financial loss and socio-cultural factors negatively affected its application. The low levels of scientific thinking reported by the majority of participants underscore the need to strengthen such competencies from the early stages of education. The study recommends strengthening entrepreneurship training and promoting evidence-based business management practices among SMEs in Kabwe.

Keywords: scientific thinking, SMEs, entrepreneurship, business performance, evidence-based decision-making, Zambia

INTRODUCTION

Small and Medium Entrepreneurs (SMEs) are widely recognized as important drivers of economic growth, employment creation, innovation, and poverty reduction across the world. In many developing countries, SMEs contribute significantly to national development by creating employment opportunities and supporting household incomes.

Globally, SMEs form the backbone of most economies. For instance, in the European Union, SMEs account for approximately 99.8% of all enterprises and contribute nearly 60% of gross domestic product while employing around 70% of the workforce (Oricchio, Lugaresi, Crovetto, & Fontana, 2017). Similar patterns are observed in Organisation for Economic Co-operation and Development (OECD) countries where SMEs represent approximately 99.7% of all businesses and provide nearly 60% of employment opportunities (Koirala, 2019). In India, SMEs contribute about 30% of GDP and provide between about 62% of employment workforce (Anu, Marco, Olivia, Maria, Jan & Kanmani, 2024).

In Zambia, SMEs occupy a strategic position within the national economy. The Ministry of Finance and National Development (2022) identifies entrepreneurship and SME development as key pillars for economic diversification, job creation, and income generation. Similarly, the Ministry of Small and Medium Enterprise Development (2023) reports that SMEs constitute approximately 97% of all registered businesses in Zambia and contribute substantially to employment and gross domestic product (GDP).

Despite their significant contribution, many SMEs continue to experience operational and managerial difficulties that limit their growth and sustainability. Studies conducted in Zambia indicate that SMEs commonly face challenges such as poor financial management, inadequate record keeping, weak strategic planning, and limited access to capital, and insufficient business management skills (Mwaanga & Moonga, 2016). Other studies have further shown that many SMEs struggle to respond effectively to changing market conditions because they rarely engage in environmental scanning, customer analysis, or systematic business evaluation (Mwange, Ndila, Moose, & Mwaanga, 2025). These challenges reduce innovation, limit competitiveness, and increase the likelihood of business failure.

One important concept that has increasingly attracted attention in entrepreneurship studies is scientific thinking. Scientific thinking, within the context of entrepreneurial decision-making, refers to a structured and disciplined cognitive approach through which individuals generate, test, and refine knowledge claims using empirical evidence rather than intuition or routine habit (Camuffo, Cordova, Gambardella, & Spina, 2020). Drawing from this definition, in this study scientific thinking is conceptualised as an evidence-oriented decision logic that integrates systematic reasoning, iterative experimentation, and reflective evaluation to reduce uncertainty in business environments.

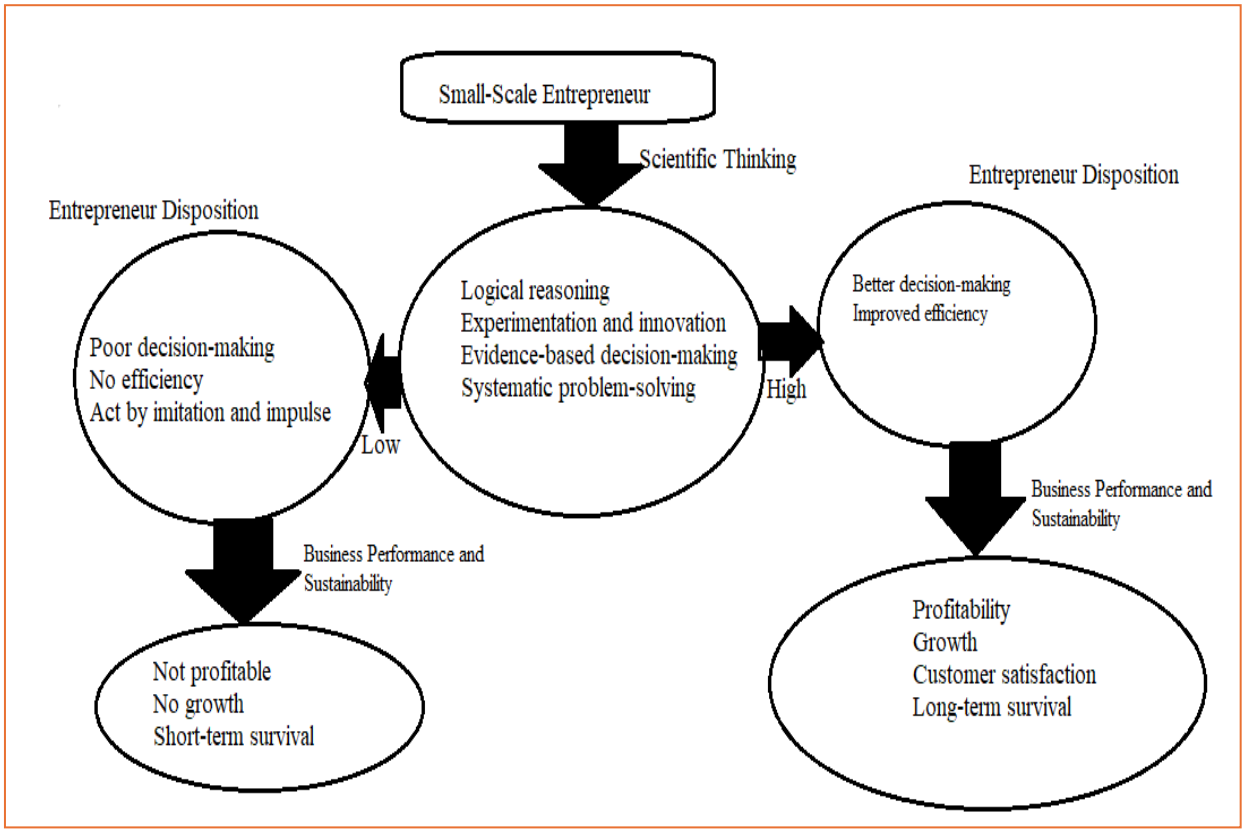
Unlike general business practices, which rely on experience, heuristics, or routines, scientific thinking is distinguished by its commitment to hypothesis-driven inquiry and continuous validation of assumptions against observable data (Dunbar & Fugelsang, 2005). By applying scientific thinking, business action is not guided merely by precedent, intuitions or guesswork, but by a deliberate process of inquiry in which business ideas are treated as propositions subject to testing and revision. This positions scientific thinking as a metacognitive capability that enhances the quality of judgement in business.

General business practices typically accentuate planning, coordination, and execution based on established procedures and experiential knowledge (Abraham & Karns, 2009). While these practices are essential for business stability, they do not inherently require systematic hypothesis testing or empirical validation. Scientific thinking, by contrast, introduces an investigative logic into business practice, where business actions are framed as experiments, outcomes are measured, and decisions are continuously revised based on feedback loops. Thus, whereas conventional business approach may ask “What has worked before?” scientific thinking asks “What works, under what conditions, and why?” This distinction is critical because it shifts SMEs from experience-dependent decision-making to evidence-adaptive learning systems.

This study, therefore, is anchored on a process-oriented capability model in which scientific thinking is conceptualised as a higher-order cognitive capability that influences SMEs performance through improved decision quality. Within this model, scientific thinking enhances decision quality by reducing cognitive bias, improving information processing, and strengthening causal inference in business judgments. Improved decision quality then translates into profitability, business growth, customer satisfaction, and long-term sustainability. Entrepreneurs who systematically apply scientific thinking are more likely to exhibit adaptive learning behaviours, efficient resource allocation, and innovation responsiveness. Their business performance outcomes also improve in dynamic and uncertain market environments. Conversely, entrepreneurs who demonstrate low levels of scientific thinking often make poor decisions and rely on imitation rather than innovation. This limitation in the application of scientific thinking limits efficiency and hinders business growth, resulting in ventures that generate little profit and have short lifespans (Camuffo, Cordova, Gambardella, & Spina, 2020).

Figure 1 summarises the conceptual framework of this study, illustrating the relationship between scientific thinking and business performance and sustainability among SMEs.

Figure 1: Summary of Conceptual Framework Grounding Scientific Thinking in Business Performance



Despite increasing global recognition of scientific thinking as a driver of entrepreneurial success, limited empirical evidence exists regarding the extent to which SMEs in Kabwe Urban town apply scientific thinking in business operations. Existing studies have primarily focused on business failure, access to finance, environmental scanning, and strategy implementation (Mwaanga & Moonga, 2016; Mundia, Nkonde, Simui, & Imasiku, 2022; Ndila, Mwange, Moose, & Mwaanga, 2024). Few studies have specifically explored how entrepreneurs apply scientific reasoning and analytical thinking in their day-to-day business operations. This study addresses this gap by exploring the level of scientific thinking, business performance and factors influencing the application of scientific thinking among Small and Medium Entrepreneurs (SMEs) in Kabwe urban town.

Research Objectives

The study was guided by the following objectives:

- To assess the level of scientific thinking among SMEs in Kabwe urban town.
- To investigate SMEs' perceptions of their business performance in Kabwe urban town.
- To identify factors influencing the application of scientific thinking among SMEs in Kabwe urban town.

Research Questions

The study sought to answer the following research questions:

- What is the level of scientific thinking among SMEs in Kabwe urban town?
- How do SMEs in Kabwe urban town perceive their business performance?
- What factors influence the application of scientific thinking among SMEs in Kabwe urban town?

METHODOLOGY

Research Design

The study employed a convergent parallel mixed-method research design within a mixed-method research approach. Creswell (2014) explains that mixed-method research combines quantitative and qualitative approaches in order to provide a comprehensive understanding of a research problem. The design enabled the researchers to collect quantitative data alongside detailed qualitative information relating to scientific thinking, business performance and factors influence the application scientific thinking among SMEs in Kabwe urban town.

Research Site

The study was conducted in Kabwe urban town in Central Province, Zambia. Specifically, the study covered Bwacha Market, Green Market, Kawama Township, Mukobeko Township, and Tedcas Market. These areas were selected because they host a variety of SMEs involved in retail trading, agro-business, and service provision.

Population, Sample Size and Sampling Technique

The target population comprised SMEs operating within Kabwe urban town. Purposive and convenience sampling techniques were used to select participants. Purposive sampling enabled the researcher to identify SMEs relevant to the study objectives (Bryman, 2012), while convenience sampling was applied based on accessibility and participants' willingness to take part in the study (Bryman, 2012).

The sample size of 25 participants was considered appropriate for an exploratory mixed-method study whose objective was to generate preliminary insights rather than statistical generalisations. The study placed emphasis on obtaining rich descriptive data from participants with direct entrepreneurial experience. Of the 25 SMEs, 2 had no formal education, 3 had primary education, 7 had junior secondary education, and 5 had senior secondary education, 5 held trades' certificates, 1 had diplomas, and 2 bachelors' degrees.

Data Collection Instrument

Data were collected using structured questionnaires and focus group discussion guides. The questionnaires generated quantitative data relating to scientific thinking and business performance, while focus group discussions provided qualitative insights into participants' perceptions and experiences on factors that affect application of scientific thinking in business operations.

The structured questionnaire had four sections. The first part collected demographic information of the participants. The second section collected data on SMEs level of scientific thinking using a five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = not sure, 4 = agree, 5 = strongly agree). Participants were asked to rate themselves across ten indicators that operationalised scientific thinking. These include:

- Ability to Identify Causes of Sales Decline
- Ability to Observe Customer Behaviour
- Ability to Test New Ideas on a Small Scale
- Ability to Keep Records of Sales and Expenses
- Ability to Use Records in Decision-Making
- Ability to Seek for Customer Feedback
- Ability to Compare Alternative Business Methods

- Ability to Avoid Guesswork in Decision-Making
- Ability to Learn from Mistakes
- Ability to Conduct Risk Analysis before Investment

Scientific thinking was operationalised using these behavioural indicators because they reflect cognitive and evidence-based orientation. For instance, identification of causes of sales decline reflects causal reasoning and diagnostic competence. Intentional and deliberate observation of customer behaviour indicates empirical attentiveness and responsiveness to market information. The testing of new ideas on a small scale reflects an experimental approach characterised by controlled innovation and risk management. Maintaining records of sales and expenses represents systematic data generation and documentation of business activity. The use of records in decision-making reflects integration of empirical evidence into managerial judgement, while seeking customer feedback relates to iterative learning and external validation of business assumptions. Comparing alternative business method indicates structured analytical evaluation, whereas avoiding guesswork reflects adherence to evidence-based reasoning. Learning from mistakes represents adaptive and reflective reasoning, and conducting risk analysis prior to investment captures anticipatory reasoning. Collectively, these indicators provide a structured basis for assessing scientific thinking in entrepreneurial practice. These indicators also align with the core dimensions of scientific thinking identified in the literature; hypothesis testing, empirical observation, analytical reasoning, and iterative refinement (Dunbar & Fugelsang, 2005; Kuhn, 2011; Hyytinen, 2021). These indicators are justified on the basis that scientific thinking, in entrepreneurial contexts, is not directly observable as a single construct but is instead manifested through consistent decision-making behaviours grounded in evidence use (Camuffo, Cordova, Gambardella, & Spina, 2020).

The third section collected data on SMEs' perception of own business performance on a five-point Likert scale (1 = decreased a lot, 2 = decreased a little, 3 = no change, 4 = increased a little, 5 = increased a lot). Participants were asked to rate their business across indicators used to operationalise business performance namely: sales trends, profit levels, number of customers, product diversification, financial performance, and ability to meet operational expenses (Corporate Finance Institute, 2020).

The fourth section of the questionnaire collected data on participants' perception of factors that influence the application of scientific thinking. Participants were asked to rate their perception on a five-Likert scale (1 = Not at all, 2 = small extent, 3 = moderate extent, 4 = large extent, 5 = very large extent) the extent to which each of the following factor influence decision-making process in their business:

- Education Level
- Business Training
- Access Information
- Access to Loan
- Fear of Losing Money
- Business Works
- Cultural and Religious Beliefs

Focus group discussions were used to collect qualitative data that provided deeper insight into entrepreneurs' experiences and perceptions regarding scientific thinking in business practice. Focus groups discussions explored the following themes: decision-making processes, experimentation with new business ideas, barriers to applying analytical approaches and factors that influence application of scientific thinking in business operations.

Content validity of the instruments was established through review by three experts in entrepreneurship and education research, who assessed the relevance, clarity and adequacy of questionnaire items. Reliability of the questionnaire, however, was not established and this was one of the limitations of this study.

Ethical Considerations

Ethical principles were observed throughout the study. Participants were informed about the purpose of the study and their right to withdraw at any stage. Participation was voluntary, and confidentiality was maintained through coding procedures. Approval to conduct the study was obtained from Kwame Nkrumah University Research and Ethics Committee through our research supervisor.

RESULTS

Level of Scientific Thinking among SMEs

The first objective of the study was to interrogate the level of scientific thinking among 25 selected SMEs in Kabwe urban town. Participants were asked to rate the extent to which the ten scientific thinking indicators best described them. Table 1 shows the results of participants' self-rated responses across ten scientific thinking indicators.

Table 1: Participants Self-rated Level of Scientific Thinking across Ten Indicators, N = 25 SMEs

Scientific Thinking Indicator	**Percentage Rating of Level of Scientific Thinking (%)**				
	Strongly Disagree	**Disagree**	**Not Sure**	**Agree**	**Strongly Agree**
Identify Causes of Sales Decline	48%	32%	12%		8%
Observe Customer Behaviour		12%	20%	44%	24%
Test New Ideas on a Small Scale	24%	28%	16%	32%	
Keep Records on Sales and Expenses	28%	60%		12%	
Use Records in Making Decision	25%			36%	40%
Learn from Mistakes	40%		40%	20%	
Conduct Risk Analysis before Investment			16%	40%	44%
Seek Customer Feedback	52%	20%		20%	8%
Compare Different Methods	32%	52%			16%
Avoid Guesswork	20%	8%	28%	44%	

The findings in table 1 shows that out of the 25 SMEs, 48% strongly disagreed and 32% disagreed with the statement that they first try to determine the cause of declining sales. The other participants (12%) were unsure, while 8% of the participants strongly agreed that they consistently engage in causal analysis. The findings reveal that a large proportion of participants (80%) reported that they do not systematically investigate the causes of declining sales.

Participants were also asked whether they observe customer behaviour before introducing business changes. The findings in table 1 shows that 44% of the participants agreed and 24% strongly agreed that they observe customer

behaviour prior to implementing changes in their businesses. Meanwhile, 20% reported being unsure and 12% of participants strongly disagreed. The results show that majority of the participants (68%) indicated that they engage in observational practices and demonstrate some level of empirical awareness by monitoring customer patterns before making decisions.

Participants were further asked whether they test new business ideas on a small scale before implementing them fully. Table 1 shows that out of 25 SMEs that took part in the study 32% of respondents agreed that they conduct small-scale testing of new ideas. However, 28% disagreed and 24% strongly disagreed that they engage in such pilot testing, while 16% were unsure. The findings show that more than half of the participants (52%) indicated that they do not test new ideas before full implementation, suggesting limited engagement in experimental reasoning among participants.

Participants were asked whether they keep records of sales and expenses. Table 1 shows that out of 25 SMEs, 28% strongly disagreed while 60% disagreed that they keep records for ales and expenses. Only 12% of the participants agreed that they keep records for sales and expenses. The results show that more than half of the participants (88%) reported weak record-keeping that they do not maintain consistent records of sales and expenses.

Participants were also asked whether they systematically learn from mistakes in their business operations. Table 1 shows that 40% of the participants strongly disagreed that they deliberately learn from past errors, while 40% were not sure of themselves and 20% agreed that they learn from past mistakes. In general, the results show that most of the participant stated that they do not learn from their past business errors.

In contrast to other dimensions of scientific thinking, participants reported to have relatively strong risk analysis abilities before investment. Table 1 shows that, 44% strongly agreed and 40% agreed that they assess risks before investing resources in their businesses, while 16% were not sure. The results show that the larger proportion of respondents (84%) indicated that they conduct risk assessments prior to investment decisions.

Participants were asked to rate their practices regarding customer feedback. Of the 25 participants, 52% strongly disagreed and 20% disagreed that they actively seek customer feedback in their businesses. In contrast, 20% agreed and 8% strongly agreed that they seek customer feedback before making service improvements. In general, the results show that most of the participants (72%) do not actively seek customer feedback.

Participants were also asked to rate themselves on their ability to engage in comparative evaluation of business methods. Table 1 shows that 52% of the participants disagreed and 32% strongly disagreed that they compare different methods before making decisions. Only 16% of participants reported that they actively compare alternative approaches in their business practices. The common trend shows that the predominant share of the participants (84%) do not engage in comparative analysis. This result points to a substantial deficiency in analytical evaluation, a key element of scientific reasoning.

Participants were then asked to rate themselves on their ability to avoid guesswork in business decision-making. Table 1 shows that 44% of the participants agreed that they avoid guesswork, while 28% indicated that they were not sure. The other 20% strongly disagreed and 8% disagreed. While 44% of the participants demonstrated awareness of the importance of avoiding guesswork, 56% showed uncertainty or disagreement suggesting inconsistency in the application of evidence-based decision-making practices.

Composite Mean Analysis of Scientific Thinking

Composite mean analysis was conducted to determine the overall level of scientific thinking among the 25 SMEs. The composite mean for the level of scientific thinking was calculated by averaging the mean scores of the ten indicators. The interpretation scale used was very low (1.00-1.80), low (1.81-2.60), moderate (2.61-3.40), high (3.41-4.20) and very high (4.21-5.00). Table 2 shows composite mean scores for scientific thinking among 25 SMEs.

Table 2: Composite Mean Score for Scientific Thinking, N = 25 SMEs

Indicator	Composite Mean Scores (M)
Ability to Identify Causes Of Sales Decline	1.88
Ability to Observe Customers' Behaviour	3.56
Ability to Test New Ideas on a Small Scale	2.68
Ability to Keep Records of Sales and Expenses	3.24
Ability to Use Records in Decision-Making	3.68
Ability to Seek Customer Feedback	2.12
Ability to Compare Different Methods	2.08
Ability to Avoid Guesswork	3.08
Ability to Learn From Mistakes	2.60
Ability to Carry Our Analysis Before Investing	4.24
Composite Mean Index	2.92

The findings in table 2 indicate that participants attained a composite mean index score of 2.92, suggesting a moderate level of scientific thinking. The findings suggest that scientific thinking is present among the participants though not fully embedded in their business operations. Participants employ analytical practices selectively rather than systematically. The highest-rated scientific thinking practice was the ability to carry out analysis before investing (M=4.24), followed by the use of records to make decisions (M=3.68) and observing customer behaviour (M=3.56). However, relatively low mean scores were observed for comparing different methods (M=2.08), seeking customer feedback (M=2.12) and identifying causes of sales decline (M=1.88). The findings suggest that although SMEs engage in some evidence-based decision-making practices, several aspects of systematic inquiry remain underutilised.

SMEs Perceptions of Business Performance

The second objective of the study sought to investigate SMEs' perceptions of their business performance in Kabwe urban town. Participants evaluated the performance of their businesses across seven indicators, namely monthly sales, monthly profit, customer base, product diversification, financial performance, ability to meet daily operational expenses, and future growth prospects. The findings are presented in Table 3.

Table 3: Participants' Self-rated Practices across Seven Indicators, N = 25 SMEs:

Indicator	SME Performance Rating by Percentage (%)				
	Decreased a lot	**Decreased a little**	**No Change**	**Increase a little**	**Increased a lot**
Monthly Sales		20%	8%	72%	
Monthly Profit		8%	56%	32%	4%
Number of Customers		8%	8%	72%	12%
Number of Products		16%	20%	32%	32%
	Very Poor	**Poor**	**Fair**	**Good**	**Very Good**
Financial Performance		16%	72%	12%	
Daily Expenses		16%	52%	24%	8%
Future Growth		8%	60%	12%	20%

With regard to monthly sales, Table 3 shows that 72% of the participants reported a slight increase, while 20% indicated that sales had slightly decreased. Only 8% reported no noticeable change. These findings suggest that although more than half of the participating SMEs continue to attract customers and generating revenue, the growth of their business remains limited and gradual.

A similar pattern emerged in relation to monthly profit levels. Table 3 shows that more than half of the participants (56%) reported that profits had remained largely unchanged, while 32% indicated a slight increase.

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Only 4% reported a substantial increase in profits, whereas 8% experienced a slight decline. The findings suggest that increases in sales may not necessarily be translating into significant profit growth. This may be attributed to rising operational costs, limited financial management skills, or unstable market conditions.

Concerning customer base expansion, most of the participants indicated moderate growth in the number of customers. Table 3 shows that 72% reported a slight increase, while 12% indicated a substantial increase in customer numbers. In contrast, 8% reported no change and another 8% experienced a slight decline. These findings suggest that most of the participants have managed to maintain customer demand despite operating within a competitive business environment.

Participants were also asked to assess changes in the number of products and services offered by their businesses. Table 3 shows that 32% reported a slight increase, while another 32% indicated a substantial increase in product diversification. However, 20% reported no change and 16% experienced a slight reduction in the range of products offered. The results suggest that some participants are attempting to diversify their products and services.

In terms of overall financial performance, participants generally rated their businesses performance as operating at a fair level. Specifically, 72% described their financial performance as fair, 16% rated it as poor, and only 12% considered it to be good (Table 3). None of the participants rated their businesses as performing very well. These findings indicate that although most of the participating SMEs remain operational, many continue to experience financial limitations that restrict business expansion and sustainability.

Participants were further asked to evaluate their ability to meet daily operational expenses. More than half of the respondents (52%) rated their ability as fair, while 24% considered it good (Table 3). On the other hand, 16% described their ability to meet daily expenses as poor and only 8% rated it as very good. The findings suggest most of the participants operate under constrained financial conditions and often struggle to maintain stable cash flow.

Lastly, participants were asked to assess the future growth prospects of their businesses. A considerable majority (60%) of the participants rated their prospects as fair, while 20% described them as very good. Additionally, 12% rated future growth prospects as good, whereas 8% perceived them as poor (Table 3). Although some participants expressed optimism regarding future business growth, the overall findings suggest cautious expectations among most SMEs.

Generally, the findings indicate that participants perceive their business performance as moderate and relatively stagnant. While some participants reported improvements in sales, customer numbers, and product diversification of the majority of participants continue to experience limited profitability, weak financial performance, and uncertainty regarding long-term growth.

Factors Influencing the Application of Scientific Thinking among SMEs

The third objective of the study sought to identify factors influencing the application of scientific thinking among 25 SMEs. Participants were asked to rate the extent to which educational, financial, technological, social, and cultural factors affect their ability to apply systematic and evidence-based approaches in business operations. The findings are presented in Table 4.

Table 4: Self-rated Perception of Factors Influencing Application of Scientific Thinking, N = 25 SMEs

Factor	**Percentage Rating of Factors Influencing the Application of Scientific Thinking (%)**				
	Very Large Extent	**Large Extent**	**Moderate Extent**	**Small Extent**	**No Influence**
Influence of Education	*40%*		*40%*	*8%*	*12%*
Influence of Training	*12%*	*48%*	*16%*	*12%*	*12%*

Access to Information	*8%*	*40%*	*32%*	*8%*	*12%*
Access to Loans	*24%*	*36%*	*20%*	*-*	*20%*
Support from Mentors	*20%*	*24%*	*32%*	*16%*	*8%*
Fear of Losing Money	*40%*	*32%*	*8%*	*20%*	*-*
Business Networks	*16%*	*44%*	*20%*	*12%*	*8%*
Cultural Beliefs	*28%*	*20%*	*32%*	*-*	*20%*

Table 4 shows that a considerable proportion of participants indicated that formal education affect their business decision-making to either a very large extent (40%) or a moderate extent (40%). Only a few participants (8%) reported that formal education had little or no influence on their business practices (12%). During focus group discussions, some participants explained that limited educational background often reduced their ability to analyse business problems critically or interpret market trends effectively. One participant remarked:

Most of us started businesses without proper training. We just copy what others are doing. Even when business is not moving well, it is difficult to know exactly what the problem is.

These findings show that majority of the participants perceive that formal education enhances analytical reasoning, problem-solving skills, and the ability to make informed business decisions.

Formal business training also emerged as an important factor influencing scientific thinking. Table 4 shows that nearly half of the participants (48%) reported that formal business training influenced their decision-making to a large extent, while 12% indicated a very large extent. Participants explained that entrepreneurship training exposed them to practical skills such as record keeping, planning, customer analysis, and risk assessment. One participant stated:

Those who attended business seminars are better at keeping records and planning. Training helps business people understand how to test ideas before investing a lot of money.

The findings indicate that majority of the participants perceive formal business training to be helpful in strengthening entrepreneurs' capacity to apply structured and evidence-based approaches in managing their enterprises.

Access to information and technology was another major factor identified to influence application of scientific thinking. Most of the participants acknowledged that information obtained through mobile phones, internet platforms, radio programmes, and social media positively influence business decision-making. Specifically, 40% reported that access to information influenced scientific thinking to a large extent, while 32% indicated a moderate extent (Table 4). Participants reported that people who had greater exposure to digital platforms had better ability to monitor market trends, compare prices, and identify customer preferences. However, some participants highlighted limited digital literacy and restricted access to reliable information sources as barriers to effective decision-making. One respondent explained:

Some of us do not know how to use technology properly. We only depend on what customers tell us or what we see from friends.

Financial resources, particularly access to loans, was also perceived as important in promoting scientific thinking. The majority of participants indicated that access to loans support experimentation and innovation either to a large extent (36%) or a very large extent (24%) (Table 4). Participants noted that financial support creates opportunities for entrepreneurs to test new ideas, invest in technology, and expand business operations without excessive fear of financial loss. Nevertheless, some respondents argued that access to capital alone may not automatically improve scientific thinking if entrepreneurs lack confidence or analytical skills.

Support from mentors, family members, and business networks also emerged as an influential factor. A large proportion of participants (92%) reported that mentorship and networking contributed positively to their business decision-making and innovation practices (Table 4). Participants noted that, through interaction with experienced business people, entrepreneurs gained exposure to alternative strategies, market information, and practical

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problem-solving approaches. Such support systems were perceived as important in encouraging learning and improving confidence in business management.

The study further reveal that fear of losing money significantly discourages experimentation and innovation among SMEs. A large proportion of participants indicated that fear of financial loss affect their willingness to test new business ideas to either a very large extent (40%) or a large extent (32%) (Table 4). Participants further explained that many entrepreneurs avoid innovative practices because of uncertainty and fear of failure. Excessive risk aversion therefore limits experimentation, creativity, and adaptive learning in business operations.

Cultural and religious beliefs were also reported to influence business decision-making among participants. While some participants viewed cultural values as a source of moral guidance and social support, others explained that certain beliefs discourage analytical evaluation and evidence-based practices. One participant stated:

On several occasions my pastor has strongly advised me never to conduct a feasibility study before expanding my business that I should just pray and depend on God's providence.

Another participant added:

I have found myself attributing decline in sales or profit to spiritual attack rather than increased competition.

The findings demonstrate that the application of scientific thinking among SMEs is shaped by multiple interconnected factors. Education, business training, access to information, financial support, mentorship, and business networks were found to positively influence analytical and evidence-based decision-making. In contrast, fear of financial loss and certain socio-cultural beliefs were identified as barriers to the effective application of scientific thinking in business operations.

DISCUSSION OF FINDINGS

Level of Scientific Thinking among SMEs

The first objective of the study sought to assess the level of scientific thinking among selected 25 SMEs in Kabwe urban town. The findings reveal that most of the participants reported low and inconsistent application of scientific thinking. Although some participants demonstrated certain aspects of analytical and evidence-based decision-making, the majority identified themselves that they rely more on intuition, routine practices, and unsystematic approaches than on scientific reasoning.

In particular, the study established that a large proportion of participants do not attempt to identify the causes of declining sales before reacting to business challenges. This suggests that majority of the participants operate without systematic problem diagnosis and engage less in reflective analysis when faced with operational difficulties. For entrepreneurs who rely primarily on routine practices, intuition, or unsystematic decision-making, business performance may be constrained by cognitive biases, subjective judgments, and limited use of evidence. Routine practices, intuition, or unsystematic decision-making lead to decisions based on untested assumptions, selective interpretation of information, and confirmation bias, thereby reducing the quality and effectiveness of managerial choices. Empirical evidence from a field experiment involving 261 entrepreneurs demonstrated that those trained in scientific decision-making achieved better economic performance when operating within well-developed business models (Novelli & Spina, 2024). Camuffo, Cordova, Gambardella and Spina (2020) also agree that scientific thinking requires entrepreneurs to analyse problems carefully, test assumptions, and make decisions based on evidence rather than impulse or routine habits. Failure to identify the causes of business problems may lead to repeated mistakes and poor strategic responses.

The findings also show that participants generally reported that they do not test new ideas on a small scale before implementing them fully. This indicates limited use of experimentation, one of the core principles of scientific thinking. Kohavi, Deng, Frasca, Walker, Xu, and Pohlmann (2013), noted that systematic experimentation enables organizations to identify ineffective innovations before large-scale deployment. According to Kohavi

and others, rigorous testing of business concepts help to prevent the implementation of numerous initiatives that are initially perceived as promising but which later prove to be ineffective (Kohavi, Deng, Frasca, Walker, XU, & Pohlmann, 2013). This evidence underscores the value of experimentation in minimizing costly mistakes and improving decision quality. Felin, Gambardella, Novelli and Zenger, (2024), also noted that entrepreneurs who adopt experimental approaches are more capable of identifying viable opportunities and avoiding costly strategic errors. Additionally, Al-Ubaydli, List and Suskind (2017), also noted that positive results obtained in small-scale studies often decline when interventions are implemented on a larger scale. Therefore, according to Al-Ubaydli, List and Suskind entrepreneurs who fail to test innovations before scaling may encounter unforeseen challenges related to customer preferences, operational efficiency, resource requirements, and market conditions. As a result, business performance may be adversely affected due to poor planning, inefficient resource allocation, and reduced customer acceptance (Al-Ubaydli, List, & Suskind, 2017). Failure to conduct small-scale experimentation before large-scale implementation is a significant constraint on business performance among small-scale entrepreneurs. Entrepreneurs who do not systematically test and refine their ideas are more likely to experience higher levels of uncertainty, increased business risks, and lower performance outcomes. Conversely, those who embrace experimentation are better positioned to make evidence-based decisions, improve their business models, and enhance overall business success.

The study also reveal weaknesses in record-keeping practices among participants. A considerable number of participants reported inconsistency in keeping records of sales and expenses. The findings are consistent with the observation made by Mwaanga and Moonga (2016) that many SMEs in Kabwe experience management difficulties due to inadequate record-keeping and limited managerial skills. However, despite weaknesses in maintaining records, many respondents acknowledged the importance of records in decision-making. This suggests that although participants understand the value of business records, many lack the discipline, skills, or systems necessary for consistent documentation another fundamental component of scientific thinking.

Another important finding is that most of the participants rarely sought customer feedback or compared alternative business methods before making decisions. These findings indicate limited analytical evaluation and weak environmental scanning practices among entrepreneurs. According to Mwange, Ndila, Moose, and Mwaanga (2025), environmental scanning is essential for identifying market changes, customer preferences, and emerging business opportunities. Failure to collect customer feedback may reduce the ability of SMEs to respond effectively to market demands and changing consumer behaviour.

The study additionally found that a significant proportion of respondents rely on guesswork when making business decisions and often repeat the same mistakes. These findings suggest low levels of reflective learning and evidence-based reasoning. Scientific thinking involves learning from outcomes, evaluating previous decisions, and making adjustments based on evidence. Entrepreneurs who repeatedly make the same mistakes demonstrate weak analytical reflection and limited adaptive learning. This observation supports Phillips (2007), who noted that many SMEs in Zambia operate within conditions of bounded rationality and depend heavily on informal assumptions rather than structured reasoning.

Despite the generally low level of scientific thinking, the findings reveal a few positive practices among some participants. Majority of respondents indicated that they analyse risks before investing and observe customer behaviour before making business changes. This suggests that some of the participants apply selective aspects of scientific reasoning, particularly in situations involving financial risk and customer interaction. These findings support Black and Dorf (2012), who argued that scientific thinking in entrepreneurship involves careful observation, analysis of market behaviour, and rational assessment of risks before making investments.

The findings suggest that scientific thinking among participants remains limited and unevenly applied. A substantial proportion participants appear to rely more on experience, intuition, and informal practices than on systematic inquiry, experimentation, and evidence-based management. This weak application of scientific thinking may partly explain the slow growth and sustainability challenges experienced by many SMEs in Kabwe urban town.

SMEs' Perceptions of own Business Performance

The second objective of the study sought to investigate SMEs' perceptions of their own business performance. The findings reveal that although some participants reported experiencing slight increases in sales, customer numbers, and products offered, the performance of their businesses remains generally moderate and stagnant.

The study found that most respondents reported slight increases in monthly sales and customer numbers. This suggests that participants continue to attract customers and maintain operations despite challenging business environments. However, the increase is mostly described as slight rather than substantial, indicating slow business growth. Similarly, many participants reported stagnation in monthly profits despite increases in sales. This may imply that rising operational costs, inflation, poor pricing strategies, or weak financial management could be reducing the benefits associated with increased sales volumes.

The findings also show that majority of participants experience slight expansion in the range of products offered. This may indicate attempts by some participants to diversify their businesses in order to survive in competitive markets. Diversification may also reflect entrepreneurs' efforts to respond to changing customer demands and market opportunities. However, the moderate nature of the reported growth suggests that such expansion remains limited and may not necessarily translate into strong profitability or sustainability.

Another important finding is that most respondents rated their overall financial performance as fair or poor. Similarly, many participants reported difficulties in meeting daily business expenses and expressed limited confidence regarding future business growth. These findings suggest that although some participants continue operating, many struggle to achieve stable financial performance and long-term sustainability. The findings are consistent with studies by Mwaanga and Moonga (2016) and Mundia, Nkonde, Simui and Imasiku (2022), who found that many SMEs and cooperatives in Kabwe experience weak performance due to limited managerial skills, insufficient resources, and poor strategic planning.

The moderate and stagnant business performance observed in this study may also be linked to the low level of scientific thinking identified among the respondents. Scientific thinking supports better planning, innovation, experimentation, and evidence-based decision-making. Entrepreneurs who fail to apply these practices may struggle to improve efficiency, respond effectively to competition, and identify profitable opportunities. This interpretation supports Camuffo, Cordova, Gambardella and Spina (2020), who found that entrepreneurs who apply scientific approaches are more likely to improve business performance and sustainability.

The findings therefore suggest that weak scientific thinking among SMEs may contribute to slow growth, weak profitability, and limited long-term sustainability. Businesses that rely heavily on intuition and informal decision-making may struggle to adapt effectively to changing business environments.

Factors Influencing the Application of Scientific Thinking among SMEs

The third objective of the study sought to identify factors influencing the application of scientific thinking among 25 SMEs in Kabwe urban town. The findings reveal that several interrelated factors influence whether entrepreneurs apply systematic and evidence-based approaches in their businesses.

One of the major factors identified is education. Most respondents indicated that formal education influences the application of scientific thinking. This finding supports Human Capital Theory, which emphasizes that knowledge, skills, and education improve individuals' problem-solving abilities and productivity. Entrepreneurs with higher levels of education are more likely to understand analytical reasoning, record interpretation, planning, and evidence-based decision-making. According to Becker (1946), education strengthens scientific reasoning and improves entrepreneurs' ability to identify and evaluate opportunities.

Business training was also identified as an important factor influencing scientific thinking. Participants acknowledged that formal training helps entrepreneurs acquire practical business knowledge and managerial skills. This finding agrees with Mano, Iddrisu, Yoshino and Sonobe (2012), who found that business training positively influences entrepreneurial practices and decision-making among SMEs. Similarly, Anampiu (2020)

and Malipula (2023) established that entrepreneurship training improves financial management, customer service, and record-keeping practices. Training therefore appears to enhance entrepreneurs' ability to apply logical and systematic approaches in managing businesses.

Access to information and technology is another major factor identified by respondents. Entrepreneurs who have access to information sources such as the internet, radio, and digital platforms are more likely to gather market information, monitor business trends, and make informed decisions. This finding supports Colovic and Lamotte (2015), who found a positive relationship between information technology and entrepreneurship development. Access to information improves entrepreneurs' ability to engage in environmental scanning, experimentation, and data-driven decision-making.

The findings further show that access to loans and financial resources influence the application of scientific thinking. Entrepreneurs with limited financial resources may avoid experimentation and innovation because of fear of financial loss. Lack of capital may also limit opportunities for investment in technology, training, and business expansion. This finding is consistent with Panda (2014), who identified limited financial access as one of the major barriers affecting SME growth and innovation.

Support from family members, mentors, and business networks also emerged as an important factor. Entrepreneurs who receive guidance and encouragement from experienced individuals are more likely to develop confidence, acquire knowledge, and adopt improved business practices. According to Gabrielsson and Politis, (2012), learning orientation and interaction with experienced individuals enhance entrepreneurial thinking and innovation.

Another notable finding is that fear of losing money discourages entrepreneurs from experimenting with new ideas. Many SMEs avoid testing unfamiliar business strategies because they fear financial failure. While caution is important in business, excessive fear may discourage innovation and learning. Scientific thinking requires entrepreneurs to test ideas systematically and learn from outcomes rather than avoid experimentation altogether.

Finally, the study establishes that cultural beliefs influence scientific thinking among SMEs. Cultural norms and beliefs may shape attitudes toward risk-taking, innovation, and business decision-making. Some entrepreneurs may rely heavily on traditional practices and informal assumptions instead of analytical reasoning. This finding supports Akhter and Sumi (2014) as well as Koe and Majid (2014), who found that sociocultural environments strongly influence entrepreneurial behaviour and decision-making.

The findings demonstrate that scientific thinking among participants was influenced by a combination of educational, financial, technological, social, and cultural factors. These factors interact to shape entrepreneurs' ability and willingness to apply systematic and evidence-based approaches in business operations. Strengthening entrepreneurship education, improving access to training and information, and promoting supportive business environments may therefore help improve scientific thinking among SMEs in Kabwe urban town.

CONCLUSION

The study established that scientific thinking among SMEs who participated in this study was generally low and inconsistently applied. Participate reported limited engagement in experimentation, record keeping, customer feedback collection, and evidence-based decision-making. Business performance was perceived as moderate, while education, training, information access, and financial resources emerged as key determinants of scientific thinking.

Although the findings of this study are generalizable only within the context of the participants involved, they remain highly relevant to the current educational and economic landscape in Zambia. The significance of these findings is particularly evident in light of the recent adoption of the Competency-Based Curriculum (CBC) across all levels of education, from early childhood to tertiary education (Ministry of Education , 2023). The CBC places emphasis on the development of critical thinking, creativity, problem-solving, analytical reasoning, innovation, and the practical application of knowledge rather than reliance on rote learning (MOE, 2023).

The low levels of scientific thinking reported by the majority of SMEs who participated in this study underscore the need to strengthen such competencies from the early stages of education. Through inquiry-based learning, experimentation, reflective practice, and evidence-based decision-making, the CBC has the potential to equip learners with the entrepreneurial and analytical skills necessary for effective business management and sustainable economic participation. Consequently, the findings of this study support the importance of effective implementation of the CBC in fostering a generation capable of applying scientific thinking to entrepreneurship, innovation, and real-life problem-solving within the Zambian economy.

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