Towards mine modernisation: Digitisation of foundational supervisory leadership development training

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Abstract

Due to the modernisation of mines, traditional training methods may be supplemented to support the upskilling of supervisors in mines. A project was initiated by the SAMERDI SATCAP programme to demonstrate the "art of possibility" through a modern training methodology. Two exemplar digital supervisory leadership development modules for underground gold and platinum-group metal conventional and modernising mines, were developed for potential uptake by the mining industry. These exemplar modules were exhibited on a digital platform, towards leading and driving mining modernisation. The research adopted a mixed method approach that included a literature review, a review of an existing supervisory leadership development programme, data gathering, a pilot study, and stakeholder validation workshops. The research supported the development of exemplar digitised modules. The two digitised modules were showcased to the industry for potential adoption. Training slides, a facilitator guide, and a training video were developed for ease of use by industry. The training modules are generic and not specific to a particular mine. They may be used by multi-commodity mines, including gold and platinum-group metals, as 'stand-alone' modules. They are customisable, through consultation with relevant service providers for specific working environments. The findings indicated that both the traditional classroom training and the new digitised online learning solution offer advantages for supervisory leadership development. Digital learning is not a new concept for supervisors at mines and modern training methods are well-supported by supervisors in the industry. A 'modernised' training solution may consider a 'blended' learning approach that combines traditional training with digital methods.

Keywords

digital training, leadership, leadership development, mine modernisation, supervisors, efficiency, scrap rate.

Introduction

To get the mining industry back on track towards becoming more healthy, safe and productive, the challenges facing the mining industry need to be revisited. One such challenge is the transition to a modernised mining industry, which includes the consideration of skills development to support a modern workforce. These challenges can be addressed through technological innovation and implementation, improving skills, and ultimately improving work conditions, thus reducing exposure to mine health and safety hazards – collectively alluding to mine modernisation. The socio-economic role of mines can also be revisited to ensure broader development of the communities in which they operate (Goodman et al., 2019).

Traditional classroom-based training methodologies versus modern immersive learning experiences needed to be reviewed to assess their respective efficiencies and effectiveness in modernising mining environments. The Successful Application of Technology Centred Around People (SATCAP) programme commissioned a study investigating an engaging learning method for selected supervisory leadership development modules to support mining modernisation, with delivery through a digital platform. The intent was to assist in upskilling supervisors to change mindsets, and drive and lead mining modernisation. SATCAP focuses on the effects, impacts, and challenges of mining modernisation on people in the mining sector and is part of the South African Mining Extraction, Research, Development and Innovation (SAMERDI) strategy of the Mandela Mining Precinct (MMP).

Through this study, an existing supervisory leadership development programme was reviewed to identify gaps and make recommendations for addressing such gaps through the development of exemplar modules for potential use by the industry. With the advent of mine modernisation, the role of traditional training may need to be reassessed in relation to modernised training approaches to support a modern workforce for modern mining. A modern training method may support the transition to mine

modernisation and upskilling of supervisors. This study focused on supervisory leadership development as supervisors are a crucial link between management and mine workers. They lead teams and are key drivers of change in mining modernisation. To ensure that mine supervisors remain relevant with respect to leadership skills for a modernised mine, this project was commissioned. Two exemplar digital supervisory leadership development modules for underground gold and platinum group metals (PGM) conventional and modernising mines were developed for potential uptake by the mining industry. This paper is based on a SATCAP Work Package 2.1 study report titled "*Final Report – Foundational Supervisory Leadership Development Training*", dated February 2022 (Auret et al., 2022).

Aim and objectives

The aim of this project was to demonstrate the "art of possibility" by supporting the development of supervisors in mining modernisation through exemplar leadership development modules in a digital format.

Literature review summary

A mini literature review was undertaken to understand key supervisory leadership development concepts, including the role of supervisors in mining modernisation, and skills, competencies, and qualities required to drive mining modernisation.

Developing leaders and supervisors to lead and drive change

Leadership development is crucial for businesses to remain relevant, especially since the advent of the Fourth Industrial Revolution (4IR). Hence, leadership development and mine modernisation should be aligned. Organisations, including mining companies, need to keep up with evolving technology automation, and modernisation in general, which subsequently necessitates the upskilling of workers and supervisors (Get Smarter, 2019).

Successful leaders need to exhibit crucial skills such as effective communication, collaboration and commitment. Through effective communication, buy-in can be achieved from a team. A good leader encourages a team to break their silos and work collaboratively towards a common goal. Commitment to one's beliefs and organisational values is also key to supporting a team and successfully working towards a common goal (Centre for Creative Leadership, 2023).

The key competency for successful leadership is for leaders to guide a process from beginning to end. Leaders need to initiate, strategise, and execute towards a common goal. Good leaders are able to understand the need for change or a process for the desired outcome and can communicate it to their team. Strategising, planning, and defining a plan of action to achieve a goal is critical to achieving successful outcomes. Additionally, the execution of the plan by assigning resources to tasks is of equal importance in achieving a desired common goal (Centre for Creative Leadership, 2023).

Supervisors in mining companies are a crucial link between higher management and the workers (Weule, 2016). They have numerous responsibilities that include problem solving and decision-making, managing people and their performances, achieving production and ensuring safety, communicating, mentoring and coaching, planning and organising. They are also responsible for translating business (and modernisation) requirements to operational behaviours (Weule, 2016). Supervisors may be deemed to be the key drivers of change in mine modernisation as they are the link between mine management and the mine workers. Supervisors have the responsibility of formulating methodologies to implement change (Berkeley University of California, 2021), and are therefore required to possess the necessary skills, competencies, and qualities.

Supervisory leadership development modules can be addressed through technological innovation and implementation, improving skills, and ultimately improving work conditions, thus reducing exposure to mine health and safety hazards. The socio-economic role of mines can be revisited to ensure broader development of the communities in which they operate (Goodman et al., 2019).

Methodology

This research study adopted a mixed methods approach. The objectives of the study were achieved by conducting a mini literature review (as summarised in the previous section), data gathering through interviews and surveys, development of the digitised training solution, a pilot study, and review and validation of the digitised training modules through an online exhibition.

Data gathering and digitisation of modules

Data was gathered through the following activities:

- A desktop review of an existing supervisory leadership development programme and a subsequent interview with the training provider;
- Circulating of survey questionnaires to mining companies;
- Conducting a pilot study of the digitised modules;
- Hosting of an exhibition and stakeholder validation session.

Each of these data gathering activities are further discussed in the following subsections. Digitisation of two modules was undertaken prior to the pilot study.

Desktop review

Existing 'as-is' foundational supervisory leadership development training modules were sourced from a relevant leadership training service provider and were reviewed. Data was gathered through a subsequent interview with the training service provider. The 'as-is' review enabled the identification of gaps that should be considered when developing modern training methods. Some of the assessment criteria included the training solution's applicability to gold and PGM mines, accreditation and certification, and customisability, amongst other criteria.

Mines survey

Survey questionnaires were submitted to five mining companies to assess the training methodologies used and preferred by the mine employees (Table 1). The participants were required to indicate their answers with "often", "sometimes", or "never." Survey responses were received from a total of 25 participants (12 training managers, 12 training facilitators, and 1 trainee).

Pilot study

The pilot study enabled the research team to gain an understanding of the challenges, effects, and impact of implementing the digital learning method aimed at upskilling and reskilling supervisors. The objectives of the pilot study were:

- To compare the impacts of traditional classroom-based training to the modernised digitised training solution.
- To qualitatively evaluate participant attention, experience, time application, and overall impact on learning based on participant feedback.

Table 1

Survey questionnaire presented to mine employees

1. What commodity is mined by your operation/company? (gold / platinum / multi-commodity).
2. In terms of your role, you are a? (training manager / facilitator or trainer / trainee).
3. Does your company make use of virtual reality (VR) training methodology?
4. Does your company make use of augmented reality (AR) training methodology?
5. Does your company make use of e-learning methodology?
6. Does your company rely on classroom-based learning?
7. Does your company rely on a blended training approach?
8. Does your company do leadership development via digital platforms?
9. Do you prefer to use digital (VR, AR) and classroom-based training as a blended approach?
10. Does your company make use of external providers' on-line training offerings for senior employees?
11. Would you consider using VR methodology for miners' training?
12. Would you consider using AR methodology for RDOs' training?
13. Would you prefer opensource applications be used in the design of digital (AR/VR) training solutions?
14. Does your company do digital literacy skills training for semi-skilled employees?
15. Does your company do digital literacy skills training for skilled employees?
16. Do you think that simulated training, VR or AR training methodologies may not allow for the physical and environmental contexts to be accommodated (e.g., weight of the drill)?
17. Does the IT/systems requirements around digital (VR, AR) training solutions hinder implementation?
18. Is the cost to use a digital (AR,VR) training solution more than the cost to deliver classroom-based learning?
19. Do you think that a digital (VR/AR) training solution offers return on investment to the company?
20. Does your company use VR training methodology for safety training?
21. Does your company use AR training methodology for safety training?
22. Does your company use a blended training methodology for safety training?
23. In your view, do you think that training should be modernised, through implementation of modern training technologies/methodologies?
24. Is integration of the digital (AR/VR) training solution with the existing IT systems on the mine a concern?
25. Is the limited 'shelf – life/lifespan' of a sourced VR/AR training solution a concern?

The participants of the pilot study were employees of a multi-commodity mining company. The participants were divided into two groups: Group 1 underwent the traditional classroom training and Group 2 underwent the self-paced online digitised learning. The sample size of each group was between 11 and 15. Each group comprised three engineering foremen, two engineering artisans, one engineering manager, two internal trainers, with three observers in Group 1, and seven observers in Group 2. The impacts of the two training methods were observed by the researchers and video recorded. The participants provided feedback before and after the pilot study. The digitised solution was reviewed and revised, based on the outcomes of the pilot study.

Exhibition and validation session

A virtual SATCAP exhibition and stakeholder validation session was held in January 2022 to demonstrate the digitised training solution and solicit feedback. A total of 87 stakeholders attended the exhibition, which included representatives from the MMP, Mining Qualifications Authority (MQA), Mining Equipment Manufacturers of South Africa (MEMSA), Mine Health and Safety Council (MHSC), collaboration partners, unions, consultants, Minerals Council South Africa (MCSA), and mining companies. The exhibition included a panel discussion, a demonstration of the solution, and a portal where the industry could access the relevant digitised modules and project files. Stakeholders provided inputs and comments for validation of the suggested modules.

Results and discussion

Desktop review: An existing supervisory leadership development training solution

The review included an existing programme comprising seven modules that gold and PGM mines currently use. Of the modules listed in the following, the study only digitised the first two training modules:

i. Your role as a management leader (digitised module);
ii. A systems approach to management (digitised module);
iii. Supervisory work of leading;
iv. Supervisory work of planning;
v. Supervisory work of organising;
vi. Supervisory work of controlling;
vii. Problem-solving, solution development, and action planning.

The results of the 'as-is' review is shown in Table 2.

In conjunction with the tabulated findings, the review further advised that the existing solution is effective but could be enhanced with aspects of digitisation to offer a more modern training mode. This digitisation could enable self-learning, support refresher training, and reduce classroom time, thus offering more flexibility. A

Table 2

Results from review of existing training solution

Assessment aspect	Finding
Mode of training	Traditional classroom-based.
Duration of training	Several days. Could impact on productivity of the core business at mines.
Content retention	Could be reduced when classroom training ends.
Applicability to gold and PGM mines	Training has been delivered at various gold and PGM mines.
Customisability	Training content, examples and case studies are customised to meet client requirements and specific work environments.
Accreditation	NQF level 4 skills programme aligned to six unit standards with 36 credits and is Sector Education and Training Authority (SETA) accredited.
Recognition	Internationally recognised.
Other	The training offers assessments, personal development, and practical assignments to enable continuous learning and embedment of the skills.

digital training platform could enable the accessibility of content at the mine working environment. The review also revealed that some key modules that support leading and driving modernisation were lacking. Current modules focused on planning, organising, leading, and controlling. The recommendation was that the training solution be supplemented with additional content and hence, informed the design of two additional modules to support supervisors' development to lead and drive mining modernisation in this study.

Data gathering: Mines survey

The survey results were analysed quantitatively using percentage distributions and response frequency, as shown in Table 3. The results were grouped according to the group of participants based on their designation: training managers, facilitators, and trainees.

The majority of the participants were from PGM mines – 58% training managers and 50% facilitators. Only one participant from the 'trainees' group responded to the survey from the 'trainees' group, and therefore, the results from this group may not be an accurate representation. This participant belonged to a multi-commodity mine. The trainee participant responded to questions 1 to 10 only, as the remainder of the survey questions did not apply to a trainee. The responses received from the training managers and facilitators groups were similar. The fundamental difference between these two groups was the response received to question 3: "*Does your company make use of virtual reality (VR) training methodology*?" A total of 88% of the training managers responded that they "sometimes" use VR training, while 67% of the facilitators indicated that they "often" use VR training methodologies. The trainee indicated that they have never used VR training.

Based on the overall survey results, it was found that more than 50% of the participants' companies often use e-learning methodologies. This implies that e-learning or digital learning is not a new concept to supervisors in the mining industry. More than 50% of the participants supported the implementation of modern training methods or elements of modernisation. The results also suggested that blended learning is the preferred approach by the mine employees.

Development: Digitisation of modules

The development process of the two 'modernised' digitised training modules entailed the following:

i. The content for the Foundational Supervisory Leadership Programme was supplied by the training provider in a Microsoft PowerPoint format.
ii. The digital training developer created a new storyline for the content for a self-paced learning journey by including step-by-step instructions, character-driven narration, and new mining-related template design and graphics.
iii. The assessments, activities, and knowledge quizzes were customised for the new digitised modules, which enabled a self-paced learning journey.
iv. The digitised modules were piloted to assess the usability, effectiveness, quality, and applicability to the mining industry.
v. Final revisions were made, and user guidelines were created for transfer to the industry.

Most of the current content in the existing solution, which is effective for supervisory leadership development, was included in the digitised modules. Additional content was added, and changes were made to ensure that the solution meets the mining industry's requirements within a modernisation context. The digitised training solution enabled self-paced learning and aimed to enhance the learning experience and ensure a positive impact on knowledge. The methodology used media-rich content that included:

i. Character creation - to enhance diversity and inclusion.
ii. Real-time assessments - to personalise the learning experience.
iii. Gamified tasks - to track learner input.
iv. Motion graphics, video and voiceovers - for improved understanding.

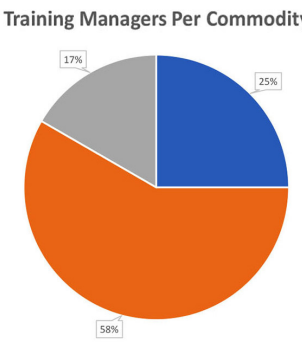
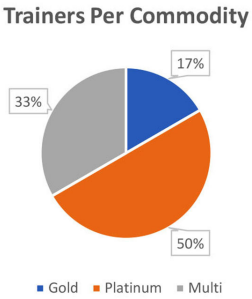
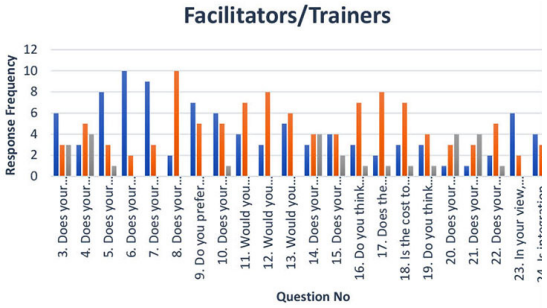
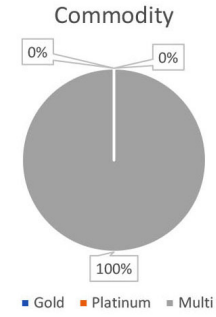
Additional content (including the characters and storyline) in the digitised modules accounted for approximately 25% – 30% of the enhancements made to the 'as-is' solution. An example of the content 'before', versus the 'after' digitisation, is shown in Figure 1 and Figure 2, respectively.

Pilot study: Training of modernised digitised content

Some of the pilot study's findings corresponded with those from the review of the existing solution. The pilot study revealed that the duration of classroom training may pose an issue for mines, due

Table 3

Summary of mines survey results

Designator	Percentage distribution of participants per commodity	Survey results
Training managers		
Facilitators/Trainers		
Trainee		

to loss of time spent on the core business. Furthermore, learning retention may be minimised when the classroom training ends, resulting in a lack of application at the workplace.

The digitised training method created an efficient and engaging learning experience that enabled self-paced learning and offered ease of access to supervisors. A downside pointed out by participants, was that they missed the face-to-face interaction with a facilitator and other participants. The use of technology also posed a challenge to some of the older participants, who were not as proficient in using technology as younger participants. Traditional classroom training and the new digitised online learning solution offer advantages for supervisory leadership development.

The advantages and disadvantages of the digitised solution, as revealed by the pilot study, are presented in Table 4.

Reviews and validation: Demonstration of digitised modules

The two digitised modules were demonstrated at the stakeholder validation session to solicit industry inputs. The industry participants reviewed the modules, and comments were received. The demonstration and exhibition of the training modules showcased the following:

i. The training context is showcased through an overview video.
ii. Project aim, objectives, and methodology.
iii. Key observations on the current realities within the mining industry.
iv. Importance of supervisory leadership development.
v. The supervisory leadership development modules and topics.
vi. Learning methods to be used in the digitised solution.
vii. The 'look and feel' of the digitised modules showcased through a demo video.
viii. Delivery options include self-paced learning and blended learning solutions.

Input obtained from the stakeholders included aspects relating to transfer to industry and customisability of the modules.

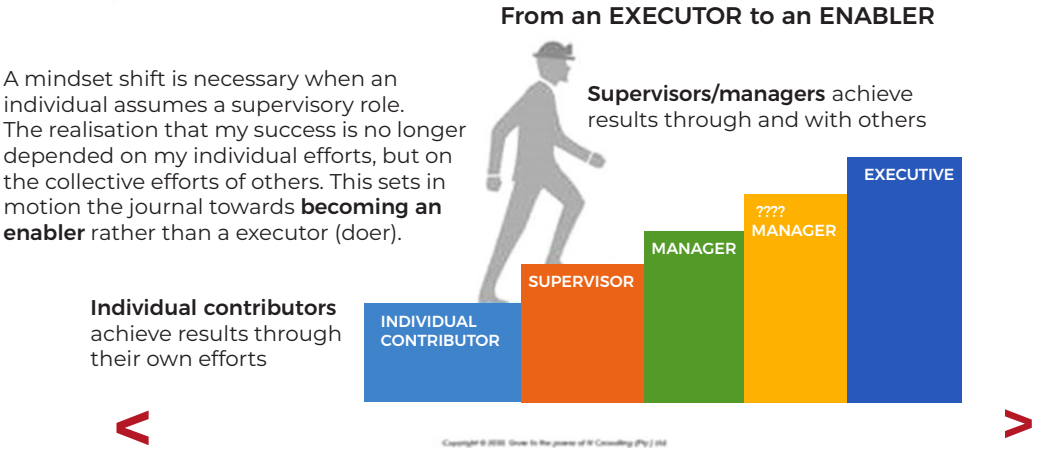


Figure 1—Example of existing 'as-is' training solution

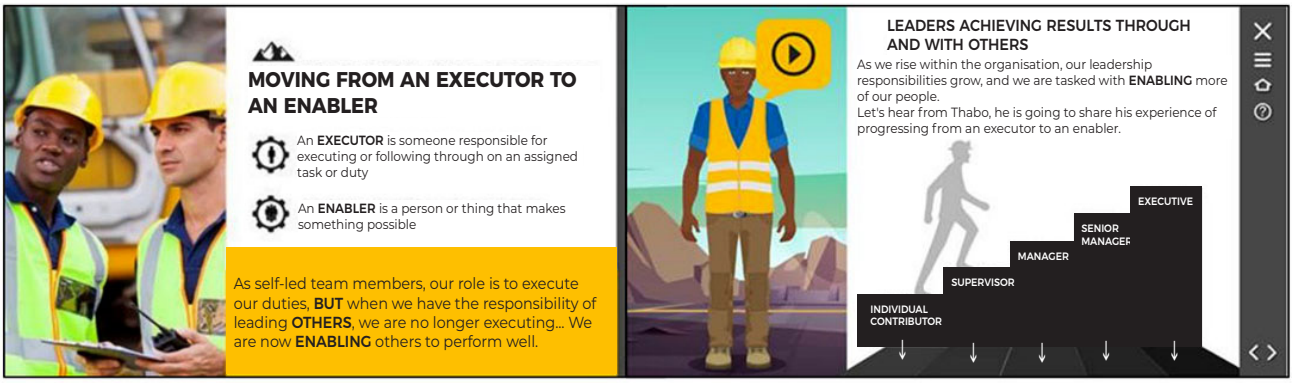


Figure 2—Example of modernised digitised content

Table 4

Advantages and disadvantages of the digitised solution

Advantages	Disadvantages
Efficient – saves time	Lack of face-to-face interaction with facilitator and other participants.
Engaging learning experience	Technological challenges (for older participants and those not proficient in the use of technology).
Enabled self-pace learning	The strength of Wi-Fi, the learning management system (LMS), or hardware used may be limiting factors if not set up for specific working environments.
Ease of access to supervisors	–
Offers new opportunities such as self-reflection that could enhance the learning experience	–

Transfer to industry: Training products

The outputs transferred to the industry included:

i. Two digitised training modules;
ii. Training slides;
iii. A facilitator guide;
iv. Training videos;
v. A final report;
vi. Access to the above items is available through the MMP website.

The two digitised modules provide an introduction and the basic principles for supervisors to lead and drive mining modernisation. The modules are generic and not specific to a particular mine. They can be used by multi-commodity mines, including gold and PGM, as 'stand-alone' modules. They are customisable (through consultation with relevant service providers) for specific working environments and the level of learners. These modules showcased the art of possibility and were not meant to replace an entire leadership training programme for supervisors.

Three of the seven modules were digitised, two of which were made available to the industry, which were:

i. Module 1 – Your role in mining modernisation.
ii. Module 2 – A system's approach.

The details pertaining to the two modules are presented in Table 5 and Table 6.

An example of the digitised module content is shown in Figure 3.

The training pack offered is in Microsoft PowerPoint format and can be used by the facilitator in the classroom in conjunction with the Facilitator Guide. The Facilitator Guide assists with the preparation and facilitation of the programme. It includes additional content, explanations, and timing guidelines to help the facilitator during the programme. The two training videos were a user guide to assist with navigating the digital modules and a video of the training provider's facilitator facilitating Module 1 of the 'as-is' programme.

Conclusion and recommendations

Based on the research findings, traditional classroom training and the new digitised online learning solution offer advantages for supervisory leadership development. Digital learning is not a new concept for supervisors at mines and modern training methods are well-supported by supervisors in the industry. A 'modernised' training solution may consider a 'blended' learning approach that combines traditional training with digital methods. The mine's transition to modern training methods will be informed by their needs, specific contexts, modernisation strategy, and stakeholder inclusion. For customisation of the digital modules, reputable and accredited training providers may be consulted for further guidance.

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Table 5

Module 1 ('Your role in modernisation') sections and topics

Secrtion 1	Section 2	Section 3	Section 4
The concept of leadership	**Becoming an effective leader**	**Self-awareness: key to effective leadership**	**The importance of effective leadership**
The definition of leadership	A leader's role in a team.	The importance of self-awareness.	Mining modernisation – a case for change.
Moving from executor to enabler	Team development stages.	How you view others.	Supervisors as a driver for change.
A leader's sphere of influence	Leadership behaviours.	The importance of diversity and inclusion.	–
Effective leadership	How we develop into effective leaders.	–	–

Table 6

Module 2 ('A system's approach') sections and topics

Section 1	Section 2
System approach	The management system of the existing solution.
Systems thinking	The needs, results, and work model.
Input-throughput-output process	Understanding stakeholder needs.
–	Classification of results.
–	Classification of work.
–	The management gap.
–	The management wheel.
–	Applying the management system.

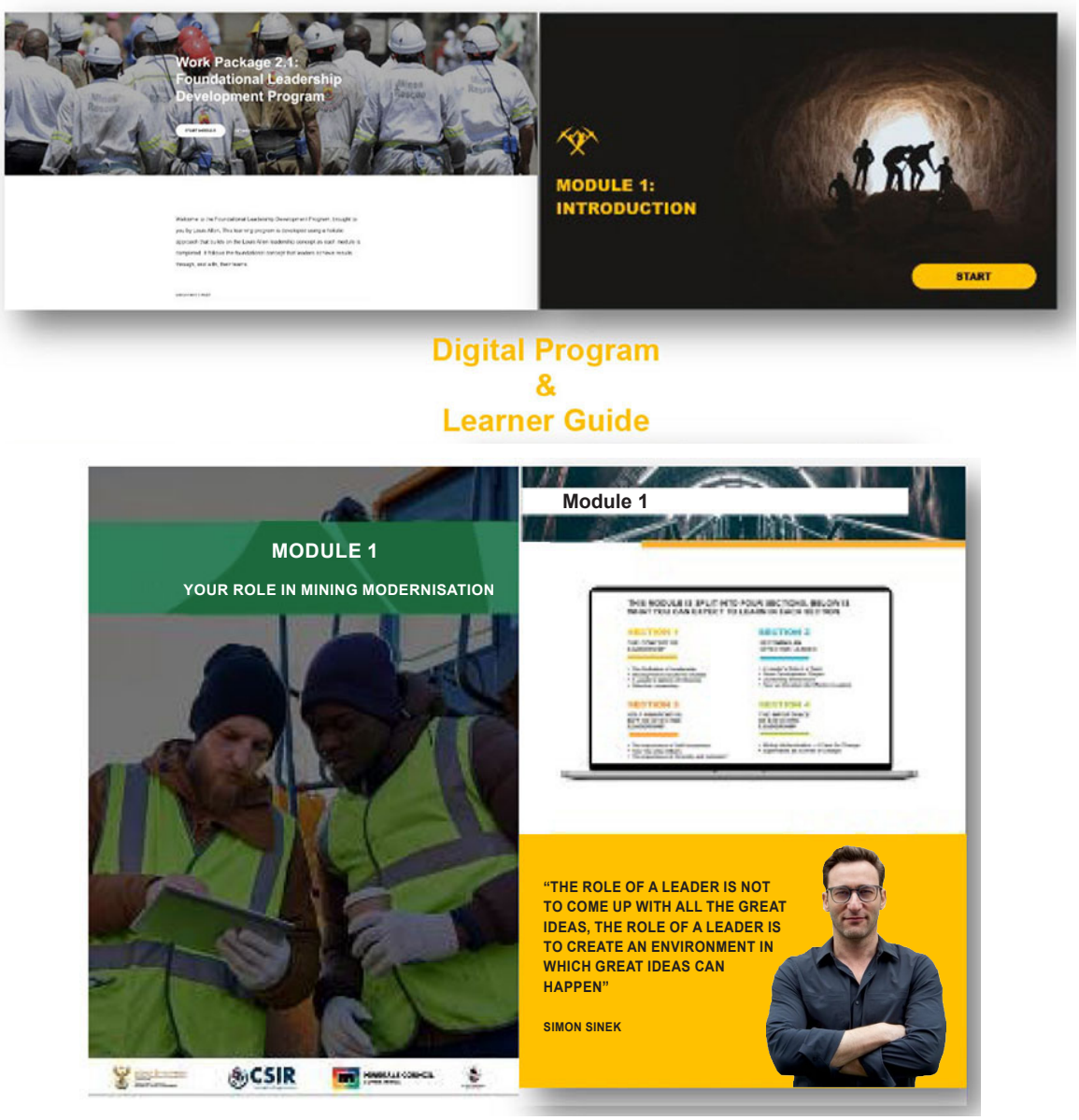

Figure 3—Example illustrating the digitised module content

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