

Exploring the use of technology for better transfer of agricultural knowledge to farmers' workplaces to optimise productivity and performance: the case of table grape farmers in Algeria

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Abstract:

The aim of this study is to evaluate the effectiveness of a method combining training videos and mental imagery for transferring knowledge and improving the performance of experts in the agricultural field. Using a qualitative approach, we confirmed that trainees' comprehension, memory and ability to apply their knowledge improved when they combined training videos with mental images. In particular, mental imagery was shown to help trainees understand concepts in depth and apply them in real-life situations. However, it became clear that the trainees' experience, motivation and problem-solving skills were also important factors in knowledge transfer. These results suggest the potential of new training methods for the effective development of human resources in agriculture.

Keywords: Agricultural continues training; knowledge transfer; training videos; mental images; Human resource development.

Jel Classification Codes : I29 ; O15 ; Q16

ملخص:

تهدف هذه الدراسة إلى تقييم فعالية طريقة تدريبية تجمع بين مقاطع الفيديو التوجيهية والصور الذهنية كوسيلة لنقل المعرفة وتعزيز أداء الخبراء في المجال الزراعي. من خلال اتباع منهجية نوعية، توصلنا إلى أن الجمع بين مقاطع الفيديو والصور الذهنية أدى إلى تحسين فهم المتدربين، وتعزيز ذاكرتهم، وزيادة قدرتهم على تطبيق المعارف المكتسبة. وقد أظهرت النتائج أن الصور الذهنية تساهم بشكل ملحوظ في تسهيل استيعاب المفاهيم المعقدة، مما يساهم في تطبيقها بشكل أفضل في مواقف الحياة الواقعية. علاوة على ذلك، تبين أن خبرة المتدربين ودوافعهم الشخصية، بالإضافة إلى مهاراتهم في حل المشكلات كانت عوامل حاسمة في نجاح عملية نقل المعرفة. تشير هذه النتائج إلى أن الأساليب التدريبية المبتكرة تحمل إمكانات كبيرة في تحسين تنمية الموارد البشرية في القطاع الزراعي وتعزيز كفاءتها.

الكلمات المفتاحية: التدريب الزراعي المستمر؛ نقل المعرفة؛ مقاطع الفيديو التدريبية؛ الصور الذهنية؛ تطوير الموارد البشرية.
تصنيف jel: I29 ; O15 ; Q16

I. Introduction:

Over the last few decades, digital technologies have revolutionised the way in which human resources development, including training and learning, takes place in companies and organisations. This transformation has transformed the way knowledge is disseminated, acquired and transferred, opening up the possibility of a flexible and personalised approach learning solutions, particularly in human resources management. Technologies such as e-learning platforms, applications and webinars have enabled training to be tailored to the needs of individual employees, promoting effective workforce development and explore new approaches to knowledge transfer and skills development, particularly in business environments.

In particular, the introduction of digital technology in the agricultural sector has had a profound impact on human resource development in agriculture, as it provides access to training resources and improves learning, as well as making it available to more learners. New technologies create an effective learning environment, providing trainers with practical experiences, opportunities for collaboration, as well as creative problem-solving skills. In addition, the use of virtual reality simulators and precision agriculture tools enable learners to learn and put their skills into practice in the field. This facilitates collaboration between learners and enables them to quickly identify the latest developments in agriculture and industry trends.

However, technological advances alone are not enough; the acquisition of practical skills is essential in the development of human resources. Video-based training is effective in addressing visual, kinesthetic and auditory learning styles, but practical practice through techniques such as mental imagery is important to enable learners to apply the knowledge gained to real-life situations. Particularly with regard to agricultural technology and management skills, employees need to be able to respond quickly and effectively to problems they face in the field. To achieve this, comprehensive training programmes combining theory and practice are needed.

This effective combination of new technologies and methodologies in human resource development can enhance the skills of employees and contribute to improving the performance of the organisation as a whole. In the agricultural sector in particular, evolving technologies require new approaches to help employees learn practical skills (Johnson, K., 2020). Optimal integration of these elements ensures sustainable and effective human resource development.

In recent years, mental imagery techniques have proven effective in skill learning and memory. Traditionally, physical practice has been the focus of skill acquisition in vocational training, but research suggests that the use of mental imagery may enhance the learning process and promote skill retention. In particular, as training using digital tools evolves, the combination of mental imagery and visualisation has been shown to be potentially more effective than traditional training methods (Martin, B., & Blair, S., 2017). This new approach may be the key to solving the cost and effort problems of traditional training programmes and to achieving efficient and effective human resource development.

In modern human resource management, effective skills development and improved training methods are critical to an organisation's competitiveness (Segar, E., et al., 2020). Traditional vocational training has relied primarily on practical skills and physical exercises, but recent research suggests that the use of mental imagery may enhance learning and promote skills retention.

- But can combining mental imagery with traditional training methods really improve the quality and cost-effectiveness of training?
- And how can this new approach be integrated into human resource development programmes to improve performance in the real workplace?

Hypothesis:

This study aims to assess the impact of mental imagery and video visualisation techniques in vocational training programmes on skill acquisition and retention. Our hypothesis is that the combination of these techniques will result in more efficient and sustained acquisition of skills by learners compared to traditional practical skills-oriented training.

We also believe that the introduction of mental imagery has the potential not only to improve the quality of training, but also to make better use of resources and reduce costs. Therefore, we predict that the addition of mental imagery techniques to traditional teaching methods could also contribute to improving the competitiveness of organisations as a new and more efficient means of human resource development.

II. The potential of digital technology and training video in an agricultural context:

Agricultural human resources are one of the most important factors that determine the effectiveness and development of the agricultural sector (Brown, J. 2019).. The human factor in agriculture is not only limited to the provision of labour, but also extends to the knowledge and skill development of employees and workers in this vital sector. It has become clear that human resource development is one of the main pillars that support the sustainability of the sector, as it contributes to improving the productivity and quality of agricultural labour, and enhances the competitiveness of farmers.

In this context, agricultural training plays a pivotal role in the development of these human resources (Eckermann, J., et al. 2016). Training is not only a tool to increase technical skills, but also a key element in empowering workers and increasing their productivity by acquiring renewed knowledge and modern skills that help them face the challenges of modern agriculture.

Vocational training in the agricultural sector is undergoing a major transformation as a result of advances in digital technology. This has enabled farmers to acquire the knowledge and skills they need more effectively and to learn remotely from expert (Aref et al, 2019). The introduction of information technology using tablets and screens is becoming increasingly important in agricultural skills development, providing learners with the opportunity to progress at their own pace, regardless of time or location (Huang et al, 2021). However, to make the most of these technologies, well-designed training programmes and tailored resources for learners are essential. Especially in a sector like agriculture, where technology and knowledge are constantly evolving, the effective integration of digital technology determines the quality of vocational training (Ibid).

Video training has great potential in developing knowledge and skills in the agricultural sector. It can provide farmers in remote and inaccessible areas with standardised training materials, which can significantly improve agricultural extension services. In particular, the ability to efficiently learn the skills required for agricultural practices (e.g. pruning techniques and harvesting methods) can contribute to increased agricultural productivity and the dissemination of sustainable agricultural practices (Ananda Jayasekaram, 2017). Videos are very effective as a means of facilitating the acquisition and retention of skills, as they allow learners to watch them repeatedly. Especially in a field such as agriculture, which requires practical knowledge, videos can be a complementary tool for learning (Ibid).

III. 2. the use of mental imagery and its effectiveness in vocational training:

The use of mental imagery, when combined with video training, has the potential to further enhance trainee's performance and learning outcomes (Figure 1). Mental imagery, also known as visualisation or mental rehearsal, is a technique for recreating sensory experiences without external stimuli Kosslyn et al (2001). Studies have shown that this technique is highly effective in areas such as sport, music and surgery, where learners simulate real tasks in their minds before performing them, which improves confidence and accuracy during practice. In agricultural

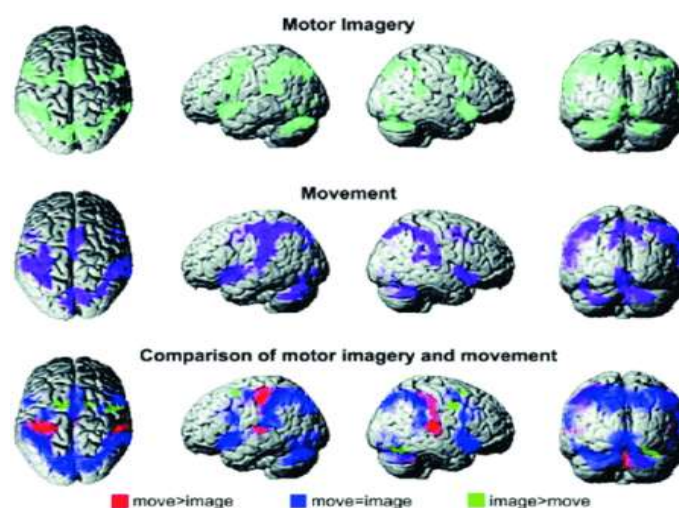
training, reproducing complex processes in the mind can facilitate the retention of practical skills and improve learning efficiency.

As part of human resource development in the agricultural sector, innovative training methods that combine training videos and visualisations are becoming increasingly important. These methods aim to improve knowledge transfer and enhance the ability to apply skills in real-life situations, which is crucial in a field that requires a deep understanding and practical application of agricultural concepts and practices. From a cognitive psychology perspective, the role of mental images in this context is a crucial tool. According to Kosslyn et al. (2001), mental images are not just a secondary aspect of cognition, but an essential and indispensable part of cognitive processes. Rather than being a passive reflection of the information we receive, mental images are an active process, with the same nervous system that controls perception and behaviour involved in their formation. In fact, mental images can be seen as mental simulations that allow us to predict the likely outcomes of future actions or decisions.

Kosslyn et al. (2001) point out that mental images are present at all levels of cognitive information processing, from basic cognitive processes such as the senses to abstract thought processes and complex problem solving. For example, when we read a text, our brain creates mental images of the objects and actions mentioned in the text, which enhances our ability to understand the text more deeply and facilitates recall. This mechanism enables us to connect new cognitive information with previous knowledge, making it easier to learn and apply in different contexts.

Based on research conducted by Kosslyn et al. (2001) and Paivio (1971), it can be argued that the combination of training videos and mental images is a powerful learning method that can contribute significantly to improving knowledge transfer and human resource development in the agricultural sector. By combining these methods with continuous motivation and practical training, the agricultural sector can make significant progress in increasing work efficiency and developing the skills of workers in this vital field.

Figure 1: Mental imagery



Source : Kosslyn et al (2001)

IV. Methods and Materials:

This study aims to investigate the effect of a combination of mental imagery and video visualisation on the acquisition and retention of viticulture skills. The study was designed to test the effectiveness of two innovative training methods in improving pruning accuracy and cutting quality in viticulture techniques. The use of mental imagery and video visualisation is one of the most recent methods in the field of training, as these methods are believed to positively influence the understanding and practical application of agricultural skills.

- Methodology of the study:

The study was conducted using a randomised controlled trial (RCT), which is one of the most powerful research methods for evaluating the effects of educational interventions on skill performance. Sixty viticulture trainees were selected to participate in the experiment. The participants were aged between 18 and 30 years old and were equally divided between males and females. Participants were randomised into three experimental groups, to ensure unbiased allocation:

1. **Video group:** This group was exposed to video demonstrations of pruning techniques and asked to mentally visualise and apply the process based on what they saw in the video.
2. **Mental imagery group:** After watching the same demonstration video, this group participates in guided mental imagery exercises, where they are guided to visualise the pruning techniques in their minds sequentially, focusing on the fine motor details of each step.
3. **The control group:** This group did not receive any kind of intervention or training during the study, and thus serves as a control group to compare the results between the different training methods.

- Training procedures:

Instructional videos were used to illustrate the pruning technique comprehensively. The video addresses correct pruning techniques according to the practices adopted in viticulture, focusing on basic aspects such as tool handling, cutting angle, and the different stages of pruning.

1. **Video group:** Participants in this group were asked to watch the demonstration video and interact with it mentally by visualising the process. This visualisation is supposed to help them deepen their understanding and facilitate the actual application process when carrying out the task.
2. **Mental imagery group:** After watching the video, participants in this group were instructed to practice guided mental imagery exercises. This type of training involves an exercise where trainees are asked to visualise themselves performing the pruning process in detail, visualising each step clearly in their minds, which enhances the ability to apply the skill more accurately.
3. **The control group:** This group did not receive any training intervention and was therefore used to compare the performance of the other groups that received the training.

- Measurement and evaluation tools:

Grape pruning skills test: To assess the skills acquired, a standardised measurement tool was used to assess the accuracy and quality of the cuts made by the participants. This test is based on rigorous industry standards including:

1. Accuracy: The extent to which the cutting conforms to the specified criteria (e.g. cutting at right angles).
2. Angle: Ensuring that the cut is made at the required angles.
3. Quality: How clean the cut is, whether the cut is smooth and homogeneous or not.
4. Location: The accuracy of where the cut is made in relation to other parts of the tree.

Performance evaluations are based on the number of correct and incorrect cuts made, with points awarded based on the effectiveness and accuracy of the pruning.

- Follow-up Skill Retention:

Follow-up evaluation: Two months after the training, a follow-up assessment was conducted to measure participants' retention of the skills learnt during the training. This assessment was designed to observe continuity in the application of correct techniques and assess the trainees' ability to use the skills independently and without interference. At this stage, trainees were tested again using the same grape pruning skills test to determine the deterioration or retention of skills over time. The aim of this evaluation is to measure the impact of the training on knowledge retention and the ability to apply the skills in the long term.

- Analytical data:

Data related to cutting accuracy and quality were collected during the initial and follow-up assessments. The researchers used statistical analysis to compare the performance of the three groups, focusing on the differences between the group that received video training, the group that used mental imagery, and the control group.

- Final Objective:

The primary objective of this study was to analyse the effect of mental imagery and video visualisation on the accuracy and quality of pruning cuts, as well as to determine the long-term retention of the skills by the participants after a period of training. This research aims to explore the effectiveness of modern training methods in improving the performance of viticultural workers, and thus these methods can be utilised in training farmers and agricultural specialists to achieve best practices in pruning techniques.

V. Results and discussion :

The method we used in our pilot study provided strong quantitative data supporting our hypothesis that mental imagery combined with video viewing improves skill learning and retention. This hypothesis was supported by the objective measurement of participants' skills using a standardised assessment tool, which provided strong evidence of the effectiveness of our experimental protocol in improving grape pruning skills, both in the acquisition and retention phases.

- Results of the first test:

The Winemaking Skills Test was used to measure participants' performance after the initial training. The results revealed a significant difference between the experimental group (which benefited from mental imagery in addition to visualisation) and the control group (which did not receive any additional mental training).

The experimental group performed significantly better than the control group.

- Experimental group: $M = 85.4$, $SD = 5.1$
- Control group: $M = 74.2$, $SD = 6.9$
- Statistically significant difference: $t(28) = 6.13$, $p < 0.001$, $d = 2.42$

These results indicate that mental imagery in addition to visualisation helped the participants to significantly improve their vine pruning skills compared to the control group. This confirms the effectiveness of combining the two techniques in improving the accuracy of performance and increasing the trainees' ability to execute the skills correctly.

- Follow-up test results:

Three weeks after the training, a follow-up test was conducted to measure participants' retention of the skills learnt. The aim of this test was to check the sustainability of the skills learnt, and whether mental imagery had improved the ability to retain them in the long term.

In the follow-up test, the experimental group showed significantly better performance than the control group:

- Experimental group: $M = 85.7$
- Control group: $M = 71.2$
- Statistically significant difference: $p < 0.05$

These results suggest that mental imagery, combined with physical practice and video learning, has a significant positive effect on long-term skill retention. Although the experimental group showed a slight decrease in performance compared to the pre-test, their performance remained significantly better than the control group.

These results show that mental imagery, when combined with video visualisation and physical practice, can have a positive impact on the learning and memorisation of agricultural skills. In particular, integrating mental imagery into the learning process makes it possible for trainees to visualise their performance during training, making it easier for them to better apply the skills in practice. This benefit materialises not only in improved accuracy of performance during training but also in their retention of the skills at a later interim period, as shown in the results of the follow-up test.

- Mains Conclusions of results:

1. Improved performance in skill learning: The results showed that integrating mental imagery with visualisation significantly contributed to improving grape pruning skills, which confirms the importance of these modern methods in improving skill performance in different training areas.
2. Skill retention: In addition to the immediate improvement in performance, the results indicate that the use of mental imagery has a positive effect on the long-term retention of skills compared to traditional methods.
3. Support for previous studies: These findings are consistent with several previous studies that have emphasised the importance of mental imagery in improving the acquisition and retention of complex skills, such as those that have been applied in areas such as sports and technical professions.

Figure 1 : Overview of results

Test	Groupe expérimental	Groupe témoin	Différence significative
Post-test	85,4 (SD=5,1)	74,2 (SD=6,9)	$p < 0,001$, $d = 2,42$
Test de suivi	85,7	71,2	$p < 0,05$

Source: author

VI. Conclusion:

The aim of the study was to investigate the influence of mental imagery training on the acquisition and retention of grape pruning skills in viticulture learners. The results of the study showed that the experimental group who received mental imagery training in addition to physical practice and video instruction showed significant gains in pruning skill acquisition compared to the control group. Furthermore, the experimental group also showed an increased ability to retain skills over time, a result that supports the effectiveness of mental imagery training.

These results are consistent with previous studies showing the effectiveness of mental imagery in the acquisition and retention of skills. It is therefore considered important to incorporate mental imagery exercises in training programmes for the agricultural industry and other professions. Specifically, a combination of video training and mental imagery exercises is recommended as an effective way to help learners better understand pruning techniques and other professional skills and prepare them for realistic situations. This allows learners to consolidate their skills in a safe and engaging environment and effectively prepare them for complex and challenging scenarios.

The use of mental imagery in vocational training has been shown not only to improve learning efficiency, but also to contribute to the long-term retention of professional skills. This also makes it a very cost-effective method of training, especially in resource-limited settings. In addition, by incorporating mental imagery training, vocational training programmes can provide a more comprehensive and effective education for learners.

Our findings suggest that incorporating mental imagery exercises is an innovative approach to improving the quality of training in vocational training programmes and ensuring that participants acquire and retain professional skills. By incorporating this approach into vocational training, institutions can provide learners with a better training experience and ultimately achieve better performance in the workplace.

In conclusion, it is strongly recommended that integrating mental imagery training into professional vocational training programmes is an effective way to promote the acquisition and retention of skills and support learners to reach their full potential. The introduction of this approach is expected to make a significant contribution to increasing productivity in the workplace and developing the skills of personnel.

The application of these methods can be extended to other training areas within agriculture and other sectors that require precise practical skills. Hybrid training methods that combine kinesthetic learning with mental training should be explored as effective ways to achieve sustainable learning and improve trainee performance in the long term.

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