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Research Article

Video annotation tools for assessing psychomotor skills in nursing education: A scoping review

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Abstract: Video annotation tools can improve assessments by enabling visualization, repeated reviews, and structured feedback, thereby promoting deeper learning. This approach is particularly relevant in health professional education, where acquiring psychomotor skills is essential. No recent reviews have focused specifically on video annotation tools for assessing psychomotor skills in nursing education. This scoping review explores tools that facilitate feedback and assessment of psychomotor performances, with a focus on those customizable for nursing-specific psychomotor skills. Included studies are published in peer-reviewed journals and utilize software that allows for annotation of psychomotor performances, integration of feedback criteria and customization for nursing education. Studies employing video annotation tools solely for machine learning algorithms or for non-psychomotor performances are excluded. Literature searches were conducted using PubMed, Web of Science Core collection, CINAHL via EBSCO, Scopus, EuropePMC, CENTRAL via Cochrane Library, ERIC via OVID, FiS Bildung, SportDiscus via EBSCO, IEEE and ACM digital library. Additional searches included snowballing and Google. The initial screening identified 18 video annotation tools. Following a second screening phase, seven tools were excluded due to the absence of essential features, such as support for multiple camera angles or isochronic annotation. Ultimately, we highlight four customizable tools that are particularly relevant to nursing education. This scoping review provides a springboard for the development of a tailored video annotation tool that builds on existing software. The aim of such a tool will be to streamline feedback and assessment processes, enhance learning outcomes for nursing students, and provide nursing lecturers with an efficient, practice-aligned solution.

1. INTRODUCTION

In nursing education, a key focus is teaching psychomotor skills, such as venipuncture or injection. These psychomotor nursing skills (PNS) are movement-oriented performances of varying complexity (INACSL, 2011). Students first practice PNS in a skills lab using task trainers, before applying them in complex real-life settings. This controlled environment allows for performance assessment, which is essential for learning through targeted feedback (Miles,

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2018). Traditionally, feedback is provided verbally or in writing, but memory bias can affect its accuracy. Video-based assessment can enhance feedback (Mayer, 2014) by providing visual footage on students' performances, supporting more precise, actionable guidance and deeper skill mastery. This provides opportunities, especially since Gen Z healthcare students prefer visual learning environments such as video (Shorey *et al.*, 2021). Bahula & Kay (2021) found that students preferred video-based over text-based feedback due to its detailed, clear, and rich quality. Epstein *et al.* (2020) demonstrated that smartphone video for practice-based learning and PNS assessment enhanced deeper learning and flexible feedback in a blended learning environment.

To deliver feedback to students, annotating video footage can be an efficient approach. Lam & Habil (2021b) describe video annotation as "a tool, a learning system, a Web 2.0 application, a platform, a device, a software, a program or simply an application of technology associated with a feature which enables individuals to annotate audio-visual content, either with textual or multimedia annotations. Most video annotation platforms are characterized by a feature for segmentation or clipping of segments of a video with comments that are synchronized with the video timeline". Video annotation positively impacts learning and professional development by facilitating reflection, comprehension, critical thinking, and satisfaction (Evi-Colombo et al., 2020; Lam & Habil, 2021b). To deliver targeted feedback, various forms of annotation can be distinguished. Rolf *et al.* (2014) identify isochronic annotations, which link content to a specific time, spatial annotations, which link content to a point in an area, and structured annotations, which add textual comments to the video. To be particularly effective in supporting the learning and assessment of PNS, a video annotation tool should meet several key criteria. First, it should support isochronic annotation, enabling feedback to be synchronized with specific time points in a skill demonstration, for example, to highlight the exact moment a critical error occurs during a procedural step. Second, spatial annotation capabilities are essential to direct the learner's attention to a specific area of the screen, such as circling incorrect hand placement during an injection. Third, tools should offer structured annotation features, including predefined categories or labels (e.g., sterility error, incorrect execution), to facilitate consistent and targeted feedback. Additionally, tools should be adaptable to the nursing education context, meaning they can be used flexibly by lecturers and students, operate within the privacy and usability constraints of healthcare training environments, and allow customization to align with specific criteria of a specific nursing skill. These features enhance learning by enabling specific and actionable feedback, fostering reflection, and supporting deliberate practice, all critical for the acquisition of PNS.

Evi-Colombo *et al.* (2020) reviewed seventeen video annotation tools (VATs), highlighting their technical and pedagogical affordances in different disciplines. Lam & Habil (2021a) identified 20 VATs for video-annotated peer feedback. Both reviews describe VideoANT, Media Annotation Tool and Collaborative Lecture Annotation System as the three most researched VATs. VATs vary in features, such as color coding, written or drawn-on annotation, tagging or labelling and exporting options (Evi-Colombo *et al.*, 2020). VATs have been researched in teacher training to improve reflections on teaching practices (Ardley & Hallare, 2020; Ardley & Johnson, 2019; McFadden *et al.*, 2014; Nagel & Engeness, 2021; Pérez-Torregrosa *et al.*, 2017; Sain, 2022), and in blended learning to annotate lecture recordings for reflective and active learning (Aubert *et al.*, 2014; Cassano & Di Blas, 2023; Douglas *et al.*, 2014; Rolf *et al.*, 2014). VATs in sports can provide insights for evaluating and enhancing physical performance (O'Donoghue & Holmes, 2014; Shih, 2018). Barriers to VAT implementation include technical issues, training needs, video camera type, workload, accessibility, storage, and cost (Ardley & Hallare, 2020; Frehner *et al.*, 2012; Hands *et al.*, 2009; Rich & Trip, 2011). In health professional education, Hands *et al.* (2009) used Dartfish to tag videos for learning and assessment, reducing student anxiety and enhancing learning. Frehner *et al.* (2012) developed and explored a VAT for reviewing self- and peer-recorded nursing skill performances, positively impacting reflective practices. Both projects encountered technical issues related to video storage. Future research should focus on the impact of learning outcomes and on developing a financially feasible and accessible tool to assess skill performances in higher education.

Despite the growing use of video in nursing education, a consolidated overview of VATs suitable for providing structured feedback on PNS is lacking. Existing reviews focus on general educational or peer-feedback contexts, but do not examine the specific features required for effective feedback on complex, stepwise psychomotor performances in healthcare education. As a result, lecturers face uncertainty when selecting or implementing VATs that align with both pedagogical needs and practical constraints.

This scoping review addresses that gap by mapping the current landscape of VATs and identifying tools with the technical and functional capacity to support accurate, customizable, and context-appropriate feedback aligned with the specific steps of each PNS (Vermeulen, 2019). To address this gap, we conducted a scoping review guided by the following research questions (RQs):

RQ 1: Which VATs can generate isochronic, spatial, and structured annotations to provide accurate visual feedback on movement-oriented performances?

RQ 2: Which of these VATs are customizable for specific PNS to provide visual, clear, precise and actionable feedback to students in nursing education?

2. METHOD

This scoping review, development of the review protocol and summary of evidence is performed using the JBI Manual for Evidence Synthesis (Peters *et al*., 2024) and is in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (Tricco *et al*., 2018). The study protocol is registered in the Research Data Repository (KU Leuven) (Leysens *et al*., 2024, December 20).

2.1. Inclusion and Exclusion Criteria

Records are eligible for inclusion if they meet the following criteria:

- Utilize software capable of annotating psychomotor performances.
- Demonstrate potential for customization to annotate the performance of PNS, specifically by embedding feedback criteria.
- Are published in peer-reviewed journals in Dutch, English, French or German.
- There are no restrictions on the publication date.

Records are excluded if they describe a VAT:

- For machine learning algorithms, such as automated image annotation.
- To annotate videos unrelated to psychomotor performances (e.g. focus on cognitive or affective learning domains, medical imaging)
- For real-time video analytics with wearable sensors or trackers
- That does not allow annotation or is not customizable.
- That was no longer available at the time of this review process.

The Population-Concept-Context-Type description with inclusion and exclusion criteria is shown in Appendix I.

2.2. Search Strategy

To answer RQ 1 and RQ 2, a literature search was conducted in PubMed, Web of Science core collection, CINAHL via EBSCO, Scopus, EuropePMC, CENTRAL via Cochrane Library, ERIC via OVID, FiS Bildung, SportDiscus via EBSCO, IEEE and ACM digital library from inception to February 5, 2024. An updated search was performed on January 8, 2025, to capture studies published since the initial search. The interdisciplinary nature of the study required a broad database search, targeting full-text primary studies, reviews, meta-analyses, text and opinion papers, guidelines, and conference proceedings. Search strings were developed in collaboration with the Biomedical Library, 2Bergen (Leuven, Belgium) and are detailed in Appendix II. Snowballing and grey literature searches were also performed, including a Google search using the term 'annotation tool.' The language was restricted to Dutch, English, French or German. An additional PubMed search using VAT names supplemented findings for RQ 2. Studies discussing the strengths and weaknesses of the selected VATs are included.

2.3. Source of Evidence Screening and Selection

After removing duplicates, titles and abstracts from the original search (up to February 5, 2024) were screened for eligibility by two independent reviewers (GL and RC), using Rayyan with a blind filter (Ouzzani *et al.*, 2016). The abstract screening followed best practice guidelines for scoping reviews (Polanin *et al.,* 2019). Discrepancies were resolved through discussion. Uncertain cases advanced to full-text screening. Relevant papers were retrieved in full, and imported into EndNoteTM 21.2 (Clarivate Analytics, PA, USA). GL and RC independently reviewed full texts. Articles without accessible full text were excluded. For the updated search (January 8, 2025), GL applied the same eligibility criteria.

2.4. Data Extraction

During full-text screening, relevant data were extracted into a standardized Excel spreadsheet. The following data items were charted for each included study: name of the tool, target group, availability, and application of the tool. The extraction form was developed based on the review questions. The data extraction was performed by both reviewers, and discrepancies were resolved through discussion.

2.5. Analysis and Presentation of Results

The data were synthesized using a descriptive, narrative approach aligned with the scoping review methodology. Extracted data were charted and grouped according to key characteristics of VATs relevant to RQ1 and RQ2. For RQ1, VATs capable of generating isochronic, spatial, and structured annotations for movement-oriented feedback were tabulated. Descriptive categories included VAT name, target group, language, open-source availability, footage used, annotation capabilities, adaptability for PNS, and source references. Where necessary, supplementary information was retrieved from official VAT websites. For RQ2, VATs requiring minimal adaptations to provide actionable feedback to nursing students were identified and summarized.

3. RESULTS

3.1. Search Results

The original search identified 999 records. After removing duplicates (n=390) and inaccessible records (n=81), 528 records remained. Title and abstract screening retained 70 reports for full-text review, with six reports excluded due to unavailability. An additional 22 records were identified through citation tracking and Google Search, leading to 86 reports for full-text screening and the assessment of 93 tools. Of these, 75 tools were excluded for different reasons, and led to the removal of 38 reports. Ultimately, 48 reports were included, mapping 18 VATs. The updated search did not identify any new records or tools. A detailed PRISMA flowchart (Page *et al.*, 2021) outlining the original search strategy is presented in Figure 1.

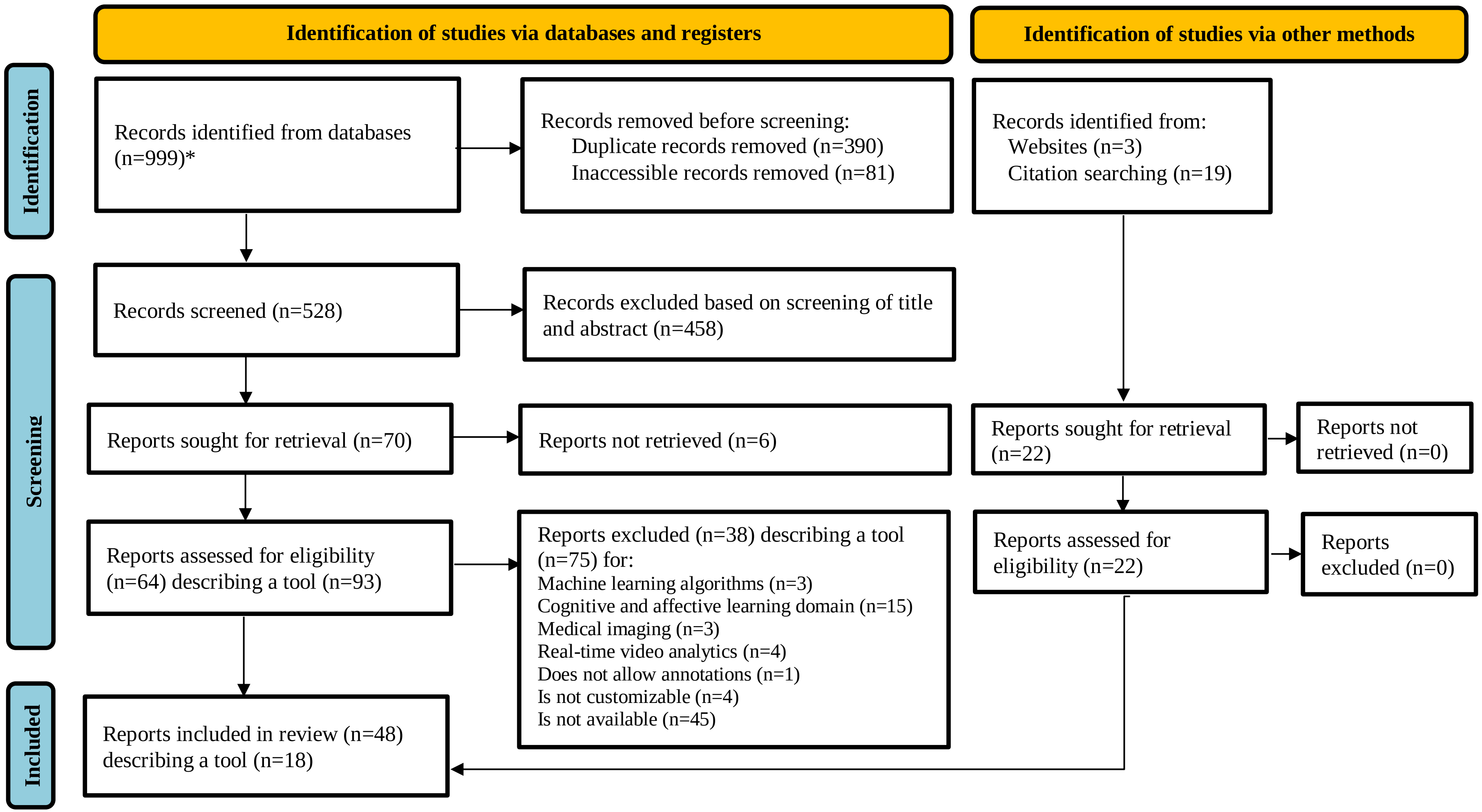

Figure 1. *Flowchart of the search strategy and results (dated 5/2/2024) according to PRISMA 2020 Statement (Page et al., 2021).*
** Search strategy per database is comprehensively reported and detailed in Appendix II*

3.2. Evidence Sources for VATs

Ultimately, 48 articles and 18 VATs were eligible for data extraction to address RQ 1. The VATs Catapult and Reclipped were discovered via Google Search. Six review articles identified CoachNow, CaTool, Dartfish, ELAN, FEVA, GoReact, Hudl Sportscode, SiliconCOACH, Spark Motion Pro, Utilius Fairplay 5, VIA, and VIAN (Barris & Button, 2008; Evi-Colombo *et al.*, 2020; Lam & Habil, 2021a; Laughlin *et al.*, 2019; Liebermann *et al.*, 2002; Shrestha *et al.*, 2023). The remaining 42 articles covered VAT studies. One study per VAT was identified for Anvil 6.0, FEVA, and Observer XT. Two studies each referred to Hudl Sportscode and GoReact and three studies mentioned SiliconCOACH or LINCE PLUS. Kinovea was used in 14 studies and Dartfish in 15 studies. Quality analysis of the research designs is beyond the scope of this review.

Table 1 presents a narrative summary of VAT characteristics, including target group, language, footage, open-source availability, type of annotation and references (RQ1). Key features such as split-screen functionality for multi-camera angles and annotation capabilities are highlighted. These inform the VAT suitability for customizing feedback on PNS performance (RQ2). All VATs are available in English. Utilius Fairplay 5 is also available in German, and LINCE PLUS in Spanish. Eight VATs (Anvil 6.0, CaTool, ELAN, FEVA, Kinovea, LINCE PLUS, VIA and VIAN) are open source and free of charge; the other VATs require a subscription or purchase. Eleven VATs (Catapult, CoachNow, Dartfish, FEVA, Hudl Sportscode, Kinovea, LINCE PLUS, Observer XT, SiliconCOACH, Spark Motion Pro and Utilius) support split-screen. All VATs support structured annotation, which can be displayed next to or below the video. CaTool and VIAN lack isochronic annotation features, while ELAN, GoReact and Reclipped do not support spatial annotation. Seven VATs cannot be customized (Anvil 6.0, CaTool, ELAN, GoReact, Reclipped, VIA and VIAN).

3.3. Evidence Sources for VATs Eligible for PNS

In addressing RQ 2, we prioritized customizability, as each PNS involves specific sequential steps, making the tailoring of assessment criteria within the VAT crucial. We emphasized the need for clear and actionable feedback by evaluating the potential for annotating multiple video angles simultaneously and incorporating isochronic, spatial, and structured annotations. Table 1 shows that 11 VATs meet these criteria (Catapult, CoachNow, Dartfish, FEVA, Hudl Sportcode, Kinovea, LINCE PLUS, Observer XT, SiliconCOACH, Spark Motion Pro, and Utilius Fairplay 5). These will be further investigated to answer RQ2. A PubMed search using each VAT's name yielded 233 articles. Ten studies discussed the strengths and weaknesses of the VAT, 44 were duplicates and 179 were irrelevant. Table 2 provides an overview of the specific features of these 11 VATs, which will be discussed further based on key questions for educators, as outlined by Rich and Trip (2011).

Table 1. *Features of 18 VATs.*

VAT	Target group	Language	Footage	Open source*	Annotation*			Customizable for PNS*	References
					isochronic	spatial	structured		
Anvil 6.0	Research: social sciences, human behavior, and digital technologies	English	Single	✓	✓	✓	✓	X	(Loukas *et al.*, 2020; Shrestha *et al.*, 2023)
Catapult	Sport performances	English	Multi	X	✓	✓	✓	✓	Google Search
CaTool	Academia collaborative annotation	English	Single	✓	X	✓	✓	X	(Lam & Habil, 2021a)
CoachNow	Sport performances	English	Multi	X	✓	✓	✓	✓	(Laughlin *et al.*, 2019)
Dartfish	Sport performances	English	Multi	X	✓	✓	✓	✓	(Abdelrasoul *et al.*, 2015; Andrews & Bressan, 2018; Barris & Button, 2008; Bobo *et al.*, 2012; Chiappedi *et al.*, 2012); (Earp *et al.*, 2016; Hands *et al.*, 2009; Judge *et al.*, 2008; Liebermann *et al.*, 2002; Maykut *et al.*, 2015; Myer *et al.*, 2012; Ong *et al.*, 2015; Post *et al.*, 2016; Rucci & Tomporowski, 2010; Schärer *et al.*, 2021; Ste-Marie *et al.*, 2016; Ste-Marie *et al.*, 2012; Walker *et al.*, 2020)
ELAN	Linguistic annotations	English	Single	✓	✓	X	✓	X	(Shrestha *et al.*, 2023)
FEVA	Computer and social sciences	English	Multi	✓	✓	✓	✓	✓	(Shrestha *et al.*, 2023)
Go-React	Education, skills-based learning	English	Single	X	✓	X	✓	X	(Ardley & Hallare, 2020; Ardley & Johnson, 2019; Evi-Colombo *et al.*, 2020; Lam & Habil, 2021a; Schulz & Gaudreault, 2023)
Hudl Sportscode	Sport performances	English	Multi	X	✓	✓	✓	✓	(Beseler *et al.*, 2024; Peeters *et al.*, 2019)
Kinovea	Sport performances	English	Multi	✓	✓	✓	✓	✓	(Amri-Dardari *et al.*, 2022; Amri-Dardari *et al.*, 2020; Cabarkapa *et al.*, 2021; Carzoli et al., 2022; Dadashi *et al.*, 2013; Gonzalvo *et al.*, 2017; Ishac

									& Eager, 2021; Puklavec *et al.*, 2021; Raiola *et al.*, 2013; Souissi *et al.*, 2023; Souissi *et al.*, 2021; Tayech *et al.*, 2022; Yang et al., 2022)
LINCE PLUS	Sport performances	English Spanish	Multi	✓	✓	✓	✓	✓	(Prieto-Lage *et al.*, 2020; Soto *et al.*, 2019; Soto-Fernández *et al.*, 2021)
Observer XT	Research: behavioral	English	Multi	X	✓	✓	✓	✓	(Dove & Astell, 2019)
Reclipped	Individual or team note taking; research; analysis and feedback	English	Single	X	✓	X	✓	X	Google Search
Silicon-COACH	Sport performances; sports retail; education; clinical practice	English	Multi	X	✓	✓	✓	✓	(Lago-Fuentes *et al.*, 2018; Liebermann *et al.*, 2002; McDonald *et al.*, 2011; Shultz *et al.*, 2013)
Spark Motion Pro	Sport performances; medical practitioners	English	Multi	X	✓	✓	✓	✓	(Laughlin *et al.*, 2019)
Utilius Fairplay 5	Sport performances	German English	Multi	X	✓	✓	✓	✓	(Barris & Button, 2008)
VIA	Academia; commercial	English	Single	✓	✓	✓	✓	X	(Shrestha *et al.*, 2023)
VIAN	Film analysis	English	Single	✓	X	✓	✓	X	(Shrestha *et al.*, 2023)

* ✓ = yes; X = no

Table 2. *Features of eligible VAT for PNS based on information from the VAT website and articles.*

VAT	Cost*	Short Keys*	Live annotation*	Speed changing*	Collaboration*	Data management*	App*	Support*	Output	Extra PubMed
Catapult	✓	?	✓	?	✓	✓	✓	✓	Custom workbook views with preset filters; 2D pitch and graphs	0
CoachNow	✓	✓	X	✓	✓	✓	✓	✓	Annotated video with possibility to attach spreadsheets, documents, notes and comments	0
Dartfish	✓	✓	✓	✓	✓	✓	✓	✓	Video with written annotations and coded segments; export as CSV, image, video, and report	75
FEVA	X	✓	X	✓	X	✓	X	X	Export as video, image, and closed caption	0
Hudl Sportscode	✓	✓	✓	✓	✓	✓	✓	✓	Annotated clips; statistical breakdowns; visualized performance data; tailored detailed reports	2
Kinovea	X	✓	X	✓	X	✓	X	✓	Export as video, images, and CSV	110
LINCE PLUS	X	✓	✓	✓	✓	✓	✓	✓	Interactive charts; exports to data analysis software programs	3
Observer XT	✓	✓	✓	✓	✓	✓	X	✓	Export as reports, graphs, and charts, and CSV	38
SiliconCOACH	✓	✓	✓	✓	✓	✓	X	✓	Export as video and to Excel	4
Spark Motion Pro	✓	✓	X	✓	X	✓	✓	✓	Export as video, snapshot, and notes	1
Utilius Fairplay 5	✓	✓	✓	✓	X	?	X	✓	Export scenes	0

* ✓ = yes; X = no; ? = not specified

3.3.1. *How will educators annotate and analyze their videos?*

Observers can annotate and analyze videos using isochronic, spatial and structured methods (Rolf *et al.*, 2014), which is supported by the 11 VATs. Key features include frame-by-frame analysis, split-screen playback, and comparison of student videos with expert demonstrations, facilitating visual feedback and imitation-based learning (White *et al.*, 2019). Additional features such as simultaneous footage, slow-motion, zoom, and frame-by-frame review enhance analysis. Observer XT (Post *et al.*, 2016) and SiliconCOACH (Carzoli *et al.*, 2022; Gabin *et al.*, 2012; Zimmerman *et al.*, 2009) offer these features, while LINCE PLUS provides multi-video observation, device compatibility and adjustable playback speed (Soto *et al.*, 2019; Soto-Fernández *et al.*, 2021). Video annotation is time-consuming, as highlighted by White *et al.* (2019), who reported that coding one hour of surgical footage using Observer XT took three to five hours. This may be due to relying on mouse-based menu options. FEVA (Shrestha *et al.*, 2023) and LINCE PLUS (Soto *et al.*, 2019; Soto-Fernández *et al.*, 2021) offer keyboard shortcuts, speed controls, and real-time labelling, improving efficiency. While most VATs support these features, it is unclear if Catapult does (Laughlin *et al.*, 2019). Live processing, as available in the tools such as Observer XT (Zimmerman *et al.*, 2009) and LINCE PLUS (Soto *et al.*, 2019; Soto-Fernández *et al.*, 2021), could expedite annotation, although VATs such as Kinovea require post-processing (Carzoli *et al.*, 2022).

3.3.2. *Will educators collaborate on their analyses?*

Any VAT will suffice for single observer annotation. However, seven VATs support multiple observers, including Dartfish (Maykut *et al.*, 2015; Rucci & Tomporowski, 2010), LINCE PLUS (Gabin *et al.*, 2012), Observer XT (Oliveira *et al.*, 2013) and SiliconCOACH (Shultz *et al.*, 2013), which allow reliability calculations between observers. LINCE PLUS also supports collaborative work via mobile devices using QR codes (Soto *et al.*, 2019; Soto-Fernández *et al.*, 2021). Mobile VATs offer immediate feedback and quick video creation, with apps available for both Apple and Android, designed to operate seamlessly across various platforms. For example, Dartfish Express mirrors Dartfish, and Hudl Technique mirrors Hudl Sportscode (Laughlin *et al.*, 2019). Mobile apps of Catapult, CoachNow, LINCE PLUS, and Spark Motion Pro also enhance versatility. Clear instructions on recording techniques, such as camera positioning and distance, are crucial for accurate observation and measurement (Ong *et al.*, 2015; Rucci & Tomporowski, 2010).

3.3.3. *How much does it cost?*

Detailed pricing information for most VATs is not publicly available. However, differences in access models can be identified. FEVA, Kinovea and LINCE PLUS are free of charge, open-source VATs (LINCE PLUS, 2025; Shrestha *et al.*, 2023). In contrast, CoachNow, Dartfish, SiliconCOACH and Spark Motion Pro require either a one-time purchase or a subscription plan, depending on additional features (CoachNow, n.d.; Dartfish, 2025; Siliconcoach, n.d.; SparkMotion, 2025). Pricing information for Catapult, Hudl Sportscode and Observer XT is not disclosed online (Catapult, n.d.; Hudl, 2007-2025; Noldus, 2025). While exact costs are difficult to determine, the accessibility and licensing model (free versus paid) can be considered a key factor in tool selection.

3.3.4. *Who should upload the videos?*

Responsibility for uploading videos varies, depending on the VAT and the educational context. In some platforms, such as CoachNow and Dartfish, students can upload their own recordings. In other cases, observers are responsible for recording and uploading performance footage, especially when institutional or privacy protocols limit student access. The ability to distribute software to students or export video analysis is advantageous. A digital drop box system allows fast and secure sharing of student footage with the observer (Hands *et al.*, 2009). Exporting data in a universal format such as .csv is valuable, as seen in LINCE PLUS, CoachNow, Dartfish, Kinovea, Observer XT and SiliconCOACH (CoachNow, n.d.; Dartfish, 2025; Gabin *et al.*, 2012; Kinovea, n.d.; LINCE PLUS, 2025; Noldus, 2025; Siliconcoach, n.d.).

3.3.5. *How secure are videos and reflections from unwanted viewing?*

Data management is crucial for storing student IDs, observer names, and other key details to analyze large groups. All VATs provide this functionality; it cannot be specified for Utilius Fairplay 5 (CCC Software, 2025). LINCE PLUS also allows for storing essential characteristics, thus streamlining observational research (Gabin *et al.*, 2012).

3.3.6. *Is the tool easy for educators to learn and use?*

Most VATs offer tutorials via YouTube or third-party creators, except FEVA, which has a demo and white paper on its website. Paid VATs provide comprehensive support through their websites, such as expert training sessions for CoachNow, Catapult and Spark Motion Pro. Observer XT includes customer support and tutorials via a MyNoldus account (Noldus, 2025), while Dartfish and Hudl Sportscode offer academy webinars (Dartfish, 2025; Hudl, n.d.). Kinovea provides multilingual tutorials and an active help forum, praised for ease of use and portability (Puig-Diví *et al.*, 2019). Utilius Fairplay 5 has a blog, a white paper, and a video analysis guide (CCC Software, 2025).

3.4. Review Findings

The customizability of a VAT is a key consideration in nursing education, where tools must be adaptable to discipline-specific psychomotor skills. Among the 11 selected VATs, four stand out in this regard. LINCE PLUS is open-source, highly adaptable, and supports fixed, mixed, and variable criteria coding (Gabin *et al.*, 2012; Prieto-Lage *et al.*, 2020; Soto-Fernández *et al.*, 2021). It accommodates direct observation, video analysis, and vocal feedback functionalities (Soto *et al.*, 2019; Soto-Fernández *et al.*, 2021). Kinovea, also open-source, offers features such as split-screen viewing and various annotation tools. It has been primarily used in research settings to measure parameters such as time, position, distance, angles, and both linear and angular kinematics (Kinovea, n.d.). While it supports a range of analytical functions, its customization options, such as the creation of new codes or commands, are currently more limited compared to some other tools. Dartfish provides advanced performance analysis options and supports the creation of media books that combine videos, images, annotations, and comments. It offers a high degree of customizability, although it requires a commercial license (Dartfish, 2025; Hands *et al.*, 2009). Observer XT is a comprehensive tool for behavioral research, allowing detailed coding and statistical analysis. It also supports integration with media and external data modules, although these modules may require additional clarification regarding price and setup (Dove & Astell, 2019; Noldus, 2025).

4. DISCUSSION and CONCLUSION

This scoping review examines VATs for annotating psychomotor performances (RQ1) and customizing PNS annotations in nursing education (RQ2). The literature search identified 528 records, leading to 86 reports describing 93 tools. Ultimately, 48 peer-reviewed articles describe 18 VATs eligible for data extraction. Factors considered include language, open-source availability, footage, and annotation type. Mandatory features, such as multi-video angles for simultaneous analysis and isochronic, spatial, and structured annotation, led to the exclusion of seven additional VATs during the second screening. In the final phase, the strengths and weaknesses of 11 selected VATs were described, with four tools standing out for their customizability to nursing education.

To contextualize the findings, some observations should be mentioned. First, while 93 tools were initially eligible for extraction, 45 were no longer available, highlighting the rapidly evolving nature of technology in this field. Second, limited information was obtained from selected articles, as most authors only mentioned VATs in the method section without discussing their advantages or disadvantages. Primary sources of information were VATs' websites and review articles. While the initial search strings addressed RQ1, an additional PubMed search using VAT names yielded 10 relevant studies discussing the strengths and weaknesses to address RQ2. Last, despite conducting the scoping review across 11 databases and a Google search, the information obtained was insufficient for a comprehensive understanding of VATs' applicability for providing feedback on PNS. This was particularly evident for non-open-source VATs, which required payment to download and test. For VATs such as Catapult, discovered via Google search, only limited website-provided information was available.

These findings highlight a mismatch between the availability of VATs and their applicability to the nursing education context. While many tools exist, few meet the criteria needed to support feedback on PNS performance. This underscores the need for tool selection to be guided not merely by availability or popularity, but by pedagogical fit, particularly the ability to deliver isochronic, spatial, and structured feedback. For lecturers, selecting a VAT that aligns with these feedback types supports student learning effectively. The review also reveals a significant gap in the literature, the lack of peer-reviewed evaluations of VATs in nursing education. Most studies did not address usability, educational impact, or implementation feasibility, which points to the need for further empirical research. In addition, the frequent discontinuation of tools suggests that institutions may benefit from investing in open-source or customizable platforms to ensure long-term access and adaptability.

This review provides insights into VATs in international literature and identifies those that can be customized for feedback to nursing students on their PNS performance. Based on our scoping review, the open-source VATs LINCE PLUS and Kinovea, and paid VATs Dartfish and Observer XT meet all required criteria, offering multi-video annotation, various annotation types and adaptability for PNS assessment. They stand out for their flexibility, versatility, and collaborative and data management options. This scoping review not only maps the current VAT landscape but also serves as a springboard for the development of a tailored VAT for feedback on PNS. By identifying critical functional requirements and existing gaps, this review can inform the design of a next-generation VAT that integrates the strengths of existing tools while addressing the specific pedagogical and practical needs of nursing education. Such a tool could enhance student learning outcomes and offer a time-efficient, user-friendly solution for educators in higher education.

As an initial mapping of this field, this review also highlights the need for further empirical research to evaluate how specific VAT features impact feedback quality, learning effectiveness, and implementation feasibility in nursing curricul.

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Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in IJATE belongs to the authors.

Contribution of Authors

Greet Leysens and **Rani Claus** are the corresponding authors of the article. **Greet Leysens:** Design of methodology, Conceptualization, Investigation, Resources, Writing - original draft, Writing - review and editing. **Rani Claus:** Conceptualization, Investigation, Resources, Writing – original draft, Writing – review. **Wim Van Petegem** and **Nathalie Charlier:** Supervision, Writing – review.

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REFERENCES

Abdelrasoul, E., Mahmoud, I., Stergiou, P., & Katz, L. (2015). The accuracy of a real time sensor in an instrumented basketball. *Procedia Engineering*, *112*, 202-206. https://doi.org/10.1016/j.proeng.2015.07.200

Amri-Dardari, A., Mkaouer, B., Amara, S., Hammoudi-Nassib, S., Habacha, H., & Zohra BenSalah, F. (2022). Immediate effect of self-Modelling with internal versus external focus of attention on teaching/learning gymnastics motor-skills. *Journal of Human Kinetics, 84*(1), 224-232. https://doi.org/10.2478/hukin-2022-0103

Amri-Dardari, A., Mkaouer, B., Nassib, S.H., Amara, S., Amri, R., & Ben Salah, F.Z. (2020). The effects of video modeling and simulation on teaching / learning basic vaulting jump on the vault table. *Science of Gymnastics Journal*, *12*(3), 325-344. https://doi.org/10.52165/sgj.12.3.325-344

Andrews, B.S., & Bressan, E.S. (2018). The effect of synchronised metronome training: a case study in a single leg, below knee Paralympic sprinter. *African journal of Disability*, *7*(1), 1-6. https://doi.org/10.4102/ajod.v7i0.367

Ardley, J., & Hallare, M. (2020). The feedback cycle: Lessons learned with video annotation software during student teaching. *Journal of Educational Technology Systems*, *49*(1), 94-112. https://doi.org/10.1177/0047239520912343

Ardley, J., & Johnson, J. (2019). Video annotation software in teacher education: Researching university supervisor's perspective of a 21st-century technology. *Journal of Educational Technology Systems*, *47*(4), 479-499. https://doi.org/10.1177/0047239518812715

Aubert, O., Prié, Y., & Canellas, C. (2014). Leveraging video annotations in video-based e-learning. *arXiv preprint arXiv:1404.4607*. https://doi.org/10.48550/arxiv.1404.4607

Bahula, T., & Kay, R. (2021). Exploring student perceptions of video-based feedback in higher education: A systematic review of the literature. *Journal of Higher Education Theory and Practice*, *21*(4), 248-258. https://doi.org/10.33423/jhetp.v21i4.4224

Barris, S., & Button, C. (2008). A review of vision-based motion analysis in sport. *Sports Medicine*, *38*(12), 1025-1043. https://doi.org/10.2165/00007256-200838120-00006

Beseler, B., Plumb, M.S., Spittle, M., Johnson, N.F., Harvey, J.T., & Mesagno, C. (2024). Examining single session peer-teaching instructional approaches on pre-service physical education teachers' throwing techniques. *Perceptual and Motor Skills*, *131*(1), 246-266. https://doi.org/10.1177/00315125231214126

Bobo, L., Benson, A.A., & Green, M. (2012). The effect of self-reported efficacy on clinical skill performance. *Athletic Training Education Journal*, *7*(4), 176-186. https://scholarworks.sfasu.edu/kinesiology/27

Cabarkapa, D., Fry, A.C., Cabarkapa, D.V., Myers, C.A., Jones, G.T., & Deane, M.A. (2021). Kinetic and kinematic characteristics of proficient and non-proficient 2-point and 3-point basketball shooters. *Sports (Basel)*, *10*(1), 2. https://doi.org/10.3390/sports10010002

Carzoli, J.P., Sousa, C.A., Helms, E.R., & Zourdos, M.C. (2022). Agreement between Kinovea video analysis and the open barbell system for resistance training movement outcomes. *Journal of human kinetics*, *81*(1), 27-39. https://doi.org/10.2478/hukin-2022-0003

Cassano, G., & Di Blas, N. (2023). A tool to support students-to-teacher feedback in asynchronous online contexts. *IEEE Transactions on Learning Technologies*, *17*, 585-593. https://doi.org/10.1109/TLT.2023.3273109

Catapult. (n.d.). *Sports video analysis software*. https://www.catapult.com/solutions/video-analysis

CCC Software. (2025). *Utilius fairplay 5*. https://ccc-sportsoftware.de/en/produkte/utilius-fairplay-5/

Chiappedi, M., Togni, R., De Bernardi, E., Baschenis, I.M.C., Battezzato, S., Balottin, U., Toffola, E.D., & Bejor, M. (2012). Arm trajectories and writing strategy in healthy children. *BMC Pediatrics*, *12*(1), 173-173. https://doi.org/10.1186/1471-2431-12-173

Chorney, J.M.L., & Kain, Z.N. (2009). Behavioral analysis of children's response to induction of anesthesia. *Anesthesia and analgesia*, *109*(5), 1434-1440. https://doi.org/10.1213/ane.0b013e3181b412cf

CoachNow. (n.d.). *Welcome to ConnectedCoaching*. https://coachnow.io/

Dadashi, F., Crettenand, F., Millet, G.P., Seifert, L., Komar, J., & Aminian, K. (2013). Automatic front-crawl temporal phase detection using adaptive filtering of inertial signals. *Journal of Sports Sciences*, *31*(11), 1251-1260. https://doi.org/10.1080/02640414.2013.778420

Dartfish. (2025). *Video analysis solutions for sports performance*. https://www.dartfish.com/

Douglas, K.A., Lang, J., & Colasante, M. (2014). The challenges of blended learning using a media annotation tool. *Journal of University Teaching & Learning Practice, 11*(2). https://doi.org/10.53761/1.11.2.7

Dove, E., & Astell, A.J. (2019). Kinect Project: People with dementia or mild cognitive impairment learning to play group motion-based games. *Alzheimer's & Dementia: Translational Research & Clinical Interventions*, *5*(1), 475-482. https://doi.org/10.1016/j.trci.2019.07.008

Earp, J.E., Newton, R.U., Cormie, P., & Blazevich, A.J. (2016). Faster movement speed results in greater tendon strain during the loaded squat exercise. *Frontiers in Physiology, 7*, 366-366. https://doi.org/10.3389/fphys.2016.00366

Epstein, I., Baljko, M., Thumlert, K., Kelly, E., Smith, J.A., Su, Y., Zaki-Azat, J., & May, N.M. (2020). "A video of myself helps me learn": A scoping review of the evidence of video-making for situated learning. *International Journal for the Scholarship of Teaching and Learning*, *14*(1), 9. https://doi.org/10.20429/ijsotl.2020.140109

Evi-Colombo, A., Cattaneo, A., & Bétrancourt, M. (2020). Technical and pedagogical affordances of video annotation: A literature review. *Journal of Educational Multimedia and Hypermedia*, *29*(3), 193-226. https://www.learntechlib.org/primary/p/215718/.

Frehner, E., Tulloch, A., & Glaister, K. (2012). “Mirror, mirror on the wall”: The power of video feedback to enable students to prepare for clinical practice. In Herrington, A., Schrape, J., & Singh, K. (Eds.), *Engaging students with learning technologies* (1-14). Curtin University.

Gabin, B., Camerino, O., Anguera, M.T., & Castañer, M. (2012). Lince: Multiplatform sport analysis software. *Procedia - Social and Behavioral Sciences*, *46*, 4692-4694. https://doi.org/10.1016/j.sbspro.2012.06.320

Gonzalvo, A.R.A., Esparza Yánez, D., Tricás Moreno, J.M., & Lucha López, M.O. (2017). Validation of a force platform clinical for the assessment of vertical jump height. *Journal of Human Sport and Exercise*, *12*(2), 367-379. https://doi.org/10.14198/jhse.2017.122.13

Hands, B.P., Parker, H., Coffey, A., Clark-Burg, K., Das, A., Gerrard, P., Hackett, C., Jenkins, S., MacNish, J., & Miller, D. (2009). *The PHENC Project final report: Interactive video analysis to develop learning and assessment of university students' practical and communication skills*. https://ltr.edu.au/resources/CG7-385_Notre%20Dame_Hands_Final%20Report_v2_May09.pdf

Hudl. (n.d.). *Hudl Sportscode fully customizable performance analysis*. https://www.hudl.com/en_gb/products/sportscode

INACSL. (2011). Standard I: Terminology. *Clinical Simulation in Nursing*, *7*(4), S3-S7. https://doi.org/10.1016/j.ecns.2011.05.005

Ishac, K., & Eager, D. (2021). Evaluating martial arts punching kinematics using a vision and inertial sensing system. *Sensors*, *21*(6), 1-25. https://doi.org/10.3390/s21061948

Judge, L.W., Hunter, I., & Gilreath, E. (2008). Using sport science to improve coaching: A case study of the American record holder in the women's hammer throw. *International Journal of Sports Science & Coaching*, *3*(4), 477-488. https://doi.org/10.1260/174795408787186440

Kinovea. (n.d.). *A microscope for your videos* https://www.kinovea.org/

Lago-Fuentes, C., Rey, E., Padrón-Cabo, A., Sal de Rellán-Guerra, A., Fragueiro-Rodríguez, A., & García-Núñez, J. (2018). Effects of core strength training using stable and unstable surfaces on physical fitness and functional performance in professional female futsal players. *Journal of human kinetics*, *65*(1), 213-224. https://doi.org/10.2478/hukin-2018-0029

Lam, C., & Habil, H. (2021a). Enriching student learning through video-annotated peer feedback activity: A guide. *International Journal of Academic Research in Progressive Education and Development*, *10*(3), 46-60. http://dx.doi.org/10.6007/IJARPED/v10-i3/10712

Lam, C., & Habil, H. (2021b). The use of video annotation in education: A review. *Asian Journal of University Education*, *17*(4), 84-94. https://doi.org/10.24191/ajue.v17i4.16208

Laughlin, M.K., Hodges, M., & Iraggi, T. (2019). Deploying video analysis to boost instruction and assessment in physical education. *Journal of Physical Education, Recreation & Dance*, *90*(5), 23-29. https://doi.org/10.1080/07303084.2019.1580637

Leysens, G., Claus, R., Van Petegem, W., & Charlier, N. (December 20, 2024). *Video annotation tools to improve psychomotor skills in health professional education: a scoping review protocol* (Version V1) KU Leuven RDR. https://doi.org/10.48804/PWWPOD

Liebermann, D.G., Katz, L., Hughes, M.D., Bartlett, R.M., McClements, J., & Franks, I.M. (2002). Advances in the application of information technology to sport performance. *Journal of Sports Sciences*, *20*(10), 755-769. https://doi.org/10.1080/026404102320675611

LINCE PLUS. (2025). *LINCE PLUS sports training, reimagined*. https://lince-plus.com/

Loukas, C., Gazis, A., & Kanakis, M.A. (2020). Surgical performance analysis and classification based on video annotation of laparoscopic tasks. *Journal of the Society of Laparoendoscopic Surgeons*, *24*(4), e2020.00057. https://doi.org/10.4293/JSLS.2020.00057

Martins, J., Baptista, R., Coutinho, V., Fernandes, M., & Fernandes, A. (2018). *Simulation in nursing and midwifery education*. WHO. https://iris.who.int/bitstream/handle/10665/345156/WHO-EURO-2018-3296-43055-60253-eng.pdf?sequence=2&isAllowed=y

Mayer, R.E. (2014). *The Cambridge handbook of multimedia learning*, edited by Richard E. Mayer, University of California, Santa Barbara (Second Edition ed.). Cambridge University Press.

Maykut, J.N., Taylor-Haas, J.A., Paterno, M.V., DiCesare, C.A., & Ford, K.R. (2015). Concurrent validity and reliability of 2d kinematic analysis of frontal plane motion during running. *International journal of Sports Physical Therapy*, *10*(2), 136-146.

McDonald, D.A., Delgadillo, J.Q., Fredericson, M., McConnell, J., Hodgins, M., & Besier, T.F. (2011). Reliability and accuracy of a video analysis protocol to assess core ability. *PM & R: the Journal of Injury, Function, and Rehabilitation*, *3*(3), 204-211. https://doi.org/10.1016/j.pmrj.2010.12.007

McFadden, J., Ellis, J., Anwar, T., & Roehrig, G. (2014). Beginning science teachers' use of a digital video annotation tool to promote reflective practices. *Journal of Science Education and Technology*, *23*(3), 458-470. https://doi.org/10.1007/s10956-013-9476-2

Miles, D.A. (2018). Simulation learning and transfer in undergraduate nursing education: A grounded theory study. *Journal of Nursing Education*, *57*(6), 347-353. https://doi.org/10.3928/01484834-20180522-05

Myer, G.D., Ford, K.R., Brent, J.L., & Hewett, T.E. (2012). An integrated approach to change the outcome part I: Neuromuscular screening methods to identify high ACL injury risk athletes. *Journal of strength and conditioning research*, *26*(8), 2265-2271. https://doi.org/10.1519/JSC.0b013e31825c2b8f

Nagel, I., & Engeness, I. (2021). Peer feedback with video annotation to promote student teachers' reflections. *Acta Didactica Norden*, *15*(3), 24. https://doi.org/10.5617/ADNO.8192

Noldus. (2025). *The Observer XT*. https://www.noldus.com/observer-xt

O'Donoghue, P., & Holmes, L. (2014). *Data analysis in sport*. Routledge.

Oliveira, A., Pinho, C., Monteiro, S., Marcos, A., & Marques, A. (2013). Usability testing of a respiratory interface using computer screen and facial expressions videos. *Computers in Biology and Medicine*, *43*(12), 2205-2213. https://doi.org/10.1016/j.compbiomed.2013.10.010

Ong, N.T., Lohse, K.R., & Hodges, N.J. (2015). Manipulating target size influences perceptions of success when learning a dart-throwing skill but does not impact retention. *Frontiers in Psychology*, *6*, 1378-1378. https://doi.org/10.3389/fpsyg.2015.01378

Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan—a web and mobile app for systematic reviews. *Systematic reviews*, *5*, 1-10. https://doi.org/10.1186/s13643-016-0384-4

Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, n71. https://doi.org/10.1136/bmj.n71

Peeters, A., Carling, C., Piscione, J., & Lacome, M. (2019). In-match physical performance fluctuations in international rugby sevens competition. *Journal of Sports Science & Medicine*, *18*(3), 419-426.

Pérez-Torregrosa, A.B., Díaz-Martín, C., & Ibáñez-Cubillas, P. (2017). The use of video annotation tools in teacher training. *Procedia - Social and Behavioral Sciences*, *237*, 458-464. https://doi.org/10.1016/j.sbspro.2017.02.090

Peters, M., Godfrey, C., McInerney, P., Munn, Z., Tricco, A., & Khalil, H. (2024). JBI Manual for evidence synthesis chapter 10 Scoping review. *JBI*. https://doi.org/10.46658/JBIMES-24-09

Polanin, J.R., Pigott, T.D., Espelage, D.L., & Grotpeter, J.K. (2019). Best practice guidelines for abstract screening large-evidence systematic reviews and meta-analyses. *Research Synthesis Methods*, *10*(3), 330-342. https://doi.org/10.1002/jrsm.1354

Post, P.G., Aiken, C.A., Laughlin, D.D., & Fairbrother, J.T. (2016). Self-control over combined video feedback and modeling facilitates motor learning. *Human Movement Science*, *47*, 49-59. https://doi.org/10.1016/j.humov.2016.01.014

Prieto-Lage, I., Rodríguez-Souto, M., Prieto, M.A., & Gutiérrez-Santiago, A. (2020). Technical analysis in Tsuri-goshi through three complementary observational analysis. *Physiology & Behavior*, *216*, 112804. https://doi.org/10.1016/j.physbeh.2020.112804

Puig-Diví, A., Escalona-Marfil, C., Padullés-Riu, J.M., Busquets, A., Padullés-Chando, X., & Marcos-Ruiz, D. (2019). Validity and reliability of the Kinovea program in obtaining angles and distances using coordinates in 4 perspectives. *PLoS One*, *14*(6), e0216448. https://doi.org/10.1371/journal.pone.0216448

Puklavec, A., Antekolovic, L., & Mikulic, P. (2021). Acquisition of the long jump skill using varying feedback. *Croatian Journal of Education-Hrvatski Casopis Za Odgoj I Obrazovanje*, *23*(1), 107-132. https://doi.org/10.15516/cje.v23i1.3994

Raiola, G., Parisi, F., Giugno, Y., & Di Tore, P.A. (2013). Video analysis applied to volleyball didactics to improve sport skills. *Journal of Human Sport and Exercise*, *8*(Proc2), 307-313. https://doi.org/10.4100/jhse.2012.8.Proc2.33

Rich, P.J., & Trip, T. (2011). Ten essential questions educators should ask when using video annotation tools. *TechTrends*, *55*, 16-24. https://doi.org/10.1007/s11528-011-0537-1

Rolf, R., Reuter, H., Abel, M., & Kai-Christoph, H. (2014). Requirements of students for video-annotations in lecture recordings. *Interactive Technology and Smart Education, 11*(3), 223-234. https://doi.org/10.1108/ITSE-07-2014-0021

Rucci, J.A., & Tomporowski, P.D. (2010). Three types of kinematic feedback and the execution of the hang power clean. *Journal of Strength and Conditioning Research, 24*(3), 771-778. https://doi.org/10.1519/JSC.0b013e3181cbab96

Sain, D. (2022). *The Use of Video Analysis to Improve Performance* [Doctor of Education Dissertations 108, Gardner-Webb University]. Digital Commons@Gardner-Webb University https://digitalcommons.gardner-webb.edu/education-dissertations/108

Schärer, C., Huber, S., Bucher, P., Capelli, C., & Hübner, K. (2021). Maximum strength benchmarks for difficult static elements on rings in male elite gymnastics. *Sports (Basel), 9*(6), 78. https://doi.org/10.3390/sports9060078

Schulz, D., & Gaudreault, K. (2023). GoReact: Video annotation software to foster feedback in physical education instruction. *Strategies, 36*(3), 8-13. https://doi.org/10.1080/08924562.2023.2195453

Shih, H.C. (2018). A survey of content-Aware video analysis for sports. *IEEE Transactions on Circuits and Systems for Video Technology, 28*(5), 1212-1231. https://doi.org/10.1109/tcsvt.2017.2655624

Shorey, S., Chan, V., Rajendran, P., & Ang, E. (2021). Learning styles, preferences and needs of generation Z healthcare students: Scoping review. *Nurse Education in Practice, 57*, 103247. https://doi.org/10.1016/j.nepr.2021.103247

Shrestha, S., Sentosatio, W., Peng, H., Fermuller, C., & Aloimonos, Y. (2023). FEVA: Fast Event Video Annotation tool. *arXiv preprint arXiv:2301.00482*. https://doi.org/10.48550/arxiv.2301.00482

Shultz, R., Anderson, S.C., Matheson, G.O., Marcello, B., & Besier, T. (2013). Test-retest and interrater reliability of the functional movement screen. *Journal of Athletic Training, 48*(3), 331-336. https://doi.org/10.4085/1062-6050-48.2.11

Siliconcoach. (n.d.). *Siliconcoach Pro: Analyse performance in detail*. https://www.siliconcoach.com/siliconcoachPro

Soto, A., Camerino, O., Iglesias, X., Anguera, M.T., & Castañer, M. (2019). LINCE PLUS: Research software for behavior video analysis. *Apunts. Educación Física y Deportes, 3*(137), 149-153. https://doi.org/10.5672/apunts.2014-0983.es.(2019/3).137.11

Soto-Fernández, A., Camerino, O., Iglesias, X., Anguera, M.T., & Castañer, M. (2021). LINCE PLUS software for systematic observational studies in sports and health. *Behavior Research Methods*, 1-9. https://doi.org/10.3758/s13428-021-01642-1

Souissi, H., Souissi, M.A., Trabelsi, O., Ben Chikha, A., Gharbi, A., & Souissi, N. (2023). Peer-to-peer online video feedback with pedagogical activity improves the snatch learning during the COVID-19-induced confinement in young weightlifting athletes. *International journal of Sports Science & Coaching, 18*(6), 2151-2159. https://doi.org/10.1177/17479541221122385

Souissi, M.A., Ammar, A., Trabelsi, O., Glenn, J.M., Boukhris, O., Trabelsi, K., Bouaziz, B., Zmijewski, P., Souissi, H., Chikha, A.B., Driss, T., Chtourou, H., Hoekelmann, A., & Souissi, N. (2021). Distance motor learning during the covid-19 induced confinement: Video feedback with a pedagogical activity improves the snatch technique in young athletes. *International journal of Environmental Research and Public Health, 18*(6), 1-13. https://doi.org/10.3390/ijerph18063069

SparkMotion. (2025, January 8). *Motion Analysis for your business has never been so easy*. https://sparkmotion.com/

Ste-Marie, D.M., Carter, M.J., Law, B., Vertes, K., & Smith, V. (2016). Self-controlled learning benefits: exploring contributions of self-efficacy and intrinsic motivation via path analysis. *Journal of Sports Sciences, 34*(17), 1650-1656. https://doi.org/10.1080/02640414.2015.1130236

Ste-Marie, D.M., Vertes, K.A., Law, B., & Rymal, A.M. (2012). Learner-controlled self-observation is advantageous for motor skill acquisition. *Frontiers in Psychology, 3*, 556. https://doi.org/10.3389/fpsyg.2012.00556

Tay, D.L., Ellington, L., Towsley, G.L., Supiano, K., & Berg, C.A. (2021). Emotional expression in conversations about advance care planning among older adult home health patients and their caregivers. *Patient Education and Counseling, 104*(9), 2232-2239. https://doi.org/10.1016/j.pec.2021.02.029

Tayech, A., Mejri, M.A., Makhlouf, I., Uthoff, A., Hambli, M., Behm, D.G., & Chaouachi, A. (2022). Reliability, criterion-concurrent validity, and construct-discriminant validity of a head-marking version of the taekwondo anaerobic intermittent kick test. *Biology of Sport, 39*(4), 951-963. https://doi.org/10.5114/biolsport.2022.109459

Tricco, A.C., Lillie, E., Zarin, W., O'Brien, K.K., Colquhoun, H., Levac, D., Moher, D., Peters, M.D.J., Horsley, T., Weeks, L., Hempel, S., Akl, E.A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M.G., Garritty, C., … Straus, S.E. (2018). PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine, 169*(7), 467-473. https://doi.org/10.7326/m18-0850

Vermeulen, M. (2019). *Stappenplannen. Technische verpleegkundige verstrekkingen* (12th ed.). Bohn Stafleu Van Loghum.

Walker, S.G., Mattson, S.L., & Sellers, T.P. (2020). Increasing accuracy of rock-climbing techniques in novice athletes using expert modeling and video feedback. *Journal of Applied Behavior Analysis, 53*(4), 2260-2270. https://doi.org/10.1002/jaba.694

White, E.J., McMahon, M., Walsh, M.T., Coffey, J.C., & O'Sullivan, L.W. (2019). A study of laparoscopic instrument use during colorectal surgery. *Applied Ergonomics, 78*, 301-308. https://doi.org/10.1016/j.apergo.2018.02.010

Yang, K., Jin, X., Wang, Z., Fang, Y., Li, Z., Yang, Z., Cong, J., Yang, Y., Huang, Y., & Wang, L. (2022). Robot-assisted subretinal injection system: development and preliminary verification. *BMC Ophthalmology, 22*(1), 484-484. https://doi.org/10.1186/s12886-022-02720-4

Zimmerman, P.H., Bolhuis, J.E., Willemsen, A., Meyer, E.S., & Noldus, L.P.J.J. (2009). The Observer XT: A tool for the integration and synchronization of multimodal signals. *Behavior Research Methods, 41*(3), 731-735. https://doi.org/10.3758/brm.41.3.731

APPENDIX

Appendix I: Inclusion and exclusion criteria.

	Description	Inclusion criteria	Exclusion criteria
Participants	Participants in included studies receive feedback on their execution of psychomotor performance.	• focus on psychomotor learning domain • persons executing a movement-oriented performance	• focus on cognitive and affective learning domain, such as feedback on communication skills or knowledge • persons executing other than movement-oriented performances
Concept	Studies that explore features of VATs capable of generating isochronic, spatial, and structured annotations on videos of psychomotor performances. Information on availability, accessibility, financial feasibility, and customizability of these tools will also be collected.	VAT • makes annotations on videos of movement-orientated performances • is available • is accessible • is customizable	VAT • has focus on cognitive and affective learning domain • for machine learning algorithm or automated image annotation • for real-time video analytics, such as wearable sensors, or trackers • for measurements on medical images such as MRI • is no longer available • is not customizable
Context	Studies that apply VATs in contexts transferable to health professional education will be included. Given that PNS involve physical, movement-oriented performances, and considering the extensive use of VAT in sports sciences, a broader scope on VATs applications will be adopted for inspiration. Focusing initially on the psychomotor aspects of a new PNS is a powerful learning strategy, fostering students' progression from novice to expert. Video footage, paired with concrete feedback on a context-free PNS, will enhance and	Use of a VAT in health professional education to provide feedback to enhance performance of PNS in students in their novice learning phase.	• feedback on performances related to cognitive or attitude learning domain • feedback related to simulation-based skills or critical reasoning

	accelerate students' mastery of task performances.		
Type of sources	Primary research and additionally, systematic reviews, meta-analyses, text and opinion papers, guidelines, and conference proceedings will be considered for inclusion. Articles must be available in full text and published in Dutch, English, French, or German. No restrictions on the publication date will be applied.	• information in Dutch, English, French and German • primary research studies • systematic reviews • meta-analyses • text and opinion papers • guidelines • conference proceedings	• information in language other than Dutch, English, French and German • no full text available • abstract conferences

Appendix II: Search Strings and hits.

Database	String	Hits (dated 5/2/2024)
PubMed	#1: (("Videotape Recording"[Mesh] OR "video annotat*"[tiab] OR "annotated video"[tiab:~2] OR "annotation video"[tiab:~2] OR "annotated videos"[tiab:~2] OR "annotation videos"[tiab:~2] OR "annotations video"[tiab:~2] OR "annotations videos"[tiab:~2] OR "video analys*"[tiab]) AND ("Knowledge of Results, Psychological"[Mesh] OR "Formative Feedback"[Mesh] OR "Peer Review"[Mesh] OR ("Learning"[Mesh:NoExp] AND "2010:2015"[mhda]) OR feedback[tiab])) AND ("Psychomotor Performance"[Mesh] OR "Athletic Performance"[Mesh] OR "Physical Functional Performance"[Mesh] OR "Psychomotor Performance"[tiab] OR "Athletic Performance"[tiab] OR "motor performance"[tiab] OR "psychomotor coordination"[tiab] OR "motor coordination"[tiab] OR "physical performance"[tiab] OR "motor skill*"[tiab] OR "task performance"[tiab])	46
	#2: ((("Videotape Recording"[Mesh] OR "video annotat*"[tiab] OR "annotated video"[tiab:~2] OR "annotation video"[tiab:~2] OR "annotated videos"[tiab:~2] OR "annotation videos"[tiab:~2] OR "annotations video"[tiab:~2] OR "annotations videos"[tiab:~2] OR "video analys*"[tiab]) AND ("Knowledge of Results, Psychological"[Mesh] OR "Formative Feedback"[Mesh] OR "Peer Review"[Mesh] OR ("Learning"[Mesh:NoExp] AND "2010:2015"[mhda]) OR “feedback”[tiab])) OR ("video feedback"[tiab])) AND ("Psychomotor Performance"[Mesh] OR "Athletic Performance"[Mesh] OR "Physical Functional Performance"[Mesh] OR "Psychomotor Performance"[tiab] OR "Athletic Performance"[tiab] OR "motor performance"[tiab] OR "psychomotor coordination"[tiab] OR "motor coordination"[tiab] OR "physical performance"[tiab] OR "motor skill*"[tiab] OR "task performance"[tiab])	87
	#3 (("Videotape Recording"[Mesh] OR "video annotat*"[tiab] OR "annotated video"[tiab:~2] OR "annotation video"[tiab:~2] OR "annotated videos"[tiab:~2] OR "annotation videos"[tiab:~2] OR "annotations video"[tiab:~2] OR "annotations videos"[tiab:~2] OR "video analys*"[tiab]) AND ("Knowledge of Results, Psychological"[Mesh] OR "Formative Feedback"[Mesh] OR “Formative Feedback” [tiab] OR "Peer Review"[Mesh] OR “Peer Review”[tiab] OR ("Learning"[Mesh:NoExp] AND "2010:2015"[mhda]) OR “feedback”[tiab] OR "Self Efficacy"[Mesh] OR "Self Efficacy"[tiab])) AND ("Psychomotor Performance"[Mesh] OR "Athletic Performance"[Mesh] OR "Physical Functional Performance"[Mesh] OR "Psychomotor Performance"[tiab] OR "Athletic Performance"[tiab] OR "motor performance"[tiab] OR "psychomotor coordination"[tiab] OR "motor coordination"[tiab] OR "physical performance"[tiab] OR "motor skill*"[tiab] OR "task performance"[tiab])	51
Web of Science	#1 (("video annotation" OR "video annotation software" OR "video annotation*" OR "video analysis*") AND ("feedback" OR "learning" OR "training" OR "professional development" OR "video assisted learning" OR "coaching") AND ("Psychomotor Performance" OR "psychomotor skill" OR "motor skill" OR "nursing skill" OR "sport performance"))	22
	#2 ((ALL=("performance")) OR ALL=("motor skill")) AND ALL=("video annotat*")	224

CINAHL	#1 TX "skill performance" AND TX "video feedback"	5
	#2 TX “video analysis” AND TX feedback AND TX performance	62
Scopus	#1 TITLE-ABS-KEY ("skill performance") AND TITLE-ABS-KEY ("video feedback")	8
	#2 TITLE-ABS-KEY ("video annotation") AND TITLE-ABS-KEY ("performance") AND TITLE-ABS-KEY ("feedback")	20
EuropePMC	#1 "skill performance" AND "video feedback"	43
	#2 "video analysis software" AND feedback AND performance	102
CENTRAL via Cochrane Library	#1 "skill performance" AND "video feedback"	1
	#2 "video annotation" AND "performance" AND "feedback"	1
ERIC	#1 "Video Technology" AND "psychomotor skill" AND "Feedback (Response)"	16
	#2 "Video Technology" AND "psychomotor skill" AND Coaching (Performance)	4
FiS Bildung	#1 ((((((((Subject: "VIDEO ANALYSIS SOFTWARE") or (Subject: "VIDEO ANNOTATION TOOLS")) or (Subject: "VIDEO ANALYSIS")) or (Subject: "VIDEO ANNOTATION")) and (Subject: "SKILL ACQUISITION")) or (Subject: "SKILL TRAINING")) or (Subject: "SKILL DEVELOPMENT")) and (Subject: FEEDBACK)) or (Subject: "FEED FORWARD")	229
SportDiscus	#1 TX "skill performance" AND TX "video feedback"	4
	#2 TX “video analysis” AND TX feedback AND TX performance	24
IEEE	#1 ("Full Text & Metadata":"skill performance") AND ("Full Text & Metadata":"video feedback")	6
	#2 ("Full Text & Metadata":"video analysis") AND ("Full Text & Metadata":feedback) AND ("Full Text & Metadata":"skill performance")	4
ACM digital library	#1 [All: "skill performance"] AND [All: "video feedback"]	2
	#2 [All: "video analysis"] AND [All: "feedback"] AND [All: "motor skill"]	38