Aus dem Institut für Tierschutz, Tierverhalten und Versuchstierkunde

des Fachbereichs Veterinärmedizin

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Zielgruppenorientierte E-Learning Schulung zur Verbesserung des Tierschutzes bei Transport und Schlachtung von Rindern

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COVID-19   Coronavirus disease 2019

EFSA   European Food Safety Authority

EU   Europäische Union

EUAW   European Union Animal Welfare

et al.   et alia

Ggf.   gegebenfalls

TierSchG   Tierschutzgesetz

TierSchlV   Tierschutz-Schlachtverordnung

TierSchTrV   Tierschutztransportverordnung

TSB   Tierschutzbeauftragte

VO   Verordnung

z. B.   zum Beispiel

Definitionen

Amtliche Tierärzt:innen	von staatlichen Behörden beauftragt, die Gesundheit von Tieren zu überwachen und sicherzustellen
Ante mortem	vor dem Tod
Bias	Abweichung/ Verzerrung
Cortisol	Stresshormon
Effektiv	wirkungsvoll
E-Learning	Onlinelehre
E-Treiber	elektrische Treibhilfe, welche durch direkte Stromeinwirkung am Tier, dieses zum vorwärtslaufen animieren soll
Evaluation	Bewertung, Beurteilung
Feedback	Rückmeldung
Implementierung	Umsetzung
Interaktiv	Austausch von Informationen zwischen Benutzern und einem System
Kontinuität	Bestehen oder Fortsetzung über einen längeren Zeitraum
Lebendviehbereich	Einrichtung im Schlachtbetrieb, indem lebende Tiere gehalten und betreut werden
Limitation	Begrenzung, Beschränkung
Lockdown	Maßnahme, bei der die Bewegungsfreiheit von Personen oder Aktivitäten in einer Region eingeschränkt wird

Definitionen

Modul	eigenständige Einheit oder Komponente, die in ein größeres System oder Programm integriert ist
Multiple-Choice-Fragen	Fragenart mit einer Mehrfachauswahl der Antwortmöglichkeiten
Obligatorisch	erforderlich oder verpflichtend
Pädagogisch	erziehungswissenschaftlich
Pandemie	Ausbreitung einer Krankheit, die auf verschiedene Länder oder Kontinente übergreift
Post mortem	nach dem Tode
Post-Test	Test, zur Ermittlung des Wissensstandes eines Lernenden, nachdem eine Schulung durchgeführt wurde
Prä-Test	Test, zur Ermittlung des Wissensstandes eines Lernenden, bevor eine Schulung durchgeführt wird
Präventiv	Maßnahmen, die darauf abzielen, Schäden zu verhindern, bevor sie auftreten
Sachkunde	Wissen und Fähigkeiten, die erforderlich sind, um eine bestimmte Aufgabe sachgerecht auszuführen
Signifikant	statistische Bezeichnung für Ergebnisse, die wahrscheinlich nicht zufällig sind und auf eine tatsächliche Beziehung hinweisen
Single-Choice-Frage	Fragenart, bei der aus einer Liste von Antwortmöglichkeiten nur eine richtige Antwort ausgewählt werden darf
Subjektiv	Basierend auf persönlichen Meinungen, Gefühlen oder Interpretationen

Definitionen

systematisches Review	Übersichtsarbeit, die auf einer Auswahl und Auswertung von Studien aufbaut
Tierschutzbeauftragte	Person, die in Organisationen oder Betrieben für die Einhaltung von Tierschutzstandards verantwortlich ist
Transportfähigkeit	Gesundheitszustandes eines Tieres, in dem es möglich ist, es zu transportieren
Wissenstandsanalyse	Bewertung des vorhandenen Wissens von Personen, um z. B. Bildungsbedürfnisse zu identifizieren
Transfer	Prozess des Übertragens von Wissen, Fähigkeiten oder Ressourcen von einer Situation auf eine andere

1. Einleitung

Tierschutz ist ein bedeutendes und sich entwickelndes Thema in der aktuellen öffentlichen Debatte, dass die sich verändernden Werte und Wahrnehmung von Tieren in der westlichen Gesellschaft widerspiegelt (Gottwald 2004, Deutscher Ethikrat 2020). Da ethische Anliegen im Umgang mit Tieren verstärkt im sozialen Diskurs Beachtung finden, werden die Werte der Gesellschaft auch durch gesetzliche Maßnahmen ausgedrückt, wie zum Beispiel die Aufnahme des Tierschutzes in das deutsche Grundgesetz im Jahr 2002 (Deimel et al. 2010, Dirscherl 2013). Es entwickelt sich eine zunehmende Aufmerksamkeit über den Umgang mit Tieren in der heutigen Nutztierhaltung und der daraus resultierenden Produktion von tierischen Lebensmitteln, was zu Forderungen nach artgerechter Haltung und Schlachtung führt (Zühlsdorf et al. 2016). Ein Fokus der Debatte liegt auf Tierschutzfragen während des Transports und der Schlachtung (Deutscher Ethikrat 2020, EFSA 2020). Der Umgang mit den Tieren während des Transportes und der Schlachtung wird genau unter die Lupe genommen, wobei ein besonderer Schwerpunkt auf den Prozessen liegt, welche Leiden bei den Tieren verursachen können (Deutscher Ethikrat 2020). Die Bundestierärztekammer bestätigt Defizite im Tierschutz während verschiedener Schritte des Schlachtprozesses, von der Entladung bis zum Ausbluten, unabhängig von der Größe des Schlachtbetriebes (Tiedemann 2021).

Das Verhalten der in Schlachtbetrieben arbeitenden Mitarbeiter:innen spielt eine entscheidende Rolle für den Tierschutz, da ihre Handlungen sich auf das Wohlergehen der Tiere auswirken können (Hultgren et al. 2014). Die Europäische Behörde für Lebensmittelsicherheit hat verschiedene Risiken für das Wohlbefinden von Rindern während der Schlachtung identifiziert und charakterisiert, von denen die meisten auf menschliches Handeln, verursacht durch fehlende Fähigkeiten oder Ermüdung zurückzuführen sind (EFSA 2020). Daher ist eine angemessene Schulung der Schlachthofmitarbeiter:innen unerlässlich, um den Tierschutz im Lebendviehbereich und während des Betäubens sicherzustellen (Iulietto et al. 2018, Deutscher Ethikrat 2020). Um Tierschutzstandards während des Transports und der Schlachtung anzugehen, gibt es nationale und europäische Vorschriften, Gesetze und Verordnungen, die die allgemeinen Anforderungen zum Schutz der Tiere festlegen.

Das Ziel der vorliegenden Studie war es, den aktuellen Stand der wissenschaftlichen Literatur zum Thema Tierschutz bei Schlachtung und Transport von Rindern zusammenzufassen, darauf basierend zwei E-Learning Module zu erstellen und den Wissenstand von Mitarbeiter:innen in Rinderschlachtbetrieben vor und nach ihrer

Einleitung

Teilnahme an den E-Learning-Modulen zu analysieren und die Konzeption dieser Module und Implementierung von Tierschutzbeauftragten/ amtlichen Tierärzt:innen testen und bewerten zu lassen.

2. Literaturübersicht

2.1 Tierschutz bei Transport und Schlachtung in Europa

Die Mensch-Tier-Beziehung hat sich im Laufe der Geschichte stark verändert. Ursprünglich wurden Tiere oft als Ressourcen für Nahrung, Kleidung und Arbeit betrachtet (Knight 2000). Mit dem Aufkommen eines wachsenden Bewusstseins für das Leiden von Tieren und dessen Betrachtung hinsichtlich Ethik und Moral entwickelte sich der Tierschutz in Europa (Knight 2000).

In der Antike waren Regelungen zum Tierschutz noch nicht etabliert und Tiere wurden oft Opfer von rituellen Zeremonien (Gladigow 2008). Im Mittelalter begannen einige religiöse Bewegungen, sich für den Tierschutz einzusetzen, und erste Vorschriften für einen schonenden Umgang mit Tieren wurden erlassen (Führer 2011).

Die Zeit der Aufklärung brachte einen Wandel im Umgang mit Tieren mit sich. Philosophen wie Immanuel Kant betonten die Bedeutung der moralischen Verantwortung gegenüber Tieren (Gerber 2004). Mit der Industrialisierung und mit dem Wachstum der städtischen Bevölkerung entstanden erste Tierschutzvereine, die sich für das Wohl von Nutz- und Arbeitstieren einsetzten (Schlenker 2022).

Das 19. Jahrhundert war eine wichtige Zeit für die Entwicklung des organisierten Tierschutzes. In Großbritannien gründete sich im Jahr 1824 die Royal Society for the Prevention of Cruelty to Animals (RSPCA) und setzte sich für die Durchsetzung von Tierschutzgesetzen ein (Schlenker 2022). Dies hatte einen dominoartigen Effekt auf andere europäische Länder, in denen daraufhin ähnliche Organisationen gegründet wurden (Schlenker 2022).

Im 20. Jahrhundert gewann der Tierschutz weiter an Bedeutung. Die sich weiterentwickelnde wissenschaftliche Forschung über das Verhalten und der Leidensfähigkeit von Tieren stärkten die Argumente für den Schutz von Tieren (Balluch 2021). Um den Tierschutz zu fördern wurden internationale Vereinbarungen wie das Bündnis über die biologische Vielfalt (Convention on Biological Diversity) und das Europäische Übereinkommen zum Schutz von Tieren in landwirtschaftlichen Betrieben (Sammlung Europäischer Verträge Nr. 87) verabschiedet (Marschall et al. 2008).

Die Europäische Union hat eine Reihe von Rechtsvorschriften erlassen, um den Tierschutz in Bezug auf die Schlachtung und den Tiertransport zu regeln. Die Verordnung (EG) Nr. 1099/2009 über den Schutz der Tiere zum Zeitpunkt der Tötung legt Standards für die Behandlung von Tieren vor und während der Schlachtung fest. Sie betont die Notwendigkeit, Schmerzen, Leiden und Stress für die Tiere zu minimieren. Ebenso regelt die Verordnung (EG) Nr. 1/2005 den Schutz von Tieren während des Transports und legt

Anforderungen an Transportbedingungen, Ruhezeiten und Futter- bzw. Wasserversorgung fest. Auf nationaler Ebene werden die europäischen Verordnungen nochmals konkretisiert. Das deutsche Tierschutzgesetzes legt fest, dass Tiere vor der Schlachtung fachgerecht betäubt oder getötet werden müssen, um Schmerzen und Leid zu minimieren (TierSchG 2006). Zudem werden Anforderungen an die Qualifikationen, sowie die Einhaltung bestimmter Verhaltensregeln der Schlachthofmitarbeiter:innen und der amtlichen Tierärzt:innen festgelegt, um den Tierschutz bei der Schlachtung zu gewährleisten (TierSchG 2006, TierSchlV 2012). Regelungen, wie z. B. die Registrierung von Transportunternehmen, die maximale Transportdauer, die Transportfähigkeit und die Versorgung der Tiere während des Transportes werden in den Tierschutz-Transportverordnung näher beschrieben (TierSchTrV 2009).

Zur weiteren Verbesserung des Tierschutzes bei der Schlachtung und während des Tiertransports haben verschiedene Zertifizierungsprogramme an Bedeutung gewonnen. Das Label "Für Mehr Tierschutz" vom Deutschen Tierschutzbund ist beispielsweise ein solches Programm, welches strengere Tierschutzstandards festlegt als die gesetzlichen Mindestanforderungen. Es konzentriert sich auf die Haltung und Transportdauer zum Schlachtbetrieb und fördert einen tierschutzkonformen Umgang mit Tieren, um deren Wohlergehen sicherzustellen (Deutscher Tierschutzbund 2023).

2.2 Zielgruppen

2.2.1 Tiertransporteur:innen

In der Europäischen Union sind Tiertransportunternehmen verpflichtet, sich gemäß der Verordnung (EG) Nr. 1/2005 über den Schutz von Tieren beim Transport zu registrieren (Europäische Kommission 2005). Diese Verordnung legt detaillierte Anforderungen für den Transport von Tieren fest, um sicherzustellen, dass ihr Wohl während des Transports gewährleistet ist. Die Verordnung enthält Bestimmungen zur Beförderung von Tieren, einschließlich Vorschriften für die Sachkunde der beteiligten Personen (Europäische Kommission 2005). Sachkundige Personen müssen über das notwendige Wissen und die Fähigkeiten verfügen, um sicherzustellen, dass die Tiere während des Transports angemessen versorgt und behandelt werden (Europäische Kommission 2005, TierSchTrV 2009). Die Sachkundeprüfung für Tiertransporteur:innen dient nicht nur dem Schutz der Tiere, sondern auch der Einhaltung der geltenden Rechtsvorschriften. Verstöße gegen die Transportvorschriften können zu rechtlichen Konsequenzen und schweren Strafen führen (Europäische Kommission 2005, TierSchTrV 2009).

Obwohl die Transporteur:innen für den Tierschutz in der Logistikkette vor der Schlachtung von zentraler Bedeutung sind und rechtlich verantwortlich sind, gibt es nur wenige Erkenntnisse über den tatsächlichen Kenntnisstand dieser Berufsgruppe (Miranda-de la Lama et al. 2010). Tiertransporteur:innen müssen z. B. die Bewertung der Transportfähigkeit der zu transportierenden Tiere vornehmen. Vor dem Verladen müssen sie sicherstellen, dass die Tiere gesund sind, keine offensichtlichen Verletzungen oder Krankheiten aufweisen und ausreichend Platz im Tiertransporter haben (TierSchTrV 2009). Während des Transports müssen Tiertransporteur:innen auf das Verhalten und den Zustand der Tiere achten, um Anzeichen von Stress oder gesundheitlichen Problemen frühzeitig erkennen zu können (TierSchTrV 2009). Tiertransporteur:innen sind somit verantwortlich für die Obhut der zu transportierenden Tiere. Bei jeglichen Bedenken oder Problemen während des Transports sind sie dazu verpflichtet, entsprechende Maßnahmen zu ergreifen, einschließlich des Abbruchs des Transports, falls die Transportfähigkeit der Tiere nicht gewährleistet werden kann (TierSchTrV 2009). González et al. (2012) beschreiben, dass die Erfahrungen der Transporteur:innen den Gewichtsverlust während der Fahrt und den Anteil der verletzen Rinder bei Ankunft im Schlachtbetrieb beeinflussen. Die EFSA gab an, dass der Umgang mit Rindern beim Auf- und Abladen ein wichtiger Faktor in Bezug auf den Transportstress ist (European Food Safety Authority 2020). Transporteur:innen haben somit einen großen Einfluss auf die Angstreaktionen und den Stress der zu transportierenden Rinder. Aus diesem Grund, sollten die Tiere von geschultem Personal transportiert werden, um ein reibungsloses und tierschutzkonformes Ver- und Entladen zu ermöglichen (EFSA 2020). Transporteur:innen sollten sich der Bedürfnisse, Wahrnehmungen und Empfindungen von Tieren bewusst sein und ihren Umgang mit den Tieren danach ausrichten (Budzik und Budzik 2019).

2.2.2 Schlachthofmitarbeiter:innen

Der schonende Umgang mit den Tieren bei der Schlachtung hat einen großen Einfluss auf deren Wohlergehen. In der zitierten Stellungnahme der EFSA ist beschrieben, dass die Hauptgefährdungen bezüglich des Tierwohls im Zusammenhang mit mangelnder Qualifikation bzw. Ausbildung des Personals und daraus resultierend unsachgemäßer Handhabung stehen (European Food Safety Authority 2020). Das Tierschutzgremium der EFSA betrachtet mangelnde Fähigkeiten oder fehlende Ausbildung des Personals als ernsthaftes Tierschutzproblem (European Food Safety Authority 2020).

Die Arbeitskräfte in der deutschen Fleischindustrie sind sowohl deutsche Staatsangehörige als auch Eingewanderte aus verschiedenen kulturellen Hintergründen.

Literaturübersicht

Historisch betrachtet, waren Eingewanderte aus osteuropäischen Ländern wie Polen und Rumänien aufgrund von wirtschaftlicher Migration als Schlachthofmitarbeiter:innen weit verbreitet (Eurofound 2015). Isbrandt et al. (2022) beschreiben, dass in großen deutschsprachigen Schlachtbetrieben ca. 50.0% der Mitarbeiter:innen Deutsch wenig bis gar nicht verstehen. Die angegebenen Herkunftsländer der Mitarbeiter:innen waren vorwiegend Deutschland, gefolgt von Rumänien, Polen, Ungarn und Bulgarien (Isbrandt et al. 2022).

Die Bildungsanforderungen für beschäftigte Schlachthofmitarbeiter:innen können variieren. Während einige Arbeitsbereiche nur eine minimale formale Bildung erfordern, können andere Arbeitsbereiche spezialisierte Schulungen und Zertifizierungen verlangen, insbesondere im Zusammenhang mit Tierschutz, Lebensmittelsicherheit und dem Umgang mit Maschinen (EFSA 2020). Die Länderarbeitsgemeinschaft Verbraucherschutz (LAV) hat in ihrem „Handbuch Tierschutzüberwachung bei der Schlachtung und Tötung" von 2019, Standardarbeitsanweisungen für den Lebendviehbereich definiert. Schlachthofmitarbeiter:innen sind im Anlieferungsbereich für die Entladung der Tiere verantwortlich. Sie müssen die Identifikation durchführen und sicherstellen, dass die Tiere schonend entladen werden und verletzte Tiere ggf. separieren (Länderarbeitsgemeinschaft Verbraucherschutz 2019). Die Identifizierung und Dokumentation der Tiere ist entscheidend für die Rückverfolgbarkeit und die Einhaltung von Vorschriften (Länderarbeitsgemeinschaft Verbraucherschutz 2019). Nach dem Entladen müssen die Tiere angemessen untergebracht werden, um Verletzungen zu minimieren (Länderarbeitsgemeinschaft Verbraucherschutz 2019). Das Treiben der Tiere in den Wartestall oder zur Betäubung erfordert auf Seiten der Schlachthofmitarbeiter:innen Geduld und Ruhe, um Stress bei den Tieren zu vermeiden (Länderarbeitsgemeinschaft Verbraucherschutz 2019). Bei der Fixierung in der Betäubungsfalle, muss das Personal sicherstellen, dass die Tiere unverzüglich nach Zutrieb betäubt werden, die Betäubungswirkung kontrolliert wird und ggf. umgehend eine Nachbetäubung durchgeführt werden muss (Länderarbeitsgemeinschaft Verbraucherschutz 2019). Im Arbeitsbereich der Entblutung müssen die Schlachthofmitarbeiter:innen das maximale Zeitintervall zwischen Betäubung und Entblutungsschnitt einhalten und Maßnahmen treffen, wenn es zu Abweichungen kommen sollte (Länderarbeitsgemeinschaft Verbraucherschutz 2019). In den genannten Arbeitsbereichen müssen laut der Länderarbeitsgemeinschaft Verbraucherschutz (2019) „Personen, die Tiere betreuen, ruhigstellen, betäuben, schlachten oder töten, gemäß Art. 7 und Art. 21 der Verordnung (EG) Nr. 1099/2009 und nach § 4 Tierschutz- Schlachtverordnung (TierSchlV) vom 20. Dezember 2012 die hierfür notwendigen Kenntnisse und Fähigkeiten (Sachkunde) haben und in angemessener Weise geschult oder qualifiziert sein."

2.2.3 Tierschutzbeauftragte am Schlachthof

Die Verantwortlichkeiten von Tierschutzbeauftragten ist in den letzten Jahren zunehmend bedeutsamer geworden (Zühlsdorf et al. 2016).

In Deutschland werden Tierschutzbeauftragte gemäß gesetzlichen Vorschriften ernannt, um die Einhaltung der Tierschutzbestimmungen in verschiedenen Bereichen zu überwachen (TierSchG 2006, Europäische Kommission 2015). Die Hauptaufgaben der Tierschutzbeauftragten in Schlachtbetrieben umfasst die Kontrolle der Tiere bei Anlieferung, die Sicherstellung der Einhaltung von Vorschriften in Bezug auf Betäubung und Schlachtung sowie die Überwachung des allgemeinen Wohlergehens der Tiere (TierSchG 2006, Europäische Kommission 2009). Ihre Ernennung zielt darauf ab, eine unabhängige und wachsame Präsenz zu gewährleisten, um Tiere vor unnötigem Leiden und Schäden zu schützen (Europäische Kommission 2015). Sie spielen eine wichtige Rolle bei der Einhaltung von Gesetzen und bei der Sicherstellung, dass die Tiere vor der Schlachtung schonend behandelt werden, angemessen untergebracht bzw. versorgt und ordnungsgemäß betäubt werden (Europäische Kommission 2009). Durch ihre kontinuierliche Überwachung und ihrer beratenen Funktion tragen sie dazu bei, hohe Standards im Tierschutz aufrechtzuerhalten und Verstöße zu minimieren (TierSchG 2006, Europäische Kommission 2015).

Eine weitere Aufgabe der Tierschutzbeauftragten besteht darin, Mitarbeiter:innen, die im Lebendviehbereich arbeiten, zu schulen und fortzubilden (Europäische Kommission 2015). Sie sollen Wissen vermitteln und das Verständnis für das Verhalten und die Bedürfnisse der Tiere fördern, um so zu einer besseren Behandlung und einem geringeren Stressniveau beizutragen (Europäische Kommission 2015).

2.2.4 Amtliche Tierärzt:innen

Amtliche Tierärzt:innen spielen eine entscheidende Rolle bei der Erhaltung der Tiergesundheit und des Wohlergehens der Tiere während des Transportes und am Schlachtbetrieb.

Beim Tiertransport besteht die Hauptaufgabe der amtlichen Tierärzt:innen darin, den Gesundheitszustand der am Schlachtbetrieb ankommenden Tiere zu überprüfen und die Transportfähigkeit sicherzustellen (Europäische Kommission 2005, TierSchTrV 2009). Zu den weiteren Aufgaben gehört die Inspektion der Transportfahrzeuge, um sicherzustellen,

dass sie den gesetzlichen Tierschutzstandards entsprechen, wie ausreichende Belüftung, genügend Platz, Schutz vor widrigen Wetterbedingungen und dem Zugang zu Wasser (Europäische Kommission 2005). Sie bewerten den Gesundheitszustand der Tiere vor dem Verladen und während des Transportes und greifen bei Verletzungen, Krankheiten oder Anzeichen von Stress ein. Darüber hinaus gewährleisten amtliche Tierärzt:innen durch stichpunktartige Kontrollen, dass die Transportunternehmen die Vorschriften bezüglich der Transportdauer, der Ruhezeiten sowie der Bereitstellung von Wasser und Futter einhalten (Europäische Kommission 2005, TierSchTrV 2009).

Am Schlachtbetrieb bestehen die Aufgaben von amtlichen Tierärzt:innen darin, die Einhaltung der Tierschutzvorschriften und die ordnungsgemäße Umsetzung der Betäubung und Schlachtung sicherzustellen (Europäische Kommission 2004). Sie führen ante mortem Untersuchungen durch, um die Eignung der Tiere für die Schlachtung zu bewerten, und post mortem Untersuchungen, um Anzeichen von Erkrankungen oder Abnormalitäten zu erkennen (Europäische Kommission 2004). Darüber hinaus überprüfen sie, ob der Schlachtablauf den gesetzlichen Anforderungen und tierschutzkonformen Praktiken der Branche entsprechen. Ihre Interventionen sind entscheidend, um den Verzehr von Fleisch von kranken oder ungeeigneten Tieren zu verhindern und damit die öffentliche Gesundheit zu schützen (Europäische Kommission 2004).

2.2.5 Schulungen zur Verbesserung des Tierschutzes

In Deutschland und der gesamten Europäischen Union gibt es vorgeschriebene Schulungen zur Verbesserung des Tierschutzes. Diese Schulungen sind in der Regel darauf ausgerichtet, Tiertransporteur:innen, Schlachthofmitarbeiter:innen, Tierärzt:innen und andere Beteiligte im Umgang mit Tieren zu schulen und die Einhaltung der Tierschutzbestimmungen zu gewährleisten (Europäische Kommission 2005, Europäische Kommission 2009, TierSchTrV 2009, TierSchlV 2012). In Deutschland müssen Tiertransporteur:innen gemäß der Tierschutz-Transportverordnung im Rahmen einer wirtschaftlichen Tätigkeit, die Befähigung für den Transport von Tieren nachweisen und hierfür eine Sachkundeprüfung ablegen (TierSchTrV 2009). Diese Sachkundeprüfung umfasst Kenntnisse zu rechtlichen Bestimmungen, Beurteilung der Transportfähigkeit, Notfallmaßnahmen, Arbeitsschutz bzw. -sicherheit und Verhaltensregeln im Umgang mit Tieren (TierSchTrV 2009).

Die Verordnung (EG) Nr. 1099/2009 schreibt vor, dass „für das Schlachten von Tieren durch Unternehmen ein Sachkundenachweis erforderlich ist, dies betrifft alle Tätigkeiten im Zusammenhang mit der Schlachtung" (Europäische Kommission 2009).

Schlachthofmitarbeiter:innen im Lebendviehbereich müssen diese Sachkunde nachweisen können und in Deutschland gemäß der Tierschutz-Schlachtverordnung und der Verordnung (EG) Nr. 1099/2009 geschult werden. Diese Schulung behandelt den tierschutzgerechten Umgang mit Tieren vor bzw. während der Schlachtung und ist in verschiedene Themenschwerpunkte (Handhabung und Pflege, Ruhigstellen, Betäuben, Entbluten und Einhängen bzw. Hochziehen) unterteilt (bsi Schwarzenbek 2009, Europäische Kommission 2009, TierSchlV 2012).

Sowohl verschiedene private und behördliche Organisationen, als auch Forschungseinrichtungen in Deutschland und Europa bieten Schulungen und Weiterbildungen für Transporteur:innen, Tierärzt:innen und Schlachthofmitarbeiter:innen an, um das Bewusstsein für Tierschutzfragen zu schärfen und bewährte Praktiken zu fördern.

2.3 E-Learning

Unter dem Begriff des E-Learnings versteht man eine digitale oder Computer basierte Wissensvermittlung (Brehmer und Becker 2017). E-Learning kann, als eine über das Internet angebotene und vorgegebene Lerneinheit verstanden werden, welche räumlich und zeitlich flexibel genutzt werden kann (Pilotto 2019).

Die Wurzeln des E-Learnings lassen sich auf frühe Experimente im Computer und Programm gestützten Lernen zurückführen. In den 1960er und 1970er Jahren entwickelten Forscher wie Pressey und Crowder computerbasierte Systeme für Bildungszwecke (Haslauer 2009). In den 1990er Jahren führte die Verbreitung des Internets zu einem signifikanten Wachstum des E-Learnings, da es die Bereitstellung von Bildungsinhalten und die Zusammenarbeit über räumliche Grenzen hinweg ermöglichte (Haslauer 2009). E-Learning-Programme sind ein wichtiger Bestandteil in der modernen Wissensvermittlung geworden (Pilotto 2019). Sie geben den Lernenden die Möglichkeit einen selbstbestimmten Lernprozess zu nutzen und sich das Wissen individuell anzueignen (Rosenberg 2001, Kraft 2003). Die COVID-19-Pandemie im Jahr 2020 unterstrich die Bedeutung des E-Learnings, als Schulen und Bildungseinrichtungen auf Fernunterricht umstellten, um die Kontinuität trotz Lockdowns und sozialer Distanzierung sicherzustellen (Hodges et al. 2020).

2.4 Evaluation von Lehrmaterialien

Literaturübersicht

Evaluation kommt aus dem lateinischen und bedeutet Bewerten (Pekrun 2000). Die Evaluation ist eine systematische Überprüfung von Resultaten oder Prozessen, mit dem Ziel diese weiter zu definieren und/oder zu optimieren (Maier und Brandl 2008). Dabei sollten laut Ritter (1993) vor Erstellung einer Evaluation folgende Fragen gestellt werden: Wer evaluiert? Was und wie soll evaluiert werden? Warum und wozu dienen die Ergebnisse der Evaluation? Durch diese Vorgehensweise kann systematisch ein passendes Evaluationsprofil entwickelt werden und die Bewertung eines Prozesses erfolgen (Pekrun 2000).

Im Bereich der Beurteilung von Aus- und Weiterbildungen dienen Evaluationen der Qualitätsüberprüfung von pädagogischen Kriterien, um die Eignung und Qualität von Bildungsmaßnahmen zu überprüfen oder ggf. zu steigern (Eigler et al. 1997, Gutknecht-Gmeiner et al. 2011).

Bei der Evaluation von Lehrmaterialien sollten Übereinstimmungen mit den vorgegebenen Lernzielen überprüft werden. Eine Übereinstimmung gewährleistet, dass den Lernenden das Wissen und die Fähigkeiten vermittelt werden, die für ihre Aus- oder Weiterbildung erforderlich sind (Gutknecht-Gmeiner et al. 2011). Lehrmaterialien sollten so gestaltet sein, dass die Aufmerksamkeit und das Interesse des Lernenden während der Schulung aufrechterhalten wird. Interaktive und gamifizierte Elemente, wie Quizfragen und Simulationen fördern die Motivation und unterstützen die aktive Beteiligung (AL-Smadi 2015, Orhan et al. 2023). Forschungsergebnisse vom AL-Smadi (2015) zeigen, dass solche Elemente ein tieferes Verständnis und eine bessere Verankerung des Wissens fördern können. Die Aktualität der Lerninhalte ist wichtig für die Glaubwürdigkeit einer Schulung. Verweise auf seriöse Quellen und aktuelle Forschungsergebnisse bieten den Lernenden verlässliche Informationen (Hake 1998). Veraltete oder fehlerhafter Lerninhalt können Lernende irritieren und ihren Lernfortschritt behindern (Hake 1998).

Ein freier Zugang zu Weiterbildungsangeboten sollte gewährleistet werden, damit alle Lernenden auf Lerninhalt zugreifen und davon profitieren können (Burgstahler und Cory 2008, Mitterer und Schön 2020). Onlineschulungen sollten kompatibel und so programmiert werden, dass die Lerninhalte möglichst mit verschiedenen Endgeräten genutzt werden können (Hermann-Ruess und Ott 2014).

Nach Staemmler (2006) sollten Lehrmaterialien unter Berücksichtigung von pädagogischen Prinzipien entwickelt werden und verschiedene Lernmethoden (aktives, konkretes, reflexives oder abstraktes Lernen) einbeziehen, um unterschiedliche Bildungsniveaus der Lernenden zu berücksichtigen. Dabei tragen eine klare Struktur und ein selbstbestimmtes Tempo zur allgemeinen pädagogischen Effektivität der Lehrmaterialien bei (Meyer 2003, Breil 2017).

Literaturübersicht

Die regelmäßige Bewertung von Lehrmaterialien durch Lernende und Lehrende ist ein wichtiger Prozess, um Verbesserungsbereiche zu identifizieren (Müller et al. 2015).

2.5 Wissenstandsanalyse

Wissenstandsanalysen sind ein weit verbreitetes Bewertungsinstrument im Bereich der Weiterbildung. Diese Analysen haben eine große Bedeutung bei der Beurteilung der Wirksamkeit von Schulungsprogrammen, indem sie Einblicke in das Vorwissen der Lernenden und ihren Fortschritt nach der Schulung bieten (Müller 2008). Diese Art der Wissensprüfung ist darauf ausgelegt, das Verständnis eines Lernenden für sachliche Informationen, Prinzipien und Theorien in einem bestimmten Bereich zu bewerten. Diese Bewertungen können in Form von Multiple- als auch Single-Choice-Fragen, wahr-falsch-Aussagen oder kurzen Freitext-Antwortmöglichkeiten dargeboten werden (Haladyna und Rodriguez 2013). Sie zielen darauf ab, das Erinnern an themenspezifischen Inhalten zu messen und das grundlegende Verständnis widerzuspiegeln, welches für den Aufbau von neuem Wissen unerlässlich ist (Haladyna und Rodriguez 2013). Die Durchführung eines Wissenstests vor der Schulung (Prä-Test) dient der Bewertung für das bestehende Wissensniveau der Lernenden (Guskey und Sparks 1991, Kirkpatrick 2006). Diese Informationen helfen bei der Gestaltung von weiteren Schulungsinhalten, die vom Anspruch angemessen und auf die Bedürfnisse der Lernenden zugeschnitten sein sollten (Pinckney et al. 2001). Darüber hinaus tragen vorab durchgeführte Wissenstests dazu bei, Verständnislücken und Probleme zu identifizieren, sodass Lehrende Maßnahmen treffen und sich auf bestimmte Schwachstellen konzentrieren können (Kühl 2008). Wissenstests nach der Schulung (Post-Test), sind für die Bewertung der Wirksamkeit des Schulungsprogramms nutzbar (Hager 2000, Halmetschlager 2002). Durch den Vorher-Nachher-Vergleich können Lehrende den Umfang des von den Teilnehmer:innen erworbenen Wissens messen (Friedman et al. 1992, Hager 2000, Halmetschlager 2002, Kirkpatrick 2006). Eine signifikante Steigerung des Wissens deutet auf eine wirksame Schulung hin, während eine geringe Verbesserung auf eine weitere Vertiefung oder Überarbeitung der Schulung hindeutet oder auf umfangreiche Kenntnisse bereits vor der Schulung (Hager 2000, Halmetschlager 2002). Wissensstandsanalysen, die nach der Schulung durchgeführt werden, bewerten nicht nur die unmittelbaren Lernergebnisse, sondern bieten auch Einblicke in den Transfer und die Implementierung des Wissens im Laufe der Zeit (Rödiger und Karpicke 2006). Diese Bewertungen geben Hinweise, ob die Lernenden das erworbene Wissen in realen Szenarien anwenden können und ob das Wissen über den Schulungszeitraum hinaus abrufbar bleibt (Rödiger und Karpicke 2006).

3. Zielsetzung der Arbeit

Die Zielsetzung dieser Arbeit ist die Entwicklung, Implementierung und Bewertung von E-Learning-Schulungsunterlagen für Schlachthofmitarbeiter:innen und Tiertransporteur:innen, um durch Schulung zur Verbesserung des Tierschutzes bei Transport und Schlachtung von Rindern beizutragen. Ein besonderer Fokus liegt auf der Entwicklung zielgruppenorientierter Schulungsmodule, die für Schlachthofmitarbeiter:innen und Tiertransporteur:innen mit geringem Bildungshintergrund und/oder begrenzten Deutschkenntnissen geeignet sind. Diese Module werden im Rahmen des vom Bundesministerium für Landwirtschaft und Ernährung geförderten interdisziplinären Forschungsprojekts „Entwicklung von zielgruppenorientierten eLearning-Schulungsunterlagen zur Verbesserung des Tierschutzes bei Transport und Schlachtung von Rind und Schwein" (Akronym: eSchulTS[2]) entwickelt, evaluiert und implementiert. Am Ende des Projekts werden diese online mehrsprachig und frei zugänglich sein.

Im Rahmen dieser Arbeit wurde eine umfassende systematische Literaturrecherche durchgeführt, die sich mit Untersuchungen zu tierschutzrelevanten Aspekten und Indikatoren im Zusammenhang mit dem Transport und der Schlachtung von Rindern befasst. Dabei sollen insbesondere die rechtlichen Bestimmungen, die seit 2009 in Kraft getreten sind, berücksichtigt werden. Zudem sollte, mithilfe der erstellten E-Learning-Schulungsunterlagen, eine Wissensstandsanalyse bei Mitarbeitenden an deutschen Schlachtbetrieben durchgeführt werden, um den aktuellen Kenntnisstand in Bezug auf Tierschutzpraktiken zu ermitteln.

In dieser Arbeit soll die von amtlichen Tierärzt:innen und Tierschutzbeauftragten durchgeführte Implementierung von zwei E-Learning-Modulen getestet werden, um deren Wirksamkeit und Relevanz zu bewerten. Diese Module wurden auf Grundlage der Literaturrecherche entwickelt.

Durch die Verknüpfung von Literaturrecherche, Wissensstandsanalyse und E-Learning Evaluierung zielt diese Arbeit darauf ab, einen Beitrag zur Verbesserung der Tierschutzschulungen und damit letztlich des Tierschutzes selbst bei Transport und Schlachtung von Rindern, durch ein Angebot für zukünftige Schulungsinitiativen in diesem Bereich, zu leisten.

4. Publikationen

4.1 Animal Welfare during Transport and Slaughter of Cattle: A Systematic Review of Studies in the European Legal Framework

Dieses Paper wurde in Animals publiziert.

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Eigenanteil von Svea Nicolaisen an dieser Publikation:
SN konzipierte und erstellte das Studiendesign, war an der Erstellung der systematischen Literaturrecherche maßgeblich beteiligt, führte die Auswertung der gefundenen Literatur durch, analysierte und interpretierte diese und verfasste das Manuskript.

Animal Welfare during Transport and Slaughter of Cattle: A Systematic Review of Studies in the European Legal Framework

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Simple Summary: This systematic review addresses animal welfare-related aspects associated with the transport and slaughter of cattle. Before transport, the husbandry system and health status of cattle can have a major impact on animal welfare. At the abattoir, personnel may inflict stress on the animals when moving them to the lairage pens and to the stunning box. Constructional conditions and the resulting environmental effects have a major influence on stress induction as well. Stress can be assessed by both behavioural observations and measurement of physiological parameters. Rapid and effective stunning is an important welfare-related criterion. Some easily verifiable and detectable indicators of unconsciousness, such as immediate collapse after stunning, loss of rhythmic breathing, and loss of the corneal reflex are routinely monitored at the abattoir. Other aspects, such as measuring stress hormones in the blood or using an electrocardiogram during stunning, provide scientific information but are neither practically nor financially achievable in routine procedures. Expertise and training of drivers and abattoir personnel are an important contribution to stress reduction during handling of cattle and, therefore, to animal welfare during transport and slaughter and, finally, to meat quality.

Abstract: Literature related to European transport and slaughter processes were included in this systematic review. The publication period is limited to the past twelve years since the European Animal Welfare Transport Regulation was enacted in 2009. Three different databases were used. The final screening resulted in the inclusion of 19 articles in this review. When handling cattle during transport and slaughter, personnel have an important impact and may inflict stress on the animals. Other factors, such as the group composition and health status prior to transport, can have a strong negative effect on animal welfare. At the abattoir, constructional conditions and the resulting environmental influences can have a negative impact on welfare as well. These include increased noise levels due to the lack of noise dampening and changing light conditions. Stress in cattle can be assessed, e.g., by measuring stress hormones or heart rate. Effective stunning is an important welfare-relevant step in the slaughtering process. Some signs of unconsciousness, such as immediate body collapse or absence of the corneal reflex, can be easily assessed. Expertise and continuous training of all personnel involved are important measures in stress reduction.

Keywords: bovines; animal welfare; abattoir; animal transport; stress

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1. Introduction

Animal welfare is an important topic in current public debate [1]. Critical social comments on modern livestock farming and the associated production of food of animal origin have been increasingly brought up in recent years [2]. In a representative survey conducted in Germany, a large proportion of respondents rejected methods that caused

suffering of animals during transport and slaughter [1]. Public debate focuses on animal welfare concerns and considerations of more animal-friendly husbandry and meat production systems [2]. Particularly regarding meat production, not only are aspects of animal husbandry of concern, but also animal transport, as well as the handling of live animals in the abattoir [3]. The German Federal Veterinary Chamber (Bundestierärztekammer e. V.) confirms that, regardless of the size of the abattoir, deficiencies in animal welfare can be identified between the processing steps of unloading and bleeding [4]. The results of this systematic review and the resulting compilation of animal welfare aspects served as the basis for an expert survey to determine which work steps during transport and slaughter are particularly relevant to animal welfare, and which of these relevant work steps could be effectively improved through employee training. The result of this expert survey in turn serves as the basis for a scientific project to produce training material for animal transporters and slaughterhouse employees.

1.1. Legal Background for Transport and Slaughter

Animal welfare during transport and slaughter is embodied in European regulations that are mandatory in all member states of the European Union (EU). Regulation (Reg.) (EC) No 1/2005 [5] sets requirements for the transport of live animals. In Germany, these are specified by national law [6]. Usually, cattle are transported from the farm to the abattoir for food production. The term 'transport' comprises the entire transport process from the loading of the first animal on the farm to unloading the last animal at the destination [5]. Transport of animals in an economic context over distances of more than 65 km must be carried out by approved transportation companies (Art. 10 & 11 of Reg. (EC) No. 1/2005) with approved long-distance transport vehicles (Art. 18 of Reg. (EC) No. 1/2005), and exclusively by transport personnel holding a certificate of competence (Art. 17 of Reg. (EC) No. 1/2005) [5]. Transport of animals is only allowed if they are fit for transport. The requirements are defined in Annex I of the regulation mentioned [5]. The fitness for transport must be assessed by the farmer as well as by the carrier personnel prior to loading. Animals not fit for transport must remain on the farm and, depending on the severity of the injuries, must get a provided treatment or be euthanized. Under certain conditions, defined in Annex II, Section I, Chapter VI of Reg. (EC) No 853/2004, such animals may also be emergency slaughtered [7]. Furthermore, bans on rough handling, such as kicking and hitting the animals during transport, are in place [5,8]. In addition, species-specific requirements regarding the conditions of the transport vehicle and the composition of the animal groups are defined [5].

Reg. (EC) No. 1099/2009 on the protection of animals at the time of killing regulates, amongst other aspects, the handling of animals during stunning and slaughter [9]. It lays down provisions on approved stunning methods for each respective animal species used for food production and other mandatory provisions for stunning and slaughtering. In Germany, the provisions of this regulation are implemented and supplemented by the Animal Welfare Slaughter Ordinance [10].

According to § 4a of the German Animal Protection Act, slaughter of animals is exclusively allowed after stunning, associated loss of consciousness and sensibility, and immediate exsanguination [8]. Exceptions to slaughter without stunning for religious reasons exist but require separate approval by the competent authority in each single case as an (usually temporary) exemption [8]. Stunning and slaughtering of animals should only be carried out by persons with a certificate of competence (Art. 21 of Regulation No. 1099/2009) [9]. Abattoirs slaughtering more than 1000 livestock units per year must designate an animal welfare officer to supervise animal welfare compliance during handling, stunning, and slaughtering. Additionally, standard operation procedures for animal handling must be created and personnel compliance must be supervised by animal welfare officers (Art. 17 of Reg. (EC) No 1099/2009) [9].

Compliance with these legal requirements is a prerequisite for animal welfare-compliant transport.

In addition to the legal regulations, supplementary scientific or instructional literature exists. The status of current scientific research on animal welfare measures in Europe during transport and slaughter is summarized in this article as a systematic literature review.

1.2. Aim of the Review

The aim of this review was to identify animal welfare-relevant aspects such as human-animal interactions that have been described and studied in the published literature on the transport and slaughter of cattle in Europe over the past twelve years.

2. Materials and Methods

This systematic literature review was conducted as part of the joint research project 'eSchulTS2' (development of target group-specific learning modules to improve animal welfare during the transport and slaughter of cattle and pigs). A systematic review provides an overview of the scientific literature on a specific topic using defined, comprehensible, and repeatable searching criteria [11]. In this type of systematic literature search, the procedure is guided by the Cochrane Guidelines Manual [12], which defines the standard methods for reviews, and the PRISMA-P (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols) protocol [13], which enables a transparent and replicable procedure.

Firstly, the search strategy was defined. This included the definition of search terms as well as inclusion and exclusion criteria for publications. The publication period was limited to 2010 to 2022, as the currently valid European regulation on the protection of animals at the time of killing (Reg. (EC) No. 1099/2009) was published in 2009 and has been mandatory since 2013 after the respective transition period [9]. Therefore, we decided to include studies from 2010, which were conducted within the scope of the Euro-pean legal requirements relating to the transport and slaughter of animals [5,9,10]. Abattoirs within the EU are also more comparable than abattoirs from other continents in terms of size and equipment. In order to assume comparability of transport conditions, only so-called short-distance transports, lasting less than 8 h according to the EU regulation, were considered, to which the same legal framework conditions apply. In addition, it is stipulated nationally in Germany that the transport duration of livestock animals for slaughter should not exceed 8 h [6]. Reviews and studies on stun-free or religion-motivated slaughter of cattle were not included.

Although it is well known that there is a variety of relevant literature available on the mentioned topic, comprising detailed manuals on animal-welfare-relevant instructions, exclusively literature from peer-reviewed journals was included in the evaluation in order to ensure scientific validity.

In the next step, the databases used for the literature search were determined. Important criteria were free accessibility and search mask availability in German or English. PubMed® (National Library of Medicine, Bethesda, MD, USA) and Web of Science™ (IPAN GmbH, Munich, Germany) were selected as English-language databases, enabling access to very extensive literature collections with and without contractual ties to publishers. In addition, Livivo was selected as a database that provides German-language articles. In the following step, the search terms, including their combinations in both English and German (Table 1), were determined in order to capture the largest possible number of relevant articles.

Table 1. Search term combinations for the systematic literature review on animal welfare during transport and slaughter of cattle.

Language	Search Term Combinations				
English	(Cattle OR Bovine)	AND	(Animal Welfare OR Welfare)	AND	(Slaughter OR Slaughterhouse OR Abattoir OR Lairage OR Bleeding OR Stunning)
	(Cattle OR Bovine)	AND	(Animal Welfare OR Welfare)	AND	(Transport)
German	(Rind)	AND	(Tierwohl OR Tierschutz)	AND	(Schlachtung OR Schlachthaus OR Schlachtbetrieb OR Schlachten OR Schlachthof OR Wartestall OR Tötung OR Betäubung OR Entblutung)
	(Rind)	AND	(Tierwohl OR Tierschutz)	AND	(Lebendtiertransport OR Tiertransport OR Viehtransport OR Transport)

A total of 2126 articles were initially retrieved from the three databases using the mentioned search terms. Removal of duplicates resulted in 702 publications (see Supplementary Material S3), which were checked for relevance by scanning both titles and keywords. The abstracts of the remaining 157 articles were assessed independently by three reviewers for relevance to content. The procedure was documented by means of a review protocol (see Supplementary Materials S1 and S2), divergent assessments were discussed within the reviewer group, and a final consensus was formed on which publications should be excluded or included. Finally, the full texts of 47 articles were assessed according to relevance, of which 19 were included in the final review (Figure 1, see Supplementary Material S4).
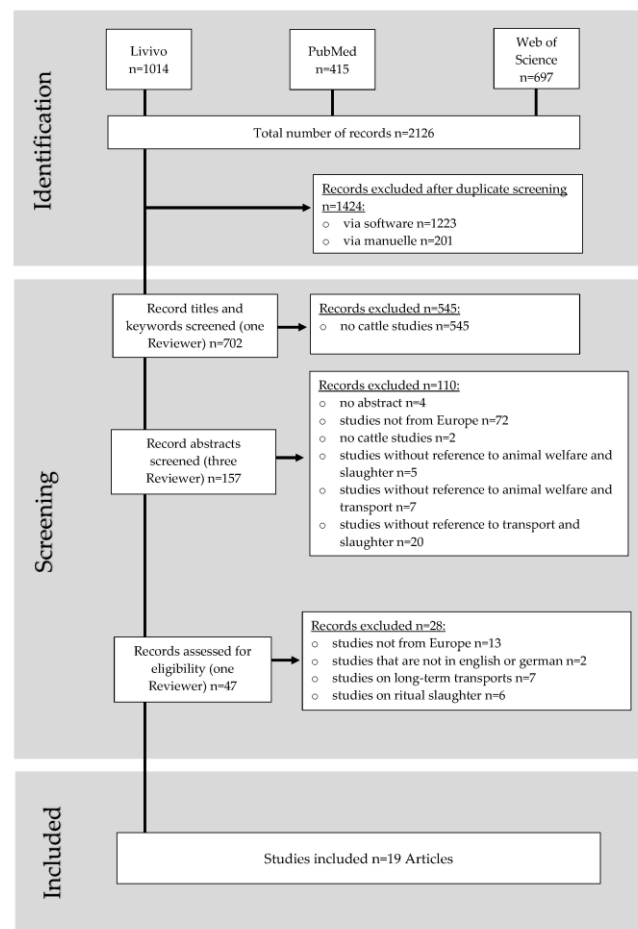
Figure 1. Flowchart of the review process.

3. Results

The presentation of the results firstly includes two studies (both from Denmark) dealing with animal welfare- and transport-relevant aspects (Table 2). Secondly, 17 studies dealing with welfare concerns in the context of abattoir management, as well as stunning and slaughtering, within the last 12 years are included. Three studies originated from Sweden and France, respectively. Then, there were two studies each from Germany, Italy, the Czech Republic, and the Netherlands, and one study each from Switzerland, the United Kingdom, and Poland (Table 2). The order of the results presented below is based on the process along the slaughter chain.

Table 2. Studies (*n* = 19) which were included in the results. These studies are from Europe, focus on cattle welfare, and have done research on slaughter or transport.

Reference	Animal Species	Country of Origin of Study	Selection Process of the Included Articles		
			Slaughter Reference	Transport Reference	Animal Welfare Reference
Dahl-Pedersen et al., 2018 [14]	Dairy Cows	Denmark	✗	✓	✓
Bourguet et al., 2011 [15]	Cattle	France	✓	✗	✓
Hultgren et al., 2014 [16]	Cattle	Sweden	✓	✗	✓
Hultgren et al. 2020 [17]	Cattle	Sweden	✓	✗	✓
Probst et al., 2014 [18]	Cattle	Switzerland	✓	✗	✓
Bourguet et al., 2010 [19]	Cattle	France	✓	✗	✓
Disanto et al., 2014 [20]	Cattle	Italy	✓	✗	✓
Iulietto et al., 2018 [21]	Cattle, Pig	Italy	✓	✗	✓
Fries et al., 2012 [22]	Cattle	Germany	✓	✗	✓
Grist, 2019 [23]	Cattle	United Kingdom	✓	✗	✓
von Wenzlawowicz et al., 2012 [24]	Cattle, Pig	Germany	✓	✗	✓
Verhoeven et al., 2016 [25]	Veal Calves	Netherlands	✓	✗	✓
Terlouw et al., 2016 [26]	Cattle	France	✓	✗	✓
Verhoeven et al., 2015 [27]	Cattle, Pig	Netherlands	✓	✗	✓
Atkinson et al., 2013 [28]	Cattle	Sweden	✓	✗	✓
Borzuta et al., 2019 [29]	Cattle, Sheep, Pig, Poultry	Poland	✓	✗	✓
Vecerek et al., 2020 [30]	Cattle	Czech Republic	✓	✗	✓
Herskin et al., 2017 [31]	Cattle, Pig	Denmark	✗	✓	✓

✗ = is not addressed in the study   ✓ = is addressed in the study.

3.1. Animal Welfare during Transport

Dahl-Pedersen et al. [14] studied dairy cows after transport. Due to a significant increase in the proportion of lame cows after transport, they recommend the exclusion of cows with pelvic asymmetries and non-specific hind leg lameness from transport [14]. Cows determined to be transported over relatively long distances were typically loaded

onto a transport vehicle at the respective farms at night [14], several hours or more after the last milking routine [14]. Transport distances of more than 100 km and a high milk yield in early lactation (<100 day of lactation) were identified as risk factors for increased spontaneous milk leakage during transport [14]. Therefore, it is recommended to milk cows immediately before loading in order to avoid increased udder pressure, which is associated with pain and discomfort [14]. At the same time, Dahl-Pedersen et al. [14] suggested a need for further research on dairy cows that were legally considered fit for transport and, as a result, the further development of the concept of fitness for transport, as well as a more detailed consideration of the animal welfare implications of transporting cattle.

Herskin et al. [31] used a questionnaire survey to describe the knowledge of fitness for transport of dairy cows among livestock drivers. A total of 94% of the drivers reported that they were aware of the regulation on fitness for transport [31]. A total of 35% said that they had at least frequent doubts about the fitness of certain cows for transport, and only 52% of respondents answered correctly to specific questions about the legislation on fitness for transport [31]. Livestock drivers need additional training to improve the welfare of animals being transported [31].

3.2. Animal Welfare at Slaughter

The assessment of aspects of animal welfare in the context of slaughter already begins at the time point of unloading, as part of the ante mortem inspection, and can also continue in lairage pens at the abattoir, and during stunning. This includes assessment of the surrounding environment with its constructional conditions and environmental factors. In addition, the behaviour of the animals and physiological parameters, such as stress hormones, can be used for stress assessment.

3.2.1. Animal Welfare at Lairage Pen and Driveway

Observing and analyzing tumbling, slipping, and the backward movements of cattle at abattoirs can provide insight into the connection between cattle handling and stress-related behaviours [15–17]. Tumbles were observed in about 1% of the animals in a study by Hultgren et al. [16], with heifers and bulls having a 3.2 times lower risk of falling than dairy cows. Cattle were most likely to move backwards in the driveway [16]. Backward movements of an animal may occur if distractions due to noise, the presence of people, conspecifics, or darkness are present in front of the animal [15,17]. Backward movements in the stunning box were observed significantly more often in bulls than in cows or heifers. It was pointed out that males were more difficult to handle and, thus, experienced a lower level of animal welfare at the abattoir [16].

Cattle to which electric prods were applied several times on their way to the stunning box showed elevated serum cortisol levels. The blood samples required were collected during exsanguination. However, these values could not be clearly statistically linked to specific stressors, such as the use of electric prods [18]. Bourguet et al. [15] evaluated the use of electric prods prior to slaughter and found a large variability in the number of electric shocks with an average of 7.1 ± 0.2 electric shocks per animal. According to their evaluation, the authors recommend the use of electric prodding only for the smallest possible proportion of animals on their way to the stunning box [15]. Sex can also have an impact on the expression of stress parameters [18]. For example, heifers driven forward had the highest cortisol levels (>90 ng/mL) compared to bulls and steers, while the type of use (crossbreeds, beef cattle, and dairy cattle) had no influence on the blood serum levels examined [18].

It was shown by electrocardiogram (ECG) that the animals' heart rates were highest shortly before slaughter, probably due to the approach to the stunning box [19].

In lairage, vocalization due to hunger, social reasons, or pain, e.g., resulting from excessive pressure of fixation devices on the head or body in the stunning box, could be observed [15].

Bourguet et al. [15] observed long lairage times of cattle in a French abattoir (average 20.2 ± 1.9 h). Male animals had a shorter lairage time than females and were slaughtered first, as they were more actively perceived by the abattoir personnel [15].

Hultgren et al. [16] found no significant associations between animal behaviour and personnel-related action. This could suggest that the construction of the abattoir or events not directly targeting the animals, such as noise or people walking by, are more significant in affecting animal welfare than direct animal-human interactions [16].

It was observed that employees who felt more pressure in their personal work situation, e.g., lack of time, tended to be more forceful in handling the animals, which can lead to increased stress [17,20]. The presence of observers, however, can lead to an observer effect or bias. In this case, the employees adapted their behaviour and, as subjects of a scientific study, avoided actions contrary to animal welfare. However, in general, employees quickly become accustomed to the presence of observers and rough handling still occurred [16]. If employees at the abattoir are trained in gentle handling, this can reduce the use of rough handling methods, such as the unauthorized use of electric prods [17,20].

The floor in the lairage pens, driveway, and stunning box must be slip-resistant and maintained in such a way that the animals cannot slip or tumble [20]. In addition, the use of rubber mats can reduce the risk of injuries [20].

The side barriers of the stunning box should be adjustable to the size of the cattle in order to avoid several cattle entering simultaneously [20]. To reduce stress, the cattle should not visually perceive animals already slaughtered before entering the stunning box. This can be achieved, e. g., by installing visual protection devices [20].

Other stress factors at abattoirs are loud noises, which were tested using a sound level meter via smartphone app at an abattoir [21]. The recommended maximum value of 80 dB for humans and animals was frequently exceeded [21]. In three abattoirs, values of 88.8 dB, 92.3 dB, and 93.0 dB were measured on average, especially in the stunning area [21]. There was often a lack of sound isolation on walls and machines. The authors also suggested better training of personnel to reduce the noise level and, thus, stress to animals and humans [21]. Exceeding the recommended maximum noise level could lead to physiological reactions in humans and animals, such as stress by excitation of the nervous system [21].

Other environmental factors include ventilation and light. Depending on the type of ventilation, moving elements such as ventilator blades and the light effects of their shadows on the floor or walls can cause irritation to the animals, which should be eliminated [20]. Furthermore, the combination of excessive light intensity and draught can cause the animals to flinch, especially in front of the entrance to the stunning box [20].

3.2.2. Animal Welfare during Stunning and Bleeding

Criteria for the correct stunning procedure, using penetrating captive bolt devices, include deviations from the optimal shot position in centimeters, the entrance angle of the shot, and if a re-shot is necessary [22,32]. The optimal position for penetrating captive bolt devices in cattle is oriented towards the intersection of two imaginary connecting lines between the center of the horn buds and the center of the contralateral eye [22,32]. With an angle of 90° to the skull surface, a maximum angular and lateral deviation of 10°, and 0 to 2.5 cm from the optimal touch down point, the brainstem should be effectively damaged with a high probability [22]. The number and placement of shots can serve as an indirect quality control measure of the stunning procedure [22]. Macroscopic post-mortem examination of bovine skulls can also be used as a tool to assess possible reasons for insufficient stunning by determining the area of the brain destroyed by the penetrating captive bolt [23] and the number and precision of the shots [22,32]. This method of verification can be carried out on frozen cattle skulls at the abattoir itself if a freezer and band saw are available [23].

Von Wenzlawowicz et al. [24] found that shot accuracy is less critical when powerful penetrating captive bolt devices are used. Heavy captive bolt devices with rounded top surfaces have an increased risk of being shot inaccurately or not perpendicular to the skull surface, which can lead to insufficient stunning, especially in heavy cattle > 600 kg [24].

Sticking for exsanguination within less than 60 s after stunning was more important in a neck cut than in a thoracic cut, since the latter leads to greater blood loss in relation to the body weight within 60 s [24]. In situations in which stunning conditions are not optimal, a well-executed sticking by thoracic cut can reliably prevent cattle from re-awakening after a captive bolt shot [24].

The absence of active behaviour, body functions, and various reflexes can be assessed as indicators of consciousness and, thus, of the effectiveness of stunning.

One sign of ineffective stunning after using a captive bolt device is the animal's attempt to rear from an abnormal position. This reaction is caused by the righting reflex [25]. These movements are purposive but often difficult to differentiate from involuntary movements, such as paddling [26]. However, the immediate collapse of an animal after a correctly executed captive bolt shot is described as a good indicator of unconsciousness after stunning, as it is easily visible [26]. Type of stunning and fixation of the animal must be considered since mechanical stunning leads to an immediate collapse, while head or body fixation impedes indicator assessment [26].

The following reflexes, listed in cranial to caudal order, were examined in further studies: threat reflex, lid reflex, palpebral reflex, corneal reflex, and righting reflex.

The threat reflex is provoked by the hand being moved quickly towards the cattle's eyes, which leads to closing the eyes or pulling back of the head in conscious animals [25]. The threat reflex is lost at an early and incomplete stage of stunning when both eyelid and corneal reflexes may still be present. Therefore, although the test may have good sensitivity, it is recommended not to be used alone to assess the stunning effect and further research in other contexts and on other species is recommended [26].

In order to test the eyelid or palpebral reflex, the eyelashes or medial corner of the eye are touched [25,27]. The physiological response in insufficiently stunned animals is to close the eyelids [15,25]. The eyelid reflex is lost before the corneal reflex [15]. When testing the corneal reflex, the cornea is touched directly, and the eye should not show any reaction if the stunning was successful [25]. In contrast to the corneal reflex, standardization and interpretation of the presence or absence of the eyelid reflex may be more difficult [26].

The loss of the corneal reflex is considered an indicator of deep unconsciousness [15]. It is considered a valid indicator but should be interpreted together with other indicators of unconsciousness. It must be considered that injuries, e.g., on the ocular surface, can lead to the loss of the corneal reflex as well [15].

The withdrawal reflex is provoked by forcefully pressing two fingers or a tool into the nasal septum or the tips of the ears to trigger immediate head withdrawal [25].

Eye following is a clear sign of consciousness, as an object is visually fixed and observed [15]. After a successful captive bolt shot and collapse of the animal, the eyes are rigid and wide open, with immobile bulbi and eyelids [26]. If movements of the eye bulbi occur, this may indicate that parts of the brainstem and cortex are still intact and, thus, stunning was not sufficient [26]. Bulbus rotation with visible sclerae can be seen as an indication of ineffective stunning or a sign of incomplete loss of consciousness [15]. Nystagmus—rapid movements from side to side—is an indication of ineffective stunning as well [28].

The absence of rhythmic breathing is also mentioned as an indicator of unconsciousness [26]. This refers to focused inhalation and exhalation and should not be confused with gasping. The respiratory muscles are innervated via the medulla oblongata, which is located in the lower part of the brainstem. The rhythm of breathing is stimulated by the reticular formation [26]. Contrarily, gasping manifests as vigorous inspiration and is triggered by brain ischemia or hypoxia [26]. If uncertain, breathing can be visualized by the fogging of a mirror placed in front of the animal's nose [29].

Successful stunning is indicated by immediate collapse after the stunning shot, followed by a phase of tonic and then clonic muscle contractions, loss of rhythmic breathing, threat, and corneal reflexes, as well as the absence of vocalization, and fixed eye bulbi [28]. Most of the indicators can be assessed visually and can therefore be easily used to check stunning success in abattoirs [30].

4. Discussion

The Animal Health and Welfare Committee of the European Food Safety Authority (EFSA) identified and characterized a total of 40 risks to cattle welfare during slaughter [33]. In total, 39 of the 40 risks were caused by humans and are mainly associated with lack of skills or fatigue [33]. The EFSA recommends preventive measures, such as livestock driver training to encourage cautious driving with regard to animal welfare during transport, or training of abattoir staff in the handling of animals [3,33]. In contrast to the human-animal interactions, other aspects such as the constructional conditions of a livestock transport vehicle or those of the abattoir, can only be affected indirectly by individuals or with a financial effort.

4.1. Transport

One study shows that there is a need for further research on dairy cows and their assessment of fitness for transport [14]. An assessment of cattle fitness for transport is mandatory, otherwise loading is not allowed. Livestock transport drivers must have the necessary knowledge for such an assessment. This can be particularly challenging in dairy cows because, unlike healthy beef cattle, they are usually slaughtered for reasons of poor health, i.e., claw, udder, or metabolic disorders, and performance, such as fertility problems, which are the most common reasons for animal disposals [34]. It is not unusual for drivers, farmers, and veterinarians to disagree on the assessment of the fitness for transport of individual animals. However, the assessment of the driver is important, as they are responsible for compliance with the legal provision. The animals are usually presented to a veterinarian for assessment only when they are unloaded at the abattoir. Herskin et al. [31] concluded that drivers need additional training and assessment tools to optimize animal welfare during transport. Transport personnel and their interactions with cattle play a very important role along the entire transport process, which consists of planning and preparing the transport, loading the animals, the transport itself, and unloading the animals at the abattoir [35]. For this reason, animals must be transported by trained personnel holding a certificate of competence [5] to ensure proper assessment of fitness for transport, as well as loading and unloading [33]. Livestock transport drivers should be aware of the needs, perception, and sensibilities of animals, and should handle them in the proper way [36]. Not all participants of training courses already have experience in handling livestock, which emphasizes the necessity of adequate and sufficient training, e.g., when loading or driving the animals [37]. Topics to be covered during training are: basic knowledge of the species to be transported, requirements for the livestock transport vehicle and loading equipment, the conduct of livestock transport, the effects of driving on animal welfare, first aid procedures for the animal, and aspects of work safety [5]. Transport companies must plan the transport carefully, which includes taking into account the actual transport route, driving, and break times, as well as information on weather and traffic conditions. In addition to the above-mentioned fitness assessment, the stocking density of the truck has to be determined according to the legal requirements [5]. Critically, none of the studies adequately investigated the effects of driving style on short-distance livestock transport. The literature merely mentions poor road conditions leading to balance problems in cattle [14], but the way in which speed, starting, and braking behaviour affects cattle is not explored in depth. In the field of long-distance livestock transport, the behaviour and heart rate of cattle during starting and braking processes was investigated and the authors showed that lying cattle stood up during starting and braking and that the heart rate increased [38]. A study from Australia found that shifting gears, starting, and braking

can lead to anxious and tensed behaviour in cattle [39]. Other studies focused on driving style in sheep and pig transport [40,41].

Unfortunately, our search did not reveal any studies with other important animal welfare aspects, such as the condition of livestock transport vehicles or heat stress of cattle during transport. Livestock transport vehicles must be designed to avoid suffering, injury, or exposure to extreme temperatures, allow for easy cleaning and disinfection, exhibit non-slip floor surfaces, and be equipped with a light source to supervise the animals [5]. Careful transport planning, considering weather conditions, can help to avoid extreme temperatures in the transporter, while driving at night during summer heat periods or using forced ventilation should also be considered [42]. In this context, transport planning should also include detailed route and time planning.

No studies from Europe in the examined time period were found which dealt with the short-distance transport of pregnant cows or the group composition of cattle during transport. Reg. (EC) No 1/2005 further specifies that groups of animals unfamiliar to each other should not be mixed [5]. It is recommended that the social environment of the cattle be maintained as far as possible during transport [5,42]. Husbandry conditions have an impact on fear reactions, as intensively reared cattle familiar with human contact will usually react with less stress to a human presence than extensively reared cattle [43]. For the latter animals, the transport itself and the confrontation with humans will probably be more stressful [43]. Handling extensively reared animals is usually more difficult and, therefore, requires qualified and animal-welfare-conscious personnel [44]. Regarding pregnant cattle, Reg. (EC) No 1/2005 requires that they be given 10% more space during transport and animals in which 90% or more of the expected gestation period has elapsed or which have given birth in the last seven days may not be transported [5]. The maximum height of vehicles in Germany is 4 m [45]. Multi-deck road vehicles present a particular challenge in terms of space above the animals' heads. In a study in which pregnant heifers were assessed during transport, no skin abrasions had been observed with a large distance (40 cm) to the ceiling [46]. The authors recommended keeping a distance of more than 20 cm between shoulder height and the ceiling to avoid injuries and additional stress in cattle [46].

4.2. Slaughter

Different studies show that vocalization and fearful behaviour in cattle, e.g., aggression, backward movements, and slipping, can be an expression of stress [15–17]. Loud vocalization in cattle is rare in a calm herd but should not be dismissed as insignificant in the context of transport and stress, as vocalization often seems to be associated with separation, pain, or anxiety [47]. Grandin [48] observed in abattoirs that when 95% or more of the cattle are forced to move with an electric prod due to backward movements or refusing to move forward, vocalization following the use of the electric prod increased significantly. The study also showed that in abattoirs where personnel did not make a lot of noise, like shouting or whistling, the lowest number of problems moving cattle to the stun box occurred [48]. The assessment of vocalization in commercial cattle abattoirs can be used to identify problems in the plant [48].

Noise is caused by the cattle and staff, as well as by technical equipment in the adjacent abattoir. The volume of surrounding noise can be determined by means of a sound level meter and should be evaluated regularly for animal and staff protection reasons. Noise reduction through sound damping is technically possible but often difficult to implement in practice due to hygiene requirements (e.g., easy-to-clean surfaces). Once an abattoir has been built, constructional conditions can often only be changed with a financial effort.

Stress hormones, such as cortisol, can provide information on both acute (e.g., measured in saliva or blood) and chronic (measured in hair) stress [49,50]. The glucocorticoid cortisol is secreted by the hypothalamic-pituitary-adrenal axis and can activate catabolic metabolic processes [51]. For the interpretation of cortisol levels, the diurnal pattern of cortisol release has to be taken into account, as well as the potentially stressful situation. Catecholamines are synthesized, particularly in the adrenal medulla. They serve as neu-

rotransmitters and have an evolutionary-biological effect, primarily on the fight-or-flight response by sympathetic activation [51]. Probst et al. [18] and Bourguet et al. [19] have shown that the cortisol levels and heart rate of cattle were increased during the approach to the stunning box. An Australian study [52] showed that plasma cortisol levels (blood taken at ventral neck incision) were increased in cases when cattle turned their head down, vocalized a lot, and when abattoir personnel pushed the animals extensively.

Determining parameters such as cortisol and catecholamine levels, as well as heart rate, could be meaningful indicators of stress in animals but are not routinely feasible and implementable at the abattoir. Blood or urine sampling from the lairage pens seems to be, likewise, possible and useful mainly in the context of scientific studies.

In the studies on stunning [22–25,32], only the method of stunning with captive bolt devices was mentioned. Before stunning, the slaughter personnel must ensure that the captive bolt device is in proper condition [6]. Its area of use and maintenance guidelines (cleaning and functional inspection at least once per day) are laid down in Reg. (EC) No 1099/2009 [9]. Captive bolt devices are regulated by Directive 2006/42/EC and must have a CE mark [53]. Random sampling of the skulls of slaughtered cattle can provide information on the shot position, the angle of the shot, and the number of stun shots fired [23]; another possibility is monitoring via video supervision for retrospective assessment. To illustrate the optimal shot position, the assessment of macroscopic lesions on bovine skulls can serve as training material for slaughter personnel [23]. The number of shots used versus animals slaughtered per day should also be checked regularly, as this provides information on how often additional bullets had to be fired.

Animals must be stunned properly before slaughter and loss of consciousness has to be maintained [9]. Indicators that serve to immediately verify the effectiveness of stunning, such as reflex and behaviour assessment, are very important. Verhoeven et al. [25] validate the interpretation of reflexes using electroencephalography (EEG) electrodes. After captive bolt stunning, the cattle showed no reflexes and the EEG recordings confirmed that the animals were unconscious [25]. Since EEG administration is too time-consuming for routine use at the abattoir, the recording was only carried out for scientific purposes and validation of procedures. The loss of reflexes can provide information on the state of consciousness after mechanical stunning and, in contrast to an EEG, can also be used time-efficiently in routine procedures at the abattoir. The immediate collapse after correct stunning is an easily visible indicator well-suited for verification, provided that the animals are not fixed in the stunning box [26].

In general, no reflex should be assessed alone regarding unconsciousness. The EFSA [3] recommends that the combinations of immediate collapse, loss of muscle tone, loss of breathing, presence of tonic spasms, loss of eyelid and corneal reflex, fixed eyes, and absence of vocalization should be checked to verify unconsciousness. If stunning success is questionable, re-stunning should be applied immediately [3].

In order to obtain an economic benefit from slaughtered cattle, the carcass must be in good condition. Bruising is caused by vascular ruptures, which can occur as a result of being hit or beaten by another animal, bumped during transport, or due to forceful human-animal interactions [54]. Animal welfare officers at the abattoir must be trained to recognize bruises and injuries on the living animal and on the carcass. In addition, certain metabolic processes, such as glycolysis, can change the quality of the meat and dark, firm, dry (DFD) meat can result. DFD meat is formed when the glycogen reserves in the muscle have already been largely depleted due to prolonged stressful situations in conjunction with exhaustion before slaughter. After slaughter, if glycogen reserves are too low, only a small amount of lactic acid can be formed via glycolysis and the pH value in the muscles drops only slightly, resulting in a high final pH value, which is associated with DFD meat [55]. Triggers for such stressful situations can be the common stabling of female and male cattle, affecting factors of the transport itself (temperature and driving style), the duration of unloading, and the skill level of the driver [56].

5. Conclusions

This systematic literature review provides an overview of the literature from the last twelve years on animal welfare during transport and slaughter of cattle within the legal framework of the EU. The aspects identified as relevant for the improvement of animal welfare, as well practically useful in terms of implementation, should be incorporated into the development of training material in order to counteract animal welfare concerns.

The effects of driving style and road conditions, specifically, on cattle should be considered and further scientific research would be desirable in this regard. Animal transporters should, therefore, receive extensive training in analyzing their own driving style and its effects on the animals being transported. At the same time, an expansion of the training regarding the assessment of the transport ability of cattle is desirable and a standardization of the assessment is necessary.

Gentle handling of animals has a major impact on animal welfare at any time of transport, or during lairage and slaughter process. According to the EFSA, the main threats to animal welfare are related to a lack of personnel skills or training, resulting in improper handling and poorly designed facilities [3]. The EFSA concluded that this lack of skills or training poses a serious animal welfare problem.

The availability of appropriate training material, with particular attention to the educational background and different language skills of animal transporters and slaughterhouse staff, is a key factor and influencing opportunity for improving animal welfare during transport and slaughter. This review of the available literature is therefore a contribution to the identification of animal-welfare-relevant and educable training sessions.

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4.2 Evaluation of Online Training to Improve Animal Welfare of Cattle during Transport and Slaughter from the Perspective of Animal Welfare officers and official Veterinarians

Eigenanteil von Svea Nicolaisen an dieser Publikation:
SN konzipierte und erstellte die Schulungsmodul sowie das Evaluationskonzept, führte die Datenerhebung durch, analysierte und interpretierte die Daten und verfasste das Manuskript.

Research Article

Evaluation of Online Training to Improve Animal Welfare of Cattle during Transport and Slaughter from the Perspective of Animal Welfare officers and official Veterinarians

Svea Nicolaisen*, Christa Thöne-Reineke, Mechthild Wiegard

Abstract

Animal welfare during transport and slaughter is a major concern for the European livestock industry. Despite existing legislation and guidelines, it remains challenging to achieve optimal animal welfare standards during these processes. The aim of this study was to evaluate the implementation and effectiveness of two multilingual online animal welfare training modules designed for less educated slaughterhouse work hands and livestock transport drivers. The training modules focused separately on animal behavior and cattle handling, with an emphasis on visual teaching materials such as pictures and videos. An online survey was conducted, in which 25 official veterinarians and animal welfare officers participated, who evaluated the two training modules. The survey included questions on design, ease of use, comprehensibility, and learning content. Participants rated the modules positively, with the majority awarding very good or good ratings for the design, layout, content, structure, and usability of the videos and interactive elements. Results also indicated that the modules provided comprehensive information and were appropriate in terms of scope and completion time. Participants expressed satisfaction with the content and agreed to use the training program themselves for teaching purposes. Feedback from the open questions indicated the strengths and areas for improvement of the modules. This study contributes to the improvement of online training materials to promote animal welfare. By providing slaughterhouse and livestock transport employees with the necessary knowledge and skills, this training program has the potential to improve animal welfare practices, reduce stress levels for workers and animals, and improve the overall work environment. Further research and development of targeted online training modules should be encouraged to improve animal welfare standards during transport and slaughter.

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Introduction

Animal welfare during transport and slaughter is an important concern in the European livestock industry, reflecting societal values and ethical considerations [1]. Animal welfare in this process has become an increasing focus and has led to efforts to improve standards and practices in Europe. European Union (EU) member states have extensive livestock industries, with millions of animals slaughtered annually [2]. Ensuring the welfare of

these animals during transport and slaughter is important for ethical and moral reasons [3]. However, despite existing animal welfare legislation and guidelines, there are still challenges in achieving optimal animal welfare standards during transport and slaughter. Problems include inadequate handling practices, poor facilities, and overcrowding that can lead to stress, fear, and physical harm to animals [4]. Addressing these challenges requires a multi-faceted approach to reduce potential animal welfare problems. Slaughterhouse work hands and livestock transport drivers have direct contact with animals, so their knowledge and experience are critical to animal welfare. Appropriate training programs can equip these individuals with the necessary skills and understanding of animal behavior, signs of stress, and appropriate handling when interacting with animals [5]. Through comprehensive training, employees can identify, prevent, and avoid potential violations of animal welfare best practice and laws. Stunning and slaughtering of animals should only be done by persons with a certified competence (Art. 21 of Regulation No. 1099/2009) [6]. Companies that slaughter more than 1,000 large animals per year must appoint an animal welfare officer to monitor animal welfare compliance during handling, stunning, and slaughter. In addition, standard operating procedures for the handling of animals must be established, and compliance must be monitored by animal welfare officers (Art. 17 of Regulation (EC) No 1099/2009) [6]. Research has demonstrated the positive impact of training programs on animal welfare in slaughterhouses. For example, studies have shown that well-trained personnel demonstrate great sensitivity to animal welfare, resulting in low stress levels for workers and animals, improved handling techniques, and more efficient processes [7,8]. Training programs not only improve animal well-being, but also contribute to a positive work environment that prioritizes animal welfare. The aims of the present study were to test the conception and implementation of two animal welfare training modules and to have them evaluated by experts. This study was carried out as part of the joint research project eSchulTS[2] (development of target group-specific learning modules to improve animal welfare during transport and slaughter of cattle and pigs). The study is intended to contribute to the improvement of online training modules for slaughterhouse work hands with differing language skills and cultural/sociological backgrounds, and who work directly with live animals during livestock transport or at slaughterhouses. Content of the modules was developed on the basis of a Delphi survey on topics that are relevant to animal welfare and that can be trained. Only the learning materials considered most important were implemented within the framework of this project. At the end of the eSchulTS[2] project, the online training modules will be made available to all interested stakeholders free of charge.

Materials and Methods

Design of the online training modules

The online training modules were targeted at slaughterhouse employees and livestock transport drivers, and were made available on the online platform tet.folio [9] via any internet-enabled computer, laptop or tablet. The experts in our study (i.e., participants) had access to two pilot modules, animal behavior and cattle handling. The participants could select a language (Romanian or German) on the start page and could choose to listen to the texts by clicking on a loudspeaker icon. The modules were deliberately designed with a minimum of text and consisted mainly of images and video material to ensure easy comprehensibility. The photo and video materials used in the modules were captured by the eSchulTS[2]-Team during livestock handling processes in German slaughterhouses. In addition, the two modules contained selectable information fields in which further content, such as the legal basis of the topic area, was provided. The time required to complete one module (below called processing time) was designed by us to be a maximum of 15 minutes. The two modules could be revisited at any time. At the end of both modules, there was a quiz on the respective topics in order to check participant's understanding.

Layout and distribution of the survey

The survey "Evaluation of online training modules for slaughterhouse staff and animal transporters" was designed and developed by employees of the Institute of Animal Welfare together with participants in the joint research project, eSchulTS[2]. The questionnaire tool Limesurvey [10] was used to create the survey. There were three groups of survey questions: questions to collect demographic data about the participants; questions on the animal behavior module and; questions on the cattle handling module. For the processing of personal data, ethical approval was obtained in advance from the Central Ethics Committee of Freie Universität Berlin for the study (CEC-No. 2023-001). The survey (Supplementary Material 1) was conducted anonymously and consisted of 19 questions, 6 of which were mandatory. In the survey, besides open (free text answer) questions and single-answer questions, most questions were evaluation questions. The answers to the evaluation questions were assigned to two groups using a six-point Likert scale: 1 (very good), 2 (good), and 3 (satisfactory) representing a positive rating or agreement, and 4 (sufficient), 5 (poor), and 6 (inadequate) representing a negative rating. The survey evaluated the modules' design, ease of use, comprehensibility, and learning content. The survey took place from April 2023 to May 2023. Invitations to complete the two online training modules and to participate in the survey (with the aim of improving the modules) were sent to 60 email addresses of animal welfare officers and official veterinarians working in slaughterhouses

in Germany. These email addresses either belonged to personal contacts of the authors or were relevant, public email addresses the authors found on the internet. A cover letter was sent to the email addresses with information about the eschulTS2 project, including a link to the online training modules and to the survey. Descriptive statistical analysis was carried out using the survey program, Limesurvey, Microsoft Excel, and IBM SPSS Statistic.

Results

Demographics

A total of 25 participants responded to the survey and evaluated the two online training modules; one of the 25 did not provide personal information. On average, the participants were 44.2 years old. Most (60%; n = 15) of the participants were female, 36% (n = 9) were male, and one participant (4.0%) did not answer the question on gender (Table 1). Most of the participants were official veterinarians (40.0%), followed by animal welfare officers (32.0%); under the item other profession, participants stated that they worked

Table 1: Demographic data of the survey participants (n = 25).

	Participants
Age	
Mean (SD)	44.2 (12.1)
Median (Min, Max)	47.0 (21.0, 60.0)
Not stated	1
Gender	
Female (%)	15 (60.0%)
Male (%)	9 (36.0%)
Not stated (%)	1 (4.0%)
Profession	
Official veterinarian (%)	10 (40.0%)
Animal welfare officer (%)	8 (32.0%)
Other (%)	5 (20.0%)
Not stated (%)	2 (8.0%)
Education level	
Habilitation (%)	0 (0.0%)
PhD (%)	10 (40.0%)
Degree from a university or comparable (%)	8 (32.0%)
Degree from a university of applied sciences or comparable (%)	3 (12.0%)
Degree of a master craftsman or comparable (%)	1 (4.0%)
Apprenticeship/skilled worker degree or comparable (%)	2 (8.0%)
Not stated (%)	1 (4.0%)
Years in profession	
Mean (SD)	12.3 (9.4)
Median (Min, Max)	10.0 (1.0, 35.0)
Not stated	1

for the industry or as a veterinarian (20.0%). The participants had been working in their professions for an average of 12.3 years (Table 1).

Animal Behavior Module

Evaluation of design and usability of the animal behavior module: About half (56.0%; n = 14) of the participants scored the design and layout of the animal behavior module as 1 (very good), 40.0% (n = 10) scored this aspect of the module as 2 (good), and 4.0% (n = 1) scored it as 3 (satisfactory) (Figure 1). Design and layout received an average score of 1.48 (SD 0.59). The structure of the conveyed content was scored as 1 (very good) by 40.0% (n = 10) of the participants and as 2 (good) by 60.0% (n = 15) (Figure 1), giving a mean score of 1.6 (SD 0.5). The usability of the videos was scored by 48.0% (n = 12) of participants as 1 (very good), by 40.0% (n = 10) as 2 (good) and by 4.0% each (each n = 1) as 3 (satisfactory), 4 (sufficient), or 5 (poor) (Figure 1). Video usability was awarded an average score of 1.67 (SD 1.01). The sound quality of the texts that were read aloud received a score of 1 (very good) from 56.0% (n = 14) of the participants, 2 (good) from 36.0% (n = 9), 3 (satisfactory) from 4.0% (n = 1), and 6 (inadequate) from 4.0% (n = 1) (Fig. 1). The average score for the sound quality of the texts that were read aloud was 1.64 (SD 1.08). The sound quality of the videos was scored as 1 (very good) by 52.0% (n = 13), 2 (good) by 36.0% (n = 9), 3 (satisfactory) by 8.0% (n = 2), and 6 (inadequate) by 4.0% (n = 1) of the participants (Figure 1). On average, the sound quality of the videos was rated 1.72 (SD 1.10). The drawings and animations in the module were scored as 1 (very good) by 56.0% (n = 14), 2 (good) by 40.0% (n = 10), and as 3 (satisfactory) by 4.0% (n = 1) of the participants (Figure 1). Drawings and animations received an average score of 1.48 (SD 0.59). The photos and videos were scored as 1 (very good) by 64.0% (n = 16), 2 (good) by 32.0% (n = 8), and as 3 (satisfactory) by 4.0% (n = 1) of the participants (Figure 1). On average, this resulted in a score of 1.40 (SD 0.58). Usability of the quiz at the end of the animal behavior module was scored as 1 by 56.0% (n = 14) of the participants, 2 by 36.0% (n = 9), and 3 by 8.0% (n = 2) (Figure 1). This resulted in an average score of 1.52 (SD 0.65).

Evaluation of comprehensibility and scope of the animal behavior module: The participants evaluated the comprehensibility of the video content in the animal behavior module, with 52.0% (n = 13) giving a score of 1 (very good), 44.0% (n= 11) scoring it 2 (good), and 4.0% scoring it 3 (satisfactory) (Figure 2). The average score for video comprehensibility was 1.52 (SD 0.59). The participants rated the information gained from the training, with 32.0% (n = 8) giving a score of 1 (very good), 52.0% (n = 13) scoring it 2 (good), 8.0% (n = 2) scoring it 3 (satisfactory), and 8.0% (n = 2) scoring it 4 (sufficient) (Figure 2). The average score for
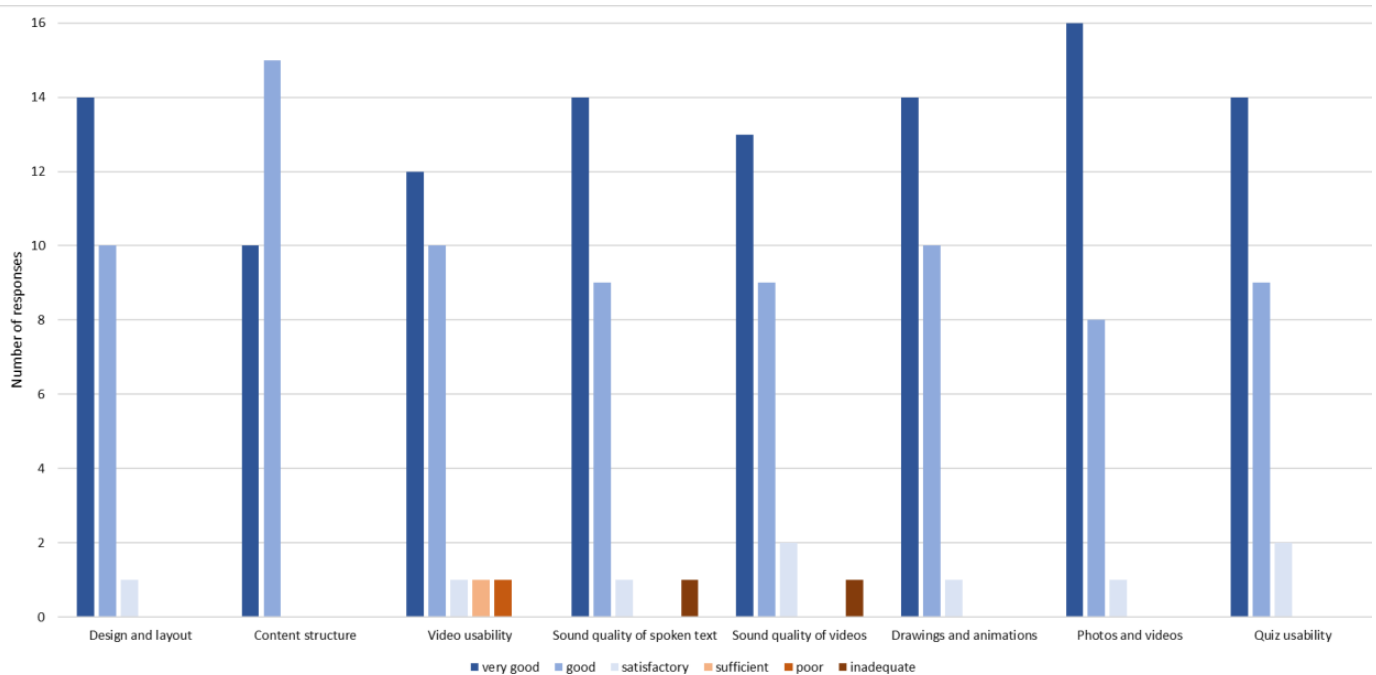
Figure 1: Satisfaction of survey participants with the design and usability of the animal behavior module. Individual items evaluated are listed on the x-axis, with the number of responses on the y-axis. Responses were very good, good, satisfactory, sufficient, poor, or inadequate.

information gained from the training was 1.92 (SD 0.86). The scope of the training (amount of information) was scored as 1 (very good) by 24.0% (n = 6) of the participants, 2 (good) by 64.0% (n = 16), 3 (satisfactory) by 8.0% (n = 2), and 4 (sufficient) by 4.0% (n = 1) (Figure 2). The average score for the scope of training was 1.92 (SD 0.70). The processing time of the module was scored as 1 (very good) by 48.0% (n = 12), as 2 (good) by 48.0% (n = 12), and as 4 (sufficient) by 4.0% (n = 1) (Figure 2). The average score for processing time was 1.60 (SD 0.70).

Evaluation of learning content in the animal behavior module: Within the learning content for the animal behavior module, the topic of cattle vision was scored as 1 (very good) by 52.0% (n = 13) of participants, 2 (good) by 36.0% (n = 9), and 3 (satisfactory) by 12.0% (n = 3) (Figure 3), with an average score of 1.60 (SD 0.70). The topic of cattle hearing was scored as 1 (very good) by 48.0% (n = 12) of the participants, 2 (good) by 48.0% (n = 12), and 3 (satisfactory) by 4.0% (n = 1) (Figure 3), corresponding to an average score of 1.56 (SD 0.58). The topic of mood states of cattle was scored as 1 (very good) by 40.0% (n = 10) of the participants, 2 (good) by 52.0% (n = 13), and 4 (sufficient) by 8.0% (n = 2) (Figure 3). The average score for this topic was 1.76 (SD 0.83). The quiz on the animal behavior module was scored according to its learning content as follows: 40.0% (n = 10) of the participants scored it as 1 (very good), 36.0% (n = 9) as 2 (good), 8.0% (n = 2) as 3 (satisfactory), 12.0% (n = 3) as 4 (sufficient), and 4.0% (n = 1) as 5 (poor) (Figure 3). The average score for the learning content of the quiz was 2.04 (SD 1.17).

Responses to the open questions for the animal behavior module: Participants were asked, "Would you use the 'animal behavior' module for your training", to which 84.0% (n = 21) answered yes and 16.0% (n = 4) did not answer. In the open question, "What I liked about the 'animal behavior' module", 28.0% (n = 7) wrote a comment, and when asked, "This could be improved in the 'animal behavior' module", 48.0% (n = 12) made some suggestions (Table 2).

Cattle handling Module

Evaluation of design and usability of the cattle handling module: Around half (48.0%; n = 12) of the participants scored the design and layout of the cattle handling module as 1 (very good), while 52.0% (n = 13) awarded a score of 2 (good) (Figure 4). The layout and design on average scored 1.52 (SD 0.51). The structuring of the content was scored as 1 (very good) by 52.0% (n = 13), 2 (good) by 44.0% (n = 11), and 3 (satisfactory) by 4.0% (n = 1) (Figure 4), which corresponded to an average score of 1.52 (SD 0.59). The usability of the videos was scored by 52.0% (n = 13) as 1 (very good), by 36.0% (n = 9) as 2 (good), and by 4.0% each (n = 1 each) as 3 (satisfactory), 4 (sufficient), and 6 (sufficient) (Figure 4). Video usability received an average score of 1.76 (SD 1.17). The sound quality of the texts that were read aloud was scored as 1 (very good) by 48.0% (n = 12) of the participants, 2 (good) by 44.0% (n = 11), 3 (satisfactory) by 4.0% (n = 1), and 6 (inadequate) by 4.0% (n = 1) (Figure 4). The average score for the texts that were read aloud was 1.72 (SD 1.06). The sound quality of the videos was rated 1 (very good) by 48.0% (n = 12) of the participants, 2 (good)
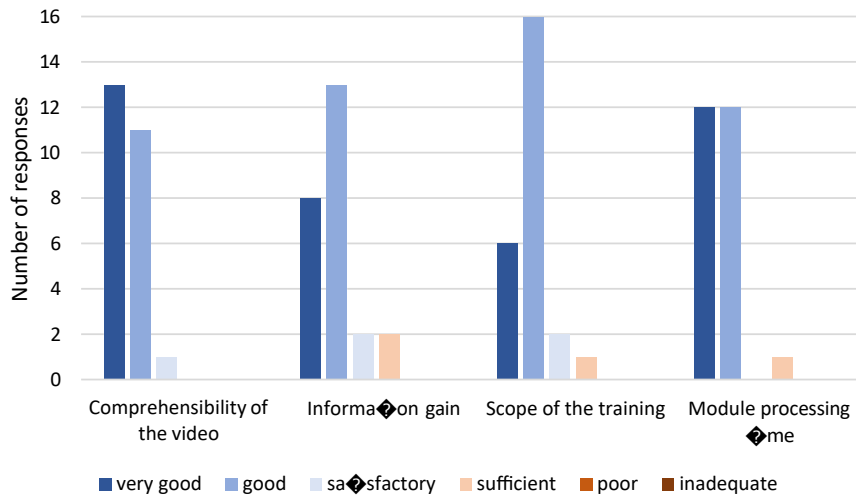
Figure 2: Satisfaction with the comprehensibility and comprehensiveness of the animal behavior module. Individual items evaluated are listed on the x-axis, with the number of responses on the y-axis. Responses were very good, good, satisfactory, sufficient, poor, or inadequate.
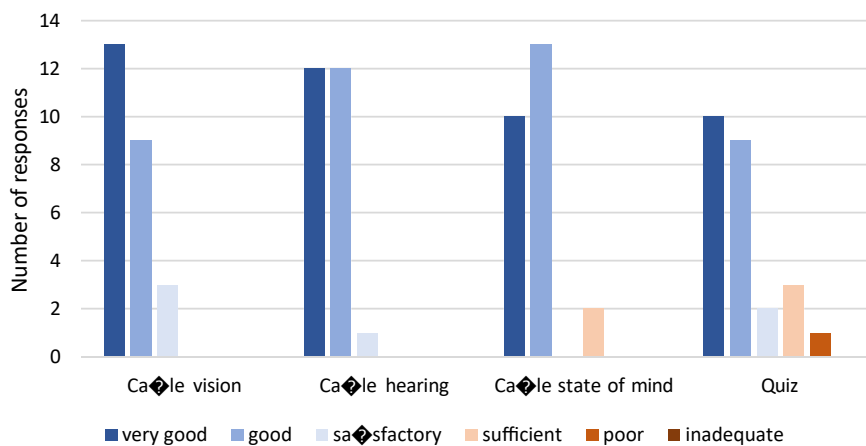

Figure 3: Satisfaction of the learning content of the animal behavior module. Individual items evaluated are listed on the x-axis, with number of responses on the y-axis. Responses were very good, good, satisfactory, sufficient, poor, or inadequate.

by 40.0% (n = 10), 3 (satisfactory) by 8.0% (n = 2), and 6 (inadequate) by 4.0% (n = 1) (Figure 4). The sound quality of the videos received an average score of 1.76 (SD 1.10). The drawings and animations of the cattle handling module were scored as 1 (very good) by 52.0% (n = 13) of participants and as 2 (good) by 48.0% (n = 12) of participants (Fig. 4) and, therefore, received an average score of 1.48 (SD 0.51). Photos and videos were scored as 1 (very good) by 52.0% (n = 13) and as 2 (good) by 48.0% (n = 12) of the participants (Figure 4). On average, this resulted in a score of 1.48 (SD 0.51). Most (56.0%; n = 14) of the participants scored the user-friendliness of the quiz at the end of this module as 1, 40.0% (n = 10) as 2, and 4.0% (n = 1) as 3 (Figure 4). This corresponded to an average score of 1.48 (SD 0.59).

Evaluation of comprehensibility and scope of the cattle

handling module: The comprehensibility of the video content was scored 1 (very good) by 64.0% (n = 16) and 2 (good) by 36.0% (n = 9) of the participants (Figure 5). The average score for comprehensibility of the cattle handling module was 1.36 (SD 0.49). The participants scored the information gained from the training as 1 (very good) by 32.0% (n = 8), 2 (good) by 56.0% (n = 14), and 3 (satisfactory) by 12.0% (n = 3) (Figure 5). The average score was 1.80 (SD 0.65). The additional information for animal welfare officers was scored 1 (very good) by 28.0% (n = 7), 2 (good) by 48.0% (n = 12), 3 (satisfactory) by 12.0% (n = 3), and 4 (sufficient) by 12.0% (n = 3) (Figure 5), giving an average score of 2.08 (SD 0.95). The scope of the training (amount of information) was scored 1 (very good) by 36.0% (n = 9) of the participants, 2 (good) by 52.0% (n = 13), 3 (satisfactory) by 12.0%

Table S2: Positive comments (+) and suggestions by participants for improvement (-) for the animal behavior module. The list of summarized comments was translated by the authors from German.

| Comments on the layout and design: |
|---|
| + Simply designed, but all-important information processed. |
| + The topics are clearly presented. |
| + Good animations. |
| - Speaker's voice is monotonous. |
| - Video guidance is complicated. |
| - The clicking on the microphones should be removed. |
| **Comments on the content:** |
| + Understandable and simply explained. |
| + Short and comprehensible. |
| + Cattle vision: Comparison human - bovine (with blurring), drift, adaptation = very good. |
| + Cattle state of mind: bull with attentive behavior = good! |
| + The topics are not boring. |
| + Comparison human to animal was very good. |
| - More comprehensive information would be nice. |
| - Comparisons with humans would be more purposeful. |
| - In the example of aggressive behavior there was only one example of how the animals behave towards each other. |
| - Speak less in the subjunctive, that could trivialize. |
| - When it comes to noise, it should be reduced as much as possible through technical methods e.g., insulation. |
| - There are many other aspects that can be covered, from loading the animal on the farm, animal transport regulations and rules on distances to be kept and calls, differences in emergency slaughter. |
| - Possibly a second quiz question per unit. |
| - Quiz a bit too ridiculous. |
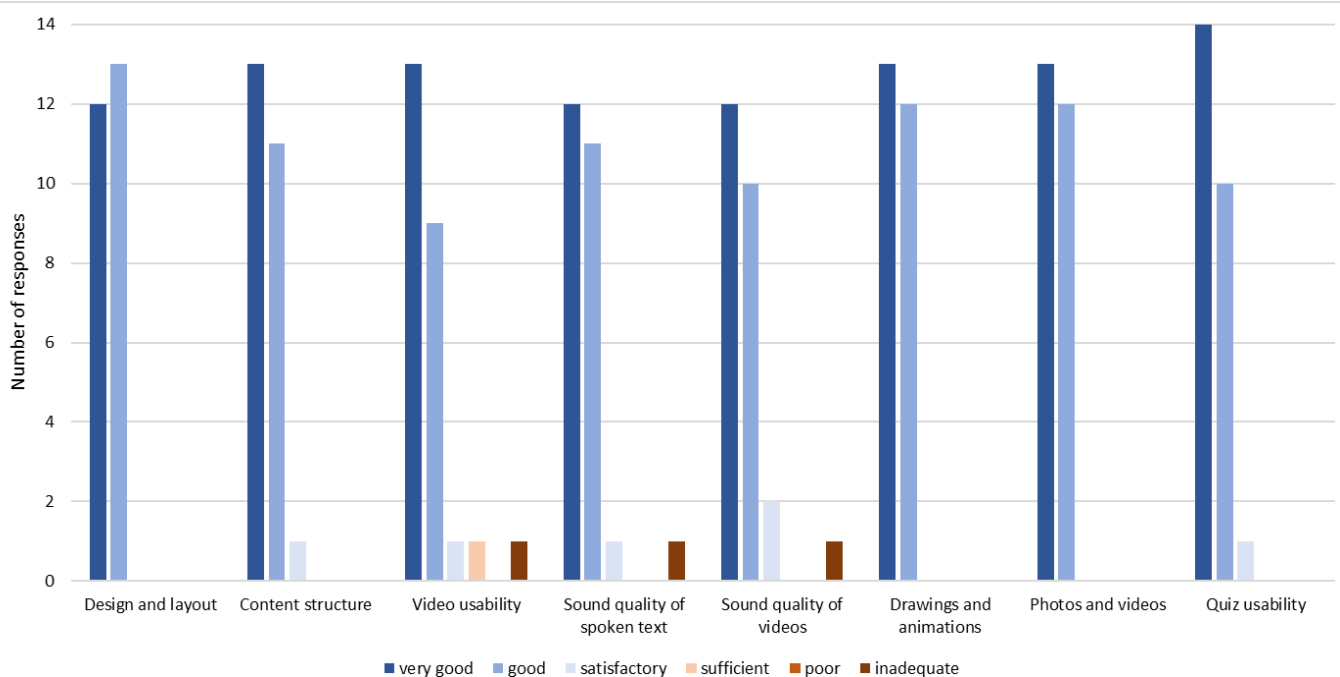
Figure 4: Satisfaction with the design and usability of the cattle handling module. Individual items evaluated are listed on the x-axis, with the number of responses on the y-axis. Responses were very good, good, satisfactory, sufficient, poor, or inadequate.

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Figure 5: Satisfaction with the comprehensibility and comprehensiveness of the cattle handling module. Individual items evaluated are listed on the x-axis, with the number of responses on the y-axis. Responses were very good, good, satisfactory, sufficient, poor, or inadequate.
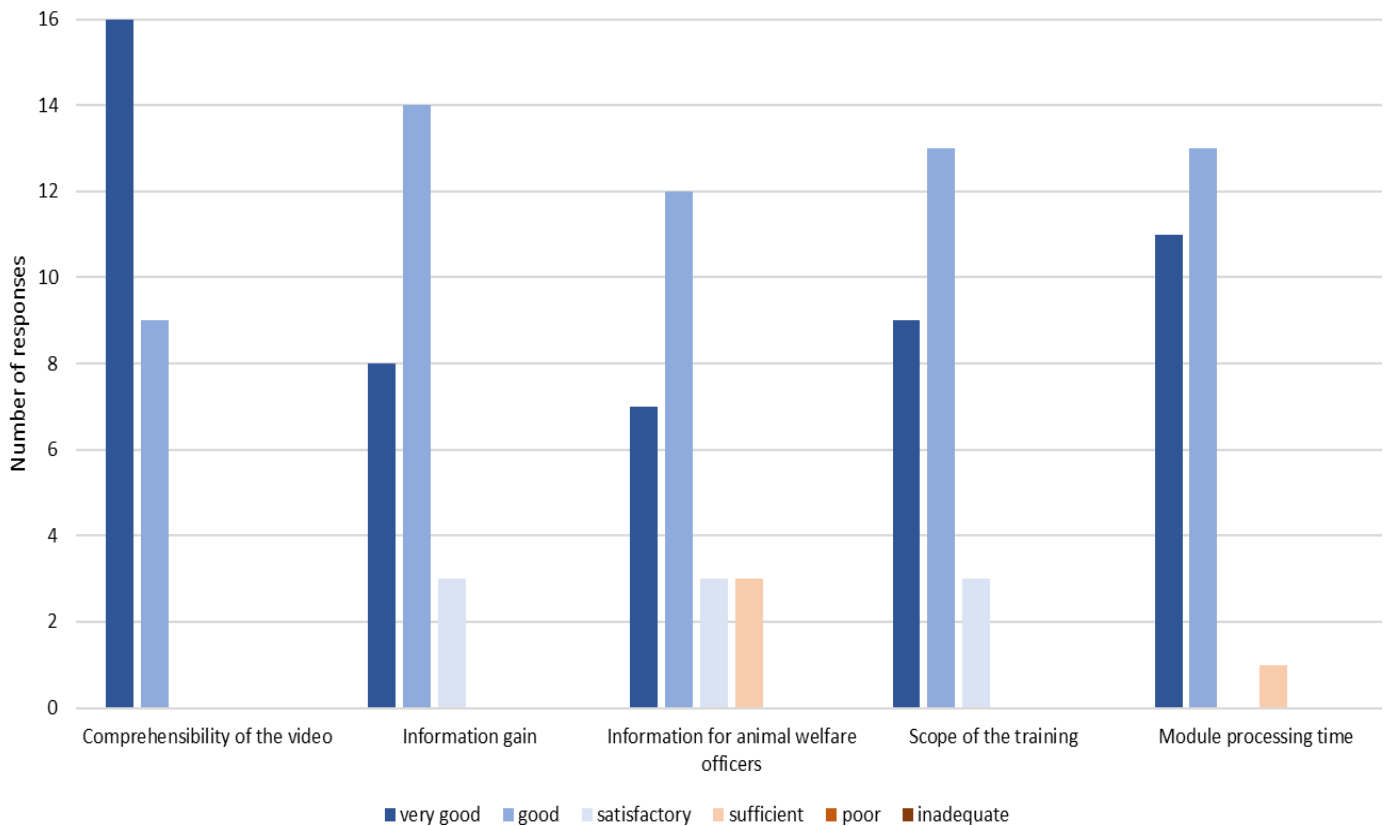
(n = 3), and 4 (sufficient) by 4.0% (n = 1) (Figure 5). The average score for the scope of the training was 1.76 (SD 0.66). The processing time for the module was scored 1 (very good) by 44.0% (n = 11) of participants, 2 (good) by 52.0% (n = 13), and 4 (sufficient) by 4.0% (n = 1) (Figure 5). The average score was 1.64 (SD 0.70).

Evaluation of learning content in the cattle handling module: Within learning content for the cattle handling module, the topic of the legal basis was scored 1 (very good) by 40.0% (n = 10) of the participants, 2 (good) by 32.0% (n = 8), 3 (satisfactory) by 16.0% (n = 4), and 4 (sufficient) by 12.0% (n = 3) (Figure 6), with an average score of 2.00 (SD 1.04). The topic of basic instructions was scored 1 (very good) by 36.0% (n = 9) of the participants, 2 (good) by 56.0% (n = 14), and 3 (satisfactory) by 8.0% (n = 2) (Fig. 6), with an average score of 1.72 (SD 0.61). Within learning content, the topic of driving aids used on animals was rated 1 (very good) by 44.0% (n = 11) of the participants, 2 (good) by 48.0% (n = 12), and 3 (satisfactory) by 8.0% (n = 2) (Figure 6). The average score for this topic was 1.64 (SD 0.64). The topic of electric prods was scored as follows: 48.0% (n = 12) of participants scored it 1 (very good), 40.0% (n = 10) scored

it 2 (good), 4.0% (n = 1) scored it 3 (satisfactory), 4.0% (n = 1) scored it 4 (sufficient), and 4.0% (n = 1) scored it 5 (poor) (Figure 6). The average score for the topic of driving aids was 1.76 (SD 1.01). The topic of prohibited driving aids was scored 1 (very good) by 56.0% (n = 14) of the participants, 2 (good) by 32.0% (n = 8), and 3 (satisfactory) by 12.0% (n = 3) (Figure 6), giving an average score of 1.56 (SD 0.72). The quiz was scored as 1 (very good) by 40.0% (n = 10) of the participants, 2 (good) by 40.0% (n = 10), 3 (satisfactory) by 12.0% (n = 3), and 4 (sufficient) and 5 (poor) each by 4.0% (n = 1 each) (Figure 6). The average score for the quiz was 1.92 (SD 1.04).

Responses to the open questions for the cattle handling module: Participants were asked if they would use the cattle handling module for their training. While the vast majority (84.0%; n = 21) answered yes, 16.0% (n = 4) did not indicate their preference. In response to the open-ended question, "What I liked about the 'cattle handling' module", 16.0% (n = 4) provided their own opinion in a comment, and in response to the question, "What could be improved about the 'cattle handling' module", 32.0% (n = 8) answered with a comment (Table 3).
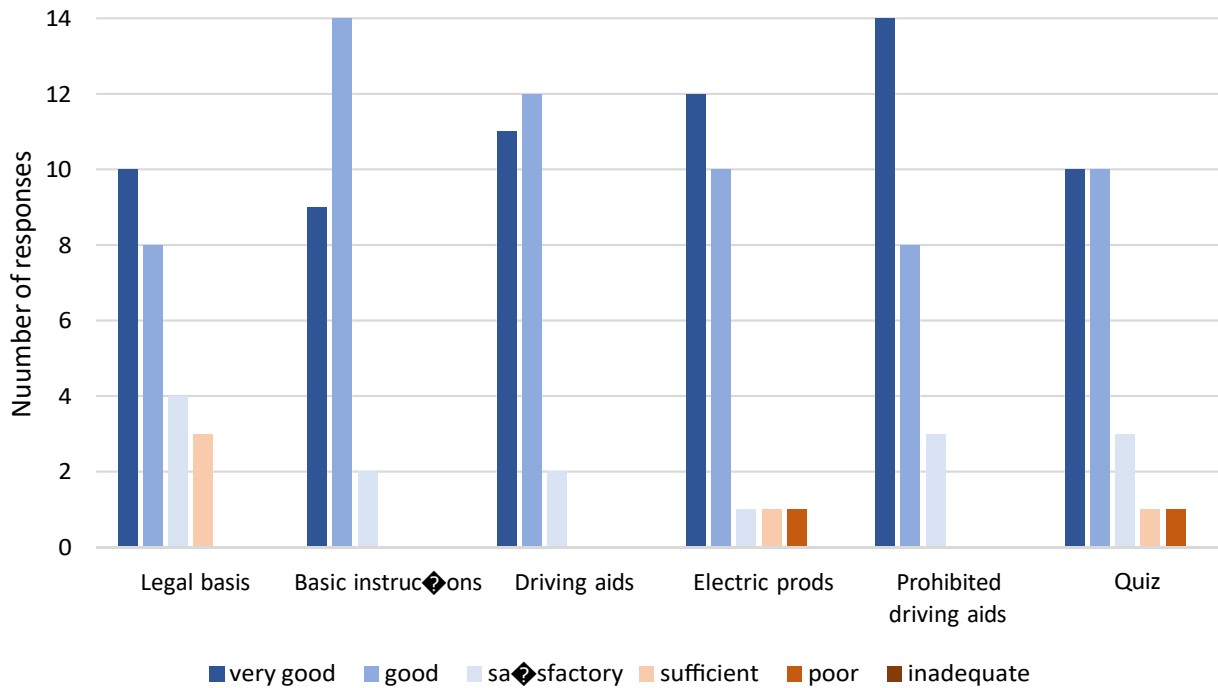
Figure 6: Satisfaction of the learning content of the cattle handling module. Individual items evaluated are listed on the x-axis, with number of responses on the y-axis. Responses were very good, good, satisfactory, sufficient, poor, or inadequate.

Table S3: Positive comments (+) and suggestions for improvement (-) for the cattle handling module mentioned by the participants. List of translated and summarized comments from German.

Comments on the layout and design:
+ Simply designed, but all-important information processed.
+ The topics are clearly presented.
+ Good animations.
+ Cartoons and schematic illustration of the use of prohibited propellants.
- Video guidance is complicated.
- The clicking on the microphones should be removed.
Comments on the content:
+ Easy to understand, directly applicable in practice, does not expire
+ Short and comprehensible.
+ Good: Use of paddles for propellants and advantages for the employers' liability insurance association.
- Too simple for animal welfare officers.
- Video electric prod use: start with the prohibitions and then explain the correct use. When explaining the correct use, the cattle should be in a single drive as instructed.
- Visual illustration of the consequences and damage.
- One additional quiz question per unit.
- Prohibition of use on sick/ambulatory animals: Here the use on the back is shown without addressing the illegality of the use at this location.
- Legal basis Animal welfare officers not highlighted.

Discussion

Out of the 60 people contacted, 25 answered the survey in complete form, a response rate of 41.67%. This might have been higher if all participants had been contacted directly, but some could only be reached via the public e-mail addresses of the veterinary offices in Germany. With only 25 participants, one limitation of the study is the small number of participants. However, it must be taken into account that the number of cattle slaughterhouses in Germany and the number of animal welfare officers and official veterinarians working there is lower than the number of pig abattoirs, and the number of cattle slaughtered in 2022 fell in comparison with previous years [11,12]. Accordingly, there are probably fewer experts in this field. Furthermore, this study should be seen as just one type of pre-evaluation, since two pilot modules were evaluated by animal welfare officers and official veterinarians before the eSchulTS[2] project was completed, and the training material could be evaluated in its entirety by all users after completion. A high percentage (60.0%) of our survey participants were female. One reason for the higher proportion of females participating in the study could be the situation at German veterinary universities, which currently are attended by more than 80% female students [13]. Another reason could be that compared with males, females have greater sensitivity to animal welfare [14] and consequently greater interest in contributing to a survey on this issue.

Altogether, 32.0% of the survey participants were animal welfare officers. They are familiar with training courses for

slaughterhouse employees, they are involved in developing or conducting such training courses themselves [15], and we speculate that they are critical and learned enough to evaluate other training courses as well. In addition, animal welfare officers provide work and action instructions in accordance with animal welfare considerations [6]. Five participants chose other as their profession, although we contacted only animal welfare officers and veterinary offices. It is possible that participants forwarded the mail to other colleagues with expertise in the field. This could also be the reason why three participants did not select a university education for the item level of education, even though veterinarians must be educated at this level. With an average of over 12 years in professions that require knowledge of animal welfare, it can be assumed that the survey participants have expertise in the slaughter process and/or livestock transport.

Evaluation of the animal behavior module

The design and layout of the module were highly rated by participants, with 96.0% considering it good to very good. The structuring of the content was also positively assessed by 60.0% of participants, emphasizing its effectiveness in presenting information. These results indicate that the module's design and layout contribute to its overall usability and potential for effective training. Online learning can cause frustration or little enthusiasm for many participants [16]. Nonetheless, approaches to address deficiencies in the learning experience can be found in the area of usability [17]. A well rated usability has several components and brings five attributes into training: learnability, efficiency, memorability, errors, and satisfaction [18]. Feldstein [19] said of usability: "Usability of e-learning is about the way the content is presented, not just the content itself." One participant (4.0%) gave a negative rating of 5 (poor) for the usability of the videos. Consistent with this negative evaluation, open questions for both modules were the comment, "Video guidance is complicated." The reason for this poor rating and the comment could be that the videos cannot simply be fast-forwarded and the participants had to watch each video until the end. However, this feature was set up by us on purpose to prevent people from clicking through the module without watching and learning the content of the videos. The sound quality of the explanations activated by the loudspeaker icons and the videos was rated 6 (inadequate) by one participant (4.0%). Since most participants gave a positive rating here, it is possible that this participant had technical problems with loudspeakers or headphones on their computer. Nonetheless, these ratings indicate areas where the modules can be improved, particularly with regard to the usability of the videos and sound quality. Participants found the video content to be highly comprehensible, with 96.0% considering it good to very good. Moreover, the majority (52.0%) acknowledged that the module provided valuable information, indicating its effectiveness in enhancing knowledge acquisition. In order to

acquire knowledge and to understand what has been learned, a certain amount of prior knowledge is always needed [20], which we expect the well-educated participants in our survey, animal welfare officers or official veterinarians, should have. It is a moot point whether also would apply to any less qualified slaughterhouse employees, especially if they have little school education and/or limited language skills. However, analysis of the participants' previous knowledge was outside the scope of this study. The scope of the training was generally considered to be adequate, with 64.0% rating it as good. This indicates that the animal behavior module successfully provides understandable and relevant contents. The learning content related to vision and listening was highly rated, with 100% of participants rating it good or very good. Similarly, the topic of mood states of cattle received positive feedback, with 40.0% rating it as very good. The quiz on the module was also positively evaluated, indicating that participants found it beneficial for reinforcing their learning success. The quizzes at the end of each module were only intended to reinforce and recall the knowledge learned [21]. If a quiz is too complex, it can lead to frustration among participants [21]. Nevertheless, the quiz for the animal behavior module was scored by one participant as 5 (poor), and also commented on as "ridiculous" in the open questions. The possible reasons for this rating and comment could be a misunderstanding of the operation or differing expectation towards the quiz. In the open questions it was suggested: "the clicking on the microphones should be removed", which could mean that the sound should be played directly without the learner having to click, or that reading the text aloud was considered by the participant to be unnecessary. On the one hand, the learners should not be overburdened with a voice that directly talks to them, and therefore, the ability for learners to deliberately click on the loudspeaker icons was installed. On the other hand, it is very important that learners with literacy issues can understand the lesson by having the texts read aloud. One comment was that there should be more comprehensive information. With a view to the target learner groups of less qualified slaughterhouse work hands and livestock transport drivers, the short learning units should convey the essential information relevant to animal welfare, but should not overwhelm the learners. The comment, "When it comes to noise, it should be reduced as much as possible by technical measures such as isolation", is relevant and was recommended previously [22], but noise reduction measures have to be implemented by the slaughterhouse management and are not always within the direct influence of the learners targeted by our training modules. Nonetheless, in the online training, learners are instructed to speak to the animals in a calm voice and to avoid shouting in order to keep the noise level low. In the open questions, it was also suggested that there are many other aspects that could be covered in the online training, such as loading the animals onto the transport vehicle at the farm, animal transport regulations, and

emergency slaughter regulations. A module on transportability of livestock is already underway for the online training, which will cover some of the aspects mentioned. However, although it is a very interesting and relevant topic, emergency slaughter did not fit into the aims of this study or project. Overall, the animal behavior module was well-received, with 84.0% of participants expressing their willingness to use it for training. This very positive acceptance of new animal welfare training courses could be due to the fact that there is a great need for illustrative training material for different target groups in the slaughterhouse industry in German-speaking countries [23]. Good training of employees in livestock production is vital to ensure animal welfare [22].

Evaluation of the cattle handling module

The design and layout of the cattle handling module received extremely positive ratings, with 48.0% considering it very good and 52.0% rating it as good. The usability of videos, sound quality, drawings, animations, and photos/videos were generally well-regarded. These findings suggest that the module's design elements effectively support its usability and audiovisual content. For the visual implementation in both modules, the positive ratings, and mentions in the open questions, could be because video-based e-learning with animations can lead to better learning results [24]. Similar to the animal behavior module, the usability of the videos in this module was rated as inadequate by one participant (4.0%). This could be attributed to the fact that the videos cannot be fast-forwarded, as mentioned above. And as already stated for the previous module animal behavior, the sound quality of the information read aloud by clicking on the loudspeaker icons and the sound quality of the videos were rated by as inadequate by one participant. Here, again, technical problems on the participant's computer might have contributed to this poor rating. Participants assessed the video content in the cattle handling module as highly comprehensible, with 64.0% rating it as very good. Additionally, the majority (56.0%) recognized the module as a valuable source of information, supporting its effectiveness in enhancing knowledge. The additional information provided for animal welfare officers was also well-received, highlighting its relevance. The scope of the training was rated positively, indicating that it covered the necessary content. As the animal welfare officers in the slaughterhouses are mostly veterinarians, the information videos for this target group are designed with more text and the contents are more complex. Similar to the animal behavior module, the quiz on the entire module was rated as poor by one participant. Here, again, the reason could be on the user's part or a differing expectation of the quiz on the participant's part. A low rating indicates that the participant found some aspects of the module unsatisfactory or inadequate. The interactive elements of the quiz might have irritated some of the participants. At the same time, a quiz can stimulate offers in the subject area, could convey the content better than

other learning elements, and can even have a lasting learning effect [25]. A quiz on a particular topic can help to acquire new skills or consolidate existing ones and can also be fun, thereby achieving several aims at the same time [25]. In the open questions, on the video concerning electric prod use, participants comments were, "When explaining the correct use, the cattle should stand in a single drive as instructed" and "speak less in the subjunctive, that could trivialize". This will be taken into consideration and will be used to graphically and linguistically improve our online training modules. The comment, "Visual illustration of consequences and damage" is important and will be included in an additional module of our online training. One suggestion from a participant regarding the quiz was to implement "one additional quiz question per unit". This is a valuable comment, especially in terms of reinforcing knowledge. We acknowledge, however, that it would make the modules longer (timewise) and could lead to more dropouts who do not finish their online training. Another comment was the "legal basis for animal welfare officers is not highlighted", which is true regarding the videos in this module. More information aimed at animal welfare officers was accessible by clicking an information button on the start page of this module, providing the respective legal requirements for each topic. Possibly this additional information button was not accessed by the participant, or this additional information was not regarded as detailed enough. The learning content on legal requirements and basic instructions within the cattle handling module received favorable ratings, indicating their effectiveness in providing valuable knowledge. However, there is room for improvement in certain areas, as some participants expressed suggestions for enhancement.

Conclusion

The overwhelming majority of participants evaluated the two online training modules positively, which suggests there is a need for this type of training. However, the online training modules need to be improved on the basis of participants' criticisms. Particular attention must be paid to sound quality, properly directing module content to the level of employee education. The overall aim of the set of training modules is to improve animal welfare during transport and around slaughter. Further studies will be needed to determine if animal welfare is actually improved as a result of transport and slaughterhouse employees completing the modules.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding

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LimeSurvey

With your support and practical experience, we want to evaluate two pilot modules from the area of animal welfare during transport and slaughter in order to optimise the implementation of the training.

In the following 18 questions you can evaluate the design and content of the modules animal behavior and cattle handling. At the end there will be questions about yourself. All data will be recorded and evaluated anonymously. It will take about 10 minutes to complete.

The data collected is part of the joint project eSchulTS2 funded by the Federal Ministry of Food and Agriculture (funding code: 2817806A18) and will be statistically analysed and published.

Tip: watch the training in parallel to this evaluation, this will make it easier to answer the questions.

LimeSurvey

Part A: Questions about the module animal behavior

A1. The following tables are based on the school grading system and are intended to be an assessment on your part for the module animal behavior. (1 very good, 2 good, 3 satisfactory, 4 sufficient, 5 poor, 6 inadequate)

	1	2	3	4	5	6
How satisfied are you with the design and layout?	☐	☐	☐	☐	☐	☐
How satisfied are you with the structuring of the content?	☐	☐	☐	☐	☐	☐
How satisfied are you with the usability of the videos?	☐	☐	☐	☐	☐	☐
How satisfied are you with the sound quality of the speaker icons?	☐	☐	☐	☐	☐	☐
How satisfied are you with the sound quality of the videos?	☐	☐	☐	☐	☐	☐
How satisfied are you with the drawings and animations?	☐	☐	☐	☐	☐	☐
How satisfied are you with photos and videos?	☐	☐	☐	☐	☐	☐
How satisfied are you with the usability of the quiz?	☐	☐	☐	☐	☐	☐

A2. How do you rate the following points about the module animal behavior? (1 very good, 2 good, 3 satisfactory, 4 sufficient, 5 poor, 6 inadequate)

	1	2	3	4	5	6
Comprehensibility of the video content	☐	☐	☐	☐	☐	☐
Information gain through the training	☐	☐	☐	☐	☐	☐
Scope of the training (amount of information)	☐	☐	☐	☐	☐	☐
Processing time of the training	☐	☐	☐	☐	☐	☐

A3. How would you rate the learning content of the module animal behavior? (1 very good, 2 good, 3 satisfactory, 4 sufficient, 5 poor, 6 inadequate)

	1	2	3	4	5	6
Cattle seeing	☐	☐	☐	☐	☐	☐
Cattle hearing	☐	☐	☐	☐	☐	☐
Cattle states of mind	☐	☐	☐	☐	☐	☐
Concluding quiz	☐	☐	☐	☐	☐	☐

LimeSurvey

A4. **Would you use the animal behavior module for your trainings?**

Yes ☐

No ☐

A5. **That's what I liked about the animal behaivor module (optional):**

A6. **This could be improved on the animal behavior module (optional):**

Part B: Questions about the module cattle handling

B1. **The following tables are based on the school grading system and are intended to be an assessment on your part for the module cattle handling . (1 very good, 2 good, 3 satisfactory, 4 sufficient, 5 poor, 6 inadequate)**

	1	2	3	4	5	6
How satisfied are you with the design and layout?	☐	☐	☐	☐	☐	☐
How satisfied are you with the structuring of the content?	☐	☐	☐	☐	☐	☐
How satisfied are you with the usability of the videos?	☐	☐	☐	☐	☐	☐
How satisfied are you with the sound quality of the speaker icons?	☐	☐	☐	☐	☐	☐
How satisfied are you with the sound quality of the videos?	☐	☐	☐	☐	☐	☐
How satisfied are you with the drawings and animations?	☐	☐	☐	☐	☐	☐
How satisfied are you with photos and videos?	☐	☐	☐	☐	☐	☐
How satisfied are you with the usability of the quiz?	☐	☐	☐	☐	☐	☐

LimeSurvey

B2.   How do you rate the following points about the module cattle handling? (1 very good, 2 good, 3 satisfactory, 4 sufficient, 5 poor, 6 inadequate)

	1	2	3	4	5	6
Comprehensibility of the video content	☐	☐	☐	☐	☐	☐
Information gain through the training	☐	☐	☐	☐	☐	☐
Additional information of animal welfare officers (legal basis)	☐	☐	☐	☐	☐	☐
Scope of the training (amount of information)	☐	☐	☐	☐	☐	☐
Processing time of the training	☐	☐	☐	☐	☐	☐

B3.   How would you rate the learning content of the module cattle handling? (1 very good, 2 good, 3 satisfied, 4 sufficient, 5 poor, 6 inadequate)

	1	2	3	4	5	6
Legal basis (of animal welfare officers)	☐	☐	☐	☐	☐	☐
Basic information	☐	☐	☐	☐	☐	☐
Driving with aids	☐	☐	☐	☐	☐	☐
Electric prods	☐	☐	☐	☐	☐	☐
Prohibited driving aids	☐	☐	☐	☐	☐	☐
Concluding quiz	☐	☐	☐	☐	☐	☐

B4.   Would you use the cattle handling module for your trainings?

Yes ☐

No ☐

B5.   That's what I liked about the cattle handling module (optional):

☐

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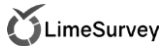
B6.   **This could be improved on the cattle handling module (optional):**

Part C: Questions on person

C1.   **How old are you?**

C2.   **What sex are you?**

female ☐

male ☐

C3.   **In which field do you work?**

Animal Welfare Officer ☐

Official veterinarian ☐

Other ▼

Other

C4.   **How long have you been working in this field (in years)?**

C5.   **On which device did you view the training?**

Computer/ Laptop ☐

Tablet ☐

Smartphone ☐

Other ▼

Other

LimeSurvey

C6.	**Further comments (optional):**

Thank you for your participation in the evaluation.

4.3 Analysis of the Knowledge Level of Slaughterhouse Employees and Evaluation of Online Training to Improve Animal Welfare

Autoren: Nicolaisen, Svea; Thöne-Reineke, Christa; Buchwald, Lisa; Kuper, Harm; Wiegard, Mechthild

Eigenanteil von Svea Nicolaisen an dieser Publikation:
SN konzipierte und erstellte die Schulungsmodul sowie die Wissenstandsanalyse, führte die Datenerhebung durch, analysierte und interpretierte die Daten und verfasste das Manuskript.

Research Article

Analysis of the Knowledge Level of Slaughterhouse Employees and Evaluation of Online Training to Improve Animal Welfare

Svea Nicolaisen[1*], Christa Thöne-Reineke[1], Lisa Buchwald[2], Harm Kuper[2], Mechthild Wiegard[1]

Abstract

The study focused on the importance of animal welfare and the need for training in the livestock industry, particularly in slaughterhouse. It reflects the public concern over animal suffering during transport and slaughter. The research aimed to assess the knowledge of slaughterhouse employees before and after their participation in an e-learning program and to evaluate their assessment of the e-learning program, with the goal of improving online training materials for animal welfare in livestock transport and slaughter. This study utilized an online platform to deliver an e-learning program on animal behavior and cattle handling. The program consisted of two pilot modules with training videos. For each module, an evaluation and a pre-test and post-test were conducted using the same set of questions. Participants were employees in German cattle slaughterhouses, and data was collected through animal welfare officers. This study involved 25 participants, predominantly German-speaking, who completed two pilot modules, a knowledge test, and an evaluation. The participants had diverse demographic characteristics, with varying years of experience and educational backgrounds. German-speaking participants performed better in the pre-test of the animal behavior module, while Romanian-speaking participants scored higher in the post-test. Romanian-speaking participants also outperformed in the cattle handling module. There was a significant improvement in scores from pre-test to post-test in both language groups. Some specific questions were sometimes incorrectly answered in the pre-test but were correctly answered in the post-test. Romanian-speaking participants took longer, potentially due to translation difficulties. Limitations included participant selection and the lack of long-term assessment. Overall, the results suggest that participants had prior knowledge, while knowledge pertaining to specific questions was improved by e-learning, possibly influenced by video-based learning.

Introduction

Animal welfare is an important topic in the current public debate [1]. In Western society, the view of the social environment and the perception of animals and their use by humans has changed [2]. According to Dirscherl [3], animal ethical issues are increasingly included in social discourse. The inclusion of animal welfare as a state target in the German Basic Law in 2002 clearly expresses society's changing values and mindsets [4]. Statements critical of society regarding modern livestock farming and the associated production of

food of animal origin have been increasingly voiced in recent years [5]. The debate focuses on animal welfare concerns and considerations of more animal-friendly husbandry and meat production systems [5]. In a representative survey conducted in Germany, a large proportion of respondents rejected methods that cause animal suffering during transport and slaughter [1]. In particular, meat production is not only about aspects of animal husbandry, but also about animal transport and the handling of live animals in the slaughterhouse [6]. The German Veterinary Association (Bundestierärztekammer e. V.) also confirms that, regardless of the size of the slaughterhouse, there are deficits in animal welfare between the process steps of unloading up to bleeding [7]. Their attitude towards livestock can influence slaughterhouse employees' behavior, which can impact the welfare of the animals [8]. The Animal Health and Welfare Committee of the European Food Safety Authority identified and characterized 40 risks to cattle welfare during slaughter [6]. In total, 39 of those 40 risks were caused by humans and are mainly associated with lack of skills or fatigue [6]. Slaughterhouse employees who have direct contact with animals must be trained to ensure animal welfare during slaughter [1,9]. National and European laws and regulations provide the general requirements for the protection of animals during slaughter and transport. Transport of animals must be carried out by approved transportation companies and by livestock drivers holding a certificate of competence [10]. Reg. (EC) No. 1099/2009 on the protection of animals at the time of killing regulates the handling of animals during stunning and slaughter. Only persons with a certificate of competence can stun and slaughter animals [11]. The certificate of competence is acquired after a training course, or after acknowledgment of and apprenticeship or study [11]. In Germany, the provisions of Regulation No. 1099/2009 are implemented and supplemented by the Animal Welfare Slaughter Ordinance [12]. This ordinance requires that for the certificate of competence, both theoretical and practical examinations must be passed [12]. The certificate of competence is issued by an official institution, and animal welfare officers at slaughterhouses can contribute to personnel training by providing them with the background information necessary to obtain the certificate [13]. Animal welfare officers are responsible for verifying that personnel have the necessary knowledge to carry out their duties and for ensuring that these competencies are maintained [13]. The certificate of competence is valid indefinitely, unless it is withdrawn after violation of Regulation (EC) No. 1099/2009 [12].

The aims of the study were to analyze the level of knowledge of slaughterhouse staff before and after participation in an e-learning program and to test and evaluate the conception and implementation of the animal welfare training. This study was conducted as part of the joint research project eSchulTS2 (development of target group-specific learning modules to improve animal welfare during the transport and slaughter of cattle and pigs and is intended to support improvement of online training materials.

Materials and Methods

Online Platform

The online platform tet.folio [14], located on a server of the Free University of Berlin, was used to create the e-learning program. The project team eSchulTS2 were the only authors who had access to the administration and stored data of the e-learning platform. No server, platform or content maintenance or updating was scheduled during the study period.

Design of the e-learning program and the knowledge test

The e-learning program consisted of two pilot modules, and the languages German or Romanian could be selected in advance. The first pilot module, animal behavior, consisted of four sections with three training videos and a final quiz. The main topics in this module were to understand the sight and hearing of cattle and to recognize their different states of mind (Table 1). The second pilot module, cattle handling, contained five sections, five training videos, and a final quiz. In this module, the main topics were animal-friendly moving of cattle with and without driving aids (Table 1). For each module, the same knowledge test (Table 2) was placed before (pre-test) and after (post-test) the learning. In order to assess the respondents' level of knowledge, the questions were the same before and after each pilot module. The questions were developed within the project team and adapted to the content and wording of the modules. In order not to overburden the participants and to prevent them from dropping out of the modules, there were only eight questions per pilot module (four before and four after the module). Each question had three different possible answers, but only one answer was correct. Test questions were single-choice questions; the pre- and post-test were each scored 4 points in each module. The knowledge test had accessibility-friendly options, whereby participants clicked on loudspeaker symbols to listen to the questions and possible answers.

Design of the evaluation

The evaluation was included in the tet.folio program and had to be filled in by the participants at the end of each module. For each module, the evaluation contained 13 statements and 2 open questions (Table 3). The answers to the evaluation statements used a five-point Likert scale: 1 (I fully agree), 2 (I agree) representing an agreement and 3 (neither nor) representing neither agree nor disagree, 4 (do not agree) and 5 (do not agree at all) representing a disagreement. To keep the evaluation simple and understandable, the Likert scale was presented in the form of five different smileys that could be selected.

Table 1: Topics and objectives of the pilot modules.

Module Topic	Learning objectives
Animal behavior	o Understand how cattle see and what to be aware of when working with cattle.
	o Understand how cattle hear and what to be aware of when working with cattle.
	o Be able to recognize friendly and aggressive behavior of cattle.
Cattle handling	o Basic instructions for handling the cattle-work safety, driving methods, and driving without aids.
	o Driving with the help of the voice, body language, and the paddle.
	o Rules for the use of electric prods in cattle.
	o Inappropriate driving aids that can cause pain, suffering, and damage.

Table 2: Design of the knowledge test.

ID Question	Question	Answers
Animal behavior		
Q1 Pre/Post AB	Which statement about sight is correct?	o Cattle and humans can see equally well.
		o Humans can see worse than cattle.
		o Cattle can see worse than humans.
Q2 Pre/Post AB	What should be considered when working with cattle?	o Cattle always work with you; you do not have to pay attention to anything.
		o Stay calm when handling the cattle and do not make any sudden movements.
		o Make quick and hectic movements to herd the cattle.
Q3 Pre/Post AB	Which statement about hearing is correct?	o Cattle can only perceive deep dull sounds.
		o Cattle have sensitive hearing, so cattle should be spoken to in a calm voice.
		o Unfamiliar and shrill sounds do not cause stress in cattle.
Q4 Pre/Post AB	What are the signs of aggressive behavior?	o Loud vocalizations such as growling and roaring, digging with the front legs, bumping and reaching head movements.
		o Attentive forward gaze, straight back line, loosely hanging tail.
		o Chewing, curious look, head down.
Cattle handling		
Q1 Pre/Post CH	You are driving cattle, what should you keep in mind?	o Be alert while working, always keep a sufficient distance from the animal and always look for an escape route.
		o Always touch the animal with your hands when driving it forward.
		o Cattle are calm and balanced; you do not need to pay attention to anything.
Q2 Pre/Post CH	Which statement about herding is correct?	o The quickest way to reach your target is to run hectically after the cattle when driving them.
		o Drive the cattle slowly and calmly to avoid slips and falls.
		o Always use a driving aid, only then will cattle run in the desired direction.
Q3 Pre/Post CH	Which statement about the use of electric prods is correct?	o The electric prod may only be used once if the animal does not want to continue walking before being separated for stunning.
		o The electric prod may be used in all areas of the farm (transporter, lairage pen, drive for stunning).
		o The electric prod may be used several times (up to 3 times) on cattle in exceptional cases.
Q4 Pre/Post CH	Which statement about driving aids is correct?	o Electric prods should only be used as a last resort and only under strict legal conditions.
		o Sharp objects such as forks can also be used as prods with gentle pressure.
		o Whips can be helpful driving aids.

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Table 3: Design of the evaluation.

Evaluation part 1 – curriculum					
	I fully agree	I agree	Neither nor	Do not agree	Do not agree at all
I found the training clearly structured in terms of content.	🙂	🙂	😐	🙁	🙁
The training was communicated in a way that I could understand.	🙂	🙂	😐	🙁	🙁
I was able to understand the aim of the training.	🙂	🙂	😐	🙁	🙁

Evaluation part 2 – usability					
	I fully agree	I agree	Neither nor	Do not agree	Do not agree at all
The photos and videos were easy to watch.	🙂	🙂	😐	🙁	🙁
The drawings and animations were easy to recognize.	🙂	🙂	😐	🙁	🙁
The speaker spoke in an understandable way.	🙂	🙂	😐	🙁	🙁
I was able to orientate myself well in the training.	🙂	🙂	😐	🙁	🙁

Evaluation part 3 – comprehension					
	I fully agree	I agree	Neither nor	Do not agree	Do not agree at all
I understood all the words in the training.	🙂	🙂	😐	🙁	🙁
I understood the content of the training.	🙂	🙂	😐	🙁	🙁
The scope of the training was appropriate for solving the tasks.	🙂	🙂	😐	🙁	🙁

Evaluation part 4 – transfer					
	I fully agree	I agree	Neither nor	Do not agree	Do not agree at all
The content of the training relates thematically to my work.	🙂	🙂	😐	🙁	🙁
I have learned something new for my work in the training.	🙂	🙂	😐	🙁	🙁
What I learned in the training I can apply to my work in the future.	🙂	🙂	😐	🙁	🙁

Open questions (optional)	
These are the things I liked about the training:	
These are the things I did not like about the training:	

Setting

The knowledge test took place from December 2022 to the end of January 2023. In prior consultation with the cooperating slaughterhouse companies an internet-capable computer with loudspeaker or headset was provided for the participants. The participants were employees in various German cattle slaughterhouses. The animal welfare officers of the slaughterhouses were sent the link to the pilot modules, a list of user names and passwords, and an Excel spreadsheet to be filled in by them with further information about the participants. The animal welfare officer collected the following demographic information from participants after they completed both knowledge tests: age, gender, position in slaughterhouse, years in slaughterhouse, years of formal education, country of origin, and ability to read and write. Each participant was seated alone at a computer and provided with their own username and password in order they could log in and to enable retrospective linking of participant with collected data. After the knowledge tests and evaluations were completed, the animal welfare officers sent the anonymized MS Excel (Microsoft®) spreadsheet to the authors. In

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addition, the cooperating slaughterhouse company was not able to see how their employees performed in the knowledge test. The participants were not provided with their knowledge test results. After the end of the response period, the results of the knowledge tests and evaluations were exported from tet. folio to MS Excel, and the statistical program SPSS (IBM®) was used to carry out a statistical evaluation in the form of descriptive statistics and a t-test ($\alpha = 0.05$) to compare the pre- and post-tests.

Results

Demographic data

A total of 25 participants viewed both pilot modules, completed the knowledge tests, and evaluated the modules. The demographic characteristics of the study participants are shown in table 3. Most (22/25) participants chose German as their language for e-learning, while 3 participants chose Romanian. The group had an age average of 42.9 years, the youngest participant was 28 and the oldest 65 years old (Table 3). Of the 25 participants, 7 were female, 17 were male and one unknown. Most (86.4%) of the German-speaking participants had a 3-year apprenticeship or a higher degree, while 2 of the 3 Romanian participants had no apprenticeship or higher degree. Most participants had a position in slaughterhouse management (32.0%), followed by butchers (28.0%) and veterinarians (20.0%). Participants' countries of origin were Germany, 64.0%, Romania, 12.0%, and other

Table 4: Demographics of slaughterhouse employees by language selected.

	German (n = 22)	Romanian (n = 3)	Overall (n = 25)
Age			
Mean (SD)	43 (12.7)	42.3 (4.0)	42.9 (11.85)
Median [Min, Max]	40.5 (27.0, 65.0)	43.0 (38.0, 46.0)	41.0 (28.0, 65.0)
Not stated	2 (9.0%)	0 (0.0%)	2 (8.0%)
Gender			
Female	7 (31.8%)	0 (0.0%)	7 (28.0%)
Male	14 (63.6%)	3 (100.0%)	17 (68.0%)
Not stated	1 (4.5%)	0 (0.0%)	1 (4.0%)
Education level			
PhD	5 (22.7%)	0 (0.0%)	5 (20.0%)
Master degree	1 (4.5%)	0 (0.0%)	1 (4.0%)
Bachelor degree	1 (4.5%)	0 (0.0%)	1 (4.0%)
Apprenticeship	12 (54.5%)	1 (33.3%)	13 (52.0%)
No apprenticeship	2 (9.0%)	2 (66.6%)	4 (16.0%)
Not stated	1 (4.5%)	0 (0.0%)	1 (4.0%)
Position in slaughter plant			
Veterinarian	5 (22.7%)	0 (0.0%)	5 (20.0%)
Butcher	5 (22.7%)	2 (66.6%)	7 (28.0%)
Slaughterhouse management	8 (36.4%)	0 (0.0%)	8 (32.0%)
Other	3 (13.6%)	1 (33.3%)	4 (16.0%)
Not stated	1 (4.5%)	0 (0.0%)	1 (4.0%)
Country of origin			
Germany	16 (72.7%)	0 (0.0%)	16 (64.0%)
Romania	0 (0.0%)	3 (100.0%)	3 (12.0%)
Other	5 (22.7%)	0 (0.0%)	5 (20.0%)
Not stated	1 (4.5%)	0 (0.0%)	1 (4.0%)
Years in slaughter plant			
Mean (SD)	6.5 (4.7)	9.7 (1.2)	6.9 (4.5)
Median [Min, Max]	5.5 (0.5, 17.0)	9.0 (9.0, 11.0)	6.0 (0.5, 17.0)
Not stated	1 (4.5%)	0 (0.0%)	1 (4.0%)
Ability to read and write			
Yes	21 (95.5%)	3 (100.0%)	24 (96.0%)
No	1 (4.5%)	0 (0.0%)	1 (4.0%)

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countries, 5.0% (Ukraine, Argentina, Iraq, and Russia). The German-speaking participants had an average of 6.5 years of experience in the slaughter industry and the Romanian-speaking participants 9.7 years. One participant reported they were unable to read and write.

Knowledge test

The participants needed an average of 35 minutes to complete both modules, including the knowledge tests (Table 4). The German-speaking participants needed an average of 6 minutes less time than the Romanian-speaking participants. German-speaking participants had a higher score (3.7) on the pre-test of the animal behaviour module than Romanian-speaking participants, but Romanian-speaking participants scored better on the post-test (4.0) (Table 5). Romanian-speaking participants performed better in the pre- and post-test (4.0, 4.0) of the cattle handling module than the German-speaking participants (3.7, 3.9). Scores for both language groups significantly improved from the pre-test to the post-test ($P < 0.05$). The bar chart shows that participants with no apprenticeship scored lower on the pre-test than participants with apprenticeship or a higher degree (Figure 1). In pre-tests, more correct answers were selected in cattle handling than in animal behaviour (Figure 2). In the pre-test, the first question (Q1 Pre AB) in animal behaviour and the fourth question (Q4 Pre CH) in cattle handling were the most frequently incorrectly selected answers, both with 12% (Figure 2). At post-test, the second question (Q2 Post AB) in animal behaviour and questions three (Q3 Post CH) and four (Q4 Post CH) in cattle handling were answered 100% correctly (Figure 2).

Evaluation

In the first part of the animal behavior module evaluation, participants were asked to rate the curriculum. Most, 87.0% (n = 20), fully agreed that the course was clearly structured in terms of content. The remaining 13.0% (n = 3) agreed. The majority, 82.6% (n = 19), of participants fully agreed, and 17.4% (n = 4) agreed that the training was taught in a way that could be understood. Among participants, 87.0% (n = 20) fully agreed and 13.0% (n =3) agreed that they could understand the aim of the training (Figure 3). The second part of the animal behavior module evaluation focused on usability. Almost all participants, 91.3% (n = 20), fully agreed that the photos and videos were easy to view, and 8.7% (n = 2) agreed. Drawings and animations were easy to

recognize, as 87.0% (n = 20) fully agreed and 13.0% (n =3) agreed. Of the participants, 82.6% fully agreed, 13.0% (n = 3) agreed, and 4.3% (n = 1) neither agreed nor disagreed that the narrator spoke in an understandable manner. Most, 91.3% (n = 21), fully agreed with the statement that they were able to orient themselves well in the module, and two participants (8.7%) agreed (Figure 3). The third part of the animal behavior module evaluation focused on comprehension. Of the participants, 82.6% (n = 19) fully agreed and 17.4% (n = 4) agreed that they understood all the words in the training. The majority (91.3% (n = 21) fully agreed and 8.7% (n =2) agreed) confirmed they understood the content of the training and that the scope of the training was appropriate for solving the tasks (Figure 3). The fourth part of the animal behavior module evaluation dealt with transfer of knowledge from training to practical work. Participants felt the content of the training related thematically to their own work; 87.0% (n = 20) fully agreed, 8.7% (n = 2) agreed and one participant neither agreed nor disagreed. For the statement 'I learned something new for my job during training', 56.5% (n = 13) fully agreed, 13.0% (n = 3) agreed, 17.4% (n = 4) neither agreed nor disagreed, but 4.3% (n = 1) disagreed, and 8.7% (n = 2) did not agree at all. When asked to rate the statement, 'what I learned in training I can apply to my work in the future', 65.2% (n = 15) fully agreed, 26.1% (n = 6) agreed, 4.3% (n = 1) neither agreed nor disagreed, and one participant did not agree at all (Figure 3).

In the first part of the of the cattle handling module evaluation, participants were asked to rate the curriculum (Figure 4). Most, 79.2% (n = 19), fully agreed that the course was clearly structured in terms of content as 12.5% (n = 3) agreed and 8.3% (n = 2) neither agreed nor disagreed. Most 79.2% (n = 19) participants fully agreed, 8.3% (n = 2) agreed, and 12.5% (n = 3) neither agreed nor disagreed that the training was communicated in an understandable manner. Among participants, 79.2% (n = 19) fully agreed, 16.7% (n = 4) agreed, and 4.2% (n = 1) neither agreed nor disagreed that they were able to understand the aim of the training (Figure 4). The second part of the cattle handling module evaluation focused on module usability. Almost all participants, 79.2% (n = 19), fully agreed and 16.7% (n = 4) agreed, although 4.2% (n = 1) disagreed that the photos and videos were easy to view. That the drawings and animations were easy to recognize, 79.2% (n = 19) fully agreed and 20.8% (n = 5) agreed. Of the participants, 83.4% (n = 20)

Table 5: Time required for modules and knowledge tests

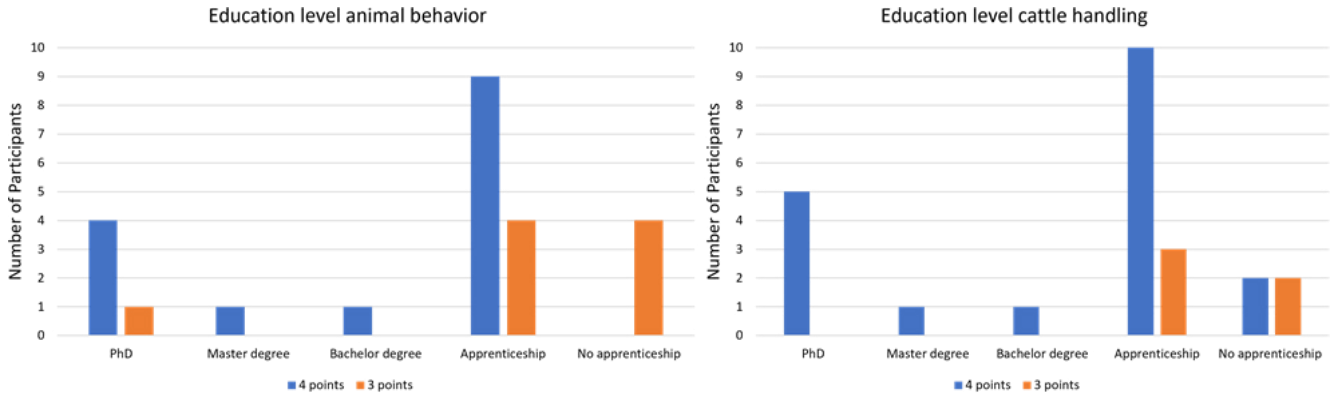|	German (n = 22)	Romanian (n = 3)	Overall (n = 25)
Required time (h)			
Animal behavior (mean)	00:17:59	00:19:09	00:18:08
Cattle handling (mean)	00:16:19	00:21:35	00:16:59
Total (mean)	00:34:18	00:40:44	00:35:07

Figure 1: Relationship between number of participants and the level of education in the pre-test.
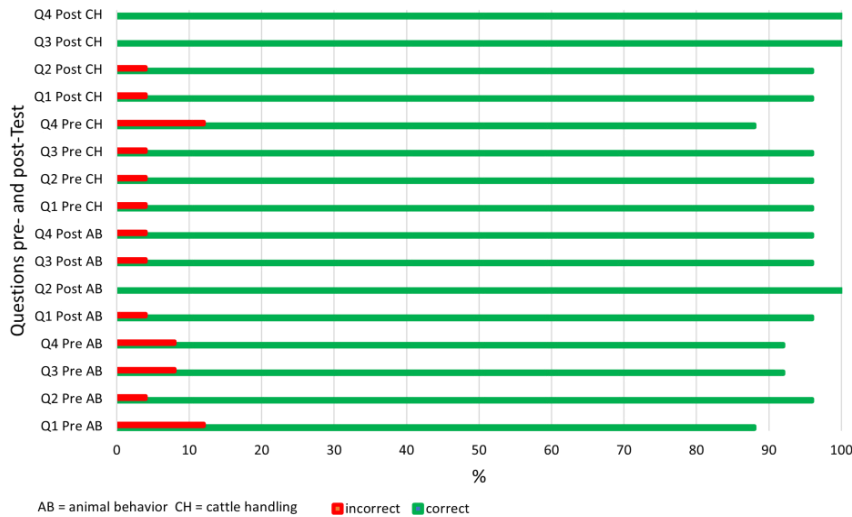

Figure 2: Pre- and post-test comparison of the number of correct and incorrect answers from both modules.

Table 6: Pre-test score, post-test score, and difference in test scores by language group. Significance is denoted by superscripts * at $P < 0.05$.

	German (n = 22)	Romanian (n = 3)	Overall (n = 25)
Animal behavior			
Pre-Test Score			
Mean (SD)	3.7 (0.5)	3.0 (0.0)	3.6 (0.5)*
Median [Min, Max]	4.0 [3.0, 4.0]	3.0 [3.0, 3.0]	4.0 [3.0, 4.0]
Post-Test Score			
Mean (SD)	3.9 (0.3)	4.0 (0.0)	3.9 (0.3)*
Median [Min, Max]	4.0 [3.0, 4.0]	4.0 [4.0, 4.0]	4.0 [3.0, 4.0]
Difference in Score			
Mean (SD)	0.2 (0.0)	1 (0.0)	0.3 (0.0)
Cattle handling			
Pre-Test Score			
Mean (SD)	3.7 (0.5)	4.0 (0.0)	3.8 (0.4)*
Median [Min, Max]	4.0 [3.0, 4.0]	4.0 [4.0, 4.0]	4.0 [3.0, 4.0]
Post-Test Score			
Mean (SD)	3.9 (0.3)	4.0 (0.0)	3.9 (0.3)*
Median [Min, Max]	4.0 [3.0, 4.0]	4.0 [4.0, 4.0]	4.0 [3.0, 4.0]
Difference in Score			
Mean (SD)	0.2 (0.0)	0.0 (0.0)	0.1 (0.0)

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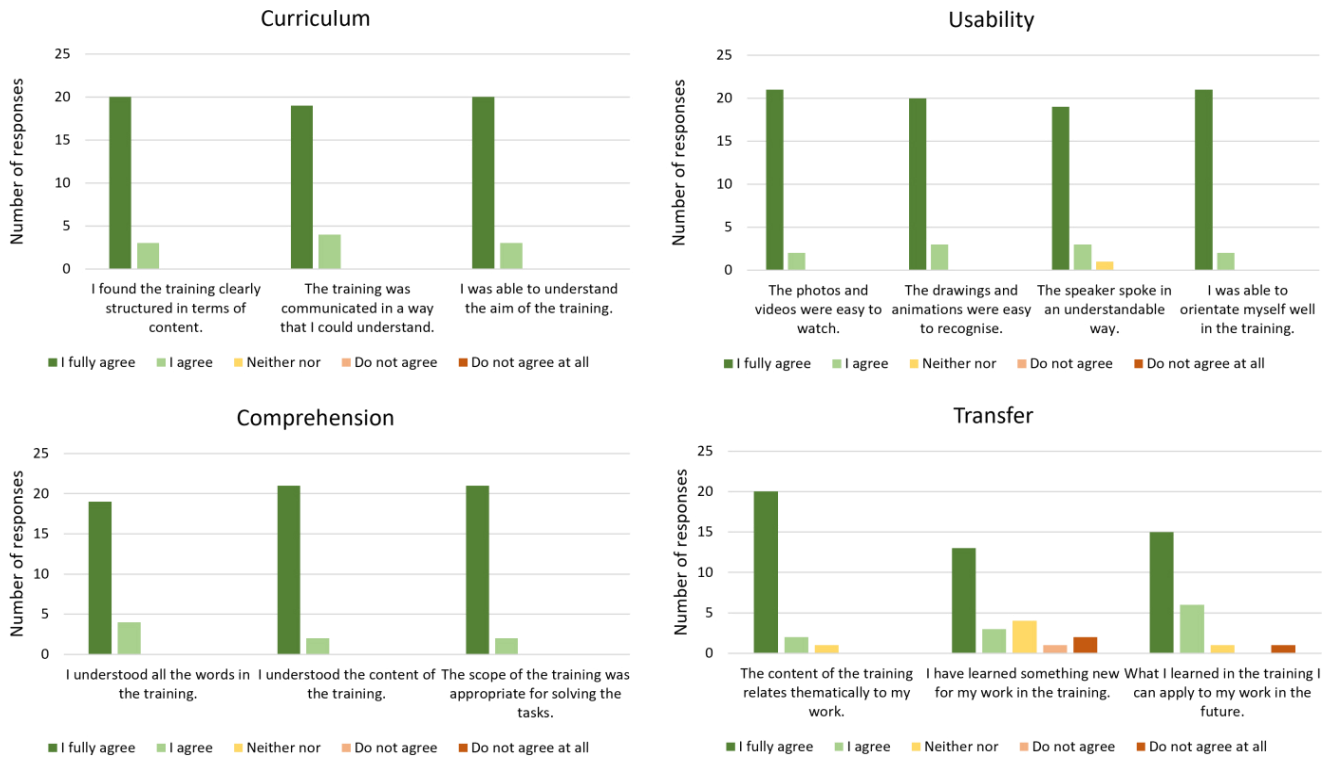
Figure 3: Results of the evaluation of the animal behavior module in the areas of curriculum, usability, comprehension, and transfer (n = 23).
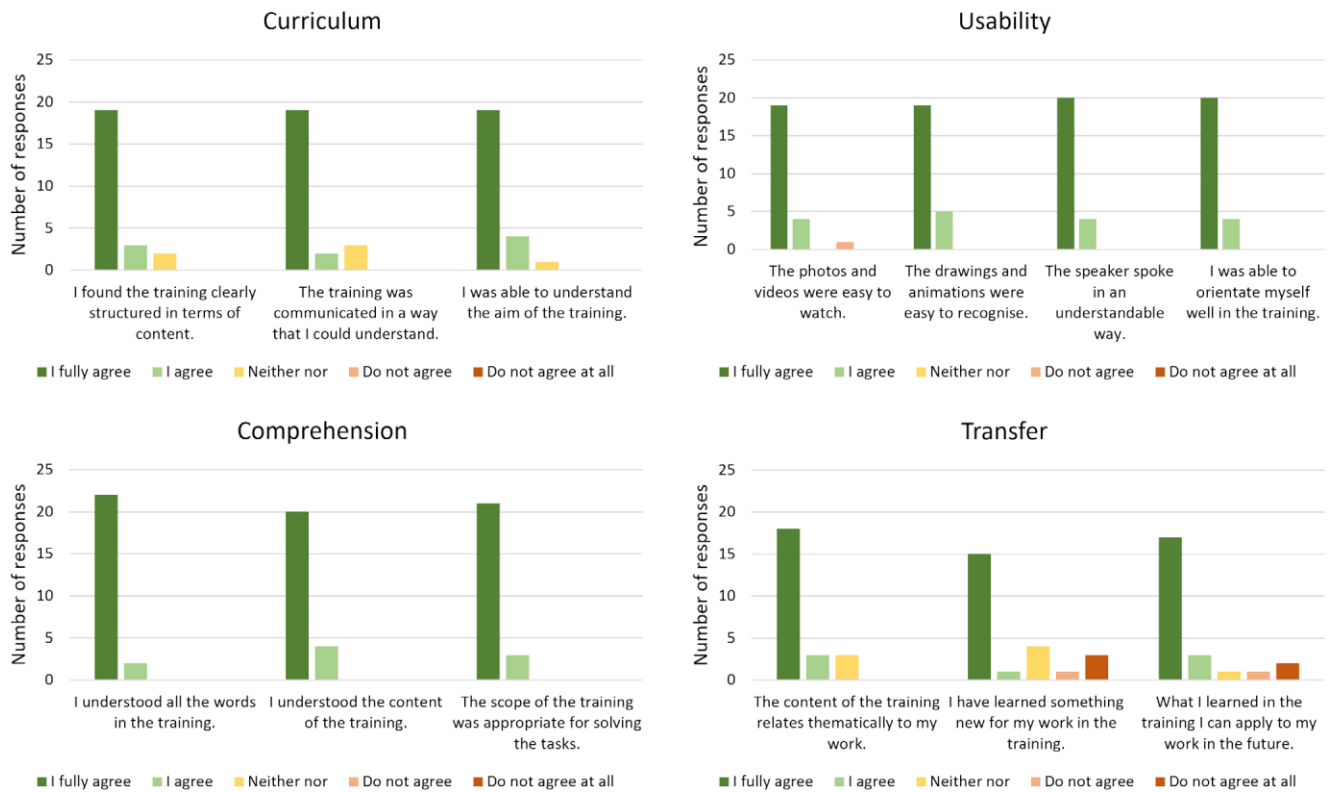

Figure 4: Results of the evaluation of the cattle handling module in the areas of curriculum, usability, comprehension, and transfer (n = 24).

fully agreed and 16.7% (n = 4) agreed that the narrator spoke understandably. To the statement that they were able to orient themselves well in the module, 83.3% (n = 20) fully agreed and four participants (16.7%) agreed (Figure 4). The third part of the cattle handling module evaluation focused on participants' understanding of the module. Of the participants, 91.7% (n = 22) fully agreed and 8.3% (n = 2) agreed that they understood all of the words in the training. The majority, 83.3% (n = 20), fully agreed and 16.7% (n = 4) agreed that they understood the content of the training. Altogether, 87.3% (n = 20) of participants fully agreed and 12.5% (n = 3) agreed that the scope of the training was appropriate for solving the tasks (Figure 4). The fourth part of the cattle handling module evaluation focused on knowledge transfer from module training to practice. Most participants, 75.0% (n = 18) fully agreed that the training related thematically to their work, 12.5% (n = 3) agreed, and 12.5% (n = 3) neither agreed nor disagreed. Over half the participants, 62.5% (n = 15), fully agreed that they had learned something new for their jobs during training, 4.2% (n = 1) agreed, and 16.7% (n = 4) neither agreed nor disagreed, but 4.2% (n = 1) disagreed or did not agree at all (12.5%; n = 3). When asked about the statement, 'what I learned in training I will be able to apply to my work in the future,' over three-quarters of participants either fully agreed, 70.8% (n = 17), or agreed, 12.5% (n = 3), while 4.2% (n = 1) neither agreed nor disagreed, but 4.2% (n = 1) disagreed, and 8.3% (n = 2) did not agree at all (Figure 4). A total of 10 comments were written in reply to the open questions (Table 6).

Discussion

Ultimately, the aim of this e-learning training course for slaughterhouse employees was to demonstrate whether employees who participated in the online training were able to improve their knowledge of cattle handling and animal behavior, judged by pre-test and post-test scores. The demographic data on the selected language in the e-leaning training course (German or Romanian) in relation to the reported demographic information (country of origin) was consistent. The demographic data collected also confirmed previous findings; most slaughterhouse workers are from Germany, followed by a large number of workers from Romania [15]. In terms of the time required for the modules, the Romanian-speaking participants took longer than the German-speaking group. The Romanian translations kindly provided by employees of the slaughterhouse involved in the project, and it is possible the translations were difficult, which could have resulted in the Romanian-speaking participants taking longer for the modules. Marchitan [16] stated that Romanian is a Romance language that has preserved the historical meaning for many lexical items, which leads to confusion for translators who do not have a complete command of the language. It is possible that the group of those who took longer to complete the modules than others had reading deficits, even though accessibility was high, as loudspeaker symbols allowed participants to listen to all texts. Due to work commitments, it is also possible that some employees could take less time for the training than others. One limitation of this study was that the selection of participants was carried out by animal welfare officers. It is, therefore, not clear if these participants simply had time for the training, or if they were especially chosen in order to perform as well as possible in the tests. The animal welfare officers stated that all participants could read and write, but it

Table 7: Positive comments (+) and suggestions for improvement (-) for the modules written by the participants. Comments were translated and summarized by the authors from the German originals.

Comments given in response to open questions:
+   I thought everything was fine.
+   My knowledge was refreshed by the module.
+   The animations and videos were meaningful, possibly showing cows with aggressive behavior in videos.
+   The videos that were filmed in the pasture.
+   Great explained.
-   Real videos of aggressive cattle are missing! And it is not able to be recognized after the assignment of the 4 cattle which cattle one assigned correctly and which not.
-   The question about vision with good or bad is kept very open, possibly specify to visual acuity or all-around vision.
-   It is not clearly regulated by law how often the electric prod can be used.
-   The animation on the topic "Use of the electric prod in the area of separation". No separation is shown here. In the background, a corner of a building is indicated, but unfortunately no separation is shown.
-   The statement about the driving aids is not well chosen. The driving paddle belonged in with it.

can be assumed that illiterate people also work at slaughterhouses, and it would have been interesting to find out how these staff would have performed. In Germany, about 6.2 million adults are considered functionally illiterate, and 47.4% of them do not have German as their language of origin [17]. A limitation of the study is the small number of only 25 participants. However, it should be taken into account that the number of people working at cattle slaughterhouses in Germany is smaller than the in pig slaughterhouses [18]. Accordingly, there are probably fewer available employees who can participate in training cattle welfare compared with in pig welfare. Another limitation of the study was that the post-tests were only administered once per module, immediately after module completion. While these measurements could indicate a short-term memory gain, it is impossible to know how much knowledge was retained by course participants in the long term- for this, additional post-tests are needed after several weeks or months. In addition, further exploration of the impact of the training on Romanian-speaking participants was limited in this study due to the small sample size (n = 3). Both language groups (German and Romanian) improved between pre-test and post-test scores. In the animal behavior module, the Romanian-speaking participants showed the greatest differences between the pre-test and post-test scores, even though their pre-test scores were the lowest of the two language groups. In the pre-test, the levels of knowledge in both language groups were high, possibly due to the participants' years (mean 6.9 years) of experience in slaughterhouse work. These results show that the participants already had good knowledge of animal behavior and cattle handling before the online training. This could be due to the fact that the slaughterhouses, in addition to the certificate of competence, also conducts further training for the employees on the topic of animal welfare. A previous study conducted in German-speaking countries showed that slaughter companies train their employees primarily once per year [15]. In the pre-test, the employees with post-school education performed better than the employees without training. It should be noted that it is not easy to compare training from abroad with the German standards for education. However, immigrants can have lower skills than natives, including German reading skills, and lower levels of education [19-21]. Questions Q1 Pre AB and Q4 Pre CH were the most frequently answered incorrectly. In previous courses/training, these questions could have been provided with misleading answers or been covered inappropriately. Questions Q2 Post AB, Q3 Post CH, and Q4 Post CH were answered 100% correctly in the post-test. In contrast to the other sections, there were two animated videos in the cattle handling module that discussed the learning content of questions Q3 Post CH and Q4 Post CH. A previous study showed that video-based e-learning with animation can lead to better learning outcomes [22]. It is possible that this type of knowledge transfer was particularly effective for our participants. In the evaluation,

there was great agreement among the participants concerning the animal behavior module in the areas of curriculum design and comprehension of the module. In the usability of the animal behavior module, there was one rating of 'neither nor' for the statement on the way the narrator spoke. Since most of the participants agreed, it is possible that this participant had technical problems with the speakers or headphones on their computer. For the animal behavior module, the greatest number of negative evaluations were given in the area of knowledge transfer. Three participants disagreed with the statement that the training had taught them something new for their work. The reasons for this could be that the participants were well trained or that this training was not comprehensive enough. It is also possible that some participants were overconfident in stating their information competencies compared to their actual competencies, so displaying behavior known as the Dunning-Kruger effect [23]. One participant disagreed with the statement that they can use the information learned for their work in the future. This may be because this participant does not work in the live cattle sector of the slaughterhouse, or the training did not provide sufficient information for their work. For the cattle handling module, some participants neither agreed nor disagreed with the curriculum design in terms of the structure of the learning content, communication, and objectives of the training. The reason for this could have been the learning objectives of the cattle handling module, which deals, among other things, with the controversial topic of electric prodding. However, the majority of participants agreed with the design of the curriculum. The transfer aspects of the cattle handling module, as for the animal behavior module, were not evaluated agreeably in terms of what was newly learned and how it could be applied to future work. Again, this could be because the participants were very well educated, or the training module had no new information to offer. In the open questions on the animal behavior module, there were comments that real videos of aggressive cattle were missing and that the statements on the topic of vision should be made more concrete. These comments are useful and should be taken into account in further revision of the training. In the cattle handling module, one participant commented, 'it is not clearly regulated by law how often the electric prod can be used', which is untrue, as Regulation No. 1099/2009 states that electric prodding of only a maximum of one second duration can be applied to cattle, and it may not be repeated if the cattle do not react. One participant criticized the presentation of the separation of cattle while using the electric prod, which we regard as a good suggestion that should be taken into account in the module revision. For the comment, 'the statement about the driving aids is not well chosen, the driving paddle belonged in with it', it was unclear what exactly statement should be improved and included in a revision. The modules were generally given positive approval ratings by the participants, which indicates the modules

provided further information and knowledge. However, there is room for module improvement in some areas, as some participants expressed suggestions for improvement.

Conclusion

This study shows that employees at slaughterhouses were able to improve their measured knowledge of cattle handling and animal welfare through the online training provided in this study. The two modules studied should be improved in accordance with the results of this study. Given the largely positive view participants have of the training they undertook, other e-learning materials with different learning objectives around animal welfare at slaughter should be made available to employees. The development and implementation of culturally, intellectually, and linguistically appropriate training for slaughterhouse employees must be future priorities for slaughterhouse companies.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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5. Diskussion

Die Bedeutung des Tierschutzes in der Transport- und Schlachtbranche verändert sich mit der Entwicklung von gesellschaftlichen und ethischen Werten (Deutscher Ethikrat 2020). Die systematische Literaturrecherche beleuchtete das komplexe Thema des Tierschutzes beim Transport und der Schlachtung von Rindern im Rahmen der Gesetzgebung der Europäischen Union. Bei den zwei Studien, "Analysis of the Knowledge Level of Slaughterhouse Employees and Evaluation of Online Training to Improve Animal Welfare" und " Evaluation of Online Training to Improve Animal Welfare of Cattle during Transport and Slaughter from the Perspective of Animal Welfare officers and official Veterinarians", wurde der Kenntnisstand von Mitarbeitenden und das Potential der entwickelten Onlineschulung zur Verbesserung des Tierschutzes bei Transport und Schlachtung von Rindern getestet und evaluiert.

Die Europäische Union hat umfassende Vorschriften (Verordnung (EG) Nr. 1/2005 und Verordnung (EG) Nr. 1099/2009) zur Regelung des Tierschutzes während des Transports und der Schlachtung erlassen. Diese Vorschriften legen strenge Anforderungen an den Umgang mit Tieren fest, wie unter anderem die Bewertung der Transportfähigkeit, Regelungen zu Transportbedingungen und geeignete tierspezifische Betäubungsmethoden. Diese rechtlichen Rahmenbedingungen zielen darauf ab, sicherzustellen, dass Tiere während des Transports und der Schlachtung sorgsam behandelt werden. Die Sachkunde weist die Kenntnisse zum Umgang mit Tieren nach und kann durch die Teilnahme an einem Lehrgang, einer abgeschlossenen Ausbildung oder eines Studiums erworben werden und ist Grundlage für einen Befähigungsnachweis (Verordnung (EG) Nr. 1099/2009). Dieses Zertifikat ist ein Schlüsselelement zur Gewährleistung eines ordnungsgemäßen Umgangs mit Tieren.

Ein zentrales Thema in der Literatur ist die bedeutende Rolle der Mensch-Tier-Interaktionen bei der Sicherstellung des Tierschutzes von Rindern. Mitarbeiter:innen in Schlachtbetrieben und Tiertransporteur:innen haben direkten Kontakt zu den Tieren und dies macht ihre Kenntnisse und Erfahrungen für das Wohl der Tiere unerlässlich (Europäische Kommission 2005). Gut ausgebildete Mitarbeiter:innen können den Umgang mit den Tieren schonend gestalten oder gar verbessern und dadurch potenzielle Verstöße vermeiden. Die Europäische Behörde für Lebensmittelsicherheit (EFSA) hat 40 Risiken für das Wohl der Rinder während der Schlachtung identifiziert, wobei fast alle auf menschliche Handlungen und Verhaltensweisen zurückzuführen sind (EFSA 2020). Diese Risiken sind hauptsächlich mit einem Mangel an Kenntnissen und Fähigkeiten bzw. Qualifikationen oder Erschöpfung bei den am Transport und der Schlachtung beteiligten Personen

verbunden (EFSA 2011, EFSA 2020). Die EFSA empfiehlt präventive Maßnahmen wie Schulungen von Tiertransporteur:innen und Mitarbeiter:innen in Schlachtbetrieben, um diese Risiken zu minimieren (EFSA 2011, EFSA 2020).

Der Transport von Rindern vom landwirtschaftlichen Betrieb zum Schlachtbetrieb ist ein entscheidender Prozessschritt in der Lebensmittelproduktion. Die Bewertung der Transportfähigkeit von Rindern vor dem Verladen ist obligatorisch, um sicherzustellen, dass die Tiere körperlich in einem Zustand sind, der einen Transport erlaubt (Europäische Kommission 2005). Die Bewertung der Transportfähigkeit von Milchkühen kann jedoch aufgrund von komplexen Gesundheitszustände, wie Stoffwechselerkrankungen und Lahmheiten, besonders herausfordernd sein (Dahl-Pedersen et al. 2015). Unterschiede hinsichtlich der Bewertung der Transportfähigkeit zwischen Tiertransporteur:innen, Landwirt:innen und Tierärzt:innen unterstreichen die Notwendigkeit umfassender Schulungen (Herskin et al. 2017). Eine solche Schulung sollte neben Themen wie tierartspezifisches Wissen auch Anforderungen an das Transportfahrzeug, den Umgang mit Tieren und Arbeitssicherheit abdecken (Europäische Kommission 2005).

Die Planung des Transportes hat eine besondere Bedeutung, einschließlich Überlegungen zu tatsächlichen Transportrouten, Fahrbedingungen, Gruppengröße der zu transportierenden Tiere und Beförderungsdauer (Europäische Kommission 2005). Darüber hinaus sollten der Fahrstil und seine Auswirkungen und die Tierschutz relevante Bedeutung einer umsichtigen Fahrweise berücksichtigt werden, um den daraus resultierenden Stress der Tiere während des Transports zu minimieren (Stockman et al. 2013, Loth 2015).

Die Abläufe innerhalb eines Schlachtbetriebes haben ebenfalls erhebliche Auswirkungen auf den Tierschutz. Es gibt verschiedene tierschutzrelevante Aspekte, wie das Verhalten von Rindern und deren Reaktionen auf Stress (Hultgren et al. 2014, Bourguet et al. 2015, Hultgren et al. 2020), welche z. B. durch einen zu hohen Lärmpegel im Lebendviehbereich oder durch umliegende Maschinen bedingt sein können (Grandin 2001).

Die Literaturrecherche betont die Bedeutung von geeigneten Betäubungsmethoden, bzw. die korrekte Durchführung, wobei beim Rind der Schwerpunkt auf der Betäubung mittels Bolzenschussgeräten liegt. Die Sicherstellung, dass die genutzten Geräte sich technisch in gutem Zustand befinden und ordnungsgemäß gewartet und gereinigt werden, ist entscheidend, um Fehlschüsse während der Betäubung zu vermeiden (Fries et al. 2012, Grist 2019). Die Überprüfung der Wirksamkeit der Betäubung durch verschiedene Indikatoren wie Reflexe, Muskeltonus und Verhalten nimmt eine wichtige Rolle hinsichtlich des Schutzes der Tiere ein (Terlouw et al. 2016, Verhoeven et al. 2016). Eine angemessene Schulung und Aufsicht von Mitarbeiter:innen in Schlachtbetrieben sind unerlässlich, um sicherzustellen, dass diese Verfahren korrekt durchgeführt werden.

Diskussion

Limitationen bei der systematische Literaturrecherche sind die vorab festgelegten Einschluss- und Ausschlusskriterien, welche spezifischere Details zur Auswahlprozedur der einbezogenen Studien geben könnten. Andererseits kann die Festlegung von Ein- und Ausschlusskriterien vor Beginn der Recherche entscheidend sein, um die Relevanz der gefundenen Literatur sicherzustellen. Dieser Schritt dient der Präzisierung der Forschungsfrage und sorgt dafür, dass die Ergebnisse möglichst passgenau, aussagekräftig und reproduzierbar sind. Dadurch wird Zeit gespart und die Wahrscheinlichkeit von irrelevanter oder unpassender Literatur wird minimiert (Higgins et al. 2019). Zudem wurden in der Studie die Datenbanken PubMed, Web of Science und Livivo für die Literaturrecherche verwendet. Es ist wichtig zu beachten, dass die Wahl der Datenbanken zu einer Auswahlverzerrung führen kann, da möglicherweise nicht alle relevanten Studien abgedeckt werden. Die Nutzung von drei Datenbanken, die bewusst ausgewählt werden, kann dazu beitragen, eine breite, aber dennoch fokussierte Grundlage für die Literaturrecherche zu schaffen (Beelmann 2021). Die Verwendung zusätzlicher Datenbanken und Suchmaschinen sowie das Führen eines detaillierten Protokolls über die Suchstrategie, kann die Gesamtheit einer Studie verbessern (Beelmann 2021). Generell kann die Protokollführung über den Auswahlprozess die Reproduzierbarkeit der Studie verbessern (Moher et al. 2009). Die Bewertung der gefundenen Literatur durch drei unabhängige Personen trägt dazu bei, die Qualität und Relevanz der Quellen zu gewährleisten und mögliche subjektive Einschätzungen einzelner Personen zu minimieren (Moher et al. 2009).

Die Festlegung auf Literatur ausschließlich aus peer-reviewten Zeitschriften führt dazu, dass möglicherweise relevante Informationen aus anderen Quellen wie Berichte, Konferenzbeiträge oder Handlungsempfehlungen nicht in die Bewertung einbezogen werden. Die Berücksichtigung der potenziellen Auswirkungen solch eines Publikationsbias und die Einbeziehung eines breiteren Spektrums von Quellen kann eine Studie in ihrer Aussagekraft stärken (Beelmann 2021). Bei der hier beschriebenen Studie wurden nur Literatur aus Ländern des europäischen Rechtsraumes und definierte Bedingungen (z. B. Kurzstreckentransporte) berücksichtigt, was eine Verallgemeinerung auf andere Regionen oder Situationen einschränken könnte (Higgins et al. 2019), in denen gleichzeitig aber auch unterschiedliche rechtliche, klimatische oder verkehrstechnische Gegebenheiten bestehen.

Nachdem die systematische Literaturrecherche einen Überblick über verschiedene untersuchte Tierschutzindikatoren bei Transport und Schlachtung von Rindern ermöglicht hat, wurden anhand dieser Erkenntnisse mögliche tierschutzrelevante Schulungsinhalte identifiziert und im Schulungsmaterial adressiert. Dies erfolgte durch die Entwicklung einer zielgruppenorientierten Onlineschulung, welche Schlachthofmitarbeiter:innen und

Tiertransporteur:innen tierschutzrelevante Informationen vermitteln soll. Die konzipierten Lerninhalte sind in erster Linie an Mitarbeiter:innen gerichtet, welche wenige oder keine deutschen Sprachkenntnisse besitzen und ein niedriges Bildungsniveau aufweisen. Die gewonnenen Erkenntnisse aus der Literaturrecherche dienten hierbei als Grundlage für die Ausarbeitung der Schulungsinhalte, die nicht nur informativ, sondern auch praxisorientiert sein sollen.

Das Evaluieren von Onlineschulungen vor der endgültigen Fertigstellung ist ein wichtiger Schritt, um sicherzustellen, dass Lehrmaterialien effektiv sind und die Bedürfnisse der Lernenden erfüllt werden. Es beinhaltet die systematische Bewertung von Lerninhalten, Lernmethoden und deren Ergebnissen.

Sowohl die durch Schlachthofmitarbeiter:innen, als auch durch Tierschutzbeauftragte und amtliche Tierärzt:innen durchgeführten Evaluationen verfolgten das gemeinsame Ziel, eine Online-Tierschutzschulung zu bewerten. Die Studien zielten darauf ab, Feedback von Expert:innen hinsichtlich Design, Inhalt und Benutzerfreundlichkeit von zwei Schulungsmodulen zu sammeln. Diese Expert:innen spielen eine entscheidende Rolle bei der Sicherstellung und Einhaltung von Tierschutzvorschriften in Schlachtbetrieben.

Die Ergebnisse deuten auf ein insgesamt positives Feedback von den Teilnehmer:innen hin, wobei die Effektivität der Module hinsichtlich der Bereitstellung wertvoller Informationen hervorgehoben wurde. Es wurden gleichzeitig Bedenken bezüglich der Benutzerfreundlichkeit im Zusammenhang mit Video- und Tonqualität sowie auch Vorschläge zur Verbesserung des Modulinhalts angemerkt. Beim positiven Feedback zu den Schulungsmodulen konnten folgende Kommentare erfasst werden: „einfach gestaltet, aber alle wichtigen Informationen verarbeitet", „die Themen wurden klar präsentiert", „gute Animationen" und „die Themen sind nicht langweilig". Die vereinfachte Darstellung und klare Präsentation entspricht den Prinzipien effektiver Lehrmaterialgestaltung und betont die Relevanz bei der Vermittlung entscheidender Informationen bzw. für das Speichern von Wissen (Regula 1998, Clark und Mayer 2023). Eine Studie von Mayer (2005) hat gezeigt, dass der Einsatz von Multimedia-Elementen wie Animationen das Lernen verbessern kann, indem es visuelle Darstellung von Konzepten anbietet. Das Aufrechterhalten des Interesses der Lernenden ist entscheidend für eine erfolgreiche Online-Bildung, dabei können kurze ansprechende Inhalte vorteilhaft sein, um eine kognitive Überlastung zu verhindern (Sweller 1988, Clark und Mayer 2023). Beim negativen Feedback gab es Kommentare wie „die Stimme des Sprechers ist monoton", „das Klicken auf die Mikrofone sollte entfernt werden", „mehr umfassende Informationen" und „weniger im Konjunktiv sprechen - es könnte banalisieren". Eine gewisse Variation in der Stimmlage ist wichtig, um das Engagement der Lernenden aufrechtzuerhalten und sollte dementsprechend angepasst werden (Clark und Mayer 2023). Das Klicken auf die

Mikrofone wurde in einem Kommentar als unnötiges Element angesehen und könnte dazu führen, dass die Lernenden abgelenkt sind und das Lernerlebnis beeinträchtigt werden könnte (Mayer 2014). Die Bereitstellung zusätzlicher Kontexte, wie es in einem Kommentar gewünscht wurde, kann die Tiefenwirkung des Verständnisses verbessern, aber auch zu einer Überforderung bei der Zielgruppe mit geringer schulischer Bildung führen (Clark und Mayer 2023). Das Sprechen im Konjunktiv kann die Zielgruppe in die Irre führen. Eine deutliche und selbstbewusste Sprache ist für eine effektive Kommunikation und das Vermitteln von Wissen entscheidend (Mayer 2014). Zusammenfassend könnte die Integration der Kommentare bzw. Vorschläge die Gesamteffektivität der Module verbessern. Limitationen der beiden Studien waren die geringe Anzahl von Teilnehmer:innen an den Evaluationen. Auch besteht die Notwendigkeit der kontinuierlichen aktuellen Überarbeitung und Anpassung der Onlineschulungsmaterialien. Evaluationen können dazu beitragen, die Qualität einer Onlineschulung zu überprüfen und zu verbessern (Nuissl 2013). Dies ist entscheidend, um sicherzustellen, dass die Lernenden eine bestmögliche Wissensvermittlung erhalten. Durch die Bewertung von Onlineschulungen können Lehrende auf sich verändernde Bedürfnisse und Technologien reagieren und ihre Schulungen gegebenenfalls anpassen, um aktuell zu bleiben (Nuissl 2013). Das Durchführen von Evaluationen kann dabei helfen, Ressourcen effizienter einzusetzen, indem sie aufzeigen, welche Lehrmethoden und Materialien am effektivsten sind (Kim und Bonk 2006, Nuissl 2013).

Zu bedenken ist, dass die Evaluation, besonders wenn sie vor Ort durchgeführt werden soll, zeitaufwändig sein kann, insbesondere wenn umfangreiche Daten gesammelt und analysiert werden müssen. Und auch die Einführung von Evaluierungssystemen erfordert oft finanzielle Mittel für die Entwicklung von Konzepten, für Personal und die Datenerhebung (Nuissl 2013). Zudem kann es bei der Bewertung von Onlineschulungen zu subjektiven Einschätzungen kommen, welche die Genauigkeit der Ergebnisse beeinflussen können (Blömeke 2014).

Um die Qualität und Aussagekraft der Studie zu verbessern, hätten quantitative Feedbackmethoden und eine größere Auswahl an Teilnehmenden hilfreich sein können, um ein besseres Verständnis der Wirksamkeit der Onlineschulung zu gewährleisten.

Bei der Studie über die Wissensstandsanalyse lag der Schwerpunkt auf der Bewertung der Auswirkungen einer Onlineschulung auf das Wissen von Schlachthofmitarbeiter:innen. In dieser Studie wurde untersucht, ob die Teilnahme an der Onlineschulung das Wissen zum Thema Tierschutz im Lebendviehbereich verbesserte. Die Single-Choice-Fragen zielten darauf ab, das Verständnis der Schlachthofmitarbeiter:innen in zwei Bereichen zu testen: Tierverhalten und Umgang mit dem Rind. Die Fragen sollten unterschiedliche Ebenen des kognitiven Anforderungsniveaus abdecken. Von grundlegenden Kenntnissen

über die Sinneswahrnehmungen bis hin zu komplexeren Vorgängen wie dem Erkennen von aggressivem Verhalten bei Rindern. Dies sollte eine umfassende Beurteilung der Fähigkeiten und des Wissens der Mitarbeiter:innen ermöglichen. Bei den Fragen zum Modul Tierverhalten ging es um die Themen Sehen, Hören und aggressives Verhalten. Diese Themen sind im laufenden Schlachtbetrieb von entscheidender Bedeutung für die Sicherheit der mit Tieren arbeitenden Mitarbeiter:innen. Die Antwortmöglichkeiten spiegelten praxisnahe Szenarien wider und erforderten ein grundlegendes Verständnis der tierischen Verhaltensweisen. Zum Beispiel sollte in Frage 2 (im Paper „Analysis of the Knowledge Level of Slaughterhouse Employees and Evaluation of Online Training to Improve Animal Welfare") des Abschnittes „Tierverhalten" die richtige Antwort („ruhig zu bleiben und keine plötzlichen Bewegungen machen") die bewährten Praktiken reflektieren, um Stress bei den Tieren zu vermeiden (Grandin 1989). Der Abschnitt Umgang mit dem Rind konzentriert sich auf das praktische Wissen bei der Arbeit mit Rindern. Die Fragen behandelten Themen wie das Treiben von Rindern, den Einsatz von Treibhilfen und dem E-Treiber. Bei einer weiteren Frage des Abschnitts „Umgang mit dem Rind", wird die Verwendung vom E-Treiber diskutiert und die korrekte Antwort betont die Bedeutung einer begrenzten Anwendung dieser Treibhilfe, insbesondere vor der Schlachtung (Grandin 2017). Die Betonung in Frage 4 des Abschnitts Umgang mit dem Rind, die elektrische Treibhilfe nur als letztes Mittel anzuwenden, entspricht den gesetzlichen Richtlinien für den Einsatz der elektrischen Treibhilfe am Schlachtbetrieb (Europäische Kommission 2009, Grandin 2017).

Zu beachten ist, dass die ausschließliche Verwendung von Single-Choice-Fragen die Bandbreite der Fähigkeiten von Schlachthofmitarbeiter:innen, möglicherweise nicht vollständig erfassen kann. Die Kombination aus offenen Fragen, Single-Choice-Fragen und szenario-basierten Fragen könnten tiefergehende Einblicke in das Verständnis des Wissens geben. Außerdem liegt der Fokus der Wissenstandsanalyse auf dem theoretischen Wissen. Für eine umfassendere Bewertung des Wissens müssten praktische Fertigkeiten und die Fähigkeit, das gelernte Wissen in realen Situationen anzuwenden, beurteilt werden.

Die Ergebnisse zeigten, dass die Teilnehmer:innen bereits über ein grundlegendes Wissen im Bereich des Tierverhaltens und im Umgang mit Rindern verfügten, wahrscheinlich aufgrund von vorherigen Schulungen, die von Schlachtbetrieben angeboten wurden. Die Studie deckte insbesondere durch Fragen, die im Prä-Test häufig falsch beantwortet wurden, Wissenslücken auf. Die Limitationen der Studie sind die geringe Stichprobengröße bei den Teilnehmenden an der Wissenstandsanalyse und mögliche Auswahlverzerrung der Teilnehmer:innen durch die jeweiligen Tierschutzbeauftragten. Insgsamt zeigte die Studie, dass Onlineschulungen das Potenzial haben, das

tierschutzrelevante Wissen von Mitarbeiter:innen und damit den Tierschutz in Schlachtbetrieben zu verbessern.

Kauffeld (2010) beschreibt, dass eine Wissensstandsanalyse immer vor Beginn einer Schulung durchgeführt werden sollte, um den Ausgangskenntnisstand der Teilnehmer:innen zu ermitteln. Aber auch während einer Schulung können Wissenstests in regelmäßigen Abständen durchgeführt werden, um sicherzustellen, dass die Lernenden die zu vermittelnden Informationen verstehen (Bloom 1956). Nach Abschluss einer Schulung sollte mittels Post-Tests überprüft werden, wie gut die Teilnehmer:innen die Lernziele erreicht haben und ob die Schulung erfolgreich war (Guskey und Sparks 1991, Rädiker 2012). Langfristige Effekte können durch periodische Follow-up-Tests bewertet werden, um sicherzustellen, dass das Wissen und die Fähigkeiten über einen längeren Zeitraum hinweg aufrechterhalten werden (Landesbildungsserver Baden-Württemberg 2023).

Wissensstandsanalysen können ein wertvolles Werkzeug im Bereich der Schulung und Bildung sein. Sie dienen dazu, die Effektivität von Schulungen zu bewerten, die Wissensspeicherung objektiv zu messen und Bereiche zu identifizieren, in denen Teilnehmer:innen möglicherweise Schwierigkeiten bzw. Wissenslücken haben oder bei denen eine zusätzliche Anleitung erforderlich ist (Bloom 1956, Cimermanová 2018). Die Ergebnisse von Wissensstandsanalysen können Lehrende zur Verbesserung ihrer Lerninhalte für zukünftige Schulungen nutzen (Kirkpatrick 1994). Zu beachten ist, dass Wissensstandsanalysen möglicherweise nur die Auffassungsgabe der Lernenden von Fakten und Informationen bewerten und die Fähigkeit zur praktischen Anwendungen nicht ausreichend Beachtung findet. Einige Teilnehmer:innen könnten zudem in einer Prüfungssituation unter Stress leiden, was sich negativ auf ihre Leistung auswirkt und die Ergebnisse verzerren kann (Pekrun und Götz 2006). Auch könnten sich Teilnehmer:innen auf ein kurzfristiges Auswendiglernen konzentrieren, um den Wissenstest zu bestehen, anstatt sich das Wissen langfristige anzueignen (Brown et al. 2014, Zoelch et al. 2019).

Fazit

Die systematische Literaturrecherche liefert einen wertvollen Überblick und Erkenntnisse über den aktuellen Stand des Wissens und der Praxis im Zusammenhang mit der Erforschung Tierschutz relevanter Parameter während des Transports und der Schlachtung von Rindern im Geltungsbereich der europäischen Gesetzgebung. Die Studie betont die entscheidende Rolle der Mensch-Tier-Interaktionen und die Notwendigkeit umfassender Schulungsprogramme für das Personal. Die Studie hebt auch die Bedeutung einer ordnungsgemäßen Transportplanung, von Betäubungsmethoden und der

Reduzierung stressauslösender Faktoren wie z. B. Lärm hervor. Letztendlich stellt das Ergebnis der systematische Literaturrecherche die laufenden Bemühungen im Bereich des Tierschutzes bei Transport und Schlachtung dar. Gleichzeitig hilft sie, Bereiche zu identifiziert, die weitere Forschung erfordern und unterstreicht die Bedeutung von Schulung und Einhaltung bestehender Vorschriften. Das gesellschaftliche Ziel sollte darin bestehen, Tierschutzbedenken zu begegnen und sicherzustellen, dass Rinder während ihres Transportes vom landwirtschaftlichen Betrieb zum Schlachtbetrieb mit der gebotenen Sorgfalt behandelt werden.

Zusammenfassend betonen die anderen beiden Studien das Potenzial von Online-Schulungsprogrammen zur Verbesserung des Wissens und der Praktiken von Mitarbeiter:innen in Schlachtbetrieben und Fachleuten, die für den Tierschutz verantwortlich sind. Sie unterstreichen die Bedeutung der Bereitstellung von Schulungsmaterialien sowie deren kontinuierlicher Verbesserungen und Anpassung an die spezifischen Bedürfnisse verschiedener Mitarbeitergruppen.

Diese dargestellten Studien tragen gemeinsam zum Ziel bei, den Tierschutz während des Transports und der Schlachtung zu fördern. Da sich wissenschaftliche Erkenntnisse sowie gesellschaftliche Werte und rechtliche Rahmenbedingungen weiterentwickeln, werden fortlaufende Bemühungen im Schulungsbereich eine entscheidende Rolle spielen, um Tierschutzstandards in der Viehbranche aufrechtzuerhalten und weiterzuentwickeln. Zukünftige Forschung wird erforderlich sein, um die langfristigen Auswirkungen solcher Schulungsprogramme auf das Wohlergehen von Tieren zu ermitteln.

6. Zusammenfassung

Zielgruppenorientierte E-Learning Schulung zur Verbesserung des Tierschutzes bei Transport und Schlachtung von Rindern

Die Untersuchungen heben die Bedeutung des Tierschutzes in der Fleischindustrie, insbesondere in Schlachtbetrieben hervor, und spiegeln die öffentliche Debatte über den Schutz der Tiere während des Transports und der Schlachtung wider.

Bereits vor dem Transport haben die Haltung und der Gesundheitszustand der Rinder einen erheblichen Einfluss auf das Wohlergehen der Tiere. Im Schlachtbetrieb kann das Verhalten der Mitarbeiter:innen oder die baulichen Bedingungen und die damit verbundenen Auswirkungen Stress bei den Tieren verursachen. Studien haben gezeigt, dass Stress sowohl durch Verhaltensbeobachtungen als auch durch die Messung physiologischer Parameter bewertet werden können. Eine schnelle und effektive Betäubung ist ein wichtiger Aspekt des Tierschutzes. Leicht überprüfbare Indikatoren für die Bewusstlosigkeit, wie der unmittelbare Zusammenbruch nachdem Bolzenschuss, Verlust des rhythmischen Atmens und des Kornealreflexes, werden routinemäßig am Schlachtbetrieb überwacht. Andere Aspekte, wie die Messung von Stresshormonen im Blut oder die Verwendung eines Elektrokardiogramms während der Betäubung, bieten wissenschaftliche Informationen für die Bewertung von Stress, sind aber in der Praxis nicht routinemäßig umsetzbar.

Schulungen für Tiertransporteur:innen und Schlachthofmitarbeiter:innen tragen erheblich zur Stressreduzierung während des Umgangs mit Rindern bei, was wiederum das Wohl der Tiere während des Transports und der Schlachtung sowie die Fleischqualität verbessert. In einer Studie wurden zwei mehrsprachige Online-Schulungsmodule zur Schulung von Mitarbeiter:innen in deutschen Rinderschlachthöfen auf den Gebieten Tierverhalten und Umgang mit Rindern entwickelt und getestet. Die Teilnehmer:innen bewerteten das Programm positiv und die Ergebnisse deuten darauf hin, dass E-Learning zur Verbesserung des Wissens beiträgt, insbesondere wenn es auf Video-basiertem Lernen basiert. Die Untersuchung zeigte, dass es Verbesserungen in den Testergebnissen vom Prä- zum Post-Test in beiden teilnehmenden Gruppen gab.

In einer weiteren Untersuchung wurde die gleiche Online-Schulung und deren Implementierung von Tierschutzbeauftragten und amtlichen Tierärzt:innen getestet und evaluiert. Die 25 an der Umfrage teilnehmenden Personen gaben den Schulungsmodulen hinsichtlich des Designs, der Lerninhalte und der Benutzerfreundlichkeit eine positive Bewertung.

Zusammenfassung

Insgesamt zeigen die Untersuchungen, dass gezielte Online-Schulungsprogramme das Potenzial haben, das Tierwohl zu fördern, Stress für Mitarbeiter:innen und Tiere zu reduzieren und die Arbeitsbedingungen insgesamt zu verbessern. Hier besteht die Notwendigkeit weiterer Forschung und Entwicklung von Online-Schulungsmodulen, um die Standards im Tierschutz während des Transports und der Schlachtung weiter zu verbessern.

7. Summary

Target group-oriented e-learning training to improve animal welfare during the transportation and slaughter of cattle

The research highlights the importance of animal welfare in the meat industry, particularly in slaughterhouses, and reflects the public debate about the protection of animals during transportation and slaughter.

Even before transportation, the husbandry and health status of cattle have a significant impact on animal welfare. At the slaughterhouse, the behavior of the employees or the structural conditions and the associated effects can cause stress in the animals. Studies have shown that stress can be assessed both by observing behavior and by measuring physiological parameters. Fast and effective stunning is an important aspect of animal welfare. Some easily verifiable indicators of unconsciousness, such as immediate collapse after captive bolt, loss of rhythmic breathing and corneal reflex, are routinely monitored at the slaughterhouse. Other aspects, such as the measurement of stress hormones in the blood or the use of an electrocardiogram during stunning, provide scientific information for assessing stress but are not always feasible in practice.

Trainings for livestock drivers and slaughterhouse employees contributes significantly to reducing stress during the handling of cattle, which in turn improves animal welfare during transportation and slaughter as well as meat quality. In a study, two multilingual online training modules were developed and tested to train employees in German cattle slaughterhouses in the areas of animal behavior and cattle handling. Participants rated the programme positively, and the results suggest that e-learning helps to improve knowledge, especially when it is based on video-based learning. The study showed that there were improvements in test scores from pre- to post-test in both participating groups.

In a further study, the same online training and its implementation was tested and evaluated by animal welfare officers and official veterinarians. The 25 people who took part in the survey gave the training modules a positive rating in terms of design, learning content and user-friendliness.

Overall, the research shows that targeted online training programmes have the potential to promote animal welfare, reduce stress for employees and animals and improve working conditions overall. There is a need for further research and development of online training modules to further improve standards of animal welfare during transportation and slaughter.

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Publikationsverzeichnis

Aus dieser Dissertation sind die folgenden Publikationen hervorgegangen:

1. **Svea Nicolaisen**, Nina Langkabel, Christa Thöne-Reineke, Mechthild Wiegard (2023). Animal Welfare during Transport and Slaughter of Cattle: A Systematic Review of Studies in the European Legal Framework. *Animals* 13(12), 1974. https://doi.org/10.3390/ani13121974

2. **Svea Nicolaisen**, Christa Thöne-Reineke, Mechthild Wiegard (2023). Evaluation of Online Training to Improve Animal Welfare of Cattle during Transport and Slaughter from the Perspective of Animal Welfare officers and official Veterinarians. *Journal of Food Science and Nutrition Research* 6: 85-101. https://doi.org/10.26502/jfsnr.2642-110000134

3. **Svea Nicolaisen**, Christa Thöne-Reineke, Lisa Buchwald, Harm Kuper, Mechthild Wiegard (2023). Analysis of the Knowledge Level of Slaughterhouse Employees and Evaluation of Online Training to Improve Animal Welfare. *Journal of Food Science and Nutrition Research* 6: 127-138. https://doi.org/10.26502/jfsnr.2642-110000138

Die Resultate wurden auf folgenden Veranstaltungen vorgestellt:

1. Vortrag und Diskussion: Tierwohl bei Transport und Schlachtung von Rindern – ein Literaturüberblick, **Svea Nicolaisen**; 01.03.2022 22. Fachtagung für Fleisch- und Geflügelfleischhygiene, Berlin

2. Vortrag und Diskussion: E-Learning-Schulungsmaterial zur Verbesserung des Tierschutzes bei Transport und Schlachtung von Rindern, **Svea Nicolaisen**; 28.02.2023 23. Fachtagung für Fleisch- und Geflügelfleischhygiene, Berlin

3. Vortrag und Diskussion: Neukonzipierte E-Learning-Schulung zur Verbesserung des Tierschutzes bei Transport und Schlachtung von Rindern, **Svea Nicolaisen**; 03.05.2023 Vortragsabend AG Tierschutz, Berlin

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Interessenskonflikte

Im Rahmen dieser Arbeit bestehen keine Interessenskonflikte durch Zuwendungen Dritter.

Interessenskonflikte

Selbstständigkeitserklärung

Hiermit bestätige ich, dass ich die vorliegende Arbeit selbständig angefertigt habe. Ich versichere, dass ich ausschließlich die angegebenen Quellen und Hilfen in Anspruch genommen habe. Die Dissertation ist in keinem früheren Promotionsverfahren angenommen oder abgelehnt worden.

Berlin, den 11.01.2024   Svea Nicolaisen